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G. G. S.	George Gregory Smith, M.A., Hon.LL.D. Professor of English Literature at Queen's University, Belfast. Author of *Scottish Literature; Character and Influence;* etc.	**Scottish Literature** (*in part*).
G. H. B.	Rev. George Herbert Box, M.A., Hon.D.D. Rector of Sutton, Beds. Hon. Canon of St. Albans. Davidson Professor of Old Testament Studies in the University of London. Professor of Hebrew and Old Testament Exegesis, King's College, London, 1918–26.	**Scribes; Shekinah.**
G. H. P.	George H. Parker. Professor of Zoology and Director of Zoological Laboratory, Harvard University. Author of *Biology and Social Problems; The Elementary Nervous System; Smell, Taste and Allied Senses.*	**Smell and Taste.**
G. H. W.	George H. Warburton. Editor of the Sixth Edition of *Oils, Fats and Waxes,* by E. Lewkowitsch and chief chemist of the Lewkowitsch Laboratories.	**Soap** (*in part*).
G. Ja.	George Jack. Architect and woodcarver.	**Sculpture Technique** (*in part*).
G. Mo.	Gaetano Mosca. Professor of Constitutional Law, University of Rome.	**Sicily** (*in part*).
G. O'B.	George O'Brien, D.Litt., F.R.Hist.S.. M.R.I.A. Professor of National Economics of Ireland, University College, Dublin. Author of *The Economic History of Ireland;* etc.	**Shannon.**
G. O. C. P.	Captain G. O. C. Probert, R.A. Research Department, Woolwich.	**Sights** (*in part*).
G. P. K.	George Philip Krapp, A.M., Ph.D. Professor of English, Columbia University, New York. Author of *Modern English; The Knowledge of English; The English Language in America;* etc.	**Slang** (*in part*).
G. R. D.	G. R. Driver. Reader in Comparative Semitic Philology, University of Oxford.	**Semitic Languages.**
G. S. Co.	G. S. Coleman, D.Sc., A.M.I.C.E., M.R.San.I. Professor of Municipal and Sanitary Engineering, Manchester College of Technology.	**Sewage Disposal; Sewer Construction.**
G. Sh.	Geoffrey Shaw. Inspector of Music and Training Colleges, Board of Education, London.	**School and Curriculum** (*in part*).
G. Sn.	George Sampson, Hon.M.A. Inspector of Schools, London County Council. Formerly Honorary General Secretary of the English Association. Member of the Departmental Committee on English Studies. Member of Cambridge Advisory Committee on Religious Instruction.	**School Libraries** (*in part*).
G. T. F.	George Topham Forrest, F.R.S.E., F.R.I.B.A., F.G.S. Superintending Architect of Metropolitan Buildings and Architect to the London County Council since 1919. County Education Architect for Northumberland, 1905–14, and for Essex, 1914–9. Author of *The Construction and Control of Buildings and the Development of Urban Areas in the United States of America;* etc.	**School Architecture** (*in part*).
G. T. M.	Gilbert T. Morgan, O.B.E., D.Sc., F.I.C., F.R.S. Director, Chemical Research Laboratory, Department of Scientific and Industrial Research, London. Formerly Mason Professor of Chemistry, University of Birmingham, Professor in the Faculty of Applied Chemistry, Royal College of Science for Ireland, and Professor of Applied Chemistry, Technical College, Finsbury. Author of *Organic Compounds of Arsenic and Antimony.* Contributor to Thorpe's *Dictionary of Applied Chemistry.* Editor of the Chemistry section, 14th Edition, *Encyclopædia Britannica.*	**Scandium; Selenium.**
G. W. R.	Major George William Redway. Author of *The War of Secession, 1861–1862; Fredericksburg, a Study in War.*	**Seven Days' Battle; Shenandoah Valley** (*in part*).
G. W. Ri.	G. W. Richards, A.M., D.D., Litt.D., D.Th. President, The Theological Seminary of the Reformed Church in the United States, Lancaster, Pa. Author of *Historical and Doctrinal Studies on the Heidelberg Catechism; Christian Ways of Salvation;* etc.	**Shakers.**
H. A. R.	Horace Arthur Rose, I.C.S. District and Sessions Judge, Punjab, 1906–17.	**Sikhs.**
H. Br.	Henry Bradley, M.A., Ph.D., F.B.A. Joint Editor of *The New English Dictionary* (Oxford). Author of *The Story of the Goths; The Making of English;* etc.	**Slang** (*in part*).
H. Bru.	Henry Bruère, Ph.B. First Vice-President and Treasurer, Bowery Savings Bank, New York. Author of *New City Government; Applied Budgeting;* etc.	**Savings Banks** (*in part*).
H. C.	Hugh Chisholm, M.A. Editor of the 11th and 12th Editions of *The Encyclopædia Britannica.*	**Sherbrooke, Robert Lowe.**
H. Ch.	H. Chambers, M.B.E. Ministry of Agriculture and Fisheries, London.	**Seed Trade** (*in part*).

H. Cl. Sir Hugh Clifford, G.B.E., G.C.M.G., F.R.G.S.
Governor of the Straits Settlements. High Commissioner for the Malay States and British Agent for Borneo since 1927. Governor of Ceylon, 1925–7. Author of *Further India* and many other works. Joint Author with Sir Frank Swettenham of a *Dictionary of the Malay Language*. — **Singapore.**

H. C. L. H. C. Long, B.Sc.
Ministry of Agriculture and Fisheries, London. Editor of *Journal of Ministry of Agriculture and Fisheries*. Author of *Common Weeds of the Farm and Garden; Plants Poisonous to Livestock; Poisonous Plants in the Farm.* — **Seed Testing** (*in part*).

H. F. Pr. Henry F. Pringle, A.B.
Author of *Alfred E. Smith;* etc. — **Smith, Alfred Emanuel.**

H. G. R. H. G. Richardson, M.A., B.Sc.
Ministry of Agriculture and Fisheries. — **Sheep Shearing Machines** (*in part*).

H. G. T. H. G. Thornton.
Head of the Bacteriology Department, Rothamsted Experimental Station, Harpenden, Hertfordshire. — **Soil** (*in part*).

H. Jn. Henry Jackson, O.M., Litt.D., F.B.A.
Late Regius Professor of Greek in the University of Cambridge. Author of *Texts to Illustrate the History of Greek Philosophy from Thales to Aristotle.* — **Sophists.**

H. N. H. Nisbet, F.T.I.
Textile Technologist and Consultant. Author of *Grammar of Textile Design.* — **Satin; Schappe; Serge; Shantung; Silk Fabrics, Artificial.**

H. R. A. Lieutenant Colonel, The Hon. H. R. Atkinson.
Instructor at the Artillery College, Woolwich. Formerly Experimental Officer at the Small Arms School, Hythe, Kent. — **Small Arms, The Development of.**

H. Re. Miss H. Reynard, M.A.
Homework and Social Science Department, King's College, London. — **School and Curriculum** (*in part*).

H. R. H. Harry Reginald Holland Hall, M.A., D.Litt., F.B.A., F.S.A.
Keeper of Egyptian and Assyrian Antiquities in the British Museum. — **Scarab** (*in part*).

H. R. McI. Henry Read McIlwaine, A.B., Ph.D.
Librarian, Virginia State University. Author of *Struggle of Protestant Dissenters for Religious Toleration in Virginia;* etc. — **Smith, John.**

H. Rob. Howard Robertson, F.R.I.B.A.
Partner of Easton and Robertson, Architects, London. — **Social Architecture** (*in part*).

H. S. K. H. S. Kingsford, M.A.
Assistant Secretary of the Society of Antiquaries, London. — **Seals** (*in part*).

H. Sl. Henri Speciael.
Managing Director, Société Internationale d'Energie Hydroélectrique. — **Société Internationale d'Energie Hydroélectrique.**

H. W. C. Harvey Wiley Corbett, F.R.I.B.A., F.A.I.A.
Lecturer in Architecture, Columbia University. Member of the firm of Helmle and Corbett, New York. Architect of Bush Terminal Office Building (New York), Bush House (London); etc. — **Social Architecture** (*in part*).

H. W. G. H. W. Griffin.
Superintending Clerk, Board of Trade (formerly Ministry of Shipping and Admiralty). First General Secretary, National Maritime Board. — **Shipping, War Losses of.**

H. W. P. H. W. Parker, B.A.
Assistant in the Department of Zoology, Natural History Museum, South Kensington. — **Sea Serpent; Snakes.**

I. A. R. Irma Richter.
Artist and writer. — **Seurat, Georges; Solario, Andrea da.**

Ig. M. Ignazio Mormino.
Director of the Banco di Sicilia. — **Sicily, Bank of.**

J. A. Sir John Anderson, P.C., G.C.B.
Permanent Under-Secretary of State, Home Office, since 1922. Secretary to Ministry of Shipping, 1917–9. — **Shipping, Ministry of.**

J. A. E. Sir (James) Alfred Ewing, K.C.B., LL.D., M.Inst.C.E., F.R.S.
Principal and Vice-Chancellor of Edinburgh University. President of the Royal Society of Edinburgh. Director of British Naval Education, 1903–16. Hon. Fellow of King's College, Cambridge. Professor of Mechanism and Applied Mechanics in the University of Cambridge, 1890–1903. Author of *Thermodynamics for Engineers.* — **Siemens, Sir William.**

J. A. Mo. James A. More.
Lecturer in Agriculture and Rural Economy, University of Edinburgh. — **Sheep** (*in part*).

J. A. S. W. James A. S. Watson, M.C.
Sibthorpian Professor of Rural Economy, University of Oxford. Formerly Professor of Agriculture and Rural Economy, University of Edinburgh. Co-author of *Farm Live Stock of Great Britain; Agriculture—The Science and Practice of British Farming.* — **Sheep** (*in part*).

J. A. V. B. J. A. V. Butler, M.Sc.
Lecturer in Chemistry, University of Edinburgh. — **Solutions.**

J. B. S. H. John Burdon Sanderson Haldane, M.A.
Sir William Dunn Reader in Biochemistry, Cambridge University, since 1922. Head of Genetical Department, John Innes Horticultural Institution, since 1927. Author of numerous scientific papers on natural selection; etc., in *Journal of Physiology; Journal of Genetics; Proceedings* of the Cambridge Philosophical Society. — **Selection** (*in part*).

J. C. B. Squadron Leader J. C. Brooke, R.A.F.
Attached British Naval Mission, Ministry of Marine, Athens. — **Seaplane.**

J. Cn.	JULES CAMBON. Grand Cross of the Legion of Honour; member of the French Academy. Sometime French Ambassador to the United States, Spain and Berlin. President of the Conference of Ambassadors.	**Security.**
J. E. Fr.	JAMES E. FRASER. Past President, National Sculpture Society. Member, National Commission of Fine Arts. Vice President, Institute of Arts and Letters.	**Sculpture** (*in part*).
J. Fra.	JOHN FRASER, M.A., LL.D. Jesus Professor of Celtic, University of Oxford and Fellow of Jesus College.	**Scottish Literature** (*in part*).
J. F. Sm.	REV. JOHN FREDERICK SMITH. Author of *Studies in Religion under German Masters;* translated Ewald's *Commentaries on the Prophets of the Old Testament.*	**Schleiermacher, Friedrich Daniel Ernst** (*in part*).
J. G. Ho.	J. G. HORNER, A.M.I.MECH.E. Author of *Plating and Boiler Making; Practical Metal Turning.*	**Screw.**
J. G. R.	JOHN GEORGE ROBERTSON, M.A., PH.D., HON.LITT.D. Professor of German Language and Literature, University of London. Director of the Department of Scandinavian Studies since 1924. Author of *History of German Literature; Schiller After a Century;* etc.	**Schiller, Johann Christoph Friedrich von.**
J. H. A. H.	JOHN HENRY ARTHUR HART, M.A. Formerly Fellow, Lecturer and Librarian of St. John's College, Cambridge.	**Sibylline Oracles** (*in part*).
J. Har.	JIRO HARADA. Of the Imperial Household Museums, Japan. Formerly Professor in the Nagoya College of Technology, and in the 8th Higher School. Imperial Japanese Government Commissioner to the Panama-Pacific International Exposition at San Francisco, 1915.	**Societies of Art** (*in part*).
J. H. D.	J. H. DRIBERG. Author of *The Lango, A Nilotic Tribe of Uganda.*	**Secret Societies** (*in part*).
J. H. H.	J. H. HUTTON, D.Sc., C.I.E. Director of Ethnology, Assam; Deputy Commissioner, Naga Hills. Author of *The Angami Nagas; The Sema Nagas* and many papers in *Journal of the Royal Anthropological Institute;* etc.	**Semang; Shan.**
J. H. R.	JOHN HORACE ROUND, M.A., LL.D. Late Historical Adviser to the Crown. President, Essex Archaeological Society, 1916–21. Author of *Feudal England; Peace and Pedigree.*	**Scutage; Serjeanty.**
J. H. Ro.	JOHN HOLLAND ROSE, M.A., D.LITT. Vere-Harmsworth Professor of Naval History, Cambridge. Reader in Modern History, 1911–9. Author of *Life of Napoleon I.; Napoleonic Studies; The Development of European Nations, 1870–1900;* etc.	**Sieyès, Emmanuel-Joseph** (*in part*).
J. Hud.	JOSEPH HUDNUT, M.S. Professor of Architecture, Columbia University, New York.	**Sculpture** (*in part*).
J. H. V. C.	BRIGADIER-GENERAL JOHN HENRY VERINDER CROWE, C.B. Commandant of the Royal Military College of Canada, 1909–13. Formerly Chief Instructor in Military Topography and Military History and Tactics at the Royal Military Academy, Woolwich. Author of *Epitome of the Russo-Turkish War, 1877–1878;* etc.	**Shipka Pass.**
J. J. M.	JAMES JOSEPH MALLON, M.A., J.P. Warden of Toynbee Hall, London. Hon. Secretary of Trade Boards Advisory Council.	**Social Settlements** (*in part*).
J. K. I.	JOHN KELLS INGRAM, LL.D. Late Regius Professor of Greek, Professor of Oratory and English Literature and Librarian, Trinity College, Dublin. *See* the biographical article: INGRAM, JOHN KELLS.	**Senior, Nassau William** (*in part*). **Slavery** (*in part*).
J. M. H. MacL.	JOHN MACLEOD HENDRIE MACLEOD, M.A., M.D., F.R.C.P. Lecturer on Skin Diseases, London School of Tropical Medicine. Physician for Diseases of the Skin, Charing Cross Hospital. Formerly Editor *British Journal of Dermatology;* Author of *Diseases of the Skin.*	**Skin Diseases.**
J. M. M.	JOHN MALCOLM MITCHELL, O.B.E., M.C., M.A., F.S.A. Secretary, Carnegie United Kingdom Trust; Vice-President, Library Association. Assistant Editor for Classics and Ancient History, 11th Edition, *Encyclopædia Britannica.*	**Solon** (*in part*).
J. M. R.	JOHN MACKINNON ROBERTSON, P.C. Author of *Montaigne and Shakespeare; Modern Humanists; The Problems of the Shakespeare Sonnets; The Shakespeare Canon; The Baconian Heresy;* etc.	**Shakespeare** (*in part*).
J. O. B.	JOHN OLIVER BORLEY, O.B.E., M.A., F.L.S. Principal Naturalist, Ministry of Agriculture and Fisheries, London.	**Seining, Netting and Trawling.**
J. Ri.	JAMES RITCHIE, M.A., D.SC., F.R.S.E. Keeper of the Natural History Department, Royal Scottish Museum, Edinburgh. President of the Royal Physical Society. Examiner in Zoology, 1919–22, and Agricultural Zoology, 1921–4, Aberdeen University.	**Sheep** (*in part*).
J. S. F.	SIR JOHN SMITH FLETT, K.B.E., D.SC., F.R.S. Director, Geological Survey of Great Britain and Museum of Practical Geology. Formerly Lecturer on Petrology in Edinburgh University.	**Scapolite** (*in part*).
J. S. H.	JULIAN SORELL HUXLEY, M.A. Hon. Lecturer, King's College, London. Fullerian Professor of Physiology in the Royal Institution. Author of *Essays of a Biologist;* etc. Editor of the Biology and Zoology section, 14th Edition, *Encyclopædia Britannica.*	**Selection** (*in part*).
J. S. M. W.	JOHN SEBASTIEN MARLOW WARD, M.A., F.S.S., F.R.ANTHROP.S. Head of the Intelligence Department of the Federation of British Industries. Author of *An Outline History of Freemasonry; The Moral Teachings of Free Masonry;* etc.	**Secret Societies** (*in part*); **Silk Trade.**
J. Wa.	JAMES WALKER. Advocate of the Scottish Bar. Author of *Intestate Succession in Scotland.*	**Sheriff or Shire-Reeve.**

J. W. E.	JOHN WILLIAM HENRY EYRE, M.D., M.S., D.P.H., F.R.S.E. Director of Bacteriological Department, Guy's Hospital, London, and Professor of Bacteriology in the Medical School. Hunterian Professor, Royal College of Surgeons, 1911–2. Joint Author of *Serums, Vaccines, and Toxins;* etc.	**Serum Therapy.**
K. T.	KOJIRO TOMITA. Keeper of Japanese Art, Museum of Fine Arts, Boston. Lecturer on Chinese and Japanese Art.	**Screen** (*in part*).
K. von O.	KARLLUDWIG VON OERTZEN. Chief of the Intelligence branch of the personal staff of the Ministry of Defence, Berlin.	**Schlieffen, Alfred.**
L. A. We.	LUTHER ALLAN WEIGLE, PH.D., D.D., LITT.D. Dean of the Divinity School and Sterling Professor of Religious Education, Yale University. Author of *The Pupil and the Teacher;* etc.	**School and Curriculum** (*in part*).
L. Br.	LEONARD BROOKS, M.A. Divisional Inspector, London County Council. Examiner for the Cambridge Geography Tripos.	**School and Curriculum** (*in part*).
L. C. M.	SIR LEO CHIOZZA MONEY, F.R.STAT.S., F.R.G.S., F.Z.S. Author and Journalist. Member of the War Trade Advisory Committee, 1915–8. Parliamentary Secretary to the Ministry of Shipping, 1916–8. Chairman of the Tonnage Priority Committee, 1917–8. Editor of the Economics Engineering and Industries section, 14th Edition, *Encyclopædia Britannica.*	**"Shell" Transport Trading Co., Ltd.**
L. D.	LOUIS MARIE OLIVIER DUCHESNE, D-ÈS-L. French scholar and ecclesiastic. Late Professor at the Catholic Institute in Paris, Lecturer in the Ecole Pratique des Hautes Etudes, 1885 and Director of the French School of Archaeology at Rome. *See* the biographical article: DUCHESNE, LOUIS MARIE OLIVIER.	**Sixtus.**
L. F. Sz.	L. F. SZILAGYI. Managing Director, Messrs. Siemens-Schukert (Great Britain), Ltd.	**Siemens.**
L. G. C. L.	L. G. CARR LAUGHTON. Author of *Old Ship Figureheads and Sterns.*	**Ships' Figureheads.**
L. H. D. B.	L. H. DUDLEY BUXTON, M.A. Reader in Physical Anthropology in the University of Oxford. Author of *Peoples of Asia.*	**Sarts;** **Seleucia;** **Shuruppak.**
L. I.	L. ISSERLIS, M.A., D.SC. Statistician to Chamber of Shipping of the United Kingdom, London.	**Shipping: Wreck Statistics** (*in part*); **Shipping: Merchant Ships of the World** (*in part*).
L. J. S.	L. J. SPENCER, M.A., SC.D., F.G.S., F.C.S., F.R.S. Keeper of Department of Mineralogy, Natural History Museum, South Kensington. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of *The Mineralogical Magazine.*	**Smaltite;** **Sodalite.**
L. J. V.	LEE J. VANCE, B.S. Publisher of *The Beverage News.*	**Soda Fountain.**
L. Len.	LEO LENTELLI, A.N.A. Member, National Sculpture Society, and Architectural League of New York. Gold Medal, National Academy of Design, 1928.	**Sculpture Technique** (*in part*).
L. Me.	LEILA MECHLIN, M.A. Editor, *The American Magazine of Art.* Secretary to the American Federation of Art.	**Societies of Art** (*in part*).
Lu.	FREDERICK DEALTRY LUGARD, 1ST BARON LUGARD OF ABINGER, P.C., G.C.M.G., C.B., D.S.O., D.C.L., LL.D. Commander of Legion of Honour, 1917. Governor-General of Nigeria, 1914–9. British Member of Permanent Mandates Commission, League of Nations, since 1922. Served Afghan War, Sudan Campaign, Burma Campaign. Author of *Our East African Empire; The Dual Mandate in British Tropical Africa;* etc.	**Slavery** (*in part*).
L. U.	MAJOR L. URWICK, O.B.E., M.C., M.A. Joint Author of *Factory Organization.*	**Scientific Management** (*in part*).
L. V.	LUIGI VILLARI. Italian Vice-Consul in New Orleans, 1906; Philadelphia, 1907. Acting Consul, Boston, 1907–10. On the Secretariat of the League of Nations, 1920–3. Author of *Italian Life in Town and Country; The Awakening of Italy;* etc.	**Savonarola, Girolamo** (*in part*); **Savoy, House of.**
L. V. K.	L. V. KOOS, M.A., PH.D. Professor of Secondary Education, University of Minnesota. Author of *The Junior High School; The Junior College Movement;* etc.	**Secondary Education** (*in part*).
M. Fn.	MARGARET FISHENDEN, D.SC., F.INST.P. Fuel Research Division, Department of Scientific and Industrial Research, Westminster.	**Smoke and Smoke Prevention** (*in part*).
M. Gi.	M. GINSBERG, M.A., D.LITT. Reader in Sociology, London School of Economics.	**Social Philosophy.**
M. H. S.	MARION H. SPIELMANN, F.S.A. Formerly Editor of the *Magazine of Art.* Member of Fine Arts Committee of International Exhibitions of Brussels, Paris, Buenos Aires, Rome and the Franco-British Exhibition, London. Author of *History of Punch; British Portrait Paintings to the Opening of the 19th Century; The Portraits of Shakespeare;* etc.	**Shakespeare, William** (*in part*).
M. J. Re.	MABEL J. REANEY, D.SC. Lecturer in Education, Furzedown Training School, London.	**School and Curriculum** (*in part*).

M. K. M.	Miss M. K. Morgan.	Scarborough; Skipton.
M. O'R.	Miss M. O'Reilly. University Museum of Archaeology and Ethnology, Cambridge.	Scandinavian Civilization (*in part*).
M. R.	Maud Robinson. Director, Greenwich House Pottery Classes. Vice-President, The Potters' Shop, Inc., New York. Contributor to *The Potters Craft.*	Sculpture Technique (*in part*).
M. T. H.	M. T. Houtsma. Formerly Professor of Semitic Languages, University of Utrecht.	Seljūks (*in part*).
M. Y.	Mahonri Young. Sculptor, Painter and Etcher. President, Society of Etchers, New York. Member, National Sculpture Society, Society of Etchers, Chicago; etc.	Sculpture Technique (*in part*).
N. A. P.	N. A. Poole, (Mrs. N. A. Reed). Author of *Simple Crafts for Girls.*	School and Curriculum (*in part*).
N. B. J.	N. B. Jopson, B.A. Reader in Comparative Slavonic Philology, London University.	Serbo-Croat Language and Literature (*in part*); Slavonic Languages; Slavs.
N. Br.	Norton Breton, M.B.E. Messrs. Henckell du Buisson, London.	Silk and Sericulture (*in part*); Silk Manufacture (*in part*).
N. E. C.	Norman E. Crump. Statistical Correspondent to the *Financial Times*, London. Joint Author of *Clare's A. B. C. of the Foreign Exchanges.*	Savings Banks (*in part*); Shares (*in part*); Sol.
N. G. G.	Nicholas G. Gedye, O.B.E., B.Sc., M.Inst.C.E. Consulting Civil Engineer, formerly chief engineer, Tyne Improvement Commission. Served B. E. F. Lt.-Colonel (late R. E.). Acting Director, Civil Engineer-in-Chief's Department, Admiralty; chief civil engineer for Docks, Harbours and Inland Waterways, Ministry of Transport.	Slipway.
N. Le.	Nathan Levi. Assistant Editor of *De Volkstem*, Pretoria.	Smuts, Jan Christiaan (*in part*).
O. A.	Osmund Airy, M.A., LL.D. Formerly H. M. Divisional Inspector of Schools and Inspector of Training Colleges, Board of Education, London. Author of *Louis XIV. and the English Restoration; Charles II.*; etc.	Sidney, Algernon (*in part*).
O. D. E.	Owen D. Evans, A.M. Superintendent of Mechanical School, Girard College, Philadelphia. Author of *Educational Opportunities for Young Workers.*	Schools, Evening.
O. J. R. H.	Osbert John Radcliffe Howarth, O.B.E., M.A. Secretary to the British Association for the Advancement of Science. Geographical Scholar, Christ Church, Oxford, 1901. Geographical Assistant, 11th Edition, *Encyclopædia Britannica.*	Scotland (*in part*).
P. A.	Percy Alden, M.A., M.P. Chairman of the British Institute of Social Service. Warden of Mansfield House Settlement, 1891–1901, Vice-President, 1902. Commissioner to Board of Agriculture for Cultivation of Lands. Author of *Housing; Democratic England; The Unemployed—A National Question;* etc.	Social Service (*in part*).
P. A. S.	Percy Alfred Scholes, B.Mus., A.R.C.M. Formerly Music Critic, British Broadcasting Corporation and Musical Editor of the *Radio Times.* Inspector of Music in Schools, London University; formerly Music Critic of *The Observer* and the *Evening Standard.* Author of *The Book of Great Musicians;* etc. Translated Jean Aubry's *Introduction to French Music.*	Scriabin, Alexander Nicholaevich.
P. G. H. B.	P. G. H. Boswell, O.B.E., D.Sc., M.Inst.M.M., F.G.S. George Herdman Professor of Geology in the University of Liverpool.	Sedimentary Rocks.
P. Man.	Paul Manship. Sculptor. Principal Works: Memorial to J. P. Morgan, Metropolitan Museum of Art; Portrait of John D. Rockefeller; etc.	Sculpture (*in part*).
P. R. W.	Lieutenant-Colonel Percy Reginald Worrall, D.S.O., M.C. Served in France, Gallipoli and Italy, 1914–8.	Smoke: in Warfare.
P. Si.	Percy Simpson, M.A. Reader in English Textual Criticism and Fellow of Oriel College, Oxford.	Shakespeare (*in part*).
P. V.	Pasquale Villari. Italian Historian and Statesman. Author of *I primi due secoli della storia di Firenze;* etc.	Savonarola, Girolamo (*in part*).
P. Vi.	Sir Paul Vinogradoff, D.C.L., LL.D. Formerly Corpus Professor of Jurisprudence in the University of Oxford and Honorary Professor of History in the University of Moscow. Author of *Villeinage in England; English Society in the 11th century,* etc.	Serfdom (*in part*); Socage.
P. Z. C.	Major-General Sir Percy Z. Cox, G.C.M.G., G.C.I.E., K.C.S.I. Acting British Minister to Persia, 1918–20. High Commissioner in Mesopotamia, 1920–3. Secretary, Foreign Department, Government of India, 1914. Consul and Political Agent, Muscat, Arabia, 1899–1904.	Seistan; Shiraz.
R.	John William Strutt, 3rd Baron Rayleigh. Professor of Natural Philosophy at the Royal Institution of Great Britain, 1887–1905. Nobel Prizeman 1904 and President of the Royal Society, 1905–8. Late Chancellor of Cambridge University. Author of *The Theory of Sound.*	Sky (*in part*).

R. A.	ROBERT ADAMSON, LL.D. Philosopher, Professor of Logic, University of Glasgow, 1895–1902. Author of *The Development of Modern Philosophy and other Essays.*	**Schelling, Friedrich Wilhelm Joseph von** (*in part*).
R. Be.	RICCARDO BERTELLI. Diploma of Beaux Arts Academy, Venice. President, Roman Bronze Works, Brooklyn, New York.	**Sculpture Technique** (*in part*).
R. F. Ch.	ROBERT FRANCIS CHOLMELEY, C.B.E., M.A. Headmaster of Owen's School, London, 1909–27. President, Incorporated Association of Headmasters, 1923 and 1927.	**Secondary Education** (*in part*).
R. G.	RICHARD GARNETT, C.B., LL.D. Librarian and Author. Late Superintendent of the Reading Room, British Museum, London, and Keeper of the Printed Books. *See* the biographical article: GARNETT, R.	**Satire** (*in part*).
R. H. Ch.	VEN. ROBERT HENRY CHARLES, M.A., D.D., LITT. D., F.B.A. Archdeacon of Westminster. Formerly Grinfield Lecturer and Lecturer in Biblical Studies, Oxford University. Professor of Biblical Greek at Trinity College, Dublin, 1898–1906.	**Solomon, Psalms of.**
R. H. Gi.	R. H. GIFFORD. Of Swift and Company, Chicago, Ill.	**Sausages** (*in part*).
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S. Ha.	SOMERVILLE HASTINGS, M.S., F.R.C.S. Senior Surgeon in Charge Nose, Ear and Throat Department, The Middlesex Hospital, London.	**Sinus.**
S. L.	STEPHEN HERBERT LANGDON, M.A., B.D., PH.D. Professor of Assyriology, Oxford, since 1919. Director of the Weld-Blundell and Field Museum Expedition to Mesopotamia since 1922.	**Sin.**

S. Rad.	MRS. SHEILA RADICE. Assistant Editor, *The Times* (London) *Educational Supplement*, since 1919. Author of *The New Children; The Book of Shapes;* Part Author *Home and School.*	**School and the Home.**
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W. B. B.	W. B. BRIERLEY, D.SC. Head of Mycology Department, Institute of Plant Pathology, Harpenden, Hertfordshire.	**Soil** (*in part*).
W. C. B. T.	W. C. B. TUNSTALL, M.A. Civilian Lecturer, Royal Naval College, Greenwich.	**Seven Years' War** (*in part*)
W. Da.	W. DALTON. Late Author of *Bridge Abridged or Practical Bridge.*	**Skat** (*in part*).
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W. E. Cx.	WARREN E. COX. Art Editor, 14th Edition, *Encyclopædia Britannica.*	**Sculpture Technique** (*in part*).

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W. M. G.	W. M. Gloag, K.C., B.A., LL.D. Professor of Law, University of Glasgow.	Scots Law.
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W. v. Bud.	Wolfgang von Buddenbrock-Hettersdorf. Professor of Zoology, University of Kiel. Director of the Zoological Institute and Museum, Kiel.	Sight, Sense of; Smell and Taste, Senses of.
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SARSAPARILLA TO SORCERY

SARSAPARILLA, a popular drug, prepared from the fibrous roots of several species of the genus *Smilax,* indigenous to Central America from the southern and western coasts of Mexico to Peru. Only two species have been identified with certainty. These are *Smilax officinalis* and *S. medica,* which yield respectively the so-called "Jamaica" and the Mexican varieties. They are large perennial dioecious climbers growing from short thick underground stems, from which rise numerous semi-woody flexuous angular stems, bearing large alternate stalked long-persistent and prominently net-veined leaves, from the base of which spring the tendrils which support the plant.

When boiled in water the root affords a dark extractive matter; boiling alcohol extracts a neutral substance in the form of crystalline prisms, which crystallize in scales from boiling water. This body, which is named *parillin,* is allied to the saponin of quillaia bark, from which it differs in not exciting sneezing. Sarsaparilla has a popular reputation as an "alterative," but is professionally regarded as inert and useless.

The varieties of sarsaparilla met with in commerce are the following: Jamaica, Lima, Honduras, Guatemala, Guyaquil and Mexican. Of these, differing in their character, the first-named yields the largest amount of extract, viz. from 33 to 44%; it is the only kind admitted into the British pharmacopoeia. On the Continent, especially in Italy, the varieties having a white starchy bark, like those of Honduras and Guatemala, are preferred.

SARSFIELD, PATRICK (?–1693), titular earl of Lucan, Irish Jacobite and soldier, belonged to an Anglo-Norman family long settled in Ireland. He was born at Lucan, but the date is unknown. His father Patrick Sarsfield married Anne, daughter of Rory (Roger) O'Moore, who organized the Irish rebellion of 1641. Patrick, who was a younger son, entered Dongan's regiment of foot on Feb. 9, 1678. During the last years of Charles II. he served in the English regiments which were attached to the army of Louis XIV. of France. The accession of King James II. led to his return home.

He took part in the suppression of the Western rebellion at the battle of Sedgemoor on July 6, 1685. In the following year he was promoted to a colonelcy. King James had adopted the dangerous policy of remodelling the Irish army so as to turn it from a Protestant to a Roman Catholic force, and Sarsfield, whose family adhered to the church of Rome, was selected to assist in this reorganization. When the king brought over a few Irish soldiers to coerce the English, Sarsfield came in command of them. As the king was deserted by his army there was no serious fighting, but Sarsfield had a brush with some of the Scottish soldiers in the service of the prince of Orange at Wincanton. When King James fled to France, Sarsfield accompanied him.

In 1689 he returned to Ireland with the king. During the earlier part of the war he did good service by securing Connaught, and was promoted to brigadier, and then major-general. After the battle of the Boyne (July 1, 1690), and during the siege of Limerick, Sarsfield came prominently forward. His capture of a convoy of military stores at one of the two places called Ballyneety between Limerick and Tipperary, delayed the siege of the town till the winter rains forced the English to retire. This achievement made him the popular hero of the war with the Irish. When the cause of King James was ruined in Ireland, Sarsfield arranged the capitulation of Limerick and sailed to France on Dec. 22, 1691. He received a commission as lieutenant-general (maréchal de camp) from King Louis XIV. and fought with distinction in Flanders till he was mortally wounded at the battle of Landen (Aug. 19, 1693). He died at Huy two or three days after the battle. In 1691 he had been created earl of Lucan by King James. He married Lady Honora de Burgh, by whom he had one son James, who died childless in 1718.

See J. Todhunter, *Life of Patrick Sarsfield* (1895).

SARTHE, a department of France, formed in 1790 out of the eastern part of Maine, and portions of Anjou and of Perche. Pop. (1926) 387,482. Area 2,410 sq.m. It is bounded north by the department of Orne, north-east by Eure-et-Loir, east by Loir-et-Cher, south by Indre-et-Loire and Maine-et-Loire and west by Mayenne. The department includes the greater part of the basin of the Sarthe, which drains the large bay in the southern flank of the hills of Normandy, and the city of Le Mans is at the focus of this bay, where the Sarthe from the north-west joins the Huisne from the north-east. It is floored largely by Jurassic and Cretaceous rocks succeeding one another eastward, with the Armorican Palaeozoics on its western border. South-east of the Huisne the Eocene deposits stand out, forming a relatively poor territory. The Loir flows through the southern edge of the department to join the Sarthe in Maine-et-Loire; along its chalky banks caves have been hollowed out which, like those along the Cher and the Loire, serve as dwelling-houses and stores. The

mean annual temperature is 51° to 52° F. The rainfall is between 25 and 26 in.

The department is mainly agricultural. There are three distinct districts:—the corn lands to the north of the Sarthe and the Huisne; the region of barren land and moor, partly planted with pine, between those two streams and the Loir; and the wine-growing country to the south of the Loir. Sarthe produces much barley and hemp. The raising of cattle and of horses, notably those of the Perche breed, prospers, and fowls and geese are fattened in large numbers for the Paris market. Apples are largely grown for cider. The chief forests are those of Bercé in the south and Perseigne in the north; the fields in the department are divided by hedges planted with trees. Coal, marble and freestone are among the mineral products. The staple industry is the weaving of hemp and flax, and cotton and wool-weaving are also carried on. Paper is made in several localities. Iron-foundries, copper and bell foundries, factories for provision-preserving, marble-works at Sablé, potteries, tile-works, glass-works and stained-glass manufactories, curriers, machine factories, wire-gauze factories, flour-mills are also important. The department is served by the Ouest-État, the Orléans and the State railways, and the Sarthe and Loir provide about 100 m. of waterway, though the latter river carries little traffic.

The department forms the diocese of Le Mans and part of the ecclesiastical province of Tours, has its court of appeal at Angers, and its académie (educational division) at Caen, and forms part of the territory of the IV. army corps, with its headquarters at Le Mans. The arrondissements are named from Le Mans, the chief town, La Flèche and Mamers. There are 33 cantons and 386 communes. The chief towns are Le Mans, La Flèche, La Ferté Bernard, Solesmes (*q.q.v.*), and Sablé.

SARTS. The Sarts are an Iranian Turkish tribe, numbering about 2,000,000, who live in Ferghana and Syr Daria territories. They are highly organized, living in permanent villages, with a developed Sufi system of education. They practise a system of agriculture, using irrigation canals, and growing fruit and cotton. They are also accomplished traders. In religion they are Sunnites, many of them belonging to the Sufi order. They have mixed considerably with the Tadjiks, the remnant of the old non-Turkic population, and physically are largely of the Alpine type. In culture they differ widely from most of the tribes speaking cognate languages. (L. H. D. B.)

SARWAT PASHA, ABDEL KHALEK (1873–1928), Egyptian statesman, was educated in Cairo, and became secretary to the Legal Control Commission. In 1905 he became vice-president of the native courts of Kena Province, and judge in the Cairo children's correctional court. In 1907 he was appointed governor of Assiut Province and in 1908 procureur-general of the native courts, a post which had for many years been filled by European officials. In 1914 he was appointed minister of justice in Rushdi Pasha's cabinet, formed after the declaration of a British protectorate. He resigned with Rushdi in 1919. In 1921 he joined Adly Pasha's cabinet as minister of the interior, and acted as prime minister during the latter's absence in London during the negotiations with Lord Curzon. The declaration of 1922, recognizing the independence of Egypt as a sovereign State, which, with the help of Lord Allenby, he was instrumental in obtaining, was a great success for him, and on March 21, 1922 he became prime minister. He resigned in Nov. 1922, because King Fuad claimed a greater degree of power than Sarwat Pasha could reconcile with the terms of the Constitution.

As Government candidate for the presidency of the Chamber in March 1925, he was defeated, and only took office again in June 1926, as minister for foreign affairs in Adly Pasha's cabinet. On the fall of Adly Pasha in April 1927, Sarwat Pasha, an independent like Adly, formed a new ministry. He came into conflict from time to time with his Wafdist supporters, and within a month of his appointment had to face the serious Anglo-Egyptian crisis resulting in the despatch of three British battleships to Egypt. (*See* EGYPT: *History*.) It is sufficient evidence of Sarwat Pasha's tact and ability that in his statement on his correspondence with Lord Lloyd and the conclusion of the dispute he was able to carry with him a majority of the Wafdist chamber of Deputies. He accompanied King Fuad to England on his visit to Europe in 1927, but his visit was interrupted by the death of Zaghlul Pasha, which obliged him to return to Egypt.

For the history of the Anglo-Egyptian negotiations of 1927–28 *see* EGYPT, *History*. The negotiations, which Sarwat continued again in London and concluded in Cairo resulted in the proposal of a treaty of alliance. This was rejected by the Wafd leaders, whom Sarwat consulted, and he then resigned (March, 1928). The king entrusted the formation of a new cabinet to Nahas Pasha, Zaghlul's successor in the leadership of the Wafd party. Sarwat Pasha died in Paris on Sept. 22, 1928.

SARZANA, a town and episcopal see of Liguria, Italy, in the province of Genoa, 9 m. E. of Spezia, on the railway to Pisa, at the point where the railway to Parma diverges to the north, 59 ft. above sea-level. Pop. (1921) 11,236 (town); 13,153 (commune). The handsome cathedral of white marble in the Gothic style, dating from 1204, was completed in 1471. It has a fine 12th cent. crucifix and other works of art. The old citadel, built by the Pisans in 1263 was re-erected by Lorenzo de' Medici in 1488. The castle of Sarzanello was built by Castruccio Castracani (d. 1328), whose tomb by the Pisan Giovanni di Balduccio is in S. Francesco. Glass bottles and bricks are made here.

Sarzana was the birthplace of Pope Nicholas V. Its position at the entrance to the valley of the Magra (anc. *Macra*), the boundary between Etruria and Liguria in Roman times, gave it military importance in the middle ages. It arose as the successor of the ancient Luna, 3 m. S.E.; the first mention of it is found in 983, and in 1202 the episcopal see was transferred hither.

SĀSANA VAMSA, a history of the Buddhist order in Burma, which was composed, in that country, by Paññā-sāmi in 1861. It is written in Pali prose; and is based on earlier documents, in Pali or Burmese, still extant, but not yet edited. The earlier part of the work deals with the history of Buddhism outside of Burma. This is based on the Mahāvamsa (*q.v.*) and other well-known Ceylon works; and has no independent value. The latter part of the work, about three-fifths of the whole, deals with Buddhism in Burma, and contains information not obtainable elsewhere. It was edited for the Pali Text Society in 1897 by Dr. Mabel Bode.

SASARAM, a town of British India, in the Shahabad district of Behar and Orissa, with a station on the East Indian railway. Pop. (1921), 22,308. It is famous as containing the tomb of the emperor Sher Shah (1540–1545). The tomb, which is the finest example of Pathan architecture in India, with a dome 101 ft. high, stands on an island in the middle of an artificial lake. The town also contains the tomb of Sher Shah's father, another fine specimen of Pathan art; a building called the Kila, or fort, said to have been his palace; and the grave and unfinished tomb of Sher Shah's son, the emperor Salim Shah. Outside is the ruined tomb of Alawal Khan, the reputed architect of Sher Shah's and his father's tomb. A rock edict of Asoka is inscribed on the Chandan Pir Shahid hill, close to the town.

SASKATCHEWAN. The middle member of the three Prairie Provinces of Canada, lies between 60° N. and 49° N. and 110° W. and 102° W. Physiographically it is divisible into two main areas by a line from about 53° 30′ N. on the eastern border (just south of Cumberland Lake) to 56° 30′ N. (just south of Buffalo Lake), on the west, *i.e.*, a line running somewhat to the south of the course of the Churchill River within the Province. The area to the north of this line comprising about one-third of the Province is a lowland—mostly over 1,000 ft. but under 1,200 ft.—developed upon Pre-Cambrian Rocks, with a narrow border of Palaeozoic sedimentaries along its southern margin. The Pre-Cambrian, *i.e.*, Laurentian Shield area is a hummocky wilderness of rock, lake, forest and swamp, with drainage to the Mackenzie system in L. Athabasca to the north, and to the Hudson Bay system via the Churchill River, to the south. This northern area has a wealth of timber, pulp wood, water power and probably metallic minerals at present untouched. Surface, and to some extent, climatic conditions, are such as to preclude any immediate likelihood of farming development, and north of

the Churchill River—if we except a limited quantity of merchantable timber in the valley of the Clearwater and about the shores of L. Athabasca—even the forests have at present little value except as a game and fur-bearing animal reserve. South of the Churchill River to the latitude of Prince Albert, there is on the Saskatchewan a commercial forest belt which, because of muskeg and fires, contains little saw timber, but is about 25% covered with potential pulp wood. This commercial timber belt overlaps the southern physiographic division which differs from the northern, (i.) in being higher (1,700 ft–2,000 ft. in the north to over 3,000 ft. in the extreme south-west); (ii.) in being developed on little disturbed sedimentaries of Cretaceous age, with some plateau-like tertiary residuals; (iii.) in the tabular nature of its major land forms.

The rise from the northern limits of this Cretaceous tableland is not quite gradual to the south-west, but is interrupted by extensive plateau masses rising some 500 ft.–800 ft. above the general levels. Such are Moose Mts., Beaver Hills and Bear Hills. An irregular but generally perceptible low scarp facing north-east runs from Estevan on the United States border to about Battleford—a continuation of the Missouri *coteau* of the United States. South-west of this line the plateau is higher—a part of the so-called third prairie steppe—and in the extreme south is itself overtopped by Cypress Hills and Wood Mts., scrub-covered plateau-like masses developed on tertiary sedimentaries. Apart from these last and a belt of grove country in the north, the land south of the north Saskatchewan river is unforested. The larger rivers, *e.g.*, the north and south Saskatchewan, flow in trench-like courses and glaciation has left its trace in innumerable lakes, abandoned *coulées*, and a general mantle of drift which thins out on the higher plateau.

Precipitation over most of the Province is between 13 in.–18 in. and over 60% occurs in the growing season (May–September). In the south-west of the Province—between the south Saskatchewan and the Cypress Hills—precipitation is, relative to evaporation, too low for effective farming. Here and on the Wood and Cypress Hill areas, open land is best used for ranching. However, the larger part of the prairie area has proved abundantly suitable for wheat farming, while mixed farming and dairy farming are developing in the northern parts of the prairie and in the grove belt. Saskatchewan leads the Prairie Provinces in agricultural production, including dairy farming, which has now assumed a very great importance. In the prairie belt the summers are a little hotter than in south-east England, but drier and much brighter. The winters are intensely cold, but dry, bright and invigorating. Rapid variations in temperature are frequent, especially in winter. The snow cover is very light.

Lignite is mined (472,000 tons in 1925) near Estevan in S. Saskatchewan. The Province has 1,087,756 h.p. water power (undeveloped) chiefly on the Lower Churchill, Saskatchewan, Reindeer and Black rivers, all in the Northern unpopulated part of the Province and too remote for immediate development.

In the settled prairie portion of the Province there is now a fairly dense network of railway.

Statistics of Principal Crops

	1920		1926		1927 (estimated only)	
	Area 000 ac.	Yield 000 bu.	Area 000 ac.	Yield 000 bu.	Area 000 ac.	Yield 000 bu.
Wheat	10,189	115,519	13,496	218,643	12,979	208,966
Oats	4,676	93,954	3,940	110,726	4,412	144,732
Barley	399	6,605	872	21,896	926	26,295
Rye	118	1,223	305	5,396	358	7,905
Flaxseed	917	3,457	515	3,706	331	3,208

Livestock Statistics, 1925

Horses 1,109,516. Milch Cows 438,245. Other cattle 721,880. Sheep 161,831. Swine 597,660.

History, Administration, Etc.—In 1905 the Dominion Government created out of the North West Territories the Provinces of Alberta and Saskatchewan. In the decade 1911–21 population in Saskatchewan increased 439%—representing one of the greatest rushes for farm lands in the history of the world. The Provincial Government is vested in a Lieutenant-Governor and a Legislative Assembly of 63 members elected for five years. Women are enfranchised and eligible for election to the Legislature. Regina is the seat of Government. The Province is represented by six Senators and twenty-one members of Parliament in the Dominion Government.

Population and Racial Origin, 1926.—British, 416,721; German, 96,498; Scandinavian, 63,370; Ukrainian, 51,474; French, 47,030; Russian, 36,208; others, 109,437; total, 820,738; in 1931 the population was 921,785. (*See* also CANADA.)

SASKATCHEWAN ("Rapid River"), a river of Alberta and Saskatchewan provinces, Canada. Two large streams known as the North and South Saskatchewan unite near Prince Albert, and thence flow east into Lake Winnipeg. The North Saskatchewan rises in the Rocky Mountains in 52° 07′ N. and 117° 06′ W., and flows east, receiving several important tributaries, including the Clearwater, Brazeau and Battle. The South Saskatchewan is formed by the union of the Bow and the Belly, the former and larger of which rises in western Alberta in one of the highest districts of the Rockies. Flowing east it receives the waters of the Red Deer, and farther on turns abruptly north to its junction with the other branch. The length of the united Saskatchewan is about 300 m. It is little used now for navigation.

SASKATOON, second largest city of the Province of Saskatchewan, Canada, is situated on the bank of the South Saskatchewan river, 160 m. N.W. of Regina and 466 m. W. of Winnipeg. From a population of 113 in 1900 it increased to 25,739 in 1921 and 43,291 in 1931. It is an important railway centre for the Canadian Pacific and Canadian National railways and the mid-western headquarters of the latter line. Its central geographical position in the province gives it freight control of about 47,000 sq.m. of distributing territory. It is the seat of the University of Saskatchewan (1,330 regular students in 1927), of the provincial agricultural school and experiment farm, and of a newly built provincial normal school. There are 12 large public schools (attendance 8,645 in 1926), 17 churches, 5 banks, a court house, customs house, Dominion land office, land title office and 2 hospitals. The city owns electric light and power, street railway, water and sewerage systems. The assessed value of taxable property in 1926 was $28,327,600. The city is the second largest manufacturing city in the province with 47 establishments in 1925 producing goods valued at $7,184,543. The chief industries were the manufacturing of flour, breakfast foods, tractors, garments, beer, bricks and cement blocks. There are also a number of large wholesale houses, the Dominion interior elevator (capacity, 3,500,000 bu.), and two daily and one weekly newspapers.

SASSAFRAS (*Sassafras variifolium*), a North American tree of the laurel family (Lauraceae), called also ague-tree, with aromatic bark and foliage. It is native to sandy soils from Maine to Ontario and Iowa and south to Florida and Texas. While usually a small tree, it sometimes attains a height of 80 ft. or more. It has furrowed bark, bright green twigs and entire, mitten-shaped or three-lobed leaves, the three forms often on the same twig. The yellow flowers, borne in small clusters, are followed by dark blue berries. The root, especially its bark, is used in household medicine; it yields oil of sassafras, used in perfumery. (*See* OREGON MYRTLE; SPICE-BUSH.)

SASSANID or SASSANIAN DYNASTY (or SASANIAN), the ruling dynasty of the neo-Persian empire founded by Ardashir I. in A.D. 226 and destroyed by the Arabs in 637. The dynasty is named after Sāsān, an ancestor of Ardashir I. *See* PERSIA: CALIPHATE.

SASSARI, a town and archiepiscopal see of Sardinia, capital of the province of Sassari, situated in the N.W. corner of the island, 12½ m. by rail S.E. of Porto Torres on the north coast, and 21½ m. N.W. of Alghero on the west coast, 762 ft. above sea-level. Pop. (1921) 36,807 (town); 42,946 (commune). The town has a modern aspect, with spacious streets and squares. S. Maria di Betlemme has a good façade and Romanesque portal of the end of the 13th century. The museum in the university has an interesting collection of antiquities from all parts of the

island, and belonging to the prehistoric, Phoenician and Roman periods. Sassari is connected by rail by a branch (28½ m. E.S.E. to Chilivani) with the main line from Cagliari to Golfo degli Aranci, and with Porto Torres and Alghero. Eleven m. to the east is the Trinità di Saccargia (12th cent.) with a lofty campanile, one of the finest Pisan churches in the island.

The name, in the form Thatari, first occurs in the 12th century A.D. when a church of S. Nicola is mentioned. The town was in existence in 1217, when a body of Corsicans, driven out of their island by the cruelties of a Visconti of Pisa, took refuge there, and gave their name to a part of it. In 1288, four years after the defeat of Meloria, Pisa ceded Sassari to Genoa; but Sassari enjoyed internal autonomy, and in 1316 published its statutes (still extant), which are perhaps in part the reproduction of earlier ones. In 1323, however, Sassari submitted to the Aragonese king. The episcopal see was transferred here from Porto Torres in 1441. It was sacked by the French in 1527.

See P. Satta-Branca, *Il Comune di Sassari nei secoli XIII. e XIV.* (Rome, 1885).

SASSINA (mod. *Sarsina*), an ancient town of Umbria, Italy, on the left bank of the river Sapis (Savio), 16 m. S. of Caesena (Cesena). In 266 B.C. both consuls celebrated a triumph over the Sassinates, and in the enumeration of the Italian allies of the Romans in 225 B.C. the Umbri and Sassinates are mentioned, on an equal footing, as providing 20,000 men between them. The poet Plautus was a native of Sassina (b. 254 B.C.). An episcopal see was founded here in the 3rd century A.D. and still exists. The present town has 1,751 inhabitants (commune, 4,431).

SASSOON, SIR ALBERT ABDULLAH DAVID, Bart, cr. 1890 (1818–1896), British Indian philanthropist and merchant, was born at Baghdad on July 25, 1818, a member of a Jewish family settled there since the beginning of the 16th century, and previously in Spain. His father, a leading Baghdad merchant, was driven by repeated Anti-Semitic outbreaks to remove from Baghdad to Bushire, Persia, and, in 1832, he settled in Bombay where he founded a large banking and mercantile business. Albert Sassoon was educated in India, and on the death of his father became head of the firm. He was a great benefactor to the city of Bombay, among his gifts being the Sassoon dock, completed in 1875. He died at Brighton, England, on Oct. 24, 1896.

SASTRI, V. S. SRINIVASA (1869–), Indian statesman, was born of poor Brahmin parents at Valangiman, near Kumbakonam, Madras, on Sept. 22, 1869. He started life as a schoolmaster, but, deeply impressed by the rules of the Servants of India Society which G. K. Gokhale founded in 1905, on a basis of self-sacrifice, purity and poverty, he was admitted to membership early in 1907. On Gokhale's nomination, made before his death in 1915, Sastri succeeded to the presidentship. Elected to the viceregal legislative council in 1916, he soon came to the front as the greatest Indian orator of his day. He gave discriminating support to the Montagu-Chelmsford reforms, being a member of the Moderate deputation to England in 1919 and serving on Lord Southborough's Franchise committee; he was elected a member of the new Council of State when the reforms took effect. In 1921 he served on the Indian Railway committee; represented India at the Imperial Conference in London, at the League of Nations Assembly at Geneva, and at the Washington Conference on the reduction of naval armaments. The same year he was called to the privy council, being the third Indian to receive this distinction, and was made a freeman of the City of London. In 1922 he was deputed to Australia, New Zealand and Canada to confer with the respective governments as to the best methods of practical interpretation of the resolution of the 1921 Imperial Conference on the rights of citizenship of lawfully domiciled Indians, and he achieved definite results. He was chairman of a deputation of non-official members of the Indian legislature to London in 1923 to support representations made by the Indians of Kenya on their disabilities, and certain disappointments led him some way in the direction of aloofness; but in 1926 he accepted an invitation of the Government of India to be a member of the Indian delegation to South Africa for a round table conference with the Union Government.

A settlement was reached and with the hearty approval of Gandhi, Sastri accepted early in 1927 appointment as the first agent-general to the Government of India in South Africa. He showed great judgment and skill in promoting good will and concord during the two years to which he limited his acceptance.

(F. H. Br.)

SATARA, a town and district of British India, in the Central division of Bombay, 10 m. from Satara Road station on the Madras and Southern Mahratta railway. The name is derived from the "seventeen" walls, towers and gates which the fort was supposed to possess. The town is 2,320 ft. above sea-level, near the confluence of the rivers Kistna and Vena, 56 m. S. of Poona. Pop. (1921) 22,454.

The District of Satara has an area of 4,916 sq.m. It contains two hill systems, the Sahyadri, or main range of the Western Ghats, and the Mahadeo range and its offshoots. The former runs through the district from north to south, and the latter from east to south-east. The Mahadeo hills are bold, presenting bare scarps of black rock. There are two river systems—the Bhima system in a small part of the north and north-east, and the Kistna system throughout the rest of the district. The hill forests have a large store of timber and firewood. The soil is a black loamy clay containing carbonate of lime, which is very fertile when well watered. Satara contains some important irrigation works, including the Kistna canal. In some of the western parts of the district the average annual rainfall exceeds 200 in.; but on the eastern side water is scanty. The population in 1921 was 1,026,259. The principal crops are millet, pulse, oil-seeds and sugar-cane. The only manufactures are cotton cloth, blankets and brass-ware. The district is traversed from north to south by the Madras and Southern Mahratta railway, passing 10 m. from Satara town. The Satara agency comprises the two feudatory states of Phaltan and Aundh (*q.v.*).

On the overthrow of the Jadhav dynasty in 1312 the district passed to the Mohammedan power, which was consolidated in the reign of the Bahmani kings. On the decline of the Bahmanis towards the end of the 15th century the Bijapur kings finally asserted themselves, and under these kings the Mahrattas arose and laid the foundation of an independent kingdom with Satara as its capital. The Peshwas, who removed the capital to Poona and degraded the raja, got the ascendancy in the 18th century, but after the war of 1817 the British restored the raja, and assigned to him the principality of Satara, with an area much larger than the present district. In consequence of political intrigues he was deposed in 1839, and his brother, who took his place, died without male heirs in 1848, when the state was resumed by the British government.

SATEEN, a term of modern usage derived from "satin" (*q.v.*). The term "sateen" is employed more especially to distinguish cotton textures that are based on the satin weave principle of fabric structure from those of the true "satin" fabrics produced from pure silk.

SATELLITE, in astronomy, a small opaque body revolving around a planet, as the moon around the earth (*see* Planet and the articles on individual planets). In the theory of cubic curves, Arthur Cayley defined the satellite of a given line to be the line joining the three points in which tangents at the intersections of the given (primary) line and curve again meet the curve.

SATIE, ERIK LESLIE (1866–1925), French composer, was born at Honfleur on May 17, 1866 (his mother being an Englishwoman), and studied at the Paris conservatoire. His early works proclaimed a persistent determination to be original, and were followed by a series of equally eccentric pianoforte pieces. He exercised influence, none the less, upon many of his younger French contemporaries of the "advanced" school, who hailed him as a prophet. But the public at large saw in him something of the *farceur,* and his interesting attempts to be daring did not seem to be accompanied by any commensurate genuine talent.

See A. Coeuroy, *La Musique française moderne* (Paris, 1922).

SATIN, a term strictly denoting a true silk texture developed with a perfectly even, smooth and glossy or lustrous surface on which either warp or weft threads preponderate and

thus entirely obscure the other series of threads. The principle of fabric structure observed in the construction of satin fabrics is that known as the "satin" weave, which constitutes one of the simplest elementary weaves in which the intersections of the warp and weft threads are so evenly and perfectly distributed that there are no pronounced textural features discernible in the fabric, as the threads, either of warp or of weft only, are displayed on the surface with the least possible amount of deflection by their interlacement with the threads of the other system.

A true silk satin fabric may be produced either with a warp surface or a weft surface of pure silk, with the reverse side of cotton or other textile material. In either case, the silk requires to be of the best quality and perfectly even.

The term "satin," however, is now applied as a general description for many fabrics (other than those composed of pure silk), constructed on the principle of the satin weaves. For example, cotton fabrics constructed on the satin-weave basis are described as "satin" or "sateen" according to whether they are developed with a warp surface or a weft surface, respectively. It is also applied indiscriminately to many other varieties of fabrics having a smooth and lustrous finish. (For Satinet *see* SATEEN.) (H. N.)

SATIN-SPAR, a name given to certain fibrous minerals which exhibit, especially when polished, a soft satiny or silky lustre, and are therefore sometimes used as ornamental stones. Such fibrous minerals occur usually in the form of veins or bands, having the fibres disposed transversely. The most common kind of satin-spar is a white finely-fibrous gypsum not infrequently found in the Keuper marls of Nottinghamshire and Derbyshire, and used for beads, etc. Other kinds of satin-spar consist of calcium carbonate, in the form of either aragonite or calcite, these being distinguished from the fibrous gypsum by greater hardness and effervescence with acids and from each other by specific gravity and optical characters. The satin-spar of Alston, Cumberland, is a finely-fibrous calcite occurring in veins in a black shale of the Carboniferous series.

SATIN-WOOD, a beautiful light-coloured hard wood, having a rich, silky lustre, sometimes finely mottled or grained, the produce of a moderate-sized tree, *Chloroxylon Swietenia* (family Meliaceae), native of India and Ceylon. A similar wood, known under the same name, is obtained in the West Indies, the tree being probably a species of *Xanthoxylum* (family Rutaceae). Satin-wood was in request for rich furniture about the end of the 18th century, the fashion then being to ornament panels of it with painted medallions and floral scrolls and borders. It is used for inlaying and small veneers.

SATIRE, in its literary aspect, may be defined as the expression in adequate terms of the sense of amusement or disgust excited by the ridiculous or unseemly, provided that humour is a distinctly recognizable element, and that the utterance is invested with literary form. Without humour, satire is invective; without literary form, it is mere clownish jeering. The first exercise of satire no doubt consisted in gibing at personal defects. To dignify satire by rendering it the instrument of morality or the associate of poetry was a development implying considerable advance in the literary art. In the accounts that have come down to us of the writings of Archilochus, the first great master of satire, we seem to trace the elevation of the instrument of private animosity to an element in public life. Simonides of Amorgus and Hipponax were distinguished like Archilochus for the bitterness of their attacks on individuals, with which the former combined a strong ethical feeling and the latter a bright active fancy. The loss of their writings, which would have thrown great light on the politics as well as the manners of Greece, is to be lamented. With Hipponax the direct line of Greek satire is interrupted; but two new forms of literary composition, capable of being the vehicles of satire, almost simultaneously appear. Although the original intention of fable does not seem to have been satirical its adaptability to satiric purposes was soon discovered. A far more important step was the elevation of the rude fun of rustic merrymakings to a literary status by the evolution of the drama from the Bacchic festival. The means had now been found of allying the satiric spirit with exalted poetry, and their union was consummated in the comedies of Aristophanes.

A rude form of satire had existed in Italy from an early date in the shape of the Fescennine verses, the rough and licentious pleasantry of the vintage and harvest. As in Greece, these eventually were developed into a rude drama. Verse, "like to the Fescennine verses in point of style and manner," was added to accompany the mimetic action, and these probably improvised compositions were entitled *Saturae,* a term denoting *miscellany,* and derived from the *satura lanx,* "a charger filled with the first-fruits of the year's produce."

The Roman people thus had originated the name of satire, and, in so far as the Fescennine drama consisted of raillery and ridicule, possessed the thing also; but it had not yet assumed a literary form among them. The real inventor of Roman satire is Gaius Lucilius (148–103 B.C.). The fragments of Lucilius preserved are scanty, but the verdict of Horace, Cicero and Quintilian demonstrates that he was a considerable poet. It is needless to dwell on compositions so universally known as the *Satires* of Lucilius's successor Horace, in whose hands this class of composition received a new development, becoming genial, playful and persuasive. The didactic element preponderates still more in the philosophical satires of Persius. Yet another form of satire, the rhetorical, was carried to the utmost limits of excellence by Juvenal, the first example of a great tragic satirist. Nearly at the same time Martial, improving on earlier Roman models now lost, gave that satirical turn to the epigram which it only exceptionally possessed in Greece, but has ever since retained. About the same time another variety of satire came into vogue, destined to become the most important of any. The Milesian tale, a form of entertainment probably of Eastern origin, grew in the hands of Petronius and Apuleius into the satirical romance, immensely widening the satirist's field and exempting him from the restraints of metre. Petronius's "Supper of Trimalchio" is the revelation of a new vein, never fully worked till our days. As the novel arose upon the ruins of the epic, so dialogue sprang up upon the wreck of comedy. In Lucian comedy appears adapted to suit the exigencies of an age in which a living drama had become impossible. With him antique satire expires as a distinct branch of literature.

In the Byzantine empire, indeed, the link of continuity is unbroken, and such raillery of abuses as is possible under a despotism finds vent in pale copies of Lucian. The first really important satire, however, of the middle ages, is a product of western Europe, recurring to the primitive form of fable, upon which, nevertheless, it constitutes a decided advance. *Reynard the Fox* (*see* FABLE), a genuine expression of the shrewd and homely Teutonic mind, is a landmark in literature. It gave the beast-epic a development of which the ancients had not dreamed. About the same time, probably, the popular instinct, perhaps deriving a hint from Rabbinical literature, fashioned Morolf, the prototype of Sancho Panza, the incarnation of sublunar mother-wit contrasted with the starry wisdom of Solomon; and the *Till Eulenspiegel* is a kindred Teutonic creation, but later and less significant. *Piers Ploughman,* the next great work of the class, adapts the apocalyptic machinery of monastic and anchoritic vision to the purposes of satire. The clergy were scourged with their own rod by a poet and a Puritan too earnest to be urbane. The Renaissance, restoring the knowledge of classic models, enlarged the armoury of the satirist. Partly, perhaps, because Erasmus was no poet, the Lucianic dialogue was the form in the ascendant of his age. Erasmus not merely employed it against superstition and ignorance with infinite and irresistible pleasantry, but fired by his example a bolder writer, untrammelled by the dignity of an arbiter in the republic of letters. The ridicule of Ulric von Hutten's *Epistolae obscurorum virorum* is annihilating, and the art of putting the ridicule into the mouth of the victim, is perhaps the most deadly shaft in the quiver of sarcasm. It was afterwards used with even more pointed wit though with less exuberance of humour by Pascal. Sir Thomas More cannot be accounted a satirist, but his idea of an imaginary commonwealth embodied the germ of much subsequent satire.

In the succeeding period politics take the place of literature and

religion, producing in France the *Satyre Ménippée*, elsewhere the satirical romance as represented by the *Argenis* of Barclay, which may be defined as the adaptation of the style of Petronius to State affairs. In Spain, where no freedom of criticism existed, the satiric spirit took refuge in the *novela picaresca,* the prototype of Le Sage and the ancestor of Fielding; Quevedo revived the mediaeval device of the vision as the vehicle of reproof; and Cervantes's immortal work might be classed as a satire were it not so much more. About the same time we notice the appearance of direct imitation of the Roman satirists in English literature in the writings of Donne, Hall and Marston. The prodigious development of the drama at this time absorbed much talent that would otherwise have been devoted to satire proper. Most of the great dramatists of the 17th century were more or less satirists, Molière perhaps the most consummate that ever existed; but, with an occasional exception like *Les Précieuses ridicules,* the range of their works is too wide to admit of their being regarded as satires. The next great example of unadulterated satire is Butler's *Hudibras.* Dignified political satire, bordering on invective, was carried to perfection in Dryden's *Absalom and Achitophel.* In France Boileau was long held to have attained the *ne plus ultra* of the Horatian style in satire and of the mock-heroic, but Pope was soon to show that further progress was possible in both. The polish, point and concentration of Pope remain unsurpassed, as do the amenity of Addison and the daring yet severely logical imagination of Swift; while the *History of John Bull* places their friend Arbuthnot in the first rank of political satirists.

The 18th century was, indeed, the age of satire. Serious poetry had for the time worn itself out; the most original geniuses of the age are decidedly prosaic, and Pope, though a true poet, is less of a poet than Dryden. In process of time imaginative power revives, but meanwhile Fielding and Smollett have fitted the novel to be the vehicle of satire and much beside, and the literary stage has for a time been almost wholly engrossed by a colossal satirist, a man who has dared the universal application of Shaftesbury's maxim that ridicule is the test of truth. The world had never before seen a satirist on the scale of Voltaire, nor had satire ever played such a part as a factor in impending change. As a master of sarcastic mockery he is unsurpassed; his manner is entirely his own; and he is one of the most intensely national of writers, notwithstanding his vast obligations to English humorists, statesmen and philosophers. English humour also played an important part in the literary regeneration of Germany, where Lessing, imbued with Pope but not mastered by him, showed how powerful an auxiliary satire can be to criticism. Another great German writer, Wieland, owes little to the English, but adapts Lucian and Petronius to the 18th century with playful if somewhat mannered grace. Goethe and Schiller, Scott and Wordsworth, are now at hand, and as imagination gains ground satire declines. Byron, who in the 18th century would have been the greatest of satirists, is hurried by the spirit of his age into passion and description, bequeathing, however, a splendid proof of the possibility of allying satire with sublimity in his *Vision of Judgment.* Two great satiric figures remain—one representative of his nation, the other most difficult to class. In all the characteristics of his genius Thackeray is thoroughly English; his satire is a thoroughly British article, a little solid, a little wanting in finish, but honest, weighty and durable. But Heine hardly belongs to any nation or country, time or place. In him the satiric spirit, long confined to established literary forms, seems to obtain unrestrained freedom.

In no age was the spirit of satire so generally diffused as in the 19th century, but many of its eminent writers, while bordering on the domains of satire, escape the definition of satirist. The term cannot be properly applied to Dickens, the keen observer of the oddities of human life; or to George Eliot, the critic of its emptiness when not inspired by a worthy purpose; or to Balzac, the painter of French society; or to Trollope, the mirror of the middle classes of England. If *Sartor Resartus* could be regarded as a satire, Carlyle would rank among the first of satirists; but the satire, though very obvious, rather accompanies than inspires the composition. The number of minor satirists of merit, on the other hand, is legion. James Russell Lowell's *Biglow Papers* represent perhaps the highest moral level yet attained by satire. Mallock, in his *New Republic,* made the most of personal mimicry, the lowest form of satire; Samuel Butler (*Erewhon*) holds an inverting mirror to the world's face with imperturbable gravity; the humour of Bernard Shaw has always an essential character of satire—the sharpest social lash. One remarkable feature of the modern age is the union of caricature (*q.v.*) with literature.

(R. G.; X.)

SATISFACTION, reparation for an injury or offence; payment, pecuniary or otherwise, of a debt or obligation; particularly, in law, an equitable doctrine of much importance. In English law, as between strangers, it was laid down in *Talbot* v. *Duke of Shrewsbury,* 1714, Pr. Ch. 394, that where a debtor bequeaths to his creditor a legacy as great as, or greater than the debt, the legacy shall be deemed a satisfaction of the debt. If the debt was incurred after the execution of the will, there is no satisfaction, nor is there where the will giving the legacy contains a direction to pay debts. As between parent and child, the doctrine operates (*a*) in the satisfaction of legacies by portions, and (*b*) of portions by legacies. In the case of (*a*), it has been laid down that where a parent, or one acting *in loco parentis,* gives a legacy to a child, without stating the purpose for which he gives it, it will be understood as a portion; and if the father afterwards advance a portion on the marriage, or preferment in life, of that child, though of less amount, it is a satisfaction of the whole, or in part. This application of the doctrine is based on the maxim that "equality is equity," as is also the rule (*b*) that where a legacy bequeathed by a parent, or one *in loco parentis,* is as great as, or greater than, a portion or provision previously secured to the child, a presumption arises that the legacy was intended by the parent as a complete satisfaction. In the United States some jurisdictions refuse to presume that a gift to a creditor is intended as a satisfaction of a debt. The testator's intention that the bequest shall operate as a satisfaction of the debt must appear upon the face of the will. A few States have abolished the doctrine of satisfaction by statute. (*See* Accord and Satisfaction; Legacy. For the theological meaning *see* Atonement.)

SATPURA, a system of hills in the centre of India. Beginning at the lofty plateau of Amarkantak, the range extends westward almost to the west coast. From Amarkantak an outer ridge runs south-west for about 100 m. to the Saletekri hills in Balaghat district. As it proceeds westward the range narrows from a broad tableland to two parallel ridges enclosing the valley of the Tapti, as far as the famous hill-fortress of Asirgarh. Beyond this point the Khandesh hills, which separate the valley of the Narbada from that of the Tapti, complete the chain as far as the Western Ghats. The mean elevation is about 2,500 ft.; but the plateaux of Amarkantak and Chauradadar in the east of Mandla district rise to nearly 3,500 ft., and many of the peaks and some of the tablelands exceed this altitude. Just east of Asirgarh there is a break in the range, through which passes the railway from Bombay to Jubbulpore, the elevation at this point being about 1,240 ft. The length of the system is about 600 m.

SATRAE, in ancient geography, a Thracian people, inhabiting part of Mount Pangaeus between the rivers Nestus (Mesta) and Strymon (Struma). According to Herodotus (vii. 110–112), they were independent in his time, and had never been conquered within the memory of man. They dwelt on lofty mountains, and on the highest of these was an oracle of Dionysus, whose utterances were delivered by a priestess. They were the chief workers of the gold and silver mines in the district. Herodotus is the only ancient writer who mentions the Satrae, and Tomaschek regards the name not as that of a people but of the warlike nobility among the Thracian Dii and Bessi. J. E. Harrison and others identify them with the Satyri (Satyrs), the attendants and companions of Dionysus, and also with the Centaurs.

See J. E. Harrison, *Prolegomena to the Study of Greek Religion* (1903), p. 379; W. Tomaschek, *Die alten Thraker* (1893).

SATRAP, in ancient history, the name given by the Persians to the governors of the provinces; Pers. *Khshatrapāvan, i.e.,* "protector (superintendent) of the country (or district)," Heb. *sakhshadrapan,* Gr. ἐξαιτράπης (insc. of Miletus, *Sitzungsber.*

Berl. Ak., 1900, 112), ἐξαιτραπεύων (insc. of Mylasa, Dittenberger, Sylloge, 3rd ed., 167) ἐξατράπης (insc. of Mylasa, Lebas, iii. 388, Theopomp, p. 111), shortened into σατράπης. By the earlier Greek authors (Herodotus, Thucydides, and often in Xenophon) it is rendered by ὕπαρχος "lieutenant, governor," in the documents from Babylonia and Egypt and in Ezra and Nehemiah by *pakha*, "governor"; and the satrap Mazaeus of Cilicia and Syria in the time of Darius III. and Alexander (Arrian, iii. 8) calls himself on his coins "Mazdai, who is [placed] over the country beyond the Euphrates and Cilicia." Cyrus the Great divided his empire into provinces; a definitive organization was given by Darius, who established twenty great satrapies and fixed their tribute (Herodot. iii. 89, sqq.). The satrap was the head of the administration of his province; he collected the taxes, controlled the local officials and the subject tribes and cities, and was the supreme judge of the province to whose "chair" (Nehem. iii. 7), every civil and criminal case could be brought. He was responsible for the safety of the roads (*cf.* Xenophon, *Anab.*, i. 9. 13), and had to put down brigands and rebels. He was assisted by a council of Persians, to which also provincials were admitted; and was controlled by a royal secretary and by emissaries of the king (esp. the "eye of the king"). The regular army of his province and the fortresses were independent of him and commanded by royal officers; but he was allowed to have troops in his own service (in later times mostly Greek mercenaries). The great provinces were divided into many smaller districts, the governors of which are also called satraps and hyparchs. The distribution of the great satrapies was changed occasionally, and often two of them were given to the same man. When the empire decayed, the satraps often enjoyed practical independence, especially as it became customary to appoint them also as generals-in-chief of their army district, contrary to the original rule. Hence rebellions of satraps became frequent from the middle of the 5th century; under Artaxerxes II. occasionally the greater part of Asia Minor and Syria were in open rebellion. The last great rebellions were put down by Artaxerxes III. The satrapic administration was retained by Alexander and his successors, especially in the Seleucid empire, where the satrap generally is designated as *strategus;* but their provinces were much smaller than under the Persians.

See further PERSIA: *Ancient History*, from the Achaemenid period onwards, and works there quoted. (ED. M.)

SATRICUM (mod. *Conca*), an ancient town of Latium, situated on a low hill surrounded by cliffs, some 30 m. to the S.E. of Rome, in a low-lying region to the south of the Alban hills, to the north-west of the Pomptine marshes. It was accessible direct from Rome by a road running more or less parallel to the Via Appia, to the south-west of it. It was a member of the Latin league of 499 B.C. and became Volscian in 488.

SATUN or SETUL, a small Siamese State in the Malay peninsula. Area 1,000 sq.m.; pop. 25,000. The principal production is pepper. (*See* also MALAY STATES: *Siamese.*)

SATURN, SATURNUS, SAETURNUS, a Roman god of sowing, or of seed-corn (*Satus*), identified with Cronos (*q.v.*), for reasons no longer apparent. His cult was so over-laid with Greek features that almost nothing is known of its original form. His cult-partner was the very obscure goddess Lua (*lues*, plague or destruction); she was amongst other things a fire-goddess in whose honour spoils were sometimes burned (*see* Rose in *Class. Rev.*, xxxvi., p. 15 *et seq.*). But, since for some reason Ops, the cult-partner of Consus (*q.v.*) became identified with Rhea, Saturn is often associated with her.

His temple stood at the foot of the *clivus Capitolinus* leading from the Forum, where the ruins of a late restoration of it are still visible. It contained the Republican treasury (*aerarium Saturni*). The statue had woollen bands around its feet, probably to keep it from running away (so at Sparta the statue of Enyalius the war-god was fettered, and there are plenty of savage parallels), *see* Macrob. *Saturn*, i. 8, 5; this too is Greek, for cult-statues are not native Roman. Also the worship was *Graeco ritu, i.e.*, with the head uncovered, not wrapped in the toga as was the Roman custom. His great festival was the Saturnalia, originally Dec. 19, but gradually extended to seven days. We may conjecture that it was connected with the winter sowing, which in modern Italy lasts in various districts from October to January. Be that as it may, in historical times it was a most lively popular festival, probably modelled on the Greek *Kronia* (*see* CRONUS). All business, public and private, was at a standstill; schools were closed, executions and military operations did not take place, slaves were temporarily free, feasting with and even waited on by their masters, and saying what they chose. All and sundry were greeted with *io Saturnalia*, and presents were freely exchanged, the traditional ones being wax candles and little clay dolls. Concerning these, the antiquaries had a quaint story that an old prophecy bade the earliest inhabitants of Latium send φῶτα to Saturn and heads to Pluto; that they interpreted this as meaning human sacrifices, but that Hercules (*q.v.*) advised them to use lights (the word ΦΩΣ means "light" or "man" according to accentuation) and not human "heads" (Macrob., *op. cit.*, i. 7, 31). Gambling with dice, generally forbidden, was allowed, a custom which is exactly paralleled from Nepal (Oldfield, *Sketches from Nepal*, ii. p. 353 *et seq.*). Saturnus himself was untied, presumably to come out and join in the fun.

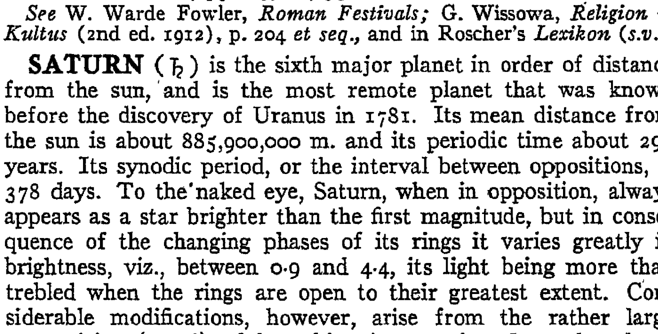
Saturni dies (Saturday) occurs first in Tibullus, I., 3, 18, *see* Colson, *The Week*, pp. 15, 16, 35.

See W. Warde Fowler, *Roman Festivals;* G. Wissowa, *Religion u. Kultus* (2nd ed. 1912), p. 204 *et seq.*, and in Roscher's *Lexikon* (*s.v.*).

SATURN (♄) is the sixth major planet in order of distance from the sun, and is the most remote planet that was known before the discovery of Uranus in 1781. Its mean distance from the sun is about 885,900,000 m. and its periodic time about 29½ years. Its synodic period, or the interval between oppositions, is 378 days. To the naked eye, Saturn, when in opposition, always appears as a star brighter than the first magnitude, but in consequence of the changing phases of its rings it varies greatly in brightness, viz., between 0·9 and 4·4, its light being more than trebled when the rings are open to their greatest extent. Considerable modifications, however, arise from the rather large eccentricity (0·056) of its orbit. As regards colour, the planet shines with a warm, yellowish light not unlike that of Arcturus.

The Globe.—In telescopic appearance the globe of Saturn exhibits strong resemblances to Jupiter. It is even more flattened at the poles, its polar and equatorial diameters being respectively about 67,000 and 75,000 m.; it is less bright near the margin than at the centre of the disc; and its surface is marked by dusky belts with light intermediate zones, but whereas these cloudlike bands are very conspicuous on Jupiter, they are usually feeble and ill-defined—partly in consequence of the planet's greater distance—in the case of Saturn.

The volume of Saturn is about 750 times that of the earth, but the periodic times of its satellites show that it exceeds the earth



FROM STEWART, "ASTRONOMY" (GINN & CO.)

PHASES OF SATURN'S RINGS

only about 95 times in mass. Its mean density, therefore, is but 0·13 of that of the earth, or over 0·7 times that of water.

Rotation.—Owing to the difficulty of detecting individual features of a sufficiently definite nature, the rotation of the planet has been observed only on comparatively rare occasions. The first determination was made in 1794 by the elder Herschel, who derived a rotation period of 10 h. 16 m. In Dec. 1876 a bright spot appeared near the equator which was observed by Asaph Hall, at Washington, for more than a month, and which showed a rotation in 10 h. 14 m. 24 s. In 1893 and 1894 A. S. Williams deduced from

observations of dark spots in the northern hemisphere mean rotation periods of 10 h. 14 m. 45 s. and 10 h. 15 m. 10 s. respectively, and in the same two years periods of 10 h. 12 m. 52 s. and 10 h. 12 m. 36 s. from a number of white equatorial spots. A further series of spots appeared in the planet's north temperate regions in 1903, and from the recorded observations of these objects Denning found a mean period of about 10 h. 38 m. It seems certain, therefore, that, as in the case of Jupiter, there are variations in the motions of the spots from year to year, and also that the rotation period is shorter near the equator than in higher latitudes.

Physical Condition.—It is further clear that what we see of Saturn is not a solid surface, but a layer of cloudlike or vaporous matter; the mean density of the globe is, indeed, less than that of any other major planet, and it is further to be noted that considerations based on the large ellipticity of the disc, which is greater than would be assumed by such a globe of anything like uniform density rotating with the angular velocity of Saturn, indicate that the larger part of the planet's mass must be strongly concentrated towards the centre.

The radiometric observations of Coblentz and Lampland suggest a surface temperature which, though considerably higher than can be accounted for by solar radiation, is a good deal lower than was formerly supposed to characterize the greater planets of the outer group. Conclusions based on such measurements, however, appear by themselves to be somewhat unreliable in consequence of the absorption of certain long-wave radiations by the earth's atmosphere, but a comparatively low temperature is supported by the theoretical work of Jeffreys. For further references to this interesting problem, and the observational evidences of considerable energy presented by the surface features of the great planets, *see* the articles PLANET and JUPITER.

There are several strong bands in the spectrum of Saturn, due to absorption in the planet's atmosphere. They are identical with those shown by the spectra of Jupiter, Uranus and Neptune, though of greater intensity than in the spectrum of the former and of less intensity than in those of the two last-mentioned planets. Their origin is still unknown.

The Rings.—But Saturn's most remarkable feature, and that which renders it unique, so far as our knowledge goes, is the magnificent system of rings by which it is surrounded. That Saturn differs in appearance from other bodies was seen at once by Galileo when he turned his little telescope towards it in 1610, but his instrument was not sufficiently powerful to show clearly what it was that he saw. He noticed that the planet had a small attendant on each side, and accordingly represented it as a triple body. But during the next few years the appendages dwindled and finally disappeared, greatly to his perplexity and chagrin, as he feared he must have been misled by some kind of illusion. When they subsequently reappeared they continued to present a difficult problem to the telescopic observers of the day—sometimes seeming like arms stretching out on each side of the central body, and sometimes like curved handles—and a number of curious drawings have come down to us which show how puzzled the observers were, but how near some of them came to the solution of the mystery. The true explanation was ultimately arrived at by Huyghens in 1655, but, wishing for further time to make sure of his solution and yet secure himself against the possible loss of priority in the discovery, he published the following series of letters:—aaaaaaa ccccc d eeeee g h iiiiiii llll mm nnnnnnnnn oooo pp q rr s ttttt uuuuu; which, when properly arranged, form the sentence:—*"Annulo cingitur, tenui, plano, nusquam cohaerente, ad eclipticam inclinato"* (It is girdled by a thin flat ring, nowhere touching, inclined to the ecliptic). These last few words explain the various appearances which so sorely puzzled the earlier observers with their imperfect instruments. The plane of the ring is inclined about 27° to the planet's orbit, and about 28° to the ecliptic, and keeps parallel to itself throughout the planet's revolution. There are accordingly two opposite portions of the orbit, viz., near longitudes 172° and 352°, where Saturn is in Leo and Aquarius respectively, at which the ring can be presented edgewise to the earth, and when this event happens (as it does either once or three times during each passage of the ring plane across the earth's orbit) the ring—owing to its thinness—disappears from view even in powerful instruments. At intermediate positions, viz., when the planet is in Taurus and Gemini and in Sagittarius, it appears opened out at an angle of 27°, and is then seen to project slightly beyond the polar diameter of the planet's globe.

The next important telescopic discovery as regards Saturn was the detection by G. D. Cassini, in 1675, of a black line or gap dividing the ring into two concentric rings. This is generally known as "Cassini's division." The ring exterior to this division is narrower and less bright than the inner ring, while the outer portion of the latter is the most brilliant part of the whole system. Within the second ring is yet another feature of great interest, viz., a third ring, commonly known as the Crape ring, of which the brightness is so feeble that it long escaped detection. It was first recorded by Galle, at Berlin, in 1838, but its existence was strangely forgotten till it was independently rediscovered, in 1850, by G. P. Bond at Harvard and W. R. Dawes in England. It can be readily traced with a comparatively small telescope as a dusky band where it crosses the planet's globe, but is not so easily seen in the portions projected against the dark sky. The three rings are often denoted by the letters A, B and C. From time to time other divisions besides that of Cassini have been reported, but they seem to have been merely partial and temporary, except that known as "Encke's division," in ring A, which is, perhaps, permanent, though probably not really a complete division. It usually appears as a pencil-like shading rather than a sharp black line, and sometimes merely as the boundary of the darker outer portion of the ring. The figures given by different authorities for the dimensions of the ring system differ somewhat, but the following are approximately correct:

Ring	Exterior diameter in miles	Breadth of ring in miles
A . . .	170,000	10,000
B . . .	145,000	16,000
C . . .	113,000	11,000

The breadth of the Cassini division is probably rather over 2,000 miles. The thickness of the rings is apparently between 20 and 40 m. only. It is noteworthy that all three are at least partly transparent; Saturn itself can be distinctly seen through the Crape ring, and on some recent photographs it also shows through the outer ring. Moreover, on Feb. 9, 1917, M. A. Ainslie, at Blackheath, and J. Knight, at Rye, observed that a seventh magnitude star (B.D. + 21° 1714), remained visible during its occultation by the outer ring, though Ainslie considered that it lost something like three-fourths of its light; it appeared to travel some distance along the Cassini division but did not pass behind ring B; and on March 14, 1920, during the occultation of Lalande 20,654 (Mag. 7·3), the star remained conspicuously visible in a 6-in. refractor at W. Reid's observatory, Rondebosch, South Africa, even when behind the brightest part of ring B, and despite the fact that, in consequence of the obliqueness of the line of sight, its light had to traverse a distance through the ring equal to eight times its real thickness.

The translucency of the ring system is also shown by the fact that it can be faintly seen against the sky as a narrow line of light on the occasions—sometimes extending over several weeks near the time of disappearance—when the plane of the rings passes between the sun and the earth. On this line of light two condensations are seen on each side of the planet, corresponding in position with the Cassini division and the Crape ring. They are apparently caused by the larger amount of sunlight transmitted at those places where the ring material is absent or relatively thin. The ring, as a whole, however, is sufficiently dense to cast a strong shadow, which is seen at such times as a narrow black band across the planet's equatorial regions.

The physical constitution of the rings is unlike that of any other object in the solar system. They are not formed of a continuous mass of solid or liquid matter, but of discrete particles

of unknown minuteness, probably widely separated in proportion to their individual volumes, yet so close as to appear continuous when viewed from the earth. This constitution was first divined by J. Cassini early in the 18th century. But, although the impossibility that a continuous ring could surround a planet without falling upon it was shown by Laplace, and must have been evident to all investigators in celestial mechanics, Cassini's explanation was forgotten until 1857. In that year James Clerk Maxwell, in an essay which was the first to gain the newly-founded Adams prize of the University of Cambridge, made an exhaustive mathematical investigation of the satellite constitution, showing that it alone could fulfil the conditions of stability. Although this demonstration placed the subject beyond doubt, it was of great interest when J. E. Keeler, at the Allegheny Observatory, proved this constitution by spectroscopic observation in 1895. He found, by measuring the velocity of different parts of the ring to or from the earth, that, as we pass from its outer to its inner regions, the velocity of revolution around the planet increases, each concentric portion having the speed belonging to a satellite revolving in a circular orbit at the same distance from the planet. The relative velocities of different parts of the system are beautifully shown by the slope of the lines in a spectrogram of Saturn made by V. M. Slipher of the Lowell Observatory.

Satellites.—Saturn is attended, so far as at present known, by nine satellites. A tenth (Themis) was announced by W. H. Pickering in 1905, but its actual existence has not been satisfactorily confirmed.

Details of the satellites are given in the following table:

Name	Distance in equatorial radii of Saturn (1=37·500 m.)	Period of revolution		Inclination of orbit to Saturn's orbit		Eccentricity	Stellar mag. at mean opposition	Discoverer	Date of discovery
		d	h	°					
Mimas	3·1	0	22·6	26	44·7	0·0190	12·1	W. Herschel	1789, Sept. 17
Enceladus	3·9	1	8·9	26	44·7	0·0001	11·6	W. Herschel	1789, Aug. 28
Tethys	4·9	1	21·3	26	44·7	0·0000	10·5	G. D. Cassini	1684, March
Dione	6·3	2	17·7	26	44·7	0·0020	10·7	G. D. Cassini	1684, March
Rhea	8·7	4	12·4	26	41·9	0·0009	10·0	G. D. Cassini	1672, Dec.
Titan	20·2	15	22·7	26	7·1	0·0289	8·3	Huyghens	1655, March
Hyperion	24·5	21	6·6	26	0·0	0·1043	13·0	Bond	1848, Sept. 16
Iapetus	58·9	79	7·9	16	18·1	0·0284	10·1 to 11·9	G. D. Cassini	1671, Oct.
Phoebe	214·2	550	10·6	174°.7		0·1659	14·5	W. H. Pickering	1898, Aug.

The diameters assigned by observers to the smaller and fainter satellites are necessarily very uncertain, but that of Titan is probably not far from 3,000 miles. The diameter of Phoebe is, perhaps, only about 150 miles.

The five inner satellites seem to form a class by themselves. Their orbits are nearly circular and their planes coincide exactly or very nearly with that of the ring system and the planet's equator. Thus, so far as the position of the planes of rotation and revolution are concerned, the system keeps together as if it were rigid. This results from the mutual attraction of the various bodies. A remarkable feature of this inner system is the near approach to commensurability in the periods of revolution. The period of Tethys is very nearly double that of Mimas, and the period of Dione about double that of Enceladus. The result of this near approach to commensurability is a wide libration in the longitudes of the satellites, having periods very long compared with the times of revolution.

Each of the four outer satellites has some special feature of interest. Titan is much the brightest of all; Hyperion is so small as to be visible only in a powerful telescope, and has a quite eccentric orbit; its time of revolution is almost commensurable with that of Titan, the ratio of the periods being 3 to 4, with the result that the major axis of the orbit of Hyperion has a retrograde motion of 18° 40′ annually, of such a character that the conjunction of the two satellites always occurs near the apocentre of the orbit, when the distance of the orbit from that of Titan is the greatest. This is among the most interesting phenomena of celestial mechanics. Iapetus has the peculiarity of always appearing brighter when seen to the west than to the east of the planet; this is explained by the supposition that, like our moon, this satellite always presents the same face to the central body.

Phoebe, the outermost satellite, is more than three and one-half times as remote from Saturn as Iapetus, and the circumstances of its discovery are interesting. In studying photographs of the neighbourhood of Saturn taken at Arequipa Observatory, Peru, Pickering found on each of three plates a very faint star which was missing on the other two. He concluded that these were the images of a satellite moving around the planet, which was then entering the Milky Way, where minute stars were so numerous that it was not easy to confirm the discovery. When Saturn began to emerge from the Milky Way no difficulty was found in relocating the object and proving that it was a ninth satellite. Its motion, however, was found to be retrograde or in a contrary direction to that of the other satellites. This difference of motion in a single system was, according to the knowledge of that time, a unique phenomenon, for although the satellite of Neptune and those of Uranus were known to have retrograde motions, they are the only satellites of those planets hitherto discovered. But more recently the eighth and ninth satellites of Jupiter have been found, and the motion of these, like that of Phoebe, is retrograde. (T. E. R. P.)

SATURNIAN METRE [Lat., *Saturnius, see* SATURN], a native Italian metre, used in some of the oldest known Latin compositions. It was in later times wholly displaced by Greek metres, and but few specimens survive. These are (1) inscriptions, notably some of the epitaphs of the Scipios, (2) fragments of Livius Andronicus's translation of the *Odyssey*, and of Naevius's *Bellum Punicum*, with a very few remnants of other authors. The following are specimens of this verse:

Dabunt malum Metelli/ Naevio poetae
Quamde mare saevom/ vis et quoi sunt magnae.

The scansion is very doubtful; on the whole it is more likely that it is accentual[1] than that it is quantitative. Some account of it will be found in Lindsay, *Early Latin Verse*, p. 9.

Nothing resembling the Saturnian exists in English; the example given by Macaulay ("The queen was in the parlour eating bread and honey") is not in the least like it.

SATURNINUS, LUCIUS APPULEIUS, Roman politician. Quaestor in 104 B.C., he superintended the importation of corn at Ostia, but was removed by the Senate, apparently without any charge against him being made, and so went over to the popular party. Tribune in 103, he made an arrangement with Marius for the allotment of 100 *iugera* of land to each of Marius' veterans. It was probably at this time also that he introduced his law on *maiestas* (treason), which seems to have been designed to increase the power of the tribunes. In 101 he was tried for violating the law of nations in connection with the embassy of Mithridates. The envoys had arrived with large sums of money to bribe the Senate, and Saturninus exposed the affair and insulted the ambassadors. He escaped by appealing to the people. He further

[1]On this theory, in its most probable form, the line has 3+2 accents, and usually consists of 7+6 syllables, as "quóius fórma virtútei parísuma fúit."

cultivated popularity by supporting the claims to citizenship of a freedman, Equitius, who posed as a son of Tiberius Gracchus (*q.v.*). Saturninus allied himself with C. Servilius Glaucia, and the two of them acted as Marius' political agents after his return from the war with the Cimbri. By bribery and murder Marius was elected consul for the sixth time in 100, Glaucia praetor and Saturninus tribune again. Saturninus then brought forward an extension of the African agrarian scheme, which included the distribution of the land north of the Po, taken from the Cimbri, among Marius' veterans, and the foundation of a number of new citizen colonies, to which Italians were to be admitted, a feature which caused a good deal of opposition. A further clause provided that every Senator should swear to observe it within five days of its becoming law. Metellus Numidicus, Saturninus' chief enemy, alone refused, and went into exile. The law was passed eventually after considerable disorder. At last Saturninus and Glaucia found themselves in danger of being disowned by Marius, and their only hope of safety lay in retaining office. In the elections at the end of 100 Saturninus was again elected tribune, and Glaucia stood for the consulship. During the voting their partisans beat C. Memmius, the senatorial candidate, to death. The Senate declared them public enemies, and called on Marius to take up arms against them. Saturninus was defeated in a battle in the forum, and took refuge in the Capitol (Dec. 10). Forced to surrender, he and Glaucia and their followers were imprisoned in the *Curia Hostilia,* and some of the opposite party tore off the roof and stoned them to death.

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SATYRS, in Greek mythology, spirits half-man, half-beast. They are not mentioned in Homer; in a fragment of Hesiod they are called brothers of the mountain nymphs and Curetes, an idle and worthless race. They were a roguish but faint-hearted folk, lovers of music, wine and women, dancing with the nymphs or pursuing them, and striking terror into men. They had a special form of dance called *Sikinnis.* In early Attic art they were represented as grotesque men with horses' tails; later they approached the type of Pan (q.v.). A famous statue, supposed to be a copy of a work of Praxiteles, represents a graceful satyr leaning against a tree with a flute in his hand. In Attica there was a species of drama known as the satyric; it treated its themes in a half-comic manner and the chorus was composed of satyrs. Sophocles's *Ichneutai* and Euripides's *Cyclops* are the only extant examples. In Italy, the satyrs are often identified with the fauni (*see* FAUNUS).

In the Authorized Version of Isa. xiii. 21; xxxiv. 14 the word "satyr" is used to render the Hebrew *sĕ'īrīm,* "hairy ones." A kind of demon or supernatural being known to Hebrew folk-lore as inhabiting waste places is meant; a practice of sacrificing to the *sĕ'īrīm* is alluded to in Lev. xvii. 7, where the English version has "devils." They correspond to the "shaggy demon of the mountain-pass" (*azabb al-'akaba*) of old Arab superstition.

See also SILENUS. For similar modern Greek beliefs, *see* Lawson, *Modern Greek Folk-lore,* p. 190.

SAUCE, a flavouring or seasoning for food, usually in a liquid or semi-liquid state, either served separately or mixed with the dish. The preparation of suitable sauces is one of the essentials of good cookery. The word comes through the Fr. from the Lat. *salsa,* salted or pickled food (*salire,* to season or sprinkle with *sal,* salt). The colloquial use of "saucy," impertinent, "cheeky" is an obvious transference from the tartness or pungency of a sauce.

Hot Sauces.—These may be divided into *White* and *Brown,* and from them many hundreds of sauces are made. Variations from a plain white sauce are egg sauce, onion sauce, anchovy sauce, parsley sauce, caper sauce, oyster sauce, celery sauce, etc. A blending of fat and flour, known in the culinary world as a *roux,* is the foundation of nearly every sauce. The fats used may be butter, oils, clarified fat, a blend of lard and butter, or margarine, or dripping. The fat is first melted and sufficient flour is stirred into it to absorb it; equal quantities of fat and flour are usual. Liquids for white sauces may be water, milk and water, milk, white stock, milk and stock. Cream may be added if liked, also beaten eggs and any flavouring such as sherry, vanilla, vinegar, lemon juice. Brown stock, water, or stock and water, are the liquids used for brown and fawn sauces. Lumpy sauces are caused by insufficient stirring which causes unequal bursting and thickening of the starch grains in the flour. Sauces must boil for 8 to 10 minutes. Espagnole, Béchamel and Velouté are white sauces used as a foundation in many variations.

Cold Sauces.—(*1*) *The Mayonnaise Class.* A simple mayonnaise is made from raw yolk of egg, salad oil, tarragon and white wine vinegars, mustard, pepper and salt. One yolk of egg will blend with as much as ½pt. oil if the oil is stirred in very gradually, drop by drop, to the yolk: the vinegar can be added from time to time as the mixture gets thick and the quantity can be left to the taste of the cook. A good mayonnaise should not taste too acid or too oily. Additions of chopped capers or gherkins to this make Tartare sauce.

2. Chaudfroid Sauces, for coating meat, poultry, fish. These may be brown, fawn, white, red, green, the foundations being a good brown or white sauce, tomato sauce, cucumber sauce. To these sauces are added aspic jelly, gelatine and a little cream.

Miscellaneous Sauces.—(a) those made from purées, some of which are thickened with cornflour, *i.e.* tomato, cucumber, spinach, apple, celery, (b) custard sauces made from eggs and milk and flavoured with vanilla, lemon or wine, *i.e.,* sherry sauce, (c) those made from syrups, *i.e.,* jam, lemon, marmalade, (d) mint, horseradish. (E. G. C.)

SAUGERTIES, a village of Ulster county, New York, U.S.A., on the west bank of the Hudson river, at the mouth of the Esopus, 100 m. N. of New York city, near the base of the Catskill mountains. It is on Federal highway 9 W. and is served by the West Shore railroad and river steamers. Pop. 1930, 4,060 Federal census. It is in the midst of picturesque scenery and there are many summer homes along the Hudson and elsewhere in the vicinity. The village of Woodstock (incorporated 1787) with its colony of artists and summer art school is 10 m. W., and 4 m. S. of Woodstock is the Ashokan reservoir. Saugerties has several paper and paper-products mills, limestone and bluestone quarries, brickyards and other industries. The village was settled about 1710 by Germans, and several houses date from the 18th century. It was incorporated in 1831.

SAUGOR or SAGAR, so named after its beautiful lake, a town and district of British India in the Jubbulpur division of the Central Provinces. The town, in a picturesque situation on a spur of the Vindhyan hills about 1,700 feet above sea level, has a station of the Indian Midland section of the G.I.P. Railway. Population (1921) 39,319. It has ceased to be a growing place, though it is still fourth in importance in the province. The town is handsomely built and the cantonment well wooded. It has no factories and its old industries, which included the manufacture of gold and silver ornaments, are not very flourishing. There is an old Mahratta fort, now used as a police school, which was held for several months by the Europeans in the Mutiny until relieved by Sir Hugh Rose.

The district of Saugor has an area of 3,962 square miles. It is an extensive, and in parts fairly level, plain, broken in places by low stony hills of Vindhyan sandstone. It is traversed by numerous streams, of which the Sunar, Beas, Dhasan and Bina are the principal, flowing in a central direction and being affluents of the Ganges. In the southern and central parts the soil is black, formed by decaying trap. In the north and east it is reddish-brown alluvium. The population in 1921 was 528,380, or some 60,000 less than in 1891, but it is likely to recover if seasons are good.

The district contains five small towns and 1,830 villages. The chief land-holding classes are Brahmins, Dangis, Lodhis and Bundela Rajputs. Mohammedans are only 5% of the population. Government forests cover 750 sq.m. but are not of great value. There is good iron ore in the Shahgarh tract smelted in small

furnaces and some fine sandstone quarries.

SAUGUS, a town of Essex county, Massachusetts, U.S.A., adjoining Lynn on the west. It is served by the Boston and Maine railroad. Pop. (1920) 10,874 (23% foreign-born white); 1930 Federal census 14,700. Saugus is now primarily a residential town, but in early times it was important industrially. It was one of the first New England towns to engage in the manufacture of shoes and woollen goods, and was the site of the first iron works, where the die for the Pine-Tree shilling was cast. Settlement dates from 1629. The town was incorporated in 1815.

SAUJBULAQ (sowj-boo-lahk′), chief town of that part of the Persian province of Azerbaijan south of Lake Urmia. Ethnographically, the district forms part of Persian Kurdistan. The town stands in a remarkably fertile valley, in 36° 45′ N., and 45° 47′ E., at an elevation of 4,272 ft. The population, till the outbreak of the World War, was about 7,000, chiefly of settled Kurds of the Mukri tribe of which it may be regarded as the local capital. The town is connected with Tabriz by a road passable for motors, via Urmia, Khoi and Julfa.

There are many more localities named Saujbulaq (Turkish, meaning "cold stream," or "cold spring") in Persia, the most notable, after the above-mentioned Kurdish city, being a district of the province of Tehran, with many villages.

SAUK and **FOX.** These two closely related Algonkin tribes were encountered west of Lake Michigan by the French in the second half of the 17th century. The Sauk (or Sac) had been driven there from Michigan by Iroquoian and Algonkin foes not long before; the Fox, probably somewhat earlier. The friendship of the French for these foes rendered the Fox, and finally the Sauk, enemies of the French. They were the only Algonkin so to align themselves; and in the end withdrew from Wisconsin to Iowa, where they found shelter in territory of the Siouan tribe of that name. This change removed them from the timber to the prairies, and their culture began to be characteristic of the open spaces. They remained restless and aggressive, and in 1832, with the Kickapoo, engaged in the Black Hawk war. The two tribes probably never numbered much more than 3,000 each, and were often considerably reduced by warfare. A total of 1,000 remain on reservations in Iowa, Kansas and Oklahoma.

SAUL, son of Kish, a Benjamite, was the first king of Israel. He began to reign *c.* 1025 B.C. The traditions as to his history are closely interwoven with those concerning Samuel and David. Various views may be taken of these records, among the most dramatic in sacred literature but, by scholars, it is generally recognized that the stories of 1 Samuel preserve two different traditions about the rise of the monarchy in Israel. In each there is an account of Saul's election; each relates that he was anointed by Samuel and records his rejection. It is probable that two distinct continuous histories have been combined in the existing text of Samuel. According to the later of the two traditions the elders of Israel, seeing that the sons of Samuel, who are destined to succeed him, are corrupt, demand that he shall make them a king "to judge them like all the nations." Samuel is displeased, but Yahweh reluctantly—for such a request was a grave affront to the deity, the true king of Israel—bids him concede the demand. The seer points out to the people that a king will oppress them, but fails to dissuade them (1 Samuel viii.). He summons a solemn assembly at Mizpah, and, once more reminding them of their folly, chooses Saul, by lot under Yahweh's direction (x. 17–24). In an elaborate sermon (xii.), he succeeds in convincing the people that their action has been sinful. And hardly has Saul seated himself upon the throne when Yahweh rejects him, and bids Samuel anoint David to succeed him in due time (xvi. 1–13). *See* SAMUEL.

The earlier tradition, which is distinctly more primitive in its religious ideas, contributes other sidelights on the matter. Samuel, to whom Saul comes seeking the seer's help in the finding of some lost asses, is previously warned by Yahweh that the suppliant is the divinely chosen saviour who is to deliver Israel from Philistine oppression. With whole-hearted enthusiasm Samuel anoints Saul to be "prince over Yahweh's inheritance" (ix.–x. 1). Saul and his son Jonathan achieve notable victories over the Philistines (xiii.). According to this tradition Saul is a God-given saviour, like the heroes in Judges, who rescues his people from the grievous domination of the Philistines. An appropriate introduction to this narrative is missing from 1 Samuel, but the introduction to the story of Jephthah (Judges x. 6–16)—to which what follows is certainly not the obvious sequel—would very well fit it. The suggestion has therefore been made that possibly according to an old tradition Saul was the immediate successor of Jephthah (*cf. Cambridge Ancient History,* vol. ii. p. 371 *seq.*).

Though the reign of Saul was marked by considerable successes he was hampered by friction within as well as by foes without. Comparatively early his relations with Samuel seem to have become strained, and his declining years were embittered by the growing importance of his rival, David. Finally he fell a victim to his ancient enemies, the Philistines, who inflicted a heavy defeat on Israel in the battle of Mount Gilboa, where his sons were slain, and he himself perished. Here, again, we have two distinct accounts. According to one, being "greatly distressed by reason of the archers," he implored his armour-bearer to kill him, that he might not be slain by uncircumcised Philistines, and when his armour-bearer refused fell upon his own sword (1 Samuel xxxi. 1–7). The other story (2 Samuel i. 1–10), represents him as making a similar request to an Amalekite camp-follower, who, unlike the armour-bearer, complies. It is possible that this is a fiction on the part of the Amalekite, though the context hardly suggests such a view.

According to one estimate of the documents, the character of Saul was depreciated by Judaean historians anxious to exalt David and by anti-monarchists whose ideal was Samuel. Others have found in the narrative an ethical significance of perpetual value. However, Saul played a considerable part in the freeing of Israel from the Philistine yoke. Though his reign ended in the gloom of tragedy he achieved notable successes on the battle-field, and was a greater king than the existing narratives would lead us to suppose. This is borne out by the ascription to him of important victories (*cf.* 1 Samuel xiv. 42–51) and even more by the ancient lament from the "book of Jashar" (2 Samuel i. 19–27), which paints the fallen king as "mighty," a warrior whose "sword returned not empty," "swifter than an eagle," "stronger than a lion," who brought good spoil to his people, and whose death was to the Philistines a source of exultation. That he maintained his position despite the popularity of David, and that his kingdom endured for a time after his death even with a weakling like his son Ishbosheth as its nominal head, point in the same direction. In short, we may discern in the Scriptural narratives the figure of a brave, impulsive, superstitious man, whose contribution towards the building up of the kingdom has been underestimated.

(W. L. W.)

SAULT SAINTE MARIE (sōō-sānt-mạ-rē′), a city of Michigan, U.S.A., at the east end of the Upper Peninsula, on St. Mary's river, the outlet from Lake Superior into Lake Huron; a port of entry and the county seat of Chippewa county. It is on Federal highway 2 and is the northern terminus of the Dixie highway; and is served by the Canadian Pacific, the Duluth, South Shore and Atlantic and the Soo Line railways, and lake steamers. A railway bridge and ferries connect it with the Canadian town of the same name in Ontario on the north side of the river. The population was 12,096 in 1920 (31% foreign-born white, chiefly from Canada) and was 13,755 in 1930 by Federal census. The river here drops ("leaps") 20 ft. in less than a mile, which explains the name given to the falls by the early French missionaries. The two canals, with their five great locks (four on the American side, one on the Canadian), are the greatest ship highway in the world. An average of 100 ships a day pass through during the navigation season of eight months, and the total traffic in 1928 amounted to 86,992,927 tons, valued at $1,183,123,800. The Davis and the Sabin locks (1,350 ft. long and 80 ft. wide) are the longest in the world. Two large hydro-electric plants generate current from the falls. The city is the centre of a summer-resort region abounding in beautiful scenery, good fishing and hunting, with a climate especially favourable to cases of hay fever. It has a considerable lake traffic (760,926 tons in

1925), chiefly in coal and limestone; is a shipping point for farm, forest and dairy products by rail; and has various manufacturing industries, with an output in 1927 valued at $8,950,416. Since 1917 it has had a commission-manager form of government.

Sault Sainte Marie is the oldest settlement in Michigan. The place was a favourite fishing-ground of the Chippewa Indians. It was visited in succession by Étienne Brule (some time between 1611 and 1623), Jean Nicollet (1634), Jogues and Rambault, who gave it its name (1641), Radisson and Groseilliers (1658), and in 1668 Father Marquette founded a mission here. In 1671 the governor-general of New France called a great council of the Indians at this spot, and in the name of the king of France took formal possession of all the country south to the Gulf of Mexico and west to the Pacific. The British flag flew over the American Sault from 1762 until June 15, 1820, when Governor Lewis Cass raised the Stars and Stripes. The first Ft. Brady was built in 1822 and was occupied until 1893, when the post was rebuilt on its present site. The village was incorporated in 1879 and was chartered as a city in 1887. St. Mary's river was navigated by the canoes and bateaux of the Indians and early *voyageurs,* who made a portage around the falls. The North West Fur company built a lock on the Canadian side of the river in 1797–98. The state lock and canal (later widened and deepened by the Federal government) were opened in 1855. The Weitzel lock (515 ft. long) was completed in 1881; the Canadian (900 ft.) in 1895; the Poe (800 ft.) in 1896; the Davis in 1914; and the Sabin in 1919. Previously to 1929 the maximum traffic passing "the Soo" in a year was 91,888,219 net tons in 1916.

SAUMAREZ, JAMES SAUMAREZ [or Sausmarez], Baron de (1757–1836), English admiral, was born at St. Peter Port, Guernsey, on March 11, 1757. He entered the navy as midshipman at the age of thirteen. For his bravery at the attack of Charleston in 1776, on board the "Bristol" he was raised to the rank of lieutenant, and he was promoted commander for his gallant services off the Dogger Bank, Aug. 5, 1781, when he was wounded. In command of the "Russell" (70), he contributed to Rodney's victory over De Grasse (April 12, 1782). For the capture of "La Réunion," a French frigate, in 1793, he was knighted. He took part in the defeat of the French fleet off Lorient, (June 22), distinguished himself in the battle of Cape St. Vincent in Feb. 1797, and was present at the blockade of Cadiz (Feb. 1797–April 1798), and at the battle of the Nile, where he was wounded. On his return from Egypt he received the command of the "Caesar" (84), with orders to watch the French fleet off Brest during the winters of 1799 and 1800. Between July 6 and 12, 1801, he routed a superior combined force of French and Spanish ships at Algeciras. On the outbreak of the war with Russia in 1809 he was given command of the Baltic fleet. He held it during the wars preceding the fall of Napoleon, and his tact was conspicuously shown towards the government of Sweden at the crisis of the invasion of Russia. At the peace of 1814 he attained the rank of admiral; Charles XIII. (Bernadotte) bestowed on him the grand cross of the military order of the Sword. He was raised to the peerage in 1831, and died at Guernsey on Oct. 9, 1836.

See *Memoirs of Admiral Lord de Saumarez,* by Sir John Ross (2 vols., 1838).

SAUMUR, a town of western France, capital of an arrondissement in the department of Maine-et-Loire, 28 m. S.E. of Angers on the railway to Tours. Pop. (1926) 13,776. The Saumur caves along the Loire and on both sides of the valley of the Thouet must have been occupied at a very remote period. The Tour du Tronc (9th century), the old stronghold of Saumur, served as a place of refuge for the inhabitants of the surrounding district during foreign invasions (whence perhaps the name Saumur, from *Salons Murus*) and became the nucleus of a monastery built by monks from St. Florent le Vieil. On the same site rose the castle of Saumur two hundred years later. The town fell into the hands of Foulques Nerra, duke of Anjou, in 1025, and passed in the 13th century into the possession of the kings of France. After the Reformation the town became the metropolis of Protestantism in France and the seat of a theological seminary which, as opposed to that of Sedan, represented the more liberal side of French Protestantism (Cameron, Amyraut, etc.). In 1623 the fortifications were dismantled; and the revocation of the edict of Nantes reduced the population by more than one half. In June 1793, the town was occupied by the Vendéens, against whom it soon afterwards became a base of operations for the republican army.

Saumur stands on the left bank of the Loire, which here receives the Thouet, and on an island in the river. A large metal bridge connects the Tours-Angers railway with that of Montreuil-Bellay, by which Saumur communicates with Poitiers and Niort. Two stone bridges (764 and 905 ft. long) unite the town on the island with the two banks of the river. The church of St. Pierre, of the 12th century, has a 17th-century façade and a Renaissance nave; and Notre-Dame of Nantilly has a remarkable façade, a doorway and choir of the 12th century, and a nave of the 11th. St. Jean is a 12th-century building in the purest Gothic style of Anjou. St. Nicolas-du-Chardonnet, 12th century Gothic, has a fine modern spire. The *hôtel de ville* is a 16th century building and the town has many houses of the 15th, 16th and 17th centuries, notably that known as the Maison de la Reine Cécile (15th century), built by René, duke of Anjou. The castle was built between the 11th century and the 13th, and remodelled in the 16th. There is also an interesting almshouse, with its chambers in part dug out in the rock. The famous cavalry school of Saumur was founded in 1768 and was used for the special training of young officers appointed to cavalry regiments on leaving the cadet school of St. Cyr. Saumur is the seat of a sub-prefect, and of a tribunal of commerce, a chamber of commerce, and a horticultural garden, with a school of vines. Saumur prepares and carries on a large trade in the sparkling white wines made in the neighbourhood, as well as in brandy, and it manufactures enamels and rosaries and carries on liqueur-distilling.

SAUNDERSON or Sanderson, **NICHOLAS** (1682–1739), English mathematician, was born at Thurlstone, Yorkshire, in Jan. 1682. When about a year old he lost his sight through smallpox; but this did not prevent him from acquiring a knowledge of Latin and Greek, and studying mathematics. In 1707 he began lecturing at Cambridge on the principles of the Newtonian philosophy, and in Nov. 1711 he succeeded William Whiston, the Lucasian professor of mathematics in Cambridge. He was admitted F.R.S. in 1736 and died on April 19, 1739.

Saunderson devised a calculating machine or abacus, by which he could perform arithmetical and algebraical operations by the sense of touch; this method is sometimes termed his *palpable arithmetic,* an account of which is given in his elaborate *Elements of Algebra* (2 vols., Cambridge, 1740).

SAUROPSIDA, a term introduced by T. H. Huxley to designate a province of the Vertebrata formed by the union of the Aves with the Reptilia. Ichthyopsida, including the Pisces and Amphibia, was used by Huxley as an antithesis. Both terms and the idea which underlay them are obsolete.

SAUSAGES are mentioned by Athenaeus in the *Deipnosophists,* A.D. 228, the oldest cookery book that has come down to us; he says "Epicharmus mentions sausages, calling them *oryae,* a name by which he even entitles one of his plays, the *Orya*"; this was written about 500 B.C. Again: "Aristophanes says in the *Clouds* (423 B.C.): 'Let them make sausages of me and serve me up to the students.'" Charles Lamb in the *Essays of Elia* (1823) mentions them "as the savouriest part, you may believe, of the entertainment" given "at the annual feast of chimney-sweepers . . . held in Smithfield, upon the yearly return of the fair of St. Bartholomew"; and Professor George Saintsbury in 1922 laments the disappearance of "that most admirable variety the Oxford Sausage" and the decadence of others.

Technically a sausage is a mixture of meat minced, seasoned, and stuffed into casings which originally consisted of the intestines of hog, sheep or cattle, those of sheep being the most delicate or tender; they are properly cleansed, soaked in lime water or lye, then washed again, and salted or soaked in brine, by specialized firms of cleaners who carry on the business in the vicinity of the abattoirs. Home-produced supplies of casings do not, however, form more than 10 per cent of total supplies of Great Britain, the bulk being received from the United States.

Manufactured casings are sold by the bundle of 100 yards, home-produced supplies fetching from 7/6d. to 10/– per bundle. As a result of research in the manufacture of synthetic sausage skins, which was begun in 1916, the American Chemical Society in 1928 announced the invention of a sausage casing made from cellulose, which may be manufactured in any size, is more quickly filled, and has none of the imperfections that are said to spoil the animal casings.

Dr. Tibbles in "Foods, their origin, composition and manufacture" (1912), remarks, "It is said that horse-flesh is sometimes used in the manufacture of German sausages," and adds that it is difficult to detect the various kinds of flesh except by microscopical and chemical examinations, as the muscular fibres are much alike. Bread and other materials are also used, and in the *Report on the Pork and Bacon Trades in England and Wales* issued by the British Ministry of Agriculture and Fisheries early in 1928 the suggestion is put forward that "from the point of view of the consumer, it is a disadvantage not to know the composition of the food which he buys. Trade organizations might, therefore, consider whether it would not be in their interests to adopt grade specifications for pork sausages according to the proportions of pork and other materials which they contain." There are considerably over one hundred varieties, some of which are further varied in different districts.

Some Well-known Varieties.—*Boudins* or *boudins noir* or *black puddings* as they are called in England, are made in some parts of Scotland of hog's blood, shredded suet, dried oatmeal and minced onions with plenty of pepper and salt; as Hudibras says:

"Fat Black Puddings—proper food
For warriors who delight in blood,"

but their seasoning varies in different localities. In England for example caraway and coriander are used in Cheshire, but the Shropshire variety has none of the former and very little of the latter; in Staffordshire the seasoning consists of equal quantities of salt, pepper, marjoram, and pimento with twice as much thyme; in Yorkshire twice as much marjoram and thyme as pepper and salt, also a little savoury and lemon thyme may be used; whilst the Stretford variety is highly seasoned with equal proportions of salt, pepper, marjoram mint and thyme. In France beetroot leaves and garlic are sometimes used; in Spain fennel may be added; in Germany thyme and marjoram.

In some parts of France it is the custom to eat black puddings on Christmas Eve after returning from midnight mass. They are always boiled directly they are made and are then kept in a cool place; when served they may be either boiled up again or grilled. In Flanders they are accompanied by a dish of baked apples.

In addition to Scottish black puddings there are Scottish white puddings made of good beef-suet minced and mixed with a third of its weight in highly toasted oatmeal, seasoned with salt and pepper stuffed into skins and boiled. Liver puddings are made in the same way with the addition of one-fourth the quantity of parboiled liver grated, and some shredded onions.

The French *Boudins Blancs* are most superior. They are made of the white parts of raw chicken finely minced, yolk of eggs, onions, breadcrumbs, salt and spices mixed with cream or milk, stuffed into skins and boiled in milk and water; when served they are grilled. Other French *boudins* are made of game, fish, etc.

Sausages are technically described as "dry" or "fresh and wet"; they may be made of raw or cooked material, and the "dry" varieties may be boiled, smoked, pickled or air-dried.

Italy and Germany vie with each other in the varieties they produce. *Salami*, a popular Italian, Hungarian and German sausage, is generally made of pork, beef, bacon, highly seasoned, coloured with red wine, and finally pickled and dried; *Bologna*, a large sausage made of finely chopped bacon, veal and pork, is sold ready to serve without further preparation; and *Mortadella* made at Florence and Bologna from the flesh of pigs which feed on the chestnuts and acorns in the surrounding forests, and seasoned with wine, garlic and spices, are all popular as hors d'oeuvre.

Frankfurt and Vienna sausages are about the length of a finger and are composed of raw lean pork and beef, well smoked; they should be eaten hot; if kept too long they get dry and are liable to turn sour. They have become increasingly popular.

Bockwürst is a small sausage at one time served with Bock beer.

The Spanish *Chorizos* is similar to the Frankfurt but very highly seasoned and air-dried.

Polony is a corruption of Bologna whose sausages it resembles. Sheffield is more celebrated for them than any other town in England.

Saveloys (Fr. *andouilles*) are short thick sausages originally made from pigs' brains and called "cervelas" of which word saveloy is a corruption; they are now made of cooked pork highly seasoned, stuffed into red skins and sold ready to eat; some varieties are smoked.

Oxford sausages, "much herbed, skinless, are moulded into sausage shape only just before cooking."

Hamburg is not only famous for its sausages but has also a special reputation for casings. "The running intestine is used for *Bolognas*, the middle for ham and chicken sausage and for *Leberwürst* or liver sausage and the larger for the full-sized German sausage.

For sausage poisoning *see* BOTULISM. (F. WH.)

The United States.—Sausage making is an important part of the meat industry in the United States. Figures published by the U.S. Department of Agriculture Bureau of Animal Industry indicate that during the Government fiscal year ending June 30, 1928, the amount of sausage chopped in establishments operating under Federal inspection amounted to 779,983,976 lb. This total compares with 679,314,965 lb. for 1923, 624,826,613 lb. for 1918 and 531,626,284 lb. for 1913, definite indication that the sausage industry in the United States is showing substantial growth. In addition to the quantities of sausage made in establishments operating under Federal inspection, large quantities are made by concerns doing an intrastate business, the maintenance of Federal inspection in such establishments not being required.

More than 100 varieties of sausage are made and sold in the United States. These may be divided into two main classes, "domestic" and "dry." Domestic sausage includes such well-known varieties as pork sausage, frankfurters, Bologna, head cheese, liver sausage, blood sausage, blood and tongue sausage and luncheon specialities. Dry sausage includes cervelat, salami, frisses, Genoa, peperoni, mortadella, capicolli, farmer, Holsteiner, Goteborg and chorizos. (R. H. GI.)

SAUSSURE, HORACE BENEDICT DE (1740–1799), Swiss physicist and Alpine traveller, was born at Geneva on Feb. 17, 1740. From 1762 to 1786 he was professor of philosophy at the academy of Geneva. He became F.R.S. in 1768, and in 1772 founded the *Société pour l'Avancement des Arts* at Geneva. His health began to fail in 1791, but he was able to complete his great work in 1796. He died on Jan. 22, 1799.

His early devotion to botanical studies led him to undertake journeys among the Alps, and from 1773 onwards he devoted his attention to the geology and physics of that great chain. He applied chemistry and physics to his studies of the geology and meteorology of the district. He examined the strata, nature of the rocks, the fossils and minerals. De Saussure designed a number of new instruments, notably his hair hygrometer with which he examined atmospheric conditions; he also made observations on the temperature of the earth and of deep water. These observations he published in *Essai sur l'hygometrie* (1783).

Among his most famous ascents were Mont Blanc (1787), Col du Géant (1788), Crammont (1784, 1788), St. Theodule pass to Zermatt (1789) Klein Matterhorn (1792).

The descriptions of seven of his Alpine journeys were published as *Voyages dans les Alpes* (4 quarto vols. 1779–96 and 8 octavo vols. 1780–96). The non-scientific portions of the work were first published in 1834, and have often been republished, under the title of *Partie pittoresque des ouvrages de M. de Saussure.*

See Lives by J. Senebier (Geneva, 1801), by Cuvier in the *Biographie universelle,* and by Candolle in *Décade philosophique,* No. xv. (trans. in the *Philosophical Magazine,* iv. p. 96); articles by E. Naville in the *Bibliothèque universelle* (March, April, May 1883), and chaps. v.–viii. of Ch. Durier's *Le Mont-Blanc* (various editions between 1877 and 1897).

SAUTERNES are white wines made in the vineyards of Sauternes and of the adjoining parishes of Bommes, Barsac, Preignac and Fargues in France. In all these parishes, which form the Sauternes district, the soil and subsoil are entirely different from the soil and subsoil of the Graves district, which it adjoins. Entirely different species of grapes are grown in the Sauternes district, species particularly well suited to the soil which produces a naturally sweet wine of unsurpassed excellence. The sweetness of Sauternes is the sweetness of the grape which is retained without the fermentation having been checked by added brandy, as is the case with sweet "fortified" wines.

The finest estate of the Sauternes district, the one which produces by far the finest Sauternes wine and usually also a far greater quantity than any other, is Château Yquem. The wines of Yquem possess both freshness and richness, a combination which is as admirable in a wine as it is rare; they have body, bouquet, breed, and, when of a good vintage, they will not only last but improve for a considerable time. The other Sauternes vineyards which produce the finest wines are those of the following châteaux: La Tour Blanche, Peyraguey, Vigneau, Rabaut, in the parish of Bommes; Suduiraut and Rieussec in the parish of Preignac; Coutet and Climens in the parish of Barsac; Guiraud and Filhot, in the parish of Sauternes.

Although part of the Sauternes district, the parish of Barsac produces wines which are quite distinctive, possessing a characteristic bouquet, and not being quite so sweet as the majority of Sauternes wines, but distinctly richer than Graves. (*See* WINE.)

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(A. L. S.)

SAVAGE, RICHARD (d. 1743), English poet, was born about 1697, probably of humble parentage. A romantic account of his origin and early life, for which he at any rate supplied the material, appeared in Curll's *Poetical Register* in 1719. On this and other information provided by Savage, Samuel Johnson founded his *Life of Savage*, one of the most elaborate of the *Lives*. It was printed anonymously in 1744, and has made the poet the object of an interest which would be hardly justified by his writings. In 1698 Charles Gerrard, 2nd earl of Macclesfield, obtained a divorce from his wife, Anna, daughter of Sir Richard Mason, who shortly afterwards married Colonel Henry Brett. Lady Macclesfield had two children by Richard Savage, 4th earl Rivers, the second of whom was born at Fox Court, Holborn, on the 16th of January 1697, and christened two days later at St. Andrews, Holborn, as Richard Smith. Six months later the child was placed with Anne Portlock in Covent Garden; nothing more is positively known of him.

In 1718 Richard Savage claimed to be this child. His statements were suspicious, and Mrs. Brett always maintained that he was an impostor. The matter was thoroughly investigated for the first time by W. Moy Thomas, who published the results of his researches in *Notes and Queries* (second series, vol. vi., 1858). Savage, impostor, or not, blackmailed Mrs. Brett and her family with some success, for after the publication of *The Bastard* (1728) her nephew, John Brownlow, Viscount Tyrconnel, purchased his silence by taking him into his house and allowing him a pension of £200 a year. Savage wrote two successful plays: *Love in a Veil* (1718), adapted from the Spanish, and *Sir Thomas Overbury* (1724). His *Miscellaneous Poems* were published by subscription in 1726. In 1727 he was arrested for the murder of James Sinclair in a drunken quarrel, and only escaped the death penalty by the intercession of Frances, countess of Hertford (d. 1754).

Savage was at his best as a satirist, and in *The Author to be Let* he published a quantity of scandal about his fellow-scribblers. Proud as he was, he was servile enough to supply Pope with petty gossip about the authors attacked in the *Dunciad*. His most considerable poem, *The Wanderer* (1729), shows the influence of Thomson's *Seasons*, part of which had already appeared. Savage tried without success to obtain patronage from Walpole, and hoped in vain to be made poet-laureate. In 1732 Queen Caroline settled on him a pension of £50 a year. Meanwhile he had quarrelled with Lord Tyrconnel, and at the queen's death was reduced to absolute poverty. Pope had been the most faithful of his friends, and had made him a small regular allowance. With others he now raised money to send him out of reach of his creditors. Savage went to Swansea, but he resented bitterly the conditions imposed by his patrons, and removed to Bristol, where he was imprisoned for debt. All his friends had ceased to help him except Pope, and in 1743 he, too, wrote to break off the connection. Savage died in prison Aug. 1, 1743.

See Johnson's *Life of Savage*, and *Notes and Queries* as already quoted. He is the subject of a novel, *Richard Savage* (1842), by Charles Whitehead, illustrated by John Leech. *Richard Savage*, a play in four acts by J. M. Barrie and H. B. Marriott-Watson, was presented at an afternoon performance at the Criterion theatre, London, in 1891. The dramatists took considerable liberties with the facts of Savage's career. *See* also S. V. Makower, *Richard Savage, a Mystery in Biography* (1909).

SAVAGE ISLAND (NIUE): *see* PACIFIC ISLANDS.

SAVANNA or **SAVANNAH,** originally a meadow land or large, grassy, treeless tract, but now also including level areas with tall grasses and isolated clumps of trees, as in Nigeria, where the more appropriate name would be *park savanna*. It has also been commonly applied to the grassy plains south of the centre of North America, and is here the equivalent of prairie (*q.v.*).

SAVANNAH, a city of south-eastern Georgia, U.S.A., on the Savannah river, 18 m. from the Atlantic ocean; a port of entry and the county seat of Chatham county. It is on Federal highways 17 and 80; has a municipal airport; and is served by the Atlantic Coast Line, the Central of Georgia, the Savannah and Atlanta, the Seaboard Air Line and the Southern railways, and by steamship lines operating to both American coasts and to foreign ports. Pop. 83,252 in 1920 (47% negroes); and 85,024 in 1930.

The city occupies 7.4 sq.m. on a plateau 42 ft. above the river. It has retained and extended the original ground plan (designed by Oglethorpe) of broad, straight streets, interspersed at frequent and regular intervals with grassy squares and parks, which now cover altogether 898 acres. Many dwellings of colonial architecture and buildings of historic interest still remain; there are numerous statues and monuments to local and national heroes; and charm is added by thousands of shade trees and many sub-tropical plants. A granite seat marks the spot where Oglethorpe first pitched his tent. Gen. Nathanael Greene is buried under a monument erected to his memory in 1829. Christ church, now occupying its third building (erected 1838), was organized by George Whitefield in 1740, and its third rector was John Wesley, who established here the first Protestant Sunday-school in America. The First African Baptist church dates its history from 1788. Ten miles south of Savannah is Bethesda, the oldest orphan asylum in the United States, founded by Whitefield in 1740. "The Hermitage," 5 m. N., is a 500 ac. plantation on the river, settled in 1783, with many of the slave huts and other ante-bellum buildings still standing. "Wormsloe," at the south end of Isle of Hope, is occupied by lineal descendants of Capt. Noble Jones, to whom it was originally granted by George II. At "Mulberry Grove," the estate given by Congress to Gen. Greene, Eli Whitney invented the cotton gin while he was a guest there in 1793. Bonaventure cemetery, with its winding avenues of live-oaks draped with Spanish moss, is one of the country's most beautiful burial-grounds. Savannah has the oldest theatre in the United States still in active use (established 1818), the oldest golf club (1811), and the oldest brick house in the State. The city itself is a favourite winter resort for many Northerners, and there are many bathing beaches, fishing grounds and other pleasure resorts near by, including Tybee island (5 sq.m.) at the mouth of the Savannah river, Montgomery, Thunderbolt and Isle of Hope (where there is a diamond-back terrapin farm). The United States Department of Agriculture has an experimental bamboo farm 12 m. from the city.

Savannah is one of the leading South Atlantic ports. Its water-borne commerce in 1927 amounted to $517,497,229, of which $115,118,264 represented foreign trade, largely exports of raw cotton and naval stores. In 1927 the output of 101 manufacturing establishments situated within the city was valued at $13,573,168. Its cotton warehouses can store 1,000,000 bales, and the two fuel-oil storage plants have a capacity of 16,000,000 gallons. Chief among the manufactures are fertilizers, rosin and turpentine, cotton-seed products and sugar. Bank debits exceed $1,000,000,000 annually. The assessed valuation of the city's taxable property for 1927 was $77,879,118.

The first European settlement in Georgia was made at Savannah in Feb. 1733, by James Edward Oglethorpe. Charles and John Wesley arrived in 1735, and George Whitefield was here in 1738 and 1740–42. Until its capture by the British in 1778, Savannah was the seat of government of Georgia. The first legislature met here on Jan. 1, 1755; the first Provincial Congress on Jan. 18, 1775 and a second on July 4, soon after which the royal Government collapsed and the city was administered by a Council of Safety. Loyalist sentiment was strong, and many families were divided among themselves. From Oct. 1776 to Feb. 1777, the convention which framed the first State Constitution of Georgia was in session in Savannah, and the first State legislature assembled here in May 1778, but on Dec. 9, the British captured the city, and the seat of government was then transferred to Augusta. In May 1782 the British evacuated, after a short siege by Gen. Anthony Wayne, and Savannah was again the capital for a few months. It was chartered as a city in 1789, and soon became a commercial rival of Charleston. In 1819 the first steamship to cross the Atlantic (the "Savannah," built by Savannah capital in the North) sailed from Savannah to Liverpool in 25 days. The convention which adopted Georgia's Ordinance of Secession met here in 1861. The port was blockaded by the Federal Government early in the war, and on Dec. 12, 1862, Ft. Pulaski, commanding the channel at the mouth of the river, was forced to capitulate. Savannah was the objective of Sherman's "march to the sea," and surrendered to him on Dec. 21, 1864.

SAVANTWADI, a native state of Bombay, India. Area, 926 sq.m. Pop. (1921) 206,440. The surface is broken and rugged, interspersed with densely-wooded hills; in the valleys are gardens and groves of cocoa-nut and betel-nut palms. Savantwadi has no considerable rivers; the chief streams are the Karli on the north and the Terakhol on the south. The climate is humid and relaxing, with an average annual rainfall of 150 in. The chief, whose title is *sar desai*, is a Mahratta of the Bhonsla family, who traces back his descent to the 16th century. The town of SAVANTWADI is picturesquely situated on the bank of a large lake, 17 m. E. of the seaport of Vengurla. Pop. (1921) 7,811.

Before the establishment of Portuguese power Savantwadi was the highway of a great traffic between the coast and the interior; but during the 16th and 17th centuries trade suffered much from the rivalry of the Portuguese, and in the disturbances of the 18th century it almost entirely disappeared. In consequence of piracy, the whole coast-line (including the port of Vengurla) was ceded to the British in 1812.

SAVARY, ANNE JEAN MARIE RENÉ, DUKE OF ROVIGO (1774–1833), French general and diplomatist, was born at Marcq in the Ardennes on April 26, 1774. He was educated at the college of St. Louis at Metz and entered the royal army in 1790. He served under Custine on the eastern frontier in 1792, then under Pichegru and Moreau, and in 1798 under Desaix in Egypt, and in Italy. After Marengo Bonaparte gave him command of the gendarmes charged with the duty of guarding the First Consul. In the discovery of the various ramifications of the Cadoudal-Pichegru conspiracy Savary showed great skill and activity. He was in command of the troops at Vincennes when the duc d'Enghien (*q.v.*) was executed. In Feb. 1805 he became general of division. Shortly before the battle of Austerlitz (Dec. 2, 1805) he was sent by Napoleon with a message to the emperor Alexander I. with a request for an armistice, a device which precipitated the attack which brought disaster to the Russians. After the battle Savary again took a message to Alexander, which induced him to treat for an armistice. In the campaign of 1806 Savary showed signal daring in the pursuit of the Prussians after the battle of Jena. Early in the next year he received command of a corps, and gained a success at Ostrolenka (Feb. 16, 1807).

After the treaty of Tilsit (July 7, 1807) Savary proceeded to St. Petersburg as the French ambassador, but was soon replaced by General Caulaincourt (*q.v.*), another accessory to the execution of the duc d'Enghien. But Napoleon needed him in Madrid. With the title of duke of Rovigo, Savary set out for Spain. With Murat Savary made skilful use of the schisms in the Spanish royal family (March–April 1808), and persuaded Charles IV., who had recently abdicated under *duresse*, and his son Ferdinand VII., the *de facto* king of Spain, to refer their claims to Napoleon. Savary induced Ferdinand to cross the Pyrenees and proceed to Bayonne—a step which cost him his crown and his liberty until 1814. In September 1808 Savary accompanied the emperor to the famous interview at Erfurt with the emperor Alexander. On the disgrace of Fouché (*q.v.*) in the spring of 1810, Savary received his appointment, the ministry of police. This office now became a veritable inquisition. Savary was among the last to desert the emperor at the time of his abdication (April 11, 1814) and among the first to welcome his return in 1815, when he became inspector-general of gendarmerie and a peer of France. After Waterloo he accompanied the emperor to Rochefort and sailed with him to Plymouth on H.M.S. "Bellerophon." He was not allowed to accompany him to St. Helena, but underwent several months' "internment" at Malta. Finally he was allowed to return to France and regained civic rights; later he settled at Rome. The July revolution (1830) brought him into favour and in 1831 he received the command of the French army in Algeria. Ill-health compelled him to return to France, and he died at Paris in June 1833.

See *Mémoires du duc de Rovigo* (4 vols., London, 1828; English edition also in 4 vols., London, 1828); a new French edition annotated by D. Lacroix (5 vols., Paris, 1900); *Extrait des mémoires de M. le duc de Rovigo concernant le catastrophe de M. le duc d'Enghien* (London, 1823); *Le Duc de Rovigo jugé par lui-même et par ses contemporains*, by L. F. E. . . . (Paris, 1823); and A. F. N. Macquart, *Réfutation de l'écrit de M. le duc de Rovigo* (1823).

SAVE or **SAVA,** a river of Yugoslavia and an affluent of the Danube. It runs almost parallel with the Drave, both having about the same length. The Save rises in the Triglav group in Carniola from two sources, the Wurzener Save and the Wocheiner Save, which join at Radmannsdorf. It then flows through Carniola and Croatia-Slavonia and joins the Danube at Belgrade. The Save has a length of 442 m., the area of its basin being 34,000 square miles. It is navigable for river steamers from Sisak to its mouth, a distance of 360 miles. (*See* DANUBE.)

SAVERNE or **ZABERN,** a town of France, capital of an arrondissement in the department of Bas-Rhin, on the Rhine-Marne canal and the Zorn, at the foot of a pass over the Vosges, and 27 m. N.W. of Strasbourg by rail. Pop. (1926) 6,954. Saverne (*Tres Tabernae*) was an important place in the times of the Romans, and, after being destroyed by the Alamanni, was rebuilt by the emperor Julian. It is interesting that, being an important point in the line of communications, it early became an ecclesiastical lordship, at first of the bishops of Metz, but from the 13th century to 1793 of the bishops of Strasbourg. It suffered much during the Thirty Years' War, but the episcopal castle, then destroyed, was rebuilt later. There is a 15th century church of a former Franciscan convent. The parish church has a 12th century tower, and 14th century Gothic choir. Saverne is the seat of a sub-prefect and of a cantonal tribunal.

In November 1913 Zabern was the scene of a fracas which caused great bitterness in France and assumed the proportions of an international incident. A German lieutenant named Forstner grossly insulted Alsatian recruits, and a street riot followed. Twenty-nine persons were arrested. On Dec. 2 Forstner caused the arrest of a boy at Zettweiler and struck him with his sabre. The affair led to a vote of censure on Bethmann-Hollweg in the Reichstag, but the military party secured the acquittal of Forstner on appeal to the war council.

SAVIGNY, FRIEDRICH KARL VON (1779–1861), German jurist, was born at Frankfort-on-Main on Feb. 21, 1779. Left an orphan at the age of 13, he was brought up by his guardian until, in 1795, he entered the university of Marburg. After the fashion of German students, Savigny visited several universities, notably Jena, Leipzig and Halle; and returning to Marburg, took his doctor's degree in 1800. In 1803 he published his famous treatise, *Das Recht des Besitzes* (the rights of possession). In 1804 Savigny married Kunigunde Brentano, the sister of Bettina von Arnim and Clemens Brentano the poet, and the same year started on an extensive tour through France and south Germany in search of fresh sources of Roman law.

In 1810 he was called, chiefly at the instance of Wilhelm von Humboldt, to fill the chair of Roman law at the new university of Berlin. Here one of his services was to create, in connection with the faculty of law, a "Sprach-Collegium," an extraordinary tribunal competent to deliver opinions on cases remitted to it by the ordinary courts; and he took an active part in its labours. This was the busiest time of his life. He was engaged in lecturing, in the government of the university, and as tutor to the crown prince in Roman, criminal and Prussian law. In 1814 appeared his pamphlet *Vom Beruf unserer Zeit für Gesetzgebung und Rechtswissenschaft* (new edition, 1892), a protest against the demand for codification.

In 1815 he founded, with Karl Friedrich Eichhorn, and Johann Friedrich Ludwig Göschen (1778–1837), the *Zeitschrift für geschichtliche Rechtswissenschaft,* as the organ of the new historical school. In 1815 appeared the first volume of his *Geschichte des römischen Rechts im Mittelalter,* the last of which was not published until 1831. This work was originally intended to be a literary history of Roman law from Irnerius to the present time. As eventually completed, it left the narrative at the 16th century and the separation of Europe into national States.

In 1835 Savigny began his elaborate work on contemporary Roman law, *System des heutigen römischen Rechts* (8 vols., 1840–1849). In March 1842, he was appointed "Grosskanzler" (High Chancellor), the title given by Frederick II. in 1746 to the official at the head of the juridical system in Prussia, and he carried out several important law reforms in regard to bills of exchange and divorce. In 1848 he resigned and returned to jurisprudence. In 1850 appeared his *Vermischte Schriften,* consisting of a collection of his minor works published between 1800 and 1844. In 1853 he published his treatise on Contracts (*Das Obligationenrecht*), a supplement to his work on modern Roman law, in which he clearly demonstrates the necessity for the historical treatment of law. Savigny died at Berlin on Oct. 25, 1861.

Savigny belongs to the so-called historical school of jurists, though he cannot claim to be regarded as its founder, an honour which belongs to Gustav Hugo. In the history of jurisprudence Savigny's great works are the *Recht des Besitzes* and the *Vom Beruf* above referred to. The former marks an epoch in jurisprudence. Professor Jhering says: "With the *Recht des Besitzes* the juridical method of the Romans was regained, and modern jurisprudence born." Savigny sought to prove that in Roman law possession had always reference to "usucaption" or to "interdicts"; that there is not a right to continuance in possession but only to immunity from interference; possession being based on the consciousness of unlimited power.

The *Beruf unserer Zeit,* in addition to the more specific object the treatise had in view, which has been already treated, expresses the idea, unfamiliar in 1814, that law is part and parcel of national life, and combats the notion, too much assumed by French jurists, especially in the 18th century, and countenanced in practice by Bentham, that law might be arbitrarily imposed on a country irrespective of its state of civilization and past history.

See Biographies by Stinzing (1862); Rudorff (1867); Bethmann-Hollweg (1867); and Landsberg (1890). *See* also ROMAN LAW.

SAVILE, SIR GEORGE (1726–1784), English politician, was the only son of Sir George Savile, Bart. (d. 1743), of Rufford, Nottinghamshire, and was born in London on July 18, 1726. He entered the House of Commons as member for Yorkshire in 1759. In general he advocated measures of relief to Roman Catholics and to Protestant dissenters, and he defended the action of the American colonists. He refused to take office and in 1783 he resigned his seat in parliament. He died unmarried in London on Jan. 10, 1784. Horace Walpole says Savile had "a large fortune and a larger mind"; Burke also had a very high opinion of him.

SAVILE, SIR HENRY (1549–1622), warden of Merton College, Oxford, and provost of Eton, was the son of Henry Savile of Bradley, near Halifax, in Yorkshire. He was educated at Brasenose College, Oxford, where he matriculated in 1561. He became a fellow of Merton in 1565, proceeded B.A. in 1566, and M.A. in 1570. He established a reputation as a Greek scholar and mathematician by voluntary lectures on the *Almagest,* and in 1575 became junior proctor. In 1578 he travelled on the continent of Europe, where he collected manuscripts. On his return he was named Greek tutor to the queen, and in 1535 was established as warden of Merton. He proved a successful and autocratic head under whom the college flourished. A translation of four Books of the Histories of Tacitus, with a learned *Commentary on Roman Warfare* in 1591, enhanced his reputation. On May 26, 1596 he obtained the provostship of Eton, the reward of persistent begging. In February 1601 he was put under arrest on suspicion of having been concerned in the rebellion of the earl of Essex. He was soon released and his friendship with the faction of Essex brought him the favour of James I.

In 1604 Savile was knighted, and in that year he was named one of the body of scholars appointed to prepare the authorized version of the Bible. He was entrusted with parts of the Gospels, the Acts of the Apostles and the Book of Revelation. His edition of Chrysostom (8 vols., fol. 1610–13) was printed by the king's printer, William Norton, in a private press erected at the expense of Sir Henry, who imported the type. At the same press he published an edition of the *Cyropaedia* in 1618. In 1619 he founded and endowed the Savilian professorships of geometry and astronomy at Oxford. He died at Eton on Feb. 19, 1622.

See W. D. Macray, *Annals of the Bodleian Library* (1868); Sir N. C. Maxwell-Lyte, *History of Eton College* (3rd ed., 1899); and John Aubrey, *Lives of Eminent Men* (1898).

SAVINGS BANKS. In any consideration of the dimensions of savings bank deposits, it is impossible to divorce the problem from the effects of the World-War and the post-war period. The general table given below takes this all-important point into account, for it is designed to include 1913, the year immediately preceding the war; 1920, the first year for which comparable figures were available after the war; and 1925, the latest year for which general information was at the time of writing available.

As shown in the articles MONEY and CURRENCY, the general effect of the war and its results was to cause widespread currency depreciation. This had several, and to some extent contradictory, results in the field of savings. To mention the first, which is partly of a theoretical character, if a uniform depreciation of the currency occurs, so that all prices, salaries and wages are doubled, each individual's margin of savings should equally be doubled. Thus if, before the war, a man earned £300 a year, spent £250 a year, and saved £50 a year, after the war, when prices were double, he should, in theory, have earned £600 a year, spent £500 a year and saved £100 a year. Hence it would be natural to find a post-war increase in the total volume of savings, and this, to some extent, the table shows. At the same time, post-war savings are in depreciated money, for even gold has lost one-third of its pre-war purchasing power. To crystallise this argument, the increases in post-war over pre-war savings, as shown by savings bank deposits, do not necessarily prove that the peoples of the world are saving a larger proportion of their income, or that the cult of thrift is increasing. They rather suggest that, as money is worth less to-day than before the war, people have to save more units of money to-day to equal in purchasing power their savings of before the war.

The next general point is the check imposed on savings by a currency in the act of depreciation. This is of a twofold character. Currency depreciation is expressed in rising prices and wages, but every wage-earner and housewife knows that prices rise first, and wages only a considerable time afterwards; so much so that,

as a rule, wages never overtake prices. So long as they lag behind, any margin in the household budget available for savings inevitably disappears, and in many cases past savings have to be drawn upon. This is the check in its first manifestation. The second is that when a currency is depreciating rapidly, saving becomes the act of a fool. What is the use of saving 10,000 marks in a year, only to find, at the end of it, that it takes a million marks to buy a dollar's worth of goods? There is the classic story from Germany of the wastrel who spent his inheritance upon champagne, and then sold the empty bottles for more marks than the champagne had originally cost him, and whether or not this is true, it is obvious that currency depreciation is a serious enemy of thrift. So long as a currency is falling in value, the exercise of thrift is not only an impossibility, but also an act of folly. Hence, while, in such countries, savings bank deposits, measured in worthless paper currency, may apparently be growing, so soon as they are reduced to gold values, they shrink to nothing. As shown later, German deposits in savings banks at the end of 1923 were, measured in paper currency, 100,000,000,000,000,000,000 marks. Reduced to gold marks, they were only 100 millions as against 19,700 millions before the war.

Only when the collapse ends in the stabilisation and revaluation of the currency, is it possible to obtain a true picture, and wherever the collapse has been a severe one, some shrinkage in the nation's savings from pre-war figures is inevitable. Thus, for all practicable purposes, the French franc had been stabilised by the end of 1926. At that date, the total volume of savings was Frs. 15,969,000,000, as against Frs. 5,829,000,000 in 1913. Superficially that suggests a great increase in the traditional thrift of the French nation, but during the intervening period, the franc had fallen to a fifth of its original gold value. To allow for this, the 1926 figure should be divided by five, reducing it to Frs. 3,194,000,000. Finally, gold itself had lost one-third of its pre-war purchasing power, so that even this last figure should be reduced by one-third to Frs. 2,129,000,000. A comparison of this last figure of two milliards with the 1913 figure of nearly six milliards shows the real inroad on French savings bank deposits made by the war and the post-war inflation.

Democratic Banking.—Two other important war tendencies affecting savings banks must also be mentioned. Neither of these is connected with currency depreciation, but both show the way in which new and formidable competitors to the savings banks have come into existence. The first is the gradual democratisation of the ordinary banking system. Fifty years ago, only the rich had banking accounts, but to-day the use of the banks has spread not only to the middle-classes but also to some extent to the artisan classes. Many banks have opened special savings banks departments, and instances of this will be found in the main table; but, in addition, in a large number of cases, people keep their savings on deposit at a bank and not in a special savings bank or savings bank account.

Next come the huge loans raised to finance the war. The belligerent governments had to draw upon the last penny of the nations' capital, and no sum was too small to escape their notice. In fact, most countries issued special forms of loans, designed to appeal to the small investor, who formed the main support of the savings banks. The outstanding example was the British war savings certificate. Sold at 15/6d., it rose to £1 in five years, and to 26/– in ten years, and as no one could hold more than 500, it was limited to the small man. The net equivalent rate of interest on these was over 5%, whereas the British post office savings bank and the Trustee savings banks (*v. infra*) only paid 2½%. The greater appeal of the savings certificate is shown clearly by the fact that, at the end of 1925, 24/– was invested in certificates to every pound deposited at the savings banks.

Finally, the economic losses of the war were reflected in a post-war period of relatively high interest rates, while interest upon savings bank deposits remained unchanged. The disparity in England between the return from savings bank deposits and savings certificates has already been noted. The same applies to interest allowed on deposits by the joint-stock banks. This is two points below bank-rate, and since the war has consequently been

Comparative Table of Savings Bank Deposits in Various Countries
(All figures in millions)

Country	Type of bank, etc.	Currency	End of 1913	End of 1920	End of 1925
United Kingdom	Post Office s.b.	£	187	267	286
	Trustee s. banks	£	68	91	110
	Total in s. banks	£	255	358	396
	Savings certificates	£	..	315	475
	Total savings	£	255	673	871
Australia	Savings banks	£	80	143	185
	Savings certificates	£	..	2	1
	Total savings	£	80	145	186
Canada	Savings banks	$	94	95	98
	Savings certificates	$	..	10	1
	Total savings	$	94	105	99
India	P.O. savings bank	Rupees	232	229	257*
	P.O. 5-year cash certificates	Rupees	..	48	210
	Total savings	Rupees	232	277	..
New Zealand	Savings banks	£	19	47	54
South Africa	Banks	£	not available	2·4	3·1
	P.O. savings	£	6·7	6·8	6·2
	Total banks	£		9·2	9·3
	Certificates	£	..	2·1	..
	Total savings	£		11·3	9·3
Austria	Banks	Krone for 1913 and 1920; Schillings for 1925†	635	3,570	185
	Savings banks		3,163	6,902	528
	Total banks		3,798	10,472	713
Belgium	General s. bank	Francs	1,123	1,535	2,571
Denmark	Savings banks	Krone	858	1,517	1,835
France	Savings banks	Francs	5,811	8,149	13,634
Germany	Savings banks	Marks	19,700	44,563	1,694
Holland	Savings banks	Florins	275	423	497
Italy	Savings banks	Lire	4,655	13,150	21,906
Norway	Savings banks	Krone	607	2,053	2,541
Russia	Savings banks	Roubles	..	..	45·9**
Spain	Savings banks	Pesetas	344	772	1,359
Sweden	Banks	Krona	349	960	780
	Savings banks	Krona	1,001	2,108	2,654
	Total banks	Krona	1,350	3,068	3,434
Switzerland	Banks	Francs	779	1,460	1,920
	Savings banks	Francs	780	1,028	1,211
	Total banks	Francs	1,559	2,488	3,131
Czechoslovakia	Banks	Koruna	..	2,216	Not available
	Savings banks	Koruna	..	5,887	12,251
	Total banks	Koruna	..	8,103	
Argentina	Bank of the nation	Pesos (paper)	215	592	779
	P.O. savings bank	Pesos (paper)	..	26	67
	Total banks	Pesos (paper)	215	618	846
Brazil	Federal s. bank	Milreis	211	321	—
Japan	Savings banks	Yen	364	1,393	1,919

For the value of the various units of currency, *see* separate articles, FRANC, MARK, etc.

*End March, 1927: the total, therefore, cannot legitimately be given.

†In 1913, 1 krone = 20·263 cents. In 1925, 1 schilling = 14.071 cents. Kronen were converted to schillings at the rate of 10,000 "paper" or depreciated kronen to 1 schilling. (*See* KRONE.)

**In 1923, 10·3 millions; in 1924, 14·5 millions.

as high as 5%, and has rarely been below 2%. During most of 1927, it was 2½%. As deposits are accepted in sums as low as £1 and are withdrawable at seven days' notice, the extent of the ordinary bank's competition with the savings bank will be apparent.

This completes the general survey of the post-war position, and will enable the table to be appreciated. The figures are taken from the League of Nations publication, "International Statistical Year-Book, 1926," published in England by Constable and Company, and so may be regarded as being derived from official sources. The writer wishes to place on record the great obligation which he and many others are under to the League Statistical Department for the wealth of information which they made available.

Great Britain.—Apart from deposits in the joint-stock and other banks and in building and co-operative societies, and investments in securities and property of all sorts and descriptions, British savings are held in three main forms, namely, deposits at the Trustee Savings Banks, the Post Office Savings Bank, and holdings of Savings Certificates. Trustee Savings Banks date from the beginning of the nineteenth century, or even earlier (*see* BANKS, HISTORY OF), while the Post Office Savings Bank dates from the middle of the nineteenth century. Savings Certificates, as explained above, were instituted during the war.

The following table shows changes in these three forms of savings, and in the proportion in which the total of savings is divided between them. Amounts are in millions of pounds.

Year	Post office		Trustee banks		Savings certificates		Total £
	£	%	£	%	£	%	
End of							
1913	187·2	73	68·5	27	..	..	255·7
1920	266·5	40	91·3	13	314·9	47	672·7
1921	264·2	38	92·3	14	336·1	48	692·6
1922	268·1	34	98·2	12	413·8	54	780·1
1923	273·1	33	103·1	13	447·5	54	823·7
1924	280·4	33	107·0	13	454·4	54	841·8
1925	285·5	33	110·4	13	472·8	54	868·7
1926	283·7	33	113·9	13	466·0	54	863·6

In analysing this table, it should be noted that the Post Office pays 2½% upon deposits, the Trustee Banks 2½% upon deposits in the ordinary section, and a rather high rate (in 1927, this rate was raised from a maximum of 3½% to one of 4%) on those in the special investment departments of the banks, while, from their institution during the war until March 1922, savings certificates were sold at 15/6d. per one pound certificate, repayable at £1 five years, and at 26/– ten years after the date of purchase. The yield on the last, if held the full time, was about 5½%, and this explains the growth in popularity of the savings certificate, as shown by the changes in the percentage columns. In March 1922, the purchase price was raised to 16/–, and in the autumn of 1923 the 10-year redemption price was reduced to 24/– corresponding to a yield of 4¾%. This rate was more consonant with those allowed by both classes of savings bank, and this explains why, since 1923, the three classes of savings increased proportionately, the percentages remaining unchanged.

In addition to holding deposits, both the Post Office and Trustee Savings Banks purchase and sell gilt-edged stocks and shares on behalf of their depositors and collect the interest thereon. The Post Office has also acted with the Bank of England as joint-issuers of big Government loans, such as 5% War Loan and Funding Loan, to the investing public, and subsequently as registrar of such loans. Stock issued by the Post Office cannot be sold on the market, but must be sold through the Post Office at the market price of the day. The Post Office is also responsible for the administration of Savings Certificates, and will issue annuities to and effect life insurance for the public.

Deposits in the Post Office and Trustee Savings Banks, and holdings of Savings Certificates are limited to £500 (par value in the case of certificates) for each individual. An exception is that when an ex-service man took his war gratuity in the form of savings certificates, they did not count as part of his maximum holding of five hundred.

The following table shows the balance-sheet of the Post Office Savings Bank, as of December 31, 1926. The figures are taken from the official "white paper," which leaves the reader to detect for himself the existence of the surplus of £33,479,180.

Post Office Savings Bank: Balance Sheet, Dec. 31, 1926

LIABILITIES to Depositors		£283,797,505
ASSETS:		
(a) British Government Stock:		
(1) Pre-war stocks . . .	34,546,045	
(2) Long-dated war & post-war stocks . . .	29,651,672	
(3) Short-term stocks (Treasury Bonds, etc.) . .	26,862,919	
(4) Treasury Bills . . .	10,000	
(5) Annuities	86,681,944	177,752,580
(b) Empire Stocks, guaranteed by British Government		71,987,053
(c) Foreign Stocks, guaranteed by British Government		2,136,400
(d) Local Loans Stock, and advances to Local Loans Fund		43,500,686
(e) Advances in relief of trade and unemployment (to Unemployment Fund and under Trade Facilities Act)		17,939,453
(f) Accrued interest and cash balances . .		3,960,513
TOTAL ASSETS . . .		£317,276,685
Surplus of Assets over Liabilities . . .		£ 33,479,180

The final comment on Great Britain must relate to the steady post-war growth in savings, despite bad trade and wide-spread unemployment. Even the coal stoppage of 1926, and its aggravation of an already serious economic and social situation did not cause more than a drop of five millions in total savings, while the Trustee Savings Banks actually improved their position.

(N. E. C.)

UNITED STATES

The name savings banks is differently applied in various parts of the United States but the typical savings bank is a mutual corporation intended to serve as a benevolent institution. In certain States savings banks are conducted as profit-making enterprises by stock corporations. In addition to the specialized savings banks there are many commercial banks maintaining thrift departments which in their functions are similar to savings banks.

The confusion of name between what are strictly savings banks conducted for profit and general banks bearing the title of savings banks makes it difficult to determine from available statistics the exact amount on deposit in stock savings banks, but the figures as of June 30, 1928, for 791 stock savings banks were approximately $1,561,218,000.

Earlier History.—The savings banks in America were adapted from similar enterprises in Great Britain. Groups of persons, usually men of substance and public spirit, secured charters for the purpose of establishing banks for the savings of the poor, the earliest being the Provident Institution for Savings in the Town of Boston, chartered on Dec. 13, 1816. There were in 1928 616 institutions whose avowed purpose was to encourage savings, and without profit to their sponsors. It can no longer be said this appeal is exclusively to the very modestly circumstanced since in New York State as much as $7,500 may be deposited by a single individual and the average amount on deposit per account in that State on June 30, 1928, was $870.96, and in the United States $739.24.

Institutions originally established to serve a particular class early found it advisable to receive deposits from all comers but it is a matter of comparatively recent development that the savings banks seek to serve their depositors with the same business-like deference which well-managed commercial undertakings have found it profitable to employ in dealing with customers. Conversely, commercial banks conducting thrift and savings departments do so as a rule in a spirit of effective service and with no intention to exploit their depositors.

The Mutual Savings Bank.—The operation of a mutual

savings bank is strictly limited by law to the receipt, investment and return of deposits with interest, in addition to minor auxiliary functions performed as services to depositors. The law also strictly limits the type of investment which may be made by such institutions with a view to the greatest possible security of depositors' funds.

The importance of the mutual savings bank in the national economy of the United States is indicated by the fact that according to reports made by the Comptroller of the Currency, on June 30, 1927, the total deposits in such banks were $8,077,099,000, and the total depositors 11,337,398. These banks are situated principally in the New England States, middle Atlantic States, New York, Pennsylvania, Delaware, Ohio and Washington, D.C.

The legal structure and general administrative features of mutual savings banks in the State of New York may be taken as indicating the mutual type of institution of which savings banks of that State are fairly representative.

Organization.—Specific requirements are laid down by statute governing the incorporation of savings banks. Not only must these requirements be met but approval must be obtained from the official having general supervision over the banking institutions in the State. A person is ineligible for election to a board of trustees of a savings bank in New York if by his election a majority of the board shall be members of the boards of commercial banks, trust companies or national banking associations operating a special interest department, or of a mortgage or title company organized under the banking law or insurance law. From time to time, and now usually every three months, the trustees of the bank declare and credit to the depositors dividends at the rate which under the law may not exceed a maximum percentage of 5%.

Savings banks are conceived of as neighbourhood institutions, and in New York State they may have only one branch and only in cities of the first class. In Massachusetts a savings bank may establish one or more branches in the town where the main office is situated and in towns not more than 15 m. distant therefrom where there is no savings bank, but only with the written permission of the commissioner of banks.

All of the earnings and surplus of a savings bank belong exclusively to depositors. In New York, when the undivided profits and guaranty fund as determined under the law amount to more than 25% of the money due depositors, the trustees must at least once in three years divide the accumulation in excess of 25% as an extra dividend to depositors. In Massachusetts such division must be made where the guaranty fund and undivided profits amount to 10½% of the deposits, after an ordinary dividend is declared.

The investments of all savings banks are governed by the law of the States in which they are situated. In New York State, savings banks may invest in the stocks and bonds of the United States, of any State of the Union, the District of Columbia, and of the cities of such States which meet certain tests as to size and powers and record of responsibility in the payment of its debts. They may invest in the mortgage bonds of railroad corporations meeting certain fiscal qualifications and which have regularly and punctually paid the maturities of principal and interest on their indebtedness for a fixed period preceding the date of the investment, and also in certain other bonds specifically named in the statute. In 1928 they were authorized to invest in the securities of public utility corporations and in railway equipment trust certificates under specific restrictions. They may invest in bankers' acceptances eligible for purchase by the Federal Reserve Bank, in promissory notes secured by collateral eligible for savings bank investments and in loans secured by the pass-books of depositors.

On Jan. 1, 1929, 63% of the combined assets of the mutual savings banks of the State of New York were invested in bond and mortgage on real estate.

Supervision.—Semi-annually a New York savings bank is required to make a written report to the superintendent of banks on a form prescribed by the superintendent, covering full details of the transactions of the bank. There is a drastic penalty imposed for the failure of the bank to make such reports. Supplementing these reports the superintendent from time to time makes unannounced examinations of the records and transactions of the bank.

Similar although not identical provisions are contained in the laws of other States. Thus once a year in Massachusetts a thorough examination and audit of the bank must be made by a certified public accountant, not connected with the bank, selected by the auditing committee of the trustees and approved by the bank commissioner. In the event that the committee fails to have such an examination made, the commissioner must have one made and the bank must pay for it.

These rigid restrictions, on the operation of mutual savings banks with a view to maintaining their integrity, arose out of early disastrous experiences with irresponsibly managed banks. The steady improvement in the standards of business morality, the effect of supervision by State officials, advances in methods of accounting and internal administration, and also the growth of competition between banks for the business of the public have all contributed to the present general high level of efficiency and responsibility of the management of banks, only emphasized by occasional individual lapses.

A considerable number of banks organized under State charters have established thrift departments. Commercial banks have accumulated in the State of New York alone upwards of $2,817,882,000 of thrift deposits (1928). These funds are not subject to segregation for special investment and may be commingled with the general funds of the bank and used in any manner in which such general funds may be used. The growth of deposits of this character is a reflection of the increased public confidence with which banks generally are held by the working class.

Extended Facilities.—Savings banks maintain and are increasingly establishing service departments to give counsel on investments, to help in the preparation of family and individual budgets, to advise regarding the use of funds, and to explain the functions of the savings bank not only to depositors but to such part of the public as comes within the walls of a bank seeking information. The progressive savings banks responding to the modern spirit of business are reaching out to encourage the public to make a maximum use of the institutions which have achieved prestige and stability, and therefore have it within their power to serve a large number of individuals satisfactorily. Some of these banks now have individually several hundred thousand depositors. Through educational publicity special forms of accounts intended to stimulate regular savings, promotion of savings for specific objects such as the purchase of a home, making of investments or the accumulation of funds for life insurance, have been developed, showing marked ingenuity in enlarging the use of the savings bank.

Stock Savings Banks.—Stock Savings Banks are organized for the purpose of making profit for their owners and are conducted by boards of directors selected by the stockholders. These banks generally exist in States where mutual savings banks have not been established. In certain cases they perform a savings bank business exclusively. In other cases the savings department is conducted as a part of the general operation of a commercial bank. These banks are organized and carried on in certain States under the general banking laws, in others under special laws regulating the operation of a savings bank.

School Savings.—The school savings bank is an imported idea brought to the United States by John H. Thiry, a savings bank official of Long Island city, and was modelled after those of France, Belgium and Germany. As a trustee of the public schools of Long Island city, Thiry found no difficulty in gaining the consent of his fellow trustees to try the experiment in those schools. From that experiment which proved successful the school savings bank idea spread until it received the general endorsement of educators as well as bankers. It has been legalized in numerous States and in the principal individual States school savings have assumed impressive proportions. There are several plans of operating a school savings bank but they are alike in that they are subsidiary to a savings or other bank in which

money collected from the children is ultimately deposited. The essential idea is that each child should be dealt with as an individual depositor, with the customary evidence of his or her status as such, as, for example, the possession of a pass book in which his or her transactions with the bank are recorded. Children taught to save in school savings banks become users of savings banks after school years. In June 1928 there were in the United States 13,835 schools with savings plans; 3,980,237 children were reported participating in them with deposits of $26,005,138.04 and net savings of $9,476,391.32.

Postal Savings System.—Under a board of trustees consisting of the postmaster general, the secretary of the Treasury and the attorney general, acting ex officio, the U.S. Government since 1910 has maintained postal savings depository offices. Accounts as low as $1.00 may be opened by persons over ten years of age. Interest at 2% per annum is allowed and is credited once a year. Individual balances may not exceed $2,500. Deposits in sums of $20 or multiples thereof may be converted by the depositor into U.S. Government bonds bearing interest at 2½%. At the close of the fiscal year 1928, there were 6,683 depositories in operation; $152,143,349 was on deposit to the credit of 412,250 depositors with an average balance per depositor of $369.06.

The system is self-supporting showing a profit of $618,602.32 in 1928.

Postal savings banks, being backed by the pledged credit of the U.S. Government, were intended to encourage thrift, supplementing the activity of banking institutions. It was expected that they would keep in the country part of the money previously sent abroad on international money orders, bring hoarded money into circulation, and offer facilities to the timid and fearful in times of financial stress.

For the first 17½ years of its operation the postal savings system received on deposit $1,586,498,397, of which $1,252,326,472 had been repaid. While it is to be doubted that the postal savings system has accomplished all that was expected of it, it is unquestioned that the system is now regarded as a permanent part of the financial machinery of the nation. (H. Bru.)

FRANCE AND GERMANY

France.—Two classes of savings banks exist, namely, the "Caisses d'Epargne Ordinaires," or private institutions, and the Caisse Nationale or Caisse d'Epargne Postale, this being the state savings bank administered by the Post Office. As is shown by the following table, the major part of the nation's savings is deposited in the private banks. The table also shows the post-war increases in nominal savings, and their actual decrease when reduced to gold values. Figures are in millions of francs (franc= $0·0392).

Year	Deposits in		Total* deposits	Total deposits (reduced to gold values)
	Caisses* ordinaires	Caisse* nationale		
End of 1913	4,011	1,818	5,829	5,829
" " 1920	5,795	2,353	8,148	2,500
" " 1921	6,884	2,697	9,581	3,960
" " 1922	7,796	3,051	10,848	4,078
" " 1923	8,286	3,271	11,558	3,066
" " 1924	8,577	3,419	11,996	3,374
" " 1925	9,831	3,937	13,768	2,705
" " 1926	†	†	15,969	3,258

*These statistics are taken from *La France Economique en 1926*, p. 247.
†Not available.

The net result is a fall in the gold value of French savings bank deposits from 5,829 millions at the end of 1913 to 3,258 millions at the end of 1926. This bears out the general theory enunciated in the first section of this article.

The results for 1926 illustrate, in striking fashion, the extent of the blow dealt to thrift by a depreciating currency. It will be remembered that, at the opening of the year, the franc stood at 3·70 cents, or 130 francs to the pound, and then fell steadily until, in July, it fell as low as 2·03 cents, or 240 francs to the pound. In July alone it fell from 2·67 to 2·03 cents, or by 24%. The result was that this month witnessed a sudden rush on the part of the public to withdraw their savings, and in this month the Caisse Nationale lost 133·7 million francs, and the Caisses Ordinaires lost 53 millions. The run on the latter institutions continued into August, possibly because of the time that elapses between a depositor giving notice of withdrawal and the actual withdrawal, and in the first ten days of that month as many as 88 millions were withdrawn. By September, the financial situation was in hand, and confidence was restored. The result was a steady increase in deposits.

The depreciation of the franc has rendered necessary large increases in the maximum sum permitted to be held by any single depositor. Before the war, it was only 1,500 francs. This limit was raised in 1916, 1919, 1925 and again in 1926, and in accordance with the provisions made in the last year, it stands at 12,000 francs for an individual, and at 50,000 for a "society." As 1,500 francs pre-war equal 7,500 francs to-day, it will be seen that the limits have been raised by a far greater extent than was required by the depreciation of the franc.

Germany.—German Savings Banks are organised into thirteen District Associations, together with two separate banks owned by the provinces of Rhineland and Westphalia. Prior to the war, deposits therein amounted to 19,700 million marks. The post-war position is shown in the following table. All figures are in millions of marks.

Year	Savings banks deposits	
	Actual	Gold equivalent
End of		
1913	19,700	19,700
1917	25,403	21,200
1918	31,834	16,400
1919	36,981	3,105
1920	44,563	2,575
1921	*	*
1922	*	*
1923	*	100
1924	608	608
1925	1,694	1,694
1926	3,091	3,091
1927	4,665	4,665

*Owing to the depreciation of the mark, the figures became meaningless. 1923 is given as the anticlimax. The actual total was 100,000,000,000,000,000 paper marks. The figures for 1924 and onwards are in new Reichsmarks. (*See* Mark.)

These statistics afford a clear example of the way in which savings lose their real value when the currency collapses. The real shrinkage began in the closing year of the war, and continued until, with the final disappearance of the old mark in 1923 as a result of inflation, savings had fallen to one-twentieth of their pre-war volume.

Following the revaluation of the mark at the ratio of one new Reichsmark to one billion paper marks, legislation was passed to determine the amounts due by savings banks to their depositors. It was obviously impossible to reach an arrangement that was both equitable and practicable. The following provisions were made:—

Savings accounts in public savings institutions or in savings banks under Government supervision were revalued by dividing the Estate "available for distribution," *i.e.*, the revalued assets of the savings banks and other available assets of the debtor. The amount so distributed was to aggregate not less than 12½% of the gold mark value of such deposits. (Authority, *Moody's Manual of Investments*, 1928.) In other words, every attempt was to be made to secure for depositors one-eighth of their original savings.

Once confidence was restored by the revaluation of the mark, savings again began to accumulate. By the end of January, 1928, they had reached 5,094 million marks. It will clearly be a long process to overcome the destructive effects of the war and the subsequent period of inflation, so as to restore savings bank deposits to the pre-war level. (N. E. C.)

SAVINKOV, BORIS (pen-name, Ropshin) (d. 1925), Russian revolutionary, joined the Russian socialist-revolutionary party at the beginning of the 20th century and reached a high position in the councils of the party, becoming one of the five members of its "Militant Organisation" and thus jointly responsible with the other members of that committee for the planning and execution of numerous terrorist assassinations. During the years immediately preceding 1914 he withdrew from active membership of the party, and in his novel *The White Horse* revealed a deeply pessimistic view of the position of the "intelligentsia" in pre-war Russia. From 1914 onwards he took a strongly pro-war attitude, and after the February 1917 revolution he became Kerensky's able assistant, holding the position of vice-minister for war in the 2nd coalition government of August. He played an equivocal part in the Kornilov affair, and after the Bolshevik revolution devoted himself to anti-Soviet activities. He was caught by the G.P.U. secretly entering Soviet Russia for purposes never clearly elucidated, was brought to trial in Moscow for his anti-Soviet activities, and was sentenced to ten years' imprisonment. He died in prison in 1925.

SAVOFF, MICHAEL (1857–1928), Bulgarian general and statesman, after three years in the Russian Staff Academy in St. Petersburg, became a captain in the Bulgarian army when, on the outbreak of war with Serbia, he commanded one wing of the Bulgarian army at their brilliant victory of Slivnitza. In 1887 he was appointed assistant to the Minister of War, and in 1891 minister. He resigned in 1897, but after a further period in the army, and as commandant of the Military Academy at Sofia, he again held the same office in 1902 in Petroff's cabinet. The military law of 1904 was largely due to him. He retired into private life in 1908, but was appointed commander-in-chief of the Bulgarian army during the 1st and 2nd Balkan wars (1912–13). Savoff signed the orders of June 29, 1913, commanding the Bulgarian Fourth Army to attack the Greek and Serbian force, thus opening the second Balkan War. For this he was recalled and an enquiry opened which was, however, never concluded; Savoff declared that the order had been given him by King Ferdinand. Although holding no command in the World War, owing to ill health, he strongly urged that Bulgaria join the Central Powers in order to recover Macedonia from Serbia. In Sept. 1918 he returned to Bulgaria from abroad in an attempt to overthrow the Malinoff Cabinet, and keep Bulgaria in the War, but found that King Ferdinand had already abdicated. On Oct. 22, 1922, he was appointed Bulgarian minister in Paris, but retired after the anti-Agrarian *coup d'état* of June 9, 1923. He died on July 22, 1928, at Vallier-de-Thiey, Alpes-Maritimes.

SAVOIE, a department of France, formed in 1860 of the old provinces of Haute Savoie, Savoie, the Tarentaise and the Maurienne, which constituted the southern portion of the duchy of Savoy. It is bounded north by the department of Haute Savoie, east and south-east by Italy, south-west by the department of the Hautes Alpes, and west by those of the Isère and the Ain. Pop. (1926) 231,210; area 2,388 sq.m. It is mainly made up of the basin of the Isère. Probably the Isère formerly communicated with the Rhone past Chambéry and the Lac du Bourget. The sources of the Isère and of the Arc are separated by the ridge of the Col du Mont Iseran (9,085 ft.). The loftiest points are the Grande Casse (12,668 ft.), the culminating summit of the Vanoise group, the Mont Pourri (12,428 ft.), the Pointe de Charbonel (12,336 ft.), the Aiguille de la Grande Sassière (12,323 ft.), the Dent Parrachée (12,179 ft.), the Levanna (11,943 ft.) and the Aiguilles d'Arves (11,529 ft.). A small portion of the department (including both shores of the Lac du Bourget) is in the part of the duchy of Savoy neutralised in 1815. The chief products are cattle and dairy-products and wine. There are general manufactures and tobacco is grown. It is divided into 3 arrondissements (Chambéry, the chief town, Albertville and St. Jean de Maurienne), 29 cantons and 330 communes. It forms the dioceses of Chambéry (an archbishopric), Moutiers-Tarentaise, St. Jean de Maurienne and Anneçy, it is in the XIVth military region (Lyons), and is in the académie (educational division) of Chambéry, where is its court of appeal. There are mineral springs at Aix-les-Bains (*q.v.*), while other sulphur springs rise at Marlioz and at Challes, those of Salins being saline, and those of Brides (the best known after Aix) alkaline. For the history of the district *see* SAVOY, HOUSE OF.

See J. J. Vernier, *Dict. top. du dèp. dé la Savoie* (Chambéry 1897).

SAVONA, a seaport and episcopal see of Liguria, Italy, the capital of the province of Savona, 27 m. W.S.W. of Genoa by rail, 33 ft. above sea-level, and after Genoa and Nice the most important of the cities of the Riviera. Pop. (1921) 53,063, town; 58,711, commune. The greater part of the town is now modern with fine streets with porticoes. It is surrounded with green-clad hills and luxuriant orange groves. Near the shore stands the castle built by the Genoese in 1542, on the area of the old cathedral, and now occupied by large iron-works. The cathedral (1589–1604) is a late Renaissance building with a 12th century font, fine choir-stalls and pulpit (1500). In the Cappella Sistina, to the north, stands the finely carved tomb erected by Sixtus IV. to his parents. Facing the cathedral is the Della Rovere palace erected by Cardinal Giulio della Rovere (Julius II.) from the plans of Giuliano da Sangallo, now occupied by various public buildings, the prefecture, the post-office and law-courts. The municipal picture gallery is interesting, and there are some fine old buildings in the town. Good majolica was made in the 16th, 17th and 18th centuries. The Teatro Chiabrera was erected in 1853 in honour of the lyric poet Chiabrera (1552–1637). The harbour, dating from 1815, has since 1880 been provided with a dock excavated in the rock, 986 ft. long, 460 ft. wide and 23 ft. deep. Savona is one of the chief seats of the Italian iron industry, having iron-works and foundries, shipbuilding, railway workshops, a railway signal factory, engineering shops, brass foundry, tinplate works, sulphur mills and glass-works. In 1926 1,610 vessels of 1,251,207 tons entered and cleared the port, dealing with 1,301,070 tons of merchandise, of which 1,202,967 tons were imports, almost entirely foreign coal and petrol. The coal is dealt with by an extensive telferage system. There is a railway through the mountains from Savona to Turin (91 m. N.N.W.).

Savona is the ancient *Savo,* a town of the Ingauni (*see* ALBENGA), but less important than Vada Sabatia (Vado), 4 m. to the W., up to which the coast road from Rome was reconstructed in 109 B.C., from which a road diverged across the Apennines to Placentia. In 1191 Savona bought up the territorial claims of the marquesses Del Carretto. Its whole history is that of a long struggle against the preponderance of Genoa. As early as the 12th century the Savonese built themselves a sufficient harbour; but in the 16th century the Genoese, fearing that Francis I. of France intended to make it a great seat of Mediterranean trade, rendered it useless by sinking at its mouth vessels filled with large stones.

SAVONAROLA, GIROLAMO (1452–1498), Italian monk and reformer, born at Ferrara on Sept. 21, 1452, was the third child of Michele Savonarola and his wife Elena Bonaccossi of Mantua. Elena was tenderly loved by her famous son, and his letters prove that she retained his fullest confidence through all the vicissitudes of his career. Girolamo was intended for the medical profession, but even as a boy he had intense pleasure in reading St. Thomas Aquinas and the Arab commentators of Aristotle, was skilled in the subtleties of the schools, wrote verses and studied music and design. To the mystic young student all festivities were repulsive, and although reared in a courtier-household he early asserted his individuality by his contempt for court life. At the age of 19 he was passionately in love with the daughter of a neighbour, a Strozzi exiled from Florence, but his suit was repulsed with disdain and this probably decided his career. He was full of doubt and self-distrust, but in 1474 his doubts were dispelled by a sermon heard at Faenza and he entered the monastery of St. Domenico at Bologna, where his novitiate was marked by a fervour of humility. He passed six quiet years in the convent, but his poems written during that period are expressive of burning indignation against the corruptions of the church.

In 1482 he reluctantly accepted a mission to Ferrara, and later he was sent to the convent of St. Mark in Florence. In 1483 he was Lenten preacher in the church of St. Lorenzo, but his plain,

earnest exhortations attracted few hearers. His first success as a preacher was gained at San Gimignano (1484–85), but it was only at Brescia in the following year that his power as an orator was fully revealed. In a sermon on the Apocalypse he shook men's souls by his terrible threats of the wrath to come, and drew tears from their eyes by the tender pathos of his assurances of divine mercy. Soon, at a Dominican council at Reggio, Savonarola had occasion to display his theological learning and subtlety. The famous Pico della Mirandola was particularly impressed by the friar's attainments, and is said to have urged Lorenzo de' Medici to recall him from Lombardy. When Savonarola returned to Florence in 1490, his fame as an orator had gone there before him, and on Aug. 1, 1490, he first preached in the church of St. Mark.

Prior of St. Mark's.—In 1491 he was invited to preach in the cathedral, and his rule over Florence may be said to begin from that date. Lorenzo sent leading citizens to him to urge him to show more respect to the head of the state. Savonarola rejected their advice and foretold the impending deaths of Lorenzo, of the pope and of the king of Naples. In the July of the same year he was elected prior of St. Mark's. As the convent had been rebuilt by Cosimo, and enriched by the bounty of the Medici, it was considered the duty of the new superior to present his homage to Lorenzo. Savonarola, however, refused to conform to the usage. His election was due to God, not Lorenzo. In April 1492, Lorenzo de' Medici was on his death-bed at Careggi. Oppressed by the weight of his sins, he summoned the unyielding prior to shrive his soul. Savonarola reluctantly came and offered absolution upon three conditions. Lorenzo asked in what they consisted. First, "You must repent and feel true faith in God's mercy." Lorenzo assented. Secondly, "You must give up your ill-gotten wealth." This, too, Lorenzo promised, after some hesitation; but upon hearing the third clause, "You must restore the liberties of Florence," Lorenzo turned his face to the wall and made no reply. Savonarola waited a few moments and then went away. And shortly after Lorenzo died unabsolved.

Savonarola's influence now rapidly increased. The same year Innocent VIII. died (July 1492) and men's minds were full of anxiety, an anxiety increased by the scandalous election of Cardinal Borgia to the papal chair. During the delivery of one of his Advent sermons, Savonarola beheld the vision, recorded in contemporary medals and engravings, that is almost a symbol of his doctrine. A hand appeared to him bearing a flaming sword inscribed with the words: "Gladius Domini supra terram cito et velociter." He heard supernatural voices proclaiming mercy to the faithful, vengeance on the guilty, and mighty cries that the wrath of God was at hand. Then the sword bent towards the earth, the sky darkened, thunder pealed, lightning flashed, and the whole world was wasted by famine, bloodshed and pestilence. He was presently addressing enthusiastic congregations at Prato and Bologna whence he returned to Florence. He was rapturously welcomed by the community of St. Mark's, and at once proceeded to re-establish the discipline of the order. For this purpose he obtained, after much difficulty, a papal brief emancipating the Dominicans of St. Mark from the rule of the Lombard vicars of that order. He thus became an independent authority, no longer at the command of distant superiors. He relegated many of the brethren to a quieter retreat outside the city, only retaining in Florence those best fitted to aid in intellectual labour. Meanwhile he thundered forth predictions of heavenly wrath. In 1494 the duke of Milan demanded the aid of France, and King Charles VIII. brought an army across the Alps. The incompetent policy of Piero de' Medici, Lorenzo's successor, towards Charles drove Florence to revolt. But even at this crisis Savonarola's influence was all-powerful, and a bloodless revolution was effected. The resuscitated republic sent a fresh embassy to the French king, to arrange the terms of his reception in Florence. Savonarola was one of the envoys, Charles being known to entertain the greatest veneration for the friar who had so long predicted his coming and declared it to be divinely ordained. Charles entered Florence on Nov. 17, 1494, but the exorbitance of his demands soon showed that he came as a foe. The signory resolved to be rid of their dangerous guest; and, when Charles threatened to sound his trumpets unless the sums exacted were paid, Capponi tore up the treaty in his face and made the memorable reply: "Then we will ring our bells." The monarch, alarmed at the dangerous possibilities of fighting in the narrow streets of the city, accepted moderate terms, and, yielding to Savonarola's remonstrances, left Florence on Nov. 24.

The citizens turned to the patriot monk whose words had freed them of King Charles, and Savonarola became the law-giver of Florence. The first thing done at his instance was to relieve the starving populace within and without the walls; shops were opened to give work to the unemployed; all taxes, especially those weighing on the lower classes, were reduced; the strictest administration of justice was enforced, and all men were exhorted to place their trust in the Lord. And, after much debate as to the constitution of the new republic, Savonarola's influence carried the day in favour of Soderini's proposal of a universal or general government, with a great council on the Venetian plan. Savonarola's programme of the new government was comprised in the following formula: (1) fear of God and purification of manners; (2) promotion of the public welfare in preference to private interests; (3) a general amnesty to political offenders; (4) a council on the Venetian model, but with no doge. At first the new machinery acted well; the public mind was tranquil.

Dictator of Florence.—Without holding any official post in the commonwealth he had created, the prior of St. Mark's was the dictator of Florence, and guarded the public weal with extraordinary political wisdom. At his instance the tyrannical system of arbitrary imposts and so-called voluntary loans was abolished, and replaced by a tax of 10% (*la decima*) on all real property. His counsels were always given as addenda to the religious exhortations in which he denounced the sins of his country and the pollution of the church, and urged Florence to cast off iniquity and become a truly Christian city, a pattern not only to Rome but to the world at large. His eloquence was now at the flood. Pleasure-loving Florence was completely changed. Abjuring pomps and vanities, its citizens observed the ascetic régime of the cloister. Hymns and psalms rang in the streets that had so recently echoed with Lorenzo's dissolute songs. Both sexes dressed with Puritan plainness; husbands and wives quitted their homes for convents and persons of all ranks—nobles, scholars and artists—renounced the world to assume the Dominican robe. Still more wonderful was Savonarola's influence over children, and their response to his appeals is a proof of the magnetic power of his goodness and purity. He organized the boys of Florence in a species of sacred militia and it was with the aid of these youthful enthusiasts that Savonarola arranged the religious carnival of 1496, when the citizens gave their costliest possessions in alms to the poor, and tonsured monks, crowned with flowers, sang hymns and performed wild dances for the glory of God. In the same spirit, and to point the doctrine of renunciation of worldly enjoyments, he celebrated the carnival of 1497 by the famous "burning of the vanities" (*i.e.* masks and other objects pertaining to the carnival festivities, indecent books and pictures, etc.) in the Piazza della Signoria. Nevertheless the artistic value of the objects consumed has been greatly exaggerated by some writers. Savonarola was foe neither to art nor to learning. On the contrary, so great was his respect for both that, when there was a question of selling the Medici library to pay that family's debts he saved the collection at the expense of the convent purse.

Conflict with the Pope.—Meanwhile his uncompromising spirit roused the hatred of political adversaries as well as of the degraded court of Rome. Even now, when his authority was at its highest, when his fame filled the land, and the vast cathedral and its precincts lacked space for the crowds flocking to hear him, his enemies were secretly preparing his downfall. Events were taking a turn hostile to the prior and Alexander VI., having seen a transcript of one of Savonarola's denunciations of his crimes, resolved to silence this daring preacher.

Bribery was the first weapon employed, and a cardinal's hat was held out as a bait. But Savonarola indignantly spurned the offer. So long as King Charles remained in Italy Alexander's concern for his own safety prevented vigorous measures against the

friar, but no Borgia ever forgave an enemy. He bided his time and in July 1495, a papal brief courteously summoned Savonarola to Rome. In terms of equal courtesy the prior declined the invitation, nor did he obey a second less softly worded, in September. Then came a third, threatening Florence with an interdict in case of renewed refusal. Savonarola disregarded the command, but went to preach for a while in other Tuscan cities. But in Lent his celebrated sermons upon Amos were delivered in the Duomo, and again he urged the necessity of reforming the church, striving by ingenious arguments to reconcile rebellion against Alexander with unalterable fidelity to the Holy See. Alexander now issued a brief, uniting St. Mark's to a new Tuscan branch of the Dominicans, thus depriving Savonarola of his independent power, while Piero de' Medici's followers continued their intrigues, and party spirit increased in virulence. The citizens were growing weary of the monastic austerities imposed on them, and Alexander foresaw that his revenge was at hand.

A signory openly hostile to Savonarola took office in May, and, in feigned anxiety for the public peace, besought him to suspend his discourses. Shortly afterwards the threatened bull of excommunication was launched against him, and Fra Mariano was in Rome stimulating the pope's wrath. Savonarola remained undaunted. The sentence was null and void, he said. His mission was divinely inspired; and Alexander, elected simoniacally and laden with crimes, was no true pope. Nevertheless the reading of the bull in the Duomo with the appropriate, terrifying ceremonial, made a deep impression on the Florentines. But in July Savonarola's friends were again in power and did their best to have his excommunication removed. During this time Rome was horror-struck by the mysterious murder of the young duke of Gandia, and the bereaved pope mourned his son with the wildest grief. Savonarola wrote him a letter of condolence, boldly urging him to bow to the will of Heaven and repent while there was yet time.

Florence then was plunged in new troubles through Medicean intrigues, and a conspiracy for the restoration of Piero was discovered and resulted in the execution of five leading citizens including Bernardo del Nero, a very aged man of lofty talents and position. It is said that at least Bernardo del Nero would have been spared had Savonarola raised his voice, but the prior would not ask mercy for them. This silence proved fatal to his popularity with moderate men. He was now interdicted from preaching even in his own convent and again summoned to Rome. As before, the mandate was disobeyed. He refrained from public preaching, but held conferences in St. Mark's with large gatherings of his disciples, and defied the interdict on Christmas Day by publicly celebrating mass and heading a procession through the cloisters. In 1498 the Piagnoni, as Savonarola's followers were called, were again at the head of the state, and at their request the prior resumed his sermons in the Duomo, while his dearest disciple, Fra Domenico Buonvicini, filled the pulpit of St. Lorenzo. For the last time the carnival was again kept with strange religious festivities, and some valuable books and works of art were sacrificed in a second bonfire of "vanities." But menacing briefs poured in from Rome, the city itself was threatened with interdict, and the Florentine ambassador could barely obtain a short delay. Now, too, the Piagnoni quitted office; the new signory was less friendly, and the prior was persuaded by his adherents to retire to St. Mark's. Alexander now demanded that the Florentines should silence the man themselves or send him to be judged by a Roman tribunal. Savonarola now despatched letters to the rulers of Europe adjuring them to assemble a council to condemn this antipope. But the papal threats were now urgent, and the signory entreated Savonarola to cease preaching. He obeyed, and concluded his last discourse with the most touching farewell.

The government hoped that Alexander would be appeased and Florence allowed to breathe freely. But although silenced, the prophet was doomed. A creature of the Arrabbiati, a Franciscan friar named Francesco di Puglia, challenged Savonarola to prove the truth of his doctrines by the ordeal of fire. At first the prior treated the provocation with merited contempt, but his too zealous disciple Fra Domenico accepted the challenge and, when the Franciscan declared that he would enter the fire with Savonarola alone, Fra Domenico protested his willingness to enter it with any one in defence of his master's cause. As Savonarola resolutely declined the trial, the Franciscan deputed a convert, one Giuliano dei Rondinelli, to go through the ordeal with Fra Domenico. Savonarola, perceiving that a trap was being laid for him, discountenanced the "experiment" until his calmer judgment was at last overborne by the fanaticism of his followers. On April 7, 1498, an immense throng gathered in the Piazza della Signoria to enjoy the barbarous sight. The Dominicans, led by Savonarola, and the Franciscans came forward, but neither Rondinelli nor Fra Francesco appeared and there were angry disputes between the two groups of friars. It was now late in the day, and a storm shower gave the authorities a pretext for declaring that heaven was against the ordeal. The Franciscans slipped away unobserved, but Savonarola raising the host attempted to lead his monks across the piazza in solemn order as before. On this the popular fury burst forth. Defrauded of their cruel diversion, the people were wild with rage. Fra Girolamo's power was suddenly at an end. Against the real culprits, the Franciscans, no anger was felt; the zealous prior, the prophet and lawgiver of Florence, was made the popular scapegoat. Notwithstanding the anguish that must have filled his heart, the fallen man preserved his dignity and calm. Mounting his own pulpit in St. Mark's he quietly related the events of the day to the faithful assembled in the church, and then withdrew to his cell, while the mob outside clamoured for his blood.

Arrest and Trial.—The next morning the government decided on his arrest, and no sooner was this made public than the populace rushed to the attack of the convent. The monks and their few remaining friends made a most desperate defence. In vain Savonarola besought them to lay down their arms. When the church was finally stormed Savonarola was seen praying at the altar, with Fra Domenico, armed with an enormous candlestick, guarding him from the blows of the mob. A few disciples dragged their beloved master to the inner library and urged him to escape, when a cowardly monk, one Malatesta Sacramoro, cried out that the shepherd should lay down his life for his flock. Thereupon Savonarola turned, bade farewell to the brethren, and, accompanied by the faithful Domenico, quietly surrendered to his enemies. The prisoners were conveyed to the Palazzo Vecchio.

Now came an exultant brief from the pope. His well-beloved Florentines were true sons of the church, but must crown their good deeds by despatching the criminals to Rome. The signory refused to send their prisoners to Rome but they did Rome's behests. Day after day Savonarola was tortured, and in his agony, with a frame weakened by constant austerity and the mental strain of the past months, he made every admission demanded by his tormentors. But directly he was released from the rack he always withdrew the confessions uttered in the delirium of pain. These being too incoherent to serve for a legal report, a false account of the friar's avowals was drawn up and published. Alexander was frantically eager to see his enemy die in Rome. But the signory insisted that the false prophet should suffer death before the Florentines whom he had so long led astray. The matter was finally compromised. A second mock trial was held by two apostolic commissioners specially appointed by the pope. Meanwhile the trial of Brothers Domenico and Silvestro was still in progress. The former remained faithful to his master and himself. No extremity of torture could make him recant or extract a syllable to Savonarola's hurt; he steadfastly repeated his belief in the divinity of the prior's mission. Fra Silvestro on the contrary gave way at mere sight of the rack, and owned himself and his master guilty of every crime laid to their charge.

The two commissioners soon ended their task. They had the pope's orders that Savonarola was to die "even were he a second John the Baptist." On three successive days they "examined" the prior with worse tortures than before. On May 22 sentence of death was pronounced on him and his two disciples. Savonarola listened unmoved to the awful words and then quietly resumed his interrupted devotions. Fra Domenico exulted in the thought of dying by his master's side; Fra Silvestro, on the contrary, raved with despair. The only favour Savonarola craved before death was a short interview with his fellow victims. This

the signory unwillingly granted. The memorable meeting took place in the hall of the Cinquecento. During their 40 days of confinement and torture each one had been told that the other had recanted, and the false report of Savonarola's confession had been shown to the two monks. The three were now face to face for the first time. Fra Domenico's loyalty had never wavered, and the weak Silvestro's enthusiasm rekindled at sight of his chief. Savonarola prayed with the two men, gave them his blessing, and exhorted them by the memory of their Saviour's crucifixion to submit meekly to their fate. The following morning he prophesied that dire calamities would befall Florence during the reign of a pope named Clement. The carefully recorded prediction was verified by the siege of 1529.

The execution took place the same morning. First came the ceremonial of degradation. Sacerdotal robes were thrown over the victims, and then roughly stripped off by two Dominicans, the bishop of Vasona and the prior of Sta. Maria Novella. To the bishop's formula, "I separate thee from the church militant and from the church triumphant," Savonarola replied: "That is beyond thy powers." His disciples' bodies already dangled from the arms of the cross before he was hung on the centre beam. Then the pile was fired. At dusk the martyrs' remains were thrown into the Arno.

Every year on the anniversary of Savonarola's martyrdom flowers are strewn on the spot where it took place.

Savonarola's writings may be classed in three categories:—(1) numerous sermons, collected mainly by Lorenzo Violi, one of his most enthusiastic hearers; (2) an immense number of devotional and moral essays and some theological works, of which *Il Trionfo della Croce* is the chief; (3) a few short poems and a political treatise on the government of Florence. Although his faith in the dogmas of the Roman Catholic Church never swerved, his strenuous protests against papal corruptions, his reliance on the Bible as his surest guide, and his intense moral earnestness undoubtedly connect Savonarola with the movement that heralded the Reformation.

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(P. V.; L. V.)

SAVOY, HOUSE OF, a dynasty which ruled over the territory of Savoy and Piedmont for nine centuries, and now reigns over the kingdom of Italy. The name of Savoy (Sabaudia) was known to the Romans during the decline of the empire. In the 5th century the territory was conquered by the Burgundians, and formed part of their kingdom; nearly a hundred years later it was occupied by the Franks. It was included in Charlemagne's empire and was divided by him into counties, which evolved there, as elsewhere, into hereditary fiefs; but after the break-up of Charlemagne's empire, the Burgundian kingdom revived and Savoy was again absorbed in it. After the collapse of that monarchy its territories passed to the German kings, and Savoy was divided between the counts of Provence, of Albon, of Gex, of Bresse, of the Genevois, of Maurienne, the lords of Habsburg, of Zähringen, etc., and several prelates.

Early Counts.—The founder of the house of Savoy was Umberto Biancamano (Humbert the White-handed), a feudal lord, who in 1003 was count of Salmourenc in the Viennois, in 1017 of Nyon on the Lake of Geneva, and in 1024 of the Val d'Aosta on the eastern slope of the Western Alps. In 1034 he obtained part of Maurienne as a reward for helping King Conrad the Salic to make good his claims on Burgundy. He also obtained the counties of Savoy, Belley, part of the Tarantaise, and the Chablais. With these territories Umberto commanded three of the great Alpine passes, viz., the Mont Cenis and the two St. Bernards. His son Oddone married Adelaide, eldest daughter and heiress of Odelrico Manfredi, marquess of Susa, a descendant of Arduino of Ivrea, king of Italy, who ruled over the counties of Turin, Auriate, Asti, Bredulo, Vercelli, etc., corresponding roughly to modern Piedmont and part of Liguria (1045). Umberto died some time after 1056 and was succeeded by his son, Amadeus I., at whose death the country passed to Oddone. Oddone ruled over territories on both sides of the Alps. He died in 1060, and was succeeded by his widow, Adelaide; but before her death in 1091 his son, Peter I., became count, and subsequently the latter's brother, Amadeus II. Under Humbert II. (1080) occurred the first clash with the Piedmontese communes, but he and his successors, Amadeus III. (who died on his way home from the crusades) and Thomas I. (1189), adopted a policy of conciliation towards them.

Thomas, who reigned until 1222, acquired extensions of territory in the Bugey, Vaud and Romont to the west of the Alps, and Carignano, Pinerolo, Moncalieri and Vigone to the east; he also exercised sway over Geneva, Albenga, Savona and Saluzzo. At his death these territories were divided among his sons, Thomas II. obtaining Piedmont, Aimone the Chablais, Peter and Philip other fiefs, and Amadeus IV., the eldest, Savoy and a general overlordship over his brothers' estates. Thomas II., during the wars in Piedmont, was made prisoner by the citizens of Turin, but was afterwards liberated.

Amadeus V. (1285–1323), son of Thomas II., reunited the county of Savoy (his own territory), the principality of Piedmont, ruled by his nephew Philip, prince of Achaea (a title acquired through his wife, Isabella of Villehardouin, heiress of Achaea and the Morea), and Vaud, ruled by his brother Louis. But although this division was formally recognized in 1295. Amadeus succeeded in enforcing his own supremacy over the whole country and in regaining by war, purchase or treaty, the fiefs lost by his predecessors. He fought against the dauphins of Viennois, the counts of Genevois, the people of Sion and Geneva, the marquesses of Saluzzo and Montferrat, and the barons of Faucigny, acted as peacemaker between France and England, accompanied the Emperor Henry VII. of Luxemburg on his expedition to Italy, reorganized the finances of the realm and reinforced the Salic law of succession. He was succeeded by his sons, Edward (1323–1329), known as "the Liberal," on account of his extravagance, and Aimone, the Peaceful (1329–1343), who strove to repair the harm done to the state's exchequer by his predecessor and proved one of the best princes of his line.

Amadeus VI. (1343–1383), son of Aimone, the Peaceful, and known as the *Conte Verde* or Green Count because of the costume he habitually wore at tourneys, succeeded at the age of nine. He won a reputation as a bold knight in the fields of chivalry and inaugurated a new policy by devoting more attention to his Italian possessions than to those on the French side of the Alps and in Switzerland. In 1366 he led an expedition to the East against the Turks; and he arbitrated between Milan and the house of Montferrat (1379), between the Scaligeri and the Visconti, and between Venice and Genoa after the "War of Chioggia" (1381). Amadeus was the first sovereign to introduce a system of gratuitous legal assistance for the poor. He espoused the cause of Louis, duke of Anjou, and while aiding that prince in his attempt to recover the kingdom of Naples he died of the plague, leaving his realm to his son, Amadeus VII., the *Conte Rosso* or "Red Count" (1383–1391); the latter added Nice (1388) and other territories to his domains.

Amadeus VIII. (1391–1451), count, extended his territories both in Savoy itself and in Italy, and in 1416 was created duke by the emperor Sigismund. In 1430 he promulgated a general

GENEALOGICAL TABLE OF THE HOUSE OF SAVOY.

Humbert the Whitehanded (Umberto Biancamano) (d. after 1056).

Amadeus I. (d. c. 1056).
Odonne or Otto = Adelaide, heiress of Turin (d. 1091)

Peter I. (d. 1078).
Amadeus II. (d. 1080).
Bertha = Emperor Henry IV.

Humbert II. the Fat (d. 1103).

Amadeus III. (d. 1148 or 1149).
Alice or Adelaide = Louis VI. of France.

Humbert III. the Saint (d. 1189).

Thomas I. (d. 1222).

Amadeus IV. (d. 1253).
Boniface (d. 1263).
Peter II., earl of Richmond (d. 1268).
Philip I. (d. 1285).
Thomas II., count of Piedmont (d. 1259).
Boniface, archbishop of Canterbury (d. 1270).

Louis I. of Vaud (d. 1302.)
Amadeus V. the Great (d. 1323).
Thomas III. (d. 1282).

Edward the Liberal (d. 1329).
Aimone the Peaceful (d. 1343).
Anne = the eastern emperor, Andronicus III.
Philip, prince of Achaea (d. 1334).

Amadeus VI. (d. 1383).
James (d. 1367).

Amadeus VII. (d. 1391).
Amadeus (d. 1402).
Louis (d. 1418).

Amadeus VIII., first duke of Savoy, afterwards Pope Felix V. (d. 1451).

Louis (d. 1465).
Philip, count of Geneva (d. 1444).

Amadeus IX. (d. 1472).
Philip II. (d. 1497).
Louis, king of Cyprus (d. 1482).

Philibert I. (d. 1482).
Charles I. (d. 1490).
Charles II. (d. 1496).
Philibert II. (d. 1504).
Charles III. (d. 1553).
Philip, founder of the house of Nemours (d. 1533).
Louise = Charles, count of Angoulême
Francis I. of France.

Emmanuel Philibert (d. 1580).

Charles Emmanuel I. (d. 1630).

Victor Amadeus I. = Christina, daughter of Henry IV. of France (d. 1637).
Thomas Francis, prince of Carignano (d. 1656).

Francis Hyacinth (d. 1638).
Charles Emmanuel II. (d. 1675).
Emmanuel Philibert (d. 1709).
Eugene Maurice count of Soissons (d. 1673).

Victor Amadeus II. (d. 1732). KING OF SARDINIA, 1720; abdicated 1730 = Anne of Orleans, granddaughter of Charles I. of England.
Victor Amadeus (d. 1741).
Eugene, the famous general (d. 1736).

Charles Emmanuel III. (d. 1773).
Louis Victor (d. 1778).

Victor Amadeus III. (d. 1796).
Victor Amadeus (d. 1780).

Charles Emmanuel (d. 1800).

Charles Emmanuel IV. (d. 1819); abdicated 1802.
Victor Emmanuel I. (d. 1824); abdicated 1821.
Charles Felix (d. 1831).
Charles Albert (d. 1849). King of Sardinia; abdicated 1849.

Victor Emmanuel II. (d. 1878). KING OF ITALY, 1861.
Ferdinand, duke of Genoa (d. 1855).

Humbert (d. 1900), king of Italy = Margherita of Savoy-Genoa
Amadeus (d. 1890), duke of Aosta. King of Spain, 1870–73.
Clothilde = Prince Napoleon (d. 1891).
Maria Pia (b. 1847) = Louis, king of Portugal.
Margherita = Humbert, king of Italy.
Thomas duke of Genoa (b. 1854).

Victor Emmanuel III., king of Italy (b. 1869) = Elena of Montenegro (b. 1873).
Emmanuel Philibert, duke of Aosta (b. 1869).
Victor Emmanuel, count of Turin (b. 1870).
Louis Amadeus, duke of the Abruzzi (b. 1873).
Humbert, count of Salemi (b. 1889).

Yolanda Margherita (b. 1901).
Mafalda (b. 1902).
Humbert, prince of Piedmont, heir to the throne (b. 1904).
Giovanna (b. 1907).
Maria (b. 1914).
Amadeus, duke of Puglia (b. 1898).
Aimone, duke of Spoleto (b. 1900).
Ferdinand, prince of Udine (b. 1884).
Philibert, duke of Pistoia (b. 1895).
Maria Bona Margherita (b. 1896).
Adalbert, duke of Bergamo (b. 1898).
Eugene (b. 1906).

statute of laws for the whole duchy, in spite of the opposition of the nobles and cities whose privileges were thereby curtailed. In 1434 he retired to the hermitage of Ripaille on the Lake of Geneva, but continued to conduct the chief affairs of the State and to mediate between foreign Powers, leaving matters of less importance to his son Louis. Five years later the council of Basel elected Amadeus pope, in spite of his not being a priest, and deposed Eugenius IV. Amadeus accepted the dignity, assuming the style of Felix V. (*q.v.*). In 1449 Amadeus abdicated and returned to his hermitage at Ripaille, where he died two years later. (*See* FELIX V.)

15th Century.—Under Louis, Savoy began to decline, for he was indolent, incapable, and ruled by his wife, Anne of Lusignan, daughter of the king of Cyprus, who induced him to fit out an expedition to Cyprus, which brought him no advantage save the barren title of king of Cyprus, Jerusalem and Armenia. He went to France to seek aid of King Louis XI. against his nobles, and died there in 1465. In spite of his incapacity he acquired the city of Freiburg and the homage of the lords of Monaco. He was succeeded by his son, Amadeus IX. (1455–1472), who on account of ill-health left the duchy in the hands of his wife, Yolande, sister of Louis XI. During the minority of his son Philibert I. (1472–1482) Savoy lost Freiburg and many other territories. Philibert was succeeded by his brother Charles I. (1482–1490), who, freed by Louis XI. from the dangerous protection of Philip of Bresse and by death from that of the French king, crushed the rebellious nobles and seized Saluzzo (1487). He did much to raise the fortunes of his house, but died at the age of 31. Under his successors the duchy lost ground until the accession of Emmanuel Philibert in 1553.

Emmanuel Philibert.—At the time of his accession, Emmanuel Philibert was serving in the Spanish armies. Emmanuel could not take possession of the duchy at once, but continued to serve the emperor as governor-general of the Low Countries. By his victory at St. Quentin over the French in 1557 he proved himself one of the first generals of the day, and by the terms of the subsequent treaty of Cateau Cambrésis he was reinstated in most of his hereditary possessions (1559). Under Emmanuel Philibert Savoy lost all traces of constitutional government and became an absolute despotism of the type then predominating throughout the greater part of Europe. At the same time he raised his country from ruin and degradation into a prosperous and powerful monarchy.

Charles Emmanuel I.—His son and successor, Charles Emmanuel I. (*q.v.*), surnamed the Great, strengthened the tendency of Savoy to become less of a French and more of an Italian Power. In 1588 he wrested Saluzzo from the French, but his expeditions to Provence and Switzerland were unsuccessful. In the war between France and Spain after the accession of Henry IV., he took the Spanish side, and at the peace of Lyons (1601), although he gave up all his territories beyond the Rhone, his possession of Saluzzo was confirmed. His attempt to capture Geneva by treachery (1602) failed, and although on the death of Francesco Gonzaga, duke of Mantua and Montferrat, he seized the latter city (1612) he was forced by Spain and her allies to relinquish it. The Spaniards invaded the duchy, but after several years of hard fighting the peace of 1618 left his territory almost intact. In 1628 he sided with Spain against France; the armies of the latter overran the duchy, and Charles Emmanuel died in 1630. (*See* CHARLES EMMANUEL.) His son, Victor Amadeus I. (1630–1637), succeeded to little more than a title, but by his alliance with France —his wife, Christina, being a daughter of Henry IV.—he managed to regain most of his territories. He proved a wise and popular ruler, and his early death was much deplored. He was succeeded by his second son, Charles Emmanuel II., who, being a minor, remained under the regency of his mother. That princess, in spite of her French origin, resisted the attempts of France, then dominated by Cardinal Richelieu, to govern Savoy, but her quarrels with her brothers-in-law led to civil war, in which the latter obtained the help of Spain, and Christina that of France. In the end the duchess succeeded in patching up these feuds and saving the dynasty, and in 1648 Charles Emmanuel II. assumed the government. The war between France and Spain continued, and Savoy, on whose territory much of the fighting took place, suffered severely in consequence. By the treaty of the Pyrenees (1669) Savoy regained most of the towns occupied by France.

Victor Amadeus II.—Charles died in 1675 and was succeeded by his only son, Victor Amadeus II. (*q.v.*). The French king's arrogant treatment of Victor Amadeus spurred the latter to join the league of Austria, Spain and Venice against him in 1690. The campaign was carried on with varying success, but usually to the advantage of Louis, and the French victory at Marsiglia and the conduct of the allies induced Victor to come to terms with France (1696). By the treaty of Ryswick a general peace was concluded. In the War of the Spanish Succession (1700) Victor fought on the French side, until, dissatisfied with the continued insolence of Louis XIV. and of Philip of Spain, he went to the Austrians in 1704. The French invaded Piedmont, but were totally defeated at the siege of Turin by Victor Amadeus and Prince Eugene of Savoy (1706), and eventually driven from the country. By the treaty of Utrecht (1713) Victor received the long-coveted Montferrat and was made king of Sicily; but in 1718 the powers obliged him to exchange that kingdom for Sardinia, which conferred on the rulers of Savoy and Piedmont the title subsequently borne by them until they assumed that of kings of Italy. In 1730 he abdicated in favour of his son, Charles Emmanuel.

Charles Emmanuel III.—Charles Emmanuel III. (1730–1773), a born soldier, took part in the War of the Polish Succession on the side of France against Austria, and for his victory at Guastalla (1734) was awarded the duchy of Milan, which, however, he was forced to relinquish at the peace of Vienna (1736), retaining only Novara and Tortona. In the War of the Austrian Succession, which broke out on the death of the Emperor Charles VI., he took the side of Maria Theresa (1742). By the peace of Aix-la-Chapelle in 1748, following on the defeat of the French, Savoy gained some further accessions of territory in Piedmont. The reign of Charles's son, Victor Amadeus III. (1773–1796), was a period of decadence; the king was incapable and extravagant, and he chose equally incapable ministers. On the outbreak of the French Revolution he sided with the royalists and was eventually brought into conflict with the French republic. The army being demoralized and the treasury empty, the kingdom fell an easy prey to the republican forces. Savoy became a French province, and, although the Piedmontese troops resisted bravely for four years in the face of continual defeats, Victor at last gave up the struggle and signed the armistice of Cherasco. On his death in 1796, he was succeeded in turn by his three sons, Charles Emmanuel IV., Victor Emmanuel I. and Charles Felix.

Charles Emmanuel IV.—Charles Emmanuel (1796–1802), believing in Bonaparte's promises, was induced to enter into a confederation with France and give up the citadel of Turin to the French, which meant the end of his country's independence. Realizing his folly he abdicated on Dec. 6, 1796, and retired to Sardinia, while the French occupied the whole of Piedmont. After the defeat of the French by the Austro-Russian armies during Bonaparte's absence in Egypt, Charles Emmanuel landed at Leghorn, hoping to regain his kingdom; but Napoleon returned, and by his brilliant victory at Marengo he reaffirmed his position in Italy. The king retired to Naples, abdicated once more (1802), and entered the Society of Jesus; he died in Rome in 1819. Victor Emmanuel I. (1802–1820) remained in Sardinia until by the Final Act of the Congress of Vienna (June 9, 1815) his dominions were restored to him, with the addition of Genoa.

Italian Allegiance.—From this time the fortunes of the house of Savoy are bound up with those of Italy. (*See* ITALY: *History.*) Victor Emmanuel I. abdicated in 1821 in favour of his brother Charles Felix (1821–1831). The latter being without a son, the succession devolved upon Charles Albert, of the cadet line of the princes of Carignano, who were descended from Thomas, youngest son of Charles Emmanuel I. Charles Albert abdicated, on the evening of his defeat at Novara (April 20, 1849), in favour of his son Victor Emmanuel II. (1849–1878), who on Feb. 18, 1861, was proclaimed king of Italy. Victor

Emmanuel had married in 1842 Maria Adelaide, daughter of the archduke Rainer, who bore him several children, viz., Princess Clothilde (b. 1843), who married Prince Napoleon; Humbert (*q.v.*), who succeeded him; Amadeus, duke of Aosta (b. 1845); Oddone, duke of Montferrat (b. 1846); and Princess Maria Pia (b. 1847). Humbert was succeeded by his only son, Victor Emmanuel III. (*q.v.*).

The second son of Victor Emmanuel II., Amadeus, duke of Aosta, was offered the crown of Spain by the Cortes in 1870, which he accepted, but, finding that his rule was not popular, he abdicated in 1873 rather than cause civil war. In 1867 he married Princess Maria Vittoria dal Pozzo della Cisterna, who bore him three sons, viz., Emmanuel Philibert, duke of Aosta (b. 1869), Victor Emmanuel, count of Turin, and Louis Amadeus, duke of the Abruzzi, an Italian naval officer and a distinguished traveller, explorer and man of science. The first wife of Amadeus, duke of Aosta, having died in 1876, he married Princess Maria Letizia Bonaparte in 1888, who bore him a son, Humbert, count of Salemi (b. in 1889). (L. V.)

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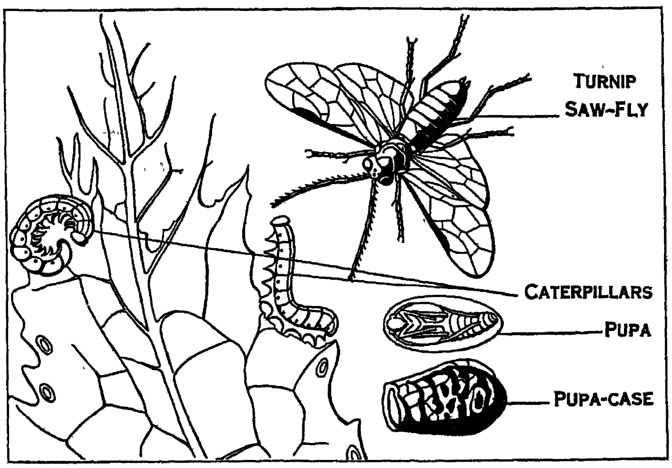
SAWANTWARI: *see* SAVANTVADI.

SAW-FLY, the name given to members of the division Symphyta of the order Hymenoptera (*q.v.*), characterized by the broad base to the abdomen, where it joins the thorax, and by the wing-veins being less reduced than in other members of the order. Their name is derived from the fact that the lower or anterior blades of the ovipositor are toothed and saw-like. Their larvae are usually caterpillars and in most cases may be distinguished from those of moths and butterflies by having six or more pairs of abdominal feet and only a single pair of simple eyes or ocelli. When disturbed they roll themselves in a spiral fashion and some species discharge a thin fluid from glands above the spiracles. The females lay their eggs in incisions in plants, cut by the saw-like blades of the ovipositor, and the larvae are vegetable feeders. Species of several genera, notably *Pontania,* form galls on willows.



THE LIFE HISTORY OF THE TURNIP SAW-FLY (ATHALIA SPINARUM)

The cause of the gall is stated to be a secretion injected along with the egg, and it has been suggested that it contains an enzyme which acts upon the plant so as to induce gall-formation. Reproduction in saw-flies is of considerable interest: in many species males are unknown and parthenogenesis (*q.v.*) is the rule. In the gooseberry saw-fly the unfertilized eggs give rise only to males, while the fertilized eggs produce individuals of both sexes, females predominating.

The true saw-flies belong to the large family *Tenthredinidae* and the larvae of many of these are injurious to plants. Thus, the gooseberry saw-fly, *Nematus ribesii,* is very destructive to that plant and to currants, while the pear slug, *Caliroa limacina,* attacks pears. These two species and also the larch saw-fly, *Lygaeonematus erichsonii,* have been accidentally imported from Europe into North America where they have likewise become destructive. Other harmful species in Europe are *Athalia spinarum,* the turnip saw-fly, and *Lophyrus pini,* which attacks plantations of Scotch firs. The best remedy is to shake off and destroy the young larvae from bushes, where practicable, or to spray with an arsenical wash. The small families *Cephidae* and *Siricidae* have larvae that are borers. The *Cephidae* include the stem saw-flies, and the best-known species is *Cephus pygmaeus,* which attacks wheat. Although seldom causing appreciable injury in Britain it is destructive in North America, where *Janus integer,* the stem-girdler of the currant, is also troublesome. The *Siricidae* bore into solid timber and are known as wood-wasps or horn-tails. *Sirex gigas* is the most familiar European wood-wasp and is not uncommon in Britain. (A. D. I.)

SAWING MACHINES. The saw is one of the most valuable tools, and just as there are many varieties of hand-saws so there are many machines, suited for sawing wood, bone, fibre, stone, marble, slate and metals, and varying in size from little fret-sawing machines to the huge machines which part off steel ingots with a 12 ft. diameter circular saw.

There are three methods of action; the reciprocating blade, cutting one way or both ways, the continuously running blade or band-saw, and the circular saw. Some materials can be cut on any system without making any real difference to the results, but often it happens that one method proves better than another. The shape to be parted off or cut to outline may be difficult or impossible with one sort of blade and easy with another, while size makes a difference in some cases. Thin saws penetrate with less consumption of power, and are the choice if they will cut truly instead of deviating. Moreover, there is less waste of material in the form of dust, an important consideration in the more expensive substances. Yet if a thin saw wanders from a true line it may not be economical, by reason of the fact that the cut surface has to be trued up afterwards with more or less expenditure of time and labour. Wood cutting saws are dealt with under WOODWORKING MACHINERY.

Machines with Reciprocating Blades.—The smallest machines of this class are the *jig-saws,* equivalents of the fret-saws for wood. The work is held upon a horizontal table up through which the saw blade reciprocates, with a stroke variable from zero to three or four inches in the smallest sizes. Dies, metal patterns and templates of intricate outline are sawn out of sheets or blocks. The reciprocation is produced by a belt pulley driving a crank-disc and connecting-rod. Some machines have holders which will grip a file instead of a saw so as to finish outlines smoothly after sawing, and an oil-stone stick or lap may also be used for truing up hardened dies.

A larger type of machine is the power hack-saw, which has a horizontal frame to strain the blade in like a hand hack-saw; it reciprocates the blade with crank and rod over a vice in which the bar or girder to be sawn is clamped. The weight of the frame is sufficient to feed the blade through, and a safety arrangement takes care of the possibility of the blade snapping as it breaks through the bar. Multiple-blade machines cut off a number of discs or slabs simultaneously, and rather big machines are now made for girder sawing. Portable machines are used for sawing tram and railway rails and girders. The hack-saw is a cheap and handy machine for any class of workshop, large or small, and the blades are cheap and quickly replaced. Until recently they were thrown away when worn too dull for efficient cutting, but now tungsten blades of fast cutting capacity can be sharpened many times.

Band-Sawing Machines.—Wide cuts are taken in wood with reciprocating saws that deal with logs, and stone-sawing machines are also built on the same principle; a long table carrying the wood or stone along under the blade, but this is

not suitable for thick metal-cutting. The band-saws cut faster, with better guidance, and the dust is carried away more effectually. These machines are either vertical or horizontal. In the former design the metal is clamped to a horizontal table and the blade runs over a top pulley and down through the work and table to the lower pulley. Straight or curved cuts are controlled by the movements of the table by handles and screws operating slides. Though small machines are occasionally used instead of the jig-saws, most band-saws are of fairly large dimensions, with pulleys from 3 ft. to about 6 ft. in diameter, the latter size admitting slabs or forgings of nearly 6 ft. in depth. The pulleys are covered with rubber tyres to give the grip to the saw, and in cutting iron and steel a soapy water solution has to be pumped on to the blade. This is run through a guide immediately above the surface of the work to assist in true cutting. Horizontal band-saws of large dimensions deal with forgings, fed along by a table as in a planing-machine, and are also very convenient for trimming off the uneven edges of flanged plates, for boiler construction, enabling the caulking to be done properly after riveting together.

Circular Sawing Machines.—These comprise a large group, from little ones to saw bone, fibre, aluminium, brass and copper, to the more powerful types that cut iron and steel. The speeds of rotation of the saws for the soft materials are high, and the feeding can often be effected by hand instead of by slides or levers such as are necessary in steel and iron sawing. Sometimes it is the saw that is fed along by a slide, sometimes the work on a slide instead. The machines which cut girders have a special yielding motion to the feed device: this causes the saw to feed more slowly through the thick sections than through the thin webs, which can naturally be penetrated at a faster rate. The saw is clamped on a spindle with nut and washer for ordinary cutting, but the *flush-side* machines have the saw attached with sunken bolts, so that one side of it is perfectly flat. This provision is essential for iron and steel foundries, to part off the superfluous runners or gates (which feed the molten metal into the mould) flush with the surface.

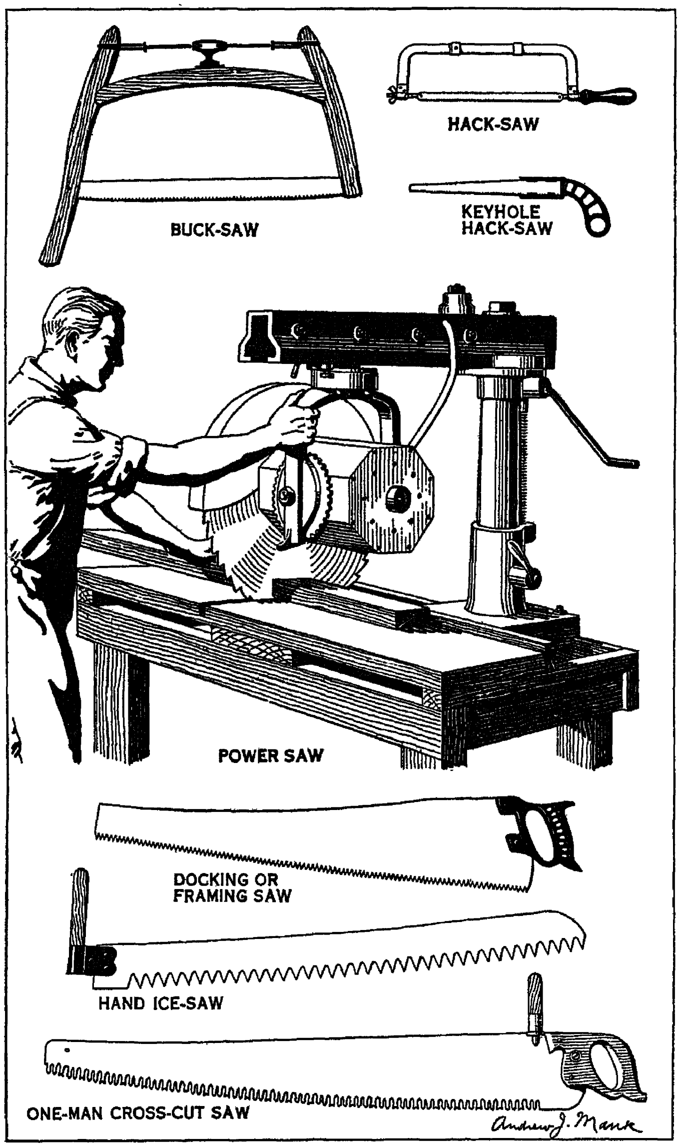
Ordinary saw blades are formed with the teeth cut in the same disc, but the larger blades, especially for steel forging sawing, have inserted teeth, each held in with a wedge and screw fastening, so that any breakages can be made good cheaply and quickly. The largest blades cut armour-plate and ingots, also pieces out of big crankshaft forgings to form the webs. Duplex blades, running side by side at the appropriate distance apart halve the time of cutting out such slabs.

In the iron and steel works hot metal during forging or rolling operations is parted by a special sort of machine, the *hot saw,* that cuts at a fast rate. The large machines act on the pendulum principle, the blade being run in bearings at the bottom end of a deep swing frame which is pushed across by hydraulic or pneumatic cylinder to pass the saw through the hot metal, resting on a slideway beneath. The speed of revolution is high, and large horse-power is consumed.

Friction Sawing Machines.—These are peculiar inasmuch as the circular blade has no cutting teeth, but is driven at so high a speed that the friction generates such heat in the immediate vicinity that the metal is burned through. For instance a railway rail of 90 lb. per yard can be parted off in 7 seconds, or a channel section of 12 in. by 6 in. with $\frac{3}{4}$ in. thick metal in 14 seconds, leaving a clean smooth finish. Some assistance is given to the action if the blade is very slightly notched around the periphery, though not like the true teeth of a saw. (F. H.)

SAW-MILL, strictly, a mill in which logs are "broken down" into balks, deals, flitches, battens, planks and boards for sale or further treatment. But often the word is applied to a mill the plant of which includes planing, moulding, tenoning and other machines for finishing processes. The biggest mills are usually situated near a timber supply, brought by river or rail, and the design of the mill is in some degree affected by the mode of transit. More space is necessary for storage in the rail-borne example. In the water-borne system the logs float right into the mill and are dragged out in turn by a winch. An overhead crane serves the stock-yard in the rail system, and carries the logs on to the machines.

The cutting is performed on various kinds of big machines, a preliminary operation often being that of cross-cutting to obtain convenient lengths. Cutting up into the various thicknesses is done by either reciprocating or band-saws, or circular saws, the log being held with dogs on a table which feeds it past the saw. Some band-sawing machines are of horizontal design, some vertical, the latter taking up less floor-space. The log-frame is a machine with a set of vertically reciprocating blades, suitably spaced apart, and it divides a log into boards at one pass of the table. The number of blades may be few, not exceeding four in some cases for cutting thick pieces, or as many as fifty for thin boards. Re-sawing machines are those for further dealing with material partly broken up, such as flitches and deals. The great quantity of sawdust and chips from the machines is neatly disposed of by pneumatic ducts ending in the boiler house, on the system mentioned in FANS.



POWER SAW BY COURTESY OF THE DE WALT PRODUCTS CO.; OTHERS BY COURTESY OF THE SIMONDS SAW AND STEEL CO.

TYPES OF SAWS WITH A MOTOR-DRIVEN WOODWORKER SAW IN THE CENTRE

SAWS, cutting-tools with toothed edges. The various types of saw may be classified into reciprocating, revolving, and travelling, *i.e.,* band-saws passing around wheels. The first class includes numerous hand- and machine-operated blades, some cutting only on the one stroke, others cutting both backwards and forwards. The second class covers the circular saws for wood,

bone, ivory and metal; the largest of the third class are made up to about 12 ft. in diameter. Large band-saws are used for cutting up big forgings into various outlines. Some saws have the teeth milled or punched out of the solid plate or web; others have teeth fastened in with wedges, so that they are easily replaced in case of fracture, besides being easier to make and temper. What are termed *friction saws* have either no teeth or but slight notches on the periphery, and they will cut through iron and steel owing to the heat generated by the friction at the great speed of rotation. Diamond saws have a large number of diamonds fixed in pockets on the rim and are employed for stone sawing. The principal difficulties with saws are clearance in the "kerf," which depends on the "set" or side projection of the teeth beyond the web or plate of the saw; and true cutting, which depends partly on guidance and partly on the truth of the blade. Circular saws for wood are hammered to make a "tension," so that although the saw does not lie true while at rest, its rim runs perfectly true at the appropriate speed for which it has been tensioned.

Saws date from Neolithic times, when they were formed from flint flakes with finely jagged edges; they were followed by metal saws made in bronze or copper. Now steel is employed exclusively, some for sawing wood being tempered soft enough to be sharpened with a file, while those for cutting metal can only be sharpened with a grinding wheel. The fineness or coarseness of teeth varies greatly, according to the class of sawing. So do the shapes of teeth, some pointing forward with straight or curved edges, others of equal angles and many of special *M* shapes for heavy cross-cutting of lumber. The most elaborate teeth have "cleaner" teeth interspaced so as to scrape out the sawdust and clean the kerf neatly. In the larger circular saws the inserted class of teeth is very common. These are held in pockets around the disc with a *V* fastening and a springy holder, or with a wedge fixing. (*See* WOODWORKING MACHINERY; MACHINE TOOLS.)

SAWTREY, WILLIAM (d. 1401), English Lollard, was a priest at Lynn who was summoned before the bishop of Norwich for heresy in 1399. He was the first Lollard martyr, being burned at St. Paul's Cross in March 1401.

SAX, ANTOINE JOSEPH, known as ADOLPHE (1814–1894), maker of musical instruments, was born at Dinant in Belgium on Nov. 6, 1814, and died in Paris in 1894. In 1835 he perfected a bass clarinet superior to any that had preceded it. He went to Paris in 1842, and set up a workshop in the Rue St. Georges. Sax discovered a new principle in the manufacture of wind instruments, viz., that it is the proportions given to a column of air vibrating in a sonorous tube, and these alone, that determine the character of the timbre produced: the material of the walls of the tube is not of the slightest importance so long as it offers enough resistance. In 1845 he patented his saxhorn and a family of cylinder instruments called saxotrombas. On June 22, 1846 he registered the saxophone. He also effected various improvements in piston instruments, of which the most important was the substitution of a single ascending piston for a number of descending ones.

See J. P. O. Cornettant, *Histoire d'un inventeur* (1860); C. Pilard, *Les Inventions Sax* (1869).

SAXA RUBRA, also called AD RUBRAS (rupes, *i.e.*, the red tufa cliffs) a post-station on the ancient Via Flaminia, 9m. north of Rome. The modern hamlet of Prima Porta takes its name from the remains of a brick arch, perhaps of Constantine period. It was the site of the defeat of Maxentius by Constantine in A.D. 312 in the decisive battle which sealed the triumph of Christianity (*see* CONSTANTINE I.). This is often known as the battle of the Milvian bridge, from the fact that Maxentius and many of his routed troops were drowned there. That Constantine's headquarters were at Malborghetto has been proved by Toebelmann.

See F. Toebelmann, *Der Bogen von Malborghetto* (Heidelberg, Akademie der Wissenschaften, Abhandlung, philosophisch-historische Klasse, 1915); T. Ashby and R. A. L. Fell in *Journal of Roman Studies XI.* (1921); G. Lugli in Bollettino Communale (1923); T. Ashby, *The Roman Campagna in Classical Times*, chap. xii. (1927).

SAXE, JOHN GODFREY (1816–1887), American poet, humorist and editor, was born at Highgate, Vt., June 2, 1816. He was best known as a writer of humorous verse and a lecturer. Some of his lyrics have genuine feeling as well as grace. His "Rhyme of the Rail," "The Proud Miss McBride," "I'm Growing Old" and "Treasures in Heaven" were once very popular. Among his published collections are *Humorous and Satirical Poems* (1850), *The Times, The Telegraph, and other Poems* (1865), and *Leisure Day Rhymes* (1875). He died at Albany, N. Y., March 31, 1887.

SAXE, MAURICE, COMTE DE (1696–1750), marshal of France, was the natural son of Augustus II. of Saxony and the countess Aurora Königsmarck. In 1698 the countess sent him to Warsaw to his father, who had been elected king of Poland in the previous year, but on account of the unsettled condition of the country the greater part of his youth was spent outside its limits. He served under Prince Eugène in the Netherlands, and under Peter the Great against the Swedes. After receiving in 1711 formal recognition from his father, with the rank of count, he accompanied him to Pomerania, and in 1712 he took part in the siege of Stralsund. In manhood he bore a strong resemblance to his father, both in person and character. His grasp was so powerful that he could bend a horse-shoe with his hand, and to the last his energy and endurance were scarcely subdued by the illnesses resulting from his many excesses. In 1714 he married a rich wife, Johanna Victoria, countess von Loeben, but he dissipated her fortune so rapidly that he was soon heavily in debt, and the marriage was annulled in 1721. Meantime, after serving in a campaign against the Turks in 1717, he had in 1719 gone to Paris, to study mathematics, and in 1720 obtained a commission as *maréchal de camp*. In 1725 negotiations were entered into for his election as duke of Courland, at the instance of the duchess Anna Ivanovna, who offered him her hand. He was chosen duke in 1726, but declining marriage with the duchess found it impossible to resist her opposition to his claims, although, with the assistance of £30,000 lent him by the French actress Adrienne Lecouvreur, he raised a force by which he maintained his authority till 1727, when he withdrew and took up his residence in Paris. On the outbreak of the war in 1734 he served under Marshal Berwick, and for a brilliant exploit at the siege at Philippsburg he was in August named lieutenant-general. On the opening of the Austrian Succession War in 1741, he took command of a division of the army sent to invade Austria, and on Nov. 19 surprised Prague during the night, and took it by assault before the garrison were aware of the presence of an enemy. After capturing the fortress of Eger on April 19, 1742, he received leave of absence, and went to Russia to push his claims on the duchy of Courland, but obtaining no success he returned to his command. His exploits had been the sole redeeming feature in an unsuccessful campaign, and on March 26, 1743, he was promoted to be marshal of France.

Marshal Saxe was now one of the first generals of the age. In 1744 he was chosen to command the expedition to England on behalf of the Pretender, which assembled at Dunkirk but did not proceed farther. After its abortive issue he received an independent command in the Netherlands, and by dexterous manoeuvring succeeded in continually harassing the superior forces of the enemy without risking a decisive battle. In the following year he besieged Tournai and inflicted a severe defeat on the relieving army of the duke of Cumberland at Fontenoy (*q.v.*). Thenceforward to the end of the war he continued to command in the Netherlands, always with success. Besides Fontenoy he added Rocoux (1746) and Lawfeldt or Val (1747) to the list of French victories, and it was under his orders that Marshal Löwendahl captured Bergen-op-Zoom. He himself won the last success of the war in capturing Maestricht in 1748. In 1747 the title formerly held by Turenne, "Marshal general of the King's camps and armies," was revived for him. But on Nov. 30, 1750, he died at Chambord.

In 1748 there had been born to him a daughter, one of several illegitimate children, whose granddaughter was George Sand. Saxe was the author of a remarkable work on the art of war, *Mes Rêveries*, which though described by Carlyle as "a strange military farrago, dictated, as I should think, under opium," is in fact a classic. It was published posthumously in 1757 (ed

Paris, 1877).

BIBLIOGRAPHY.—Saxe's *Lettres et mémoires choisis* appeared in 1794. *See* C. von Weber, *Moritz Graf von Sachsen, Marschall von Frankreich* (Leipzig, 1863); St. René Taillandier, *Maurice de Saxe, étude historique d'après les documents des archives de Dresde* (1865); and C. F. Vitzthum, *Maurice de Saxe* (Leipzig, 1861); also H. Pichat, *La Campagne du Maréchal de Saxe dans les Flanders . . . Suivie d'une correspondence inédite de Maurice de Saxe pendant cette campagne* (1909), which contains a full bibliography.

SAXE-ALTENBURG. The district later forming the duchy of Saxe-Altenburg came into the possession of the margrave of Meissen about 1329, and later with Meissen formed part of the electorate of Saxony. In 1603 Saxe-Altenburg was made into a separate duchy, but this only lasted until 1672. In 1825 it again became a separate duchy under Frederick, previously Duke of Saxe-Hildburghausen. His family's reign was terminated by the German revolution of 1918.

SAXE-COBURG-GOTHA, formerly a sovereign duchy of Germany and a constituent member of the German empire, and since 1918 amalgamated into Thuringia. (*See* THURINGIA and BAVARIA.)

History.—The district of Coburg came into the possession of the family of Wettin in the 14th century, and after the Wettins had become electors of Saxony this part of their lands fell at the partition of 1485 to the Ernestine branch of the house. From that time onwards Coburg, Gotha and Saalfeld were frequently partitioned and repartitioned until 1826, when Ernest, duke of Saxe-Coburg-Saalfeld, exchanged Saalfeld for Gotha, took the title of duke of Saxe-Coburg-Gotha and became the founder of the house which ruled until the revolution of 1918. On the death of Ernest II. in 1893 the succession passed to the children of his brother Albert, the English prince consort, whose son Prince Alfred reigned from 1893 to 1900, and was succeeded by his nephew Charles Edward, duke of Albany, the last reigning duke.

SAXE-MEININGEN, a former grand duchy of Germany, and since 1918 amalgamated into Thuringia (*q.v.*).

History.—The Duchy of Saxe-Meiningen, or more correctly Saxe-Meiningen-Hildburghausen, was founded in 1681 by Bernard, the third son of Ernest the Pious, duke of Saxe-Gotha, and consisted originally of the western part of the later duchy, the district around Meiningen.

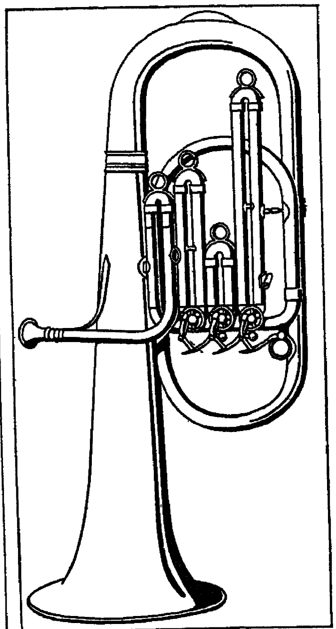
By the rearrangement of the Saxon duchies in 1826, Saxe-Meiningen benefited greatly, its area being more than doubled by the receipt of 530sq.m. of territory. The additions consisted of the duchy of Saxe-Hildburghausen, the duchy of Saxe-Saalfeld, which had been united with Saxe-Coburg in 1735; and the districts of Themar, Kranichfeld and Kamburg. Saxe-Meiningen became a member of the new German empire in 1871. In 1918 the ruling family lost its power in the general revolution.

SAXE-WEIMAR-EISENACH, formerly a grand duchy of Germany and a sovereign and constituent State of the German empire, and since 1918 amalgamated into Thuringia (*q.v.*).

History.—In early times Weimar and district belonged to the counts of Orlamünde, and from the end of the 10th century until 1067 it was the seat of the counts of Weimar. In the 14th century it passed to the elector of Saxony, falling at the partition of 1485 to the Ernestine branch of the Wettin family. It was not until 1641 that Saxe-Weimar emerged into an independent historical position. In this year, having just inherited Coburg and Eisenach, the three brothers William, Albert, and Ernest founded the three principalities of Saxe-Weimar, Saxe-Eisenach, and Saxe-Gotha. Eisenach fell to Saxe-Weimar in 1644, and although the enlarged principality of Saxe-Weimar-Eisenach was temporarily split up into the lines Saxe-Weimar, Saxe-Eisenach, and Saxe-Jena, it was again united under Ernest Augustus, who began to reign in 1728. The reign of Charles Augustus, who assumed the government in 1775, is the most brilliant in the history of Saxe-Weimar. An intelligent patron of literature and art, he attracted to his court the leading scholars in Germany; Goethe, Schiller, and Herder were members of this illustrious band, and the little state attracted the eyes of all Europe.

The Congress of Vienna in 1815 added about 660sq.m. to its area and gave its ruler the title of grand-duke. Charles Augustus was the first German sovereign to give a constitution to his state under Article XIII. of the Federal Act. Freedom of the press being secured under its constitution, Weimar became a focus of liberal agitation, which drew down upon the grand-duke the wrath of the reactionary powers (*see* GERMANY, *History*). He was thus forced to curtail some of the liberties granted. In 1866 the grand-duchy joined Prussia against Austria and afterwards entered the North German Confederation and the new German empire. In 1919 the grand-duchy was absorbed in the new republican state of Thuringia, of which Weimar became the capital.

SAXHORN, the generic name of a family of brass wind instruments (not horns but valve-bugles) with cup-shaped mouthpieces, invented by Adolphe Sax and in use chiefly in French and Belgian military bands and in small wind-bands. The saxhorns came into being in 1843, when Sax applied a modification of the valve system, invented in Germany in 1815, to the keyed bugle. The saxhorn consists of a conical tube of a calibre greater than that of French horn and trumpet, but smaller than that of the tubas or bombardons, and capable therefore of producing by overblowing the members of the harmonic series from the 2nd to the 8th, in common with the cornets, bugles, valve-trombones and the Wagner tubas. The saxhorns are furnished with three valves, by means of which the compass is rendered chromatic, and which lower the pitch as in other valve instruments. The difference between saxhorns and bombardons or tubas consists in the calibre of the bore, which in the latter is sufficiently wide in proportion to the length to produce the fundamental note of the harmonic series an octave below the lowest note of the saxhorns.



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THE SAXHORN (A MODIFICATION OF THE KEYED BUGLE) INVENTED BY ADOLPHE SAX IN 1843

SAXIFRAGACEAE, in botany, a small family of dicotyledons belonging to the sub-class Archichlamydeae and the cohort Rosales. There are ninety genera with about 750 species distributed through the Arctic and north temperate zone, often alpine. It is represented in Britain by its largest genus *Saxifraga* (*see* SAXIFRAGE), *Chrysosplenium* (golden saxifrage) and *Parnassia* (grass of Parnassus). The plants are herbs, generally with scattered exstipulate leaves with a broad leaf-base. The small flowers are generally arranged in cymose inflorescences and are bisexual, regular and hypogynous, perigynous or more frequently more or less epigynous, this variation in the relative position of the ovary occurring in one and the same genus *Saxifraga*. The free stamens are obdiplostemonous, *i.e.*, those of the outer whorl are opposite to the petals, and two carpels. The carpels are sometimes free, more generally united at the base, or sometimes completely joined to form a one- or two-chambered ovary with two free styles. The fruit is a many-seeded capsule.

Nearly half the species (350) are contained in the genus *Saxifraga*. *Chrysosplenium*, with 45 species, two of which are British, has a very similar distribution. The North American genus *Heuchera* has sometimes apetalous flowers. *Astilbe* has 20 species in temperate Asia and north-eastern North America; *A. japonica* is commonly grown in the spring as a pot-plant, and often misnamed Spiraea.

The family is now extended to include other groups of genera differing in habit and more or less in general conformation from those referred to. Among these is the genus *Ribes*, to which belong the gooseberry (*R. Grossularia*) and currants of gardens. These are shrubs with racemes of flowers which have only one whorl of

stamens (isostemonous), an inferior unilocular ovary with two parietal placentas, and fruit a berry. Other genera are *Hydrangea* (*q.v.*), *Deutzia* and *Philadelphus*, all well-known garden plants; *P. coronarius* is the so-called syringa or mock-orange. They are shrubs or trees with simple generally opposite leaves, pentamerous flowers with epigynous stamens and a tri- to pentalocular ovary. *Escallonia*, which represents a small group of genera with leathery gland-dotted leaves, is also included.

In North America, *Saxifraga* is represented by about 30 species, the other prominent genera being *Ribes* (currant and gooseberry) with 20 species, and *Heuchera* (alum root) with 10 species.

For further details *see* F. Engler and A. Prantl, *Die Natürlichen Pflanzenfamilien* (Leipzig, 1887–1908); A. B. Rendle, *Classification of Flowering Plants* (Cambridge, 1925).

SAXIFRAGE (*Saxifraga*), a genus of plants which gives its name to the family (Saxifragaceae) of which it is a member. There are about 350 species distributed in the temperate and Arctic parts of the northern hemisphere, frequently at considerable heights on the mountains, and also found on the Andes. They are mostly herbs, native to mountains and rocky places, with perennial rootstocks and leaves in tufts or scattered on the flower-stalks. The arrangement of the flowers is very various, as also are the size and colour of the flowers themselves. Thirteen species are natives of Britain, some alpine plants of great beauty (*S. oppositifolia, S. nivalis, S. aizoides*, etc.), and others, like *S. granulata*, frequenting meadows and low ground, while *S. tridactylites* may be found on almost any dry wall. *S. umbrosa* is London pride or St. Patrick's cabbage, a common garden plant, a native of the Spanish peninsula and also of the mountains of west and south-west Ireland. Some 70 species occur in North America, most numerously in the Rocky Mountain region. Well-known species are the early saxifrage (*S. virginiensis*) and the swamp saxifrage (*S. pennsylvanica*), of the eastern United States and Canada, and the tufted saxifrage (*S. caespitosa*), found on rocks in mountains across the continent. Many species are in cultivation, including the numerous alpine species, such as *S. pyramidalis, S. cotyledon*, etc., with tall panicles studded with white flowers, and others, many adapted for rockwork. The strawberry-geranium (*S. sarmentosa*) is an old conservatory and window plant.

SAXO GRAMMATICUS (*c.* 1150–*c.* 1206), Danish historian and poet, belonging to a family of warriors, his father and grandfather having served under Valdemar I., king of Denmark (d. 1182). Saxo was in the service of Archbishop Absalon from about 1182 to 1201. At the archbishop's suggestion he began, about 1185, to write the history of the Danish Christian kings from the time of Sweyn Astridson (d. 1076), but later Absalon prevailed on him to write also the history of the earlier heathen times, and to combine both into a great work, *Gesta Danorum*, or *Historia Danica*. The archbishop died before the work was finished, and therefore the preface, written about 1208, dedicates the work to his successor Archbishop Andreas, and to King Valdemar II. Nothing else is known about Saxo's life and person; a chronicle of 1265 calls him "mirae et urbanae eloquentiae clericus"; and an epitome of his work from about 1340 describes him as "egregius grammaticus, origine Sialandicus."

The surname of "Grammaticus" is probably of later origin, scarcely earlier than 1500, apparently owing to a mistake. The title of "provost of Röskilde," given him in the 16th century, is also probably incorrect, the historian being confounded with an older contemporary, the provost of the same name. Saxo, from his apprenticeship as the archbishop's secretary, had acquired a brilliant but somewhat euphuistic Latin style, and wrote fine Latin verses, but otherwise he does not seem to have had any very great learning or extensive reading. His models of style were Valerius Maximus, Justin and Martianus Capella, especially the last. Occasionally he mentions Bede, Dudo of St. Quentin and Paulus Diaconus, but he does not seem to have studied them or any other historical works thoroughly. His sources are partly Danish traditions and songs, partly the statements of Archbishop Absalon, partly the accounts of Icelanders and, lastly, some few earlier sources, lists of Danish kings and short chronicles, which furnished him with some reliable chronological facts. His work is a loose series of biographies of Danish kings and heroes.

The first nine books of the *Gesta Danorum* comprise traditions of kings and heroes of the half-mythical time up to about 950. Here we have traditions about Fredfrode, about Amleth (Hamlet) and Fenge, about Hrolfr Kraki, Hadding, the giant Starkather, Harald Hildetann and Ragnarr Lodbrok. In this earlier history Saxo has also embodied myths of national gods who in tradition had become Danish kings, for instance, Balder and Hother, and of foreign heroes, likewise incorporated in Danish history, as the Gothic Jarmunrik (A.S. Eormenríc), the Anglian Vermund (A.S. Gármund) and Uffe (A.S. Offa), the German Hedin and Hild and others. Frequently the narrative is interrupted by translations of poems, which Saxo has used as authentic sources, although they are often only a few generations older than himself. In the later books (x.–xvi.) of his work he follows to a greater extent historical accounts, and the more he approaches his own time the fuller and the more trustworthy his relation becomes; especially brilliant is his treatment of the history of King Valdemar and of Absalon. But his patriotism and want of critical sense often blind him to the historical truth.

Saxo's work was published for the first time, from a ms. afterwards lost, in Paris, 1514, by the Danish humanist Christiern Pedersen; this edition was reprinted at Basel, 1534, and at Frankfort, 1576. The last complete edition is that of Alfred Holder (Strassburg, 1886). There is an English translation by O. Elton and F. Y. Powell (London, 1894). There is a later edition of the first nine books of Saxo's works, *Saxo Grammaticus: Die ersten neun Bücher der dänischen Geschichte* (ed. H. Jantzen, 1899–1900); and a commentary and German trans., P. Hermann, *Erläuterungen zu den ersten neun Büchern der dänischen Geschichte des Saxo Grammaticus* (1901–02). There is also a new Danish edition, *Sakses Danesaga* (ed. J. Olick, 1925), and a Danish study of Saxo's life and work, S. C. Larsen, *Saxo Grammaticus, hans Verk og Person* (1925).

SAXONS, a Teutonic people mentioned for the first time by Ptolemy about the middle of the 2nd century. At that time they are said to have inhabited the neck of the Cimbric peninsula, by which we have probably to understand the modern province of Schleswig, together with three islands lying off its western coast. We next hear of them in connection with piratical expeditions in the North sea about the year 286. These raids became more frequent during the 4th century, and at the beginning of the 5th century the northern coast of Gaul and the south-east coast of Britain were known at *litora Saxonica*. During the same period the Saxons appear to have conquered a considerable portion of north-west Germany. According to their own traditions they landed at Hadeln in the neighbourhood of Cuxhaven and seized the surrounding districts from the Thuringians. By the middle of the 4th century they had advanced westwards into the basin of the Ysel, and in the following centuries we find them in possession of the whole of the basin of the Ems, except the coast district, while that of the Weser with all its tributaries belonged to them as far south as the Diemel, where they bordered on the Hessian Franks, the ancient Chatti. The conquest of the Boructuari who dwelt between the Lippe and the Ruhr marks the extent of their progress towards the south-west. This took place shortly before the end of the 7th century. They frequently came into conflict with the Franks and on several occasions had to submit to their supremacy. No thorough conquest was, however, carried until the time of Charlemagne, who, between the years 772 and 785, annexed the whole region as far as the Elbe, destroying in 772 the Irminsul, their great sanctuary, near Marsberg on the Diemel. Up to this time they had remained entirely heathen. At the beginning of the following century Charlemagne also conquered the Saxons known as Nordalbingi in western Holstein, a district which had perhaps been occupied by a southward movement from the original home of the tribe.

It is doubtful how far the Saxons who invaded Britain were really distinct from the Angli, for all their affinities both in language and custom are with the latter and not with the Saxons (Old Saxons) of the Continent. During the 5th century we hear also of Saxon settlements on the coasts of Gaul. The most important were those at the mouth of the Loire founded in the time of Childeric, Clovis's father, and at Bayeux, in a district which remained in their possession until towards the close of the 6th century. From the 6th century onwards, however, we hear practically

nothing of the Saxons as a seafaring people. Almost all the southern coast of the North sea had now come into the possession of the Frisians, and one can hardly help concluding that most of the maritime Saxons had either voluntarily or by conquest become incorporated in that kingdom.

See Ptolemy ii. 11; Eutropius ix. 21; Zosimus iii. 6; Ammianus Marcellinus xxvi. 4. 5, xxvii. 8. 5, xxviii. 2. 12, 7. 8, xxx. 5. 1 and 4; *Notitia dignitatum;* Gregory of Tours, *Historia Francorum,* ii. 19, iv. 10. 14, v. 27, x. 9; Bede, *Hist. Eccl.* v. 10 *seq.; Annales Einhardi; Translatio S. Alexandri;* Hucbald, *Vita S. Lebuini;* Widukind, *Res Gestae Saxonicae,* i. 1 ff. (F. G. M. B.)

SAXONY, a republic of Germany, ranking among the constituent states of the German Reich fifth in area and third in population, bounded on the south by Czechoslovakia, on the west by Bavaria and Thuringia and on the west, north and east by Prussia. Its frontiers have a circuit of 760 m. and, with the exception of some small exclaves and enclaves, it forms a compact whole of a triangular shape, its base extending from north-east to south-west, and its apex pointing north-west. Its greatest length is 130 m.; greatest breadth 93 m., and total area 5,787 sq.m.

Physical Features.—Saxony belongs almost entirely to the central mountain region of Germany, only the districts along the north border and around Leipzig descending into the great north-European plain. The chief mountain range is the Erzgebirge, stretching for 90 m. along the south border, and reaching in the Fichtelberg (3,979 ft. and 3,953 ft.) the highest elevation in the country. The west and south-west is occupied by ramifications and subsidiary groups of this range, such as the Central Saxon chain, and the Oschatz group. The south-east angle of Saxony is occupied by the mountains of Upper Lusatia (highest summit 2,600 ft.). North-west from this group, and along both banks of the Elbe, which divides it from the Erzgebirge, extends the picturesque Saxon Switzerland. The action of water and ice upon the soft sandstone of which the hills here are chiefly composed has produced deep gorges and isolated fantastic peaks, but the highest summit attains a height of only 1,830 ft.; the more interesting peaks, as the Lilienstein, Königstein and the Bastei, are lower. Saxony lies almost wholly in the basin of the Elbe, which has a navigable course of 72 m. from south-east to north-west. The Mulde, formed of two branches, is the second river of Saxony; others are the Black Elster, the White Elster, the Pleisse and the Spree, all part of the Elbe system. There are no lakes of any size. The best known of many mineral springs is at Bad Elster in the Vogtland.

Climate.—The climate is mildest in the valleys of the Elbe, Mulde and Pleisse and severest in the Erzgebirge. The average temperature varies from 48° to 50°. The Erzgebirge is the rainiest district, 27½ to 33½ in. falling yearly; the amount decreases as one proceeds northward, and Leipzig, with an average annual rainfall of 17 in., enjoys the driest climate.

Population.—In 1925 the population of Saxony was 4,970,301, or 858·8 per square mile. Except the free towns, Saxony is the most densely peopled member of the German Republic. The growth of the population since 1815, when Saxony received its present limits, has been as follows: (1815) 1,178,802; (1830) 1,402,066; (1840) 1,706,275; (1864) 2,344,094; (1875) 2,760,586; (1895) 3,787,688; (1905) 4,508,601. The preponderating industrial activity fosters the tendency of the population to concentrate in towns, and no German state, with the exception of the Hanseatic towns, has so large a proportion of urban population. The people of Saxony are chiefly of pure Teutonic stock; a proportion are Germanized Slavs, and to the south of Bautzen there is a large settlement of Wends, who retain their language.

The chief towns are Dresden (pop. 1925, 608,025), Leipzig (660,140), Chemnitz (323,153), Plauen (109,953), Zwickau (71,826), Zittau (40,387), Meissen (41,800), Freiberg (34,146), Bautzen (44,000), Meerane (23,421), Glauchau (25,502), Reichenbach (30,394), Krimmitzschau (27,253), Werdau (21,140), Pirna (30,237).

Communications.—The roads in Saxony are numerous and good, and there are over 2,119 m. of railway. The only navigable river is the Elbe.

Agriculture.—Saxony is one of the most fertile parts of Germany, and is highly developed agriculturally. Fertility diminishes as we ascend towards the south, until on the bleak crest of the Erzgebirge cultivation ceases. In 1834 a law was passed providing for the union of the scattered lands belonging to each proprietor, and that may be considered the dawn of modern Saxon agriculture. The richest grain districts are near Meissen, Grimma, Bautzen, Döbeln and Pirna. The chief crop is rye, but oats are hardly second to it. Wheat and barley are grown in considerably less quantity. Very large quantities of potatoes are grown, especially in the Vogtland. Beet is also grown extensively. Flax is grown in the Erzgebirge and Lusatian mountains, where the manufacture of linen was at one time a flourishing domestic industry. Enormous quantities of cherries, plums and apples are annually borne by the trees round Leipzig, Dresden and Colditz. The Saxon vineyards, chiefly on the banks of the Elbe near Meissen and Dresden, have passed through difficult times of late years, owing to the ravages of the phylloxera.

Live Stock.—Cattle rearing, which has been an industry since the advent of the Wends in the 6th century, is important on the extensive pastures of the Erzgebirge and in the Vogtland. In 1765 the regent Prince Xaver imported 300 merino sheep from Spain, and so improved the native breed by this new strain that Saxon sheep were eagerly imported by foreign nations to improve their flocks, and "Saxon electoral wool" became one of the best brands in the market. Sheep farming, however, has considerably declined within the last few decades. Swine furnish a very large proportion of the flesh diet of the people. Geese abound particularly round Leipzig and in Upper Lusatia, poultry about Bautzen.

Forests.—The forests of Saxony are extensive and have long been well cared for both by government and by private proprietors. The famous school of forestry at Tharandt was founded in 1811. The Vogtland is the most densely wooded portion of Saxony, and next comes the Erzgebirge.

Mining.—Silver was raised in the 12th century, and argentiferous lead is still the most valuable ore mined; tin, iron and cobalt rank next, and coal is one of the chief exports. Copper, zinc and bismuth are also worked. The country is divided into four mining districts: Freiberg, where silver and lead are the chief products; Altenberg, where tin is mainly raised; Schneeberg, yielding cobalt, nickel and ironstone; and Johanngeorgenstadt, with ironstone and silver mines. The coal is found principally in two fields—one near Zwickau, and the other in the governmental district of Dresden. Brown coal or lignite is found chiefly in the north and north-west. Peat is especially abundant on the Erzgebirge. Immense quantities of bricks are made all over the country. Excellent sandstone for building is found on the hills of the Elbe. Fine porcelain clay occurs near Meissen, and coarser varieties elsewhere.

Industries.—The central-European position of Saxony has fostered its commerce; and its manufactures have been encouraged by the abundant water-power throughout the country. Nearly one-half of the motive power used in Saxon factories is supplied by the streams, of which the Mulde, in this respect, is the chief. The early foundation of the Leipzig fairs, and the enlightened policy of the rulers of the country, have also done much to develop its commercial and industrial resources. The manufacture of textiles is carried on at Zwickau, Chemnitz, Glauchau, Meerane, Hohenstein, Kamenz, Pulsnitz and Bischofswerda. The centre of the cotton manufacture (especially of cotton hosiery) is Chemnitz; cotton-muslins are made throughout the Vogtland, ribbons at Pulsnitz and its neighbourhood. Woollen cloth and buckskin are woven at Kamenz, Bischofswerda and Grossenhain, all in the north-east, woollen and half-woollen underclothing at Chemnitz, Glauchau, Meerane and Reichenbach; while Bautzen and Limbach produce woollen stockings. Linen is manufactured chiefly in the mountains of Lusatia, where the looms are still to some extent found in the homes of the weavers. Damask is produced at Gross-Schönau and other places. Lace-making, discovered or introduced by Barbara Uttmann in the latter half of the 16th century, and now fostered by government schools, was long an important domestic industry among the villages of the Erzgebirge, and has attained to a great industry

in Plauen. Straw-plaiting is carried on by the inhabitants of the mountain slopes between Gottleuba and Lockwitz. Waxcloth is manufactured at Leipzig, and artificial flowers at Leipzig and Dresden. Stoneware and earthenware are made at Chemnitz, Zwickau, Bautzen and Meissen, porcelain ("Dresden china") at Meissen, chemicals in and near Leipzig. Döbeln, Werdau and Lossnitz are the chief seats of the Saxon leather trade; cigars are very extensively made in the town and district of Leipzig, and hats and pianofortes at Leipzig, Dresden and Chemnitz. Paper is made chiefly in the west of Saxony. Machinery of all kinds is produced, from the sewing-machines of Dresden to the steam-locomotives and marine-engines of Chemnitz. The last-named place, though the centre of the iron-manufacture of Saxony, has to import every pound of iron by railway. The leading branch is the machinery used in the industries of the country—mining, paper-making and weaving. The very large printing trade of Leipzig encourages the manufacture of printing-presses in that city. In 1925–26 Saxony contained 144 active breweries. The smelting and refining of the metal ores is also an important industry.

The principal exports are wool, woollen, cotton, linen goods, machinery, china, pianofortes, cigarettes, flannels, stockings, curtains and lace, cloth from Reichenbach and Zittau, watches of superlative value from Glashütte and toys from the Vogtland.

Constitution.—The Constitution of the Republic of Saxony dates from Nov. 1, 1920. The Landtag consists of 96 members.

For administrative purposes Saxony is divided into five Kreishauptmannschaften, or governmental departments, centring in the cities of Dresden, Leipzig, Chemnitz, Bautzen and Zwickau respectively. The Oberlandesgericht has its seat at Dresden, and the Reichsgericht—the supreme court of law for the whole German Reich—at Leipzig.

Church.—The great majority of the inhabitants of Saxony are Protestants. The government of the Evangelical-Lutheran Church is vested in the Evangelical Consistory at Dresden. Its representative assembly consisting of 40 clergymen and 46 lay members (1923) is called a synod (*Synode*). The Moravian Brethren have their chief seat at Herrnhut.

Education.—Of the four universities founded by the Saxon electors at Leipzig, Jena, Wittenberg, later transferred to Halle, and Erfurt, now extinct, only the first is included in the present Republic of Saxony. There are famous endowed schools (Fürstenschulen) at Meissen and Grimma. Saxony is particularly well-equipped with technical schools, the textile industries being especially fostered by numerous schools of weaving, embroidery and lace-making; but the mining academy at Freiberg and the school of forestry at Tharandt are probably the most widely known. The conservatory of music at Leipzig and the art collections at Dresden have a world-wide reputation.

HISTORY

The name Saxony has been borne by two distinct blocks of territory. The first was the district in the north-west of Germany, inhabited originally by the Saxons, which became a duchy and attained its greatest size and prosperity under Henry the Lion in the 12th century. In 1180 it was broken up, and the name of Saxony disappeared from the greater part of it, remaining only with the districts around Lauenburg and Wittenberg. Five centuries later Lauenburg was incorporated with Hanover, and Wittenberg is the nucleus of modern Saxony, the name being thus transferred from the west to the east of Germany. In 1423 Meissen and Thuringia were united with Saxe-Wittenberg under Frederick of Meissen, and gradually the name of Saxony spread over all the lands ruled by this prince and his descendants.

The earlier Saxony was the district lying between the Elbe and the Saale on the east, the Eider on the north and the Rhine on the west, with a fluctuating boundary on the south. This territory was a stronghold of Germanic heathenism and included at Eresburg, the modern Marsberg, one of the chief Germanic sanctuaries, marked by the *Irminsul,* a wooden pillar which was the centre of Saxon worship. The prolonged resistance which the Saxons offered to Christianity was chiefly due to their hostility to the Franks who threatened their independence. The reduction of the Saxons was attempted by Charles Martel and Pippin the short, and was finally carried through in a series of campaigns by Charlemagne (*q.v.*). Before his death Saxony had permanently passed under Frankish supremacy, and within a century it had come to form an outpost of German and Christian influence against the Slavs of the provinces south of the Baltic.

The conversion of the Saxons to Christianity, which during this time had been steadily progressing, was continued in the reign of the emperor Louis I. Bishoprics were established at Bremen, Münster, Verden, Minden, Paderborn, Osnabrück, Hildesheim, Hamburg and Halberstadt. The abbey of Corvey soon became a centre of learning for the country, and the Saxons undertook with the eagerness of converts the conversion of their heathen neighbours. Towards the middle of the century there are signs of a reaction against Frankish rule and towards heathenism among the Saxon free peasantry, but it had no permanent result, and the connection with the empire was unbroken. By the treaty of Verdun in 843 Saxony fell to Louis the German, but he paid little attention to the northern part of his kingdom, which was harassed by the Normans and the Slavs. About 850, however, he appointed a Saxon noble named Liudolf as margrave to defend the *Limes Saxoniae,* a narrow strip of land on the eastern frontier. Liudolf, who is sometimes called "duke of the East Saxons," carried on a vigorous warfare against the Slavs and extended his influence over other parts of Saxony. He died in 866, and was succeeded by his son Bruno, who was killed fighting the Normans in 880. Liudolf's second son, Otto the Illustrious, was recognized as duke of Saxony by King Conrad I., and on the death of Burkhard, margrave of Thuringia in 908, obtained authority over that country also. He made himself practically independent in Saxony, and played an important part in the affairs of the empire. He died in 912 and his son Henry I., the Fowler, not only retained his hold over Saxony and Thuringia, but in 919 was elected German king. He extended the Saxon frontier almost to the Oder, improved the Saxon forces by training and equipment, established new marks, and erected forts on the frontiers for which he provided regular garrisons. Towns were walled, where it was decreed markets and assemblies should be held, churches and monasteries were founded, civilization was extended and learning encouraged. Henry's son, Otto the Great, was crowned emperor in 962, and his descendants held this dignity until the death of the emperor Otto III. in 1002. Under this able dynasty the Slavs were driven back, the domestic policy of Henry the Fowler was continued, the Saxon court became a centre of learning visited by Italian scholars, and in 968 an archbishopric was founded at Magdeburg for the lands east of the Elbe. The extent of Otto the Great's dominions compelled him to delegate much of his authority in Saxony and in 960 he gave to a trusted relative Hermann Billung certain duties and privileges on the eastern frontier, and from time to time appointed him as his representative in Saxony. Hermann gradually extended his authority, and when he died in 973 was followed by his son Bernard I., who was undoubtedly duke of Saxony in 986. When Henry II. was chosen German king in 1002 he met the Saxons at Merseburg, and on promising to observe their laws Bernard gave him the sacred lance, thus entrusting Saxony to his care. Bernard was succeeded by his son Bernard II., who took up a hostile attitude towards the German kings, Conrad II. and Henry III. His son and successor Ordulf, who became duke in 1059, carried on a long and obstinate struggle with Adalbert, archbishop of Bremen, who was compelled to cede one-third of his possessions to Ordulf's son Magnus in 1066. The emperor Henry III. sought to win the allegiance of the Saxons by residing among them. He built a castle at Goslar and the Harzburg; and his successor Henry IV. also spent much time in Saxony.

In 1070 Otto of Nordheim, duke of Bavaria, who held large estates in this country, was accused of a plot to murder Henry, and his lands were confiscated. Otto, in alliance with Magnus, won considerable support in Saxony, but after some fighting both submitted and were imprisoned; and Magnus was still in confinement when on his father's death in 1072 he became titular duke of Saxony. As he refused to give up his duchy he was kept

in prison, while Henry confiscated the estates of powerful nobles, demanded the restoration of ducal lands by the bishops, and garrisoned newly-erected forts with Swabians. These proceedings aroused suspicion and discontent, which were increased when the emperor assembled an army, ostensibly to attack the Slavs. The Saxon nobles refused to join the host until their grievances were redressed, and in 1073 a league was formed at Wormesleben. When the insurgents under Duke Otto were joined by the Thuringians, Henry was compelled in 1074 to make various concessions to them, and in particular to release Magnus. At last Henry, having obtained help from the princes of the Rhineland, attacked and defeated the Saxons at Hohenburg near Langensalza but pardoned Otto, whom he appointed administrator of the country. The Saxons, however, were not quite subdued; risings took place from time to time, and the opponents of Henry IV. found considerable support in Saxony. During the century which followed the death of Hermann Billung, there had been constant warfare with the Slavs, but although the emperors had often taken the field, the Saxons had been driven back to the Elbe, which was at this time their eastern boundary. In 1106 Magnus died, and the German king Henry V. bestowed the duchy upon Lothair, count of Supplinburg, whose wife Richenza inherited the Saxon estates of her grandfather Otto of Nordheim, on the death of her brother Otto in 1116. Lothair quickly made himself independent, defeated Henry at Welfesholz in 1115, and prosecuted the war against the Slavs with vigour. In 1125 he became German king, and in 1137 gave Saxony to Henry the Proud, duke of Bavaria, who had married his daughter Gertrude, and whose mother Wulfhild was a daughter of Magnus Billung. The succeeding German king Conrad III. refused to allow Henry to hold two duchies, and gave Saxony to Albert the Bear, margrave of Brandenburg, who like his rival was a grandson of Magnus Billung. Albert's attempts to obtain possession failed, and after Henry's death in 1139 he formally renounced Saxony in favour of Henry's son, Henry the Lion (*q.v.*). The new duke improved its internal condition, increased its political importance, and pushed its eastern frontier towards the Oder. In 1180, however, he was placed under the imperial ban and Saxony was broken up. Henry retained Brunswick and Luneburg; Westphalia, as the western portion of the duchy was called, was given to Philip, archbishop of Cologne, and a large part of the land was divided among nine bishops and a number of counts who thus became immediate vassals of the emperor. The title duke of Saxony was given to Bernard, the sixth son of Albert the Bear, together with the small territories of Lauenburg and Wittenberg, which were thus the only portions of the former duchy which now bore the name of Saxony. Bernard, whose paternal grandmother, Eilicke, was a daughter of Magnus Billung, took a prominent part in German affairs, but lost Lauenburg which was seized by Waldemar II., king of Denmark. Dying in 1212, Bernard was succeeded in Wittenberg by his younger son Albert I., who recovered Lauenburg after the defeat of Waldemar at Bornhöved in 1227. Albert died in 1260, and soon after his death his two sons divided his territories, when the elder son John took Lauenburg which was sometimes called lower Saxony, and the younger, Albert II., took Wittenberg or upper Saxony. Both retained the ducal title and claimed the electoral privilege, a claim which the Lauenburg line refused to abandon when it was awarded to the Wittenberg line by the Golden Bull of 1356.

Saxe-Lauenburg was governed by John until his death in 1285, when it passed to his three sons John II., Albert III. and Eric I. As Albert had no sons the duchy was soon divided into two parts, until on the death of duke Eric III., a grandson of John II., in 1401, it was reunited by Eric IV., a grandson of Eric I. When Eric IV. died in 1412 he was succeeded by his son Eric V., who made strenuous but vain efforts to obtain the electoral duchy of Saxe-Wittenberg, which fell vacant on the death of the elector Albert III. in 1422. Eric died in 1436 and was followed by his brother Bernard IV., whose claim to exercise the electoral vote was quashed by the electors in 1438; and who was succeeded by his son John IV. in 1463. The next duke, John's son Magnus I., spent much time in struggles with the archbishop of Bremen and the bishop of Ratzeburg; he also assisted the progress of the Reformation in Lauenburg. Magnus, who was formally invested with the duchy by the emperor Charles V. in 1530, was the first duke to abandon the claim to the electoral privilege. After his death in 1543 his son Francis I. reigned for the succeeding 28 years, and his grandsons, Magnus II. and Francis II., until 1619. Francis, who did something to improve the administration of his duchy, was succeeded in turn by his two sons and his two grandsons; but on the death of Julius Francis, the younger of his grandsons, in 1689 the family became extinct.

Several claimants to Saxe-Lauenburg thereupon appeared, the most prominent of whom were George William, duke of Lüneburg-Celle, and John George III., elector of Saxony. George William based his claim upon a treaty of mutual succession made in 1369 between his ancestor Magnus II., duke of Brunswick, and the reigning dukes of Saxe-Lauenburg. John George had a double claim. Duke Magnus I. had promised that in case of the extinction of his family Lauenburg should pass to the family of Wettin, an arrangement which had been confirmed by the emperor Maximilian I. in 1507. Secondly, John George himself had concluded a similar treaty with Julius Francis in 1671. In 1689 the elector received the homage of the people of Lauenburg. George William, however, took Ratzeburg, and held it against the troops of a third claimant, Christian V., king of Denmark; and in 1702 he bought off the claim of John George, his successor being invested with the duchy in 1728. Since that date its history has been identified with that of Hanover (*q.v.*).

In Saxe-Wittenberg Albert II. was succeeded in 1298 by his son Rudolph I., who was followed in 1356 by his son Rudolph II. He in turn was succeeded in 1370 by his half-brother Wenceslaus, who temporarily acquired the duchy of Lüneburg for his house. He was followed in 1388 by his eldest son Rudolph III. Lavish expenditure during the progress of the council of Constance reduced Rudolph to poverty and on the death in 1422 of his brother Albert III., who succeeded him in 1419, this branch of the family became extinct.

THE ELECTORATE

A new era in the history of Saxony dates from 1423, when the Emperor Sigismund bestowed the vacant electoral duchy of Saxe-Wittenberg upon Frederick, margrave of Meissen. Frederick was a member of the family of Wettin, which since his day has played a prominent part in the history of Europe, and he owed his new dignity to the money and other assistance which he had given to the emperor during the Hussite war. The new and more honourable title of elector of Saxony now superseded his other titles, and the name Saxony gradually spread over his other possessions, which included Meissen and Thuringia as well as Saxe-Wittenberg. His new position as elector combined with his personal qualities to make him one of the most powerful princes in Germany, and had the principle of primogeniture been established in his country, Saxony and not Prussia might later have been the leading power in the German empire. He died in 1428, just before his lands were ravaged by the Hussites in 1429 and 1430. The division of his territory between his two sons, the elector Frederick II. and William, occasioned a destructive internecine war. Frederick II.'s two sons, Ernest and Albert, succeeded to their father's possessions in 1464, and for 20 years ruled together peaceably. The land prospered rapidly during this respite from the horrors of war. The childless death of their uncle William in 1482 brought Thuringia to the two princes, and Albert insisted on a division of their common possessions. The important partition of Leipzig accordingly took place in 1485, and resulted in the foundation of the two main lines of the Saxon house. The lands were never again united. Ernest, the elder brother, obtained Saxe-Wittenberg with the electoral dignity, Thuringia and the Saxon Vogtland; while Albert received Meissen, Osterland being divided between them. Something was still held in common, and the division was probably made intricate to render war difficult.

The Reformation Period.—The elector Ernest was succeeded in 1486 by his son, Frederick the Wise, one of the most

illustrious princes in German history. Under him Saxony was perhaps the most influential state in the empire, and became the cradle of the Reformation. He died in 1525 while the Peasants' War was desolating his land, and was succeeded by his brother John, who was an enthusiastic supporter of the reformed faith and who shared with Philip, landgrave of Hesse, the leadership of the league of Schmalkalden. John's son and successor, John Frederick the Magnanimous, who became elector in 1532, might with equal propriety have been surnamed the Unfortunate. He took part in the war of the league of Schmalkalden, but in 1547 he was captured at Mühlberg by the Emperor Charles V. and was forced to sign the capitulation of Wittenberg. This deed transferred the electoral title and a large part of the electoral lands from the Ernestine to the Albertine branch of the house, whose astute representative, Maurice, had taken the imperial side during the war. Only a few scattered territories were reserved for John Frederick's sons, although these were increased by the treaty of Naumburg in 1554, and on them were founded the Ernestine duchies of Saxe-Gotha, Saxe-Weimar, Saxe-Coburg, Saxe-Meiningen and Saxe-Altenburg. For the second time in the history of the Saxon electorate the younger line secured the higher dignity, for the Wittenberg line was junior to the Lauenburg line. The Albertine line became later the royal line of Saxony.

Maurice, who became elector of Saxony in consequence of the capitulation of Wittenberg, was a Protestant, but he did not allow his religious faith to blind him to his political interests. He refused to join the other Protestant princes in the league of Schmalkalden, but made a secret treaty with Charles V. His fidelity to Charles V. was rewarded by the capitulation of Wittenberg. All the lands torn from John Frederick were not, however, assigned to Maurice; he was forced to acknowledge the superiority of Bohemia over the Vogtland and the Silesian duchy of Sagan. Moreover, Roman Catholic prelates were reinstated in the bishoprics of Meissen, Merseburg and Naumburg-Zeitz. Recognizing now as a Protestant prince that the best alliance for securing his new possessions was not with the emperor, but with the other Protestant princes, Maurice began to withdraw from the former and to conciliate the latter. In 1552, suddenly marching against Charles at Innsbruck, he drove him to flight and then extorted from him the peace of Passau.

Amid the distractions of outward affairs, Maurice had not neglected the internal interests of Saxony. To its educational advantages, already conspicuous, he added the three *Fürstenschulen* at Pforta, Grimma and Meissen, and for administrative purposes, especially for the collection of taxes, he divided the country into the four circles of the Electorate, Thuringia, Meissen and Leipzig. During his reign coal-mining began in Saxony. Over 200 religious houses were suppressed, the funds being partly applied to educational purposes. The country had four universities, those of Leipzig, Wittenberg, Jena and Erfurt; books began to increase rapidly, and, by virtue of Luther's translation of the Bible, the Saxon dialect became the ruling dialect of Germany.

Augustus I., brother and successor of Maurice, was one of the best domestic rulers that Saxony ever had. He increased the area of the country by the "circles" of Neustädt and the Vogtland, and by parts of Henneberg and the silver-yielding Mansfeld, and he devoted his long reign to the development of its resources. Under him lace-making began on the Erzgebirge, and cloth-making flourished at Zwickau. With all his virtues, however, Augustus was an intolerant Lutheran, and used very severe means to exterminate the Calvinists. Under John George (succeeded 1611) the country was devastated by the Thirty Years' War. After the death of Gustavus Adolphus at the battle of Lützen, not far from Leipzig, in 1632, the elector, who was at heart an imperialist, detached himself from Sweden with whom he had been allied since 1629, and in 1635 concluded the peace of Prague with the emperor. By this peace he was confirmed in the possession of Upper and Lower Lusatia. Saxony had now to suffer from the Swedes a repetition of the devastations of Wallenstein. No other country in Germany was so scourged by this terrible war. When the war was ended by the peace of Westphalia in 1648, Saxony found that its influence had begun to decline in Germany. John George's will made the decline worse by detaching the three duchies of Saxe-Weissenfels, Saxe-Merseburg and Saxe-Zeitz as appanages for his younger sons. By 1746, however, these lines were all extinct, and their possessions had returned to the main line.

The 18th Century.—The next three electors, who each bore the name of John George, had uneventful reigns. John George IV. was succeeded in 1694 by his brother Frederick Augustus I., or Augustus the Strong. This prince was elected king of Poland as Augustus II. in 1697, but any weight which the royal title might have given him in the empire was more than counterbalanced by the fact that he became a Roman Catholic in order to qualify for the new dignity. In order to defray the expenses of Poland's wars with Charles XII. Augustus pawned and sold large districts of Saxon territory, while he drained the electorate of both men and money.

From this reign dates the privy council (*Geheimes Kabinet*), which lasted till 1830. The caste privileges of the estates (*Stände*) were increased by Augustus, a fact which tended to alienate them more from the people, and so to decrease their power. Frederick Augustus II., who succeeded his father in the electorate in 1733, and was afterwards elected to the throne of Poland as Augustus III., was an indolent prince, wholly under the influence of Count Heinrich von Brühl (*q.v.*). Under him Saxony sided with Prussia in the First Silesian War, and with Austria in the other two. It gained nothing in the first, lost much in the second, and in the third, the Seven Years' War (1756–63), suffered renewed miseries. The country was deserted by its king and his minister, who retired to Poland. By the end of the war it had lost 90,000 men and 100,000,000 thalers; its coinage was debased and its trade ruined; and the whole country was in a state of frantic disorder. The elector died seven months after his return from Poland; Brühl died 23 days later. The connection with Poland was now at an end. The elector's son and successor, Frederick Christian, survived his father only two months, dying also in 1763, leaving a son, Frederick Augustus III., a boy of 13. Prince Xaver, the elector's uncle, was appointed guardian, and he set himself to the work of healing the wounds of the country.

THE KINGDOM OF SAXONY

Frederick assumed the government in 1768, and in his long and eventful reign, which saw the electorate elevated to the dignity of a kingdom, though deprived of more than half its area, he won the surname of the Just. As he was the first king of Saxony, he is usually styled Frederick Augustus I. When the Bavarian succession fell open in 1777, Frederick Augustus joined Prussia in protesting against the absorption of Bavaria by Austria, and Saxon troops took part in the bloodless "potato-war." The elector commuted his claims in right of his mother, the Bavarian princess Maria Antonia, for 6,000,000 florins, which he spent chiefly in redeeming Saxon territory that had been pawned to other German states. When Saxony joined the *Fürstenbund* in 1785, it had an area of 15,185 sq.m. and a population of nearly 2,000,000, but its various parts had not yet been combined into a homogeneous whole, for the two Lusatias, Querfurt, Henneberg and the ecclesiastical foundations of Naumburg and Merseburg had each a separate diet and government, independent of the diet of the electorate proper. In 1791 Frederick declined the proffered crown of Poland. Next year saw the beginning of the great struggle between France and Germany. Frederick's first policy was one of abstention but when war broke out in 1806 against Napoleon, 22,000 Saxon troops shared the defeat of the Prussians at Jena, but the elector immediately afterwards abandoned his former ally. At the peace of Posen (Dec. 11, 1806) Frederick assumed the title of king of Saxony, and entered the Confederation of the Rhine as an independent sovereign, promising a contingent of 20,000 men to Napoleon.

In 1807 his submission was rewarded with the duchy of Warsaw (to which Cracow and part of Galicia were added in 1809) and the district of Kottbus, though he had to surrender some of his former

territory to the new kingdom of Westphalia. The king of Saxony's faith in Napoleon was shaken by the disasters of the Russian campaign, but when the allies invaded Saxony in the spring of 1813, he refused to declare against Napoleon and fled to Prague, though he withdrew his contingent from the French army. After Napoleon's victory at Lützen (May 2, 1813), the Saxon king and the Saxon army were once more at the disposal of the French. During the battle of Leipzig in Oct. 1813, the popular Saxon feeling was displayed by the desertion of the Saxon troops to the side of the allies. Frederick was taken prisoner in Leipzig, and the government of his kingdom was assumed for a year by the Russians. The congress of Vienna assigned the northern portion, consisting of 7,800 sq.m., with 864,404 inhabitants, to Prussia, leaving 5,790 sq.m., with a population of 1,182,744, to Frederick, who was permitted to retain his royal title. On June 8, 1815, King Frederick joined the new German Confederation.

Constitutionalism.—From the partition in 1815 to the war of 1866 the history of Saxony is mainly a narrative of the slow growth of constitutionalism and popular liberty within its limits. Its influence on the general history of Europe ceased when the old empire was dissolved. In the new German empire it was too completely overshadowed by Prussia to have any objective importance by itself. Frederick lived 12 years after the division of his kingdom. The commercial and industrial interests of the country continued to be fostered, but only a few of the most unavoidable political reforms were granted. Religious equality was extended to the Reformed Church in 1818, and the separate diet of Upper Lusatia was abolished. Frederick Augustus was succeeded in 1827 by his brother Anthony who initiated a few unimportant reforms. An active opposition began to make itself evident in the diet and in the press, and in 1830, under the influence of the July revolution in Paris, riots broke out in Leipzig and Dresden, and a constitution was promised. After consultation with the diet the king promulgated, on Sept. 4, 1831, a new constitution by which the feudal estates were replaced by two chambers, largely elective, and the privy council by a responsible ministry of six departments.

While Saxony's political liberty was thus enlarged, its commerce and credit were stimulated by its adhesion to the Prussian *Zollverein* and by the construction of railways. Anthony had died in 1836, and Frederick Augustus II., since 1830 co-regent, became sole king. The burning questions were the publicity of legal proceedings and the freedom of the press; and on these the government sustained its first heavy defeat in the lower chamber in 1842. In 1843 the prime minister Lindenau was forced by the action of the aristocratic party to resign, and was replaced by Julius Traugott von Könneritz (1792–1866), a statesman of reactionary views. This increased the opposition of the Liberal middle classes to the Government. Religious considerations arising out of the attitude of the Government towards the "German Catholics," and a new constitution for the Protestant Church, began to mingle with purely political questions.

Warned by the sympathy excited in Saxony by the revolutionary events at Paris in 1848, the king dismissed his reactionary ministry, and a Liberal cabinet took its place in March 1848. The privileges of the nobles were curtailed; the administration of justice was put on a better footing; the press was unshackled; publicity in legal proceedings was granted; trial by jury was introduced for some special cases; and the German Catholics were recognized. The feudal character of the first chamber was abolished, and its members made mainly elective from among the highest tax-payers, while an almost universal suffrage was introduced for the second chamber. The first demand of the overwhelmingly democratic diet returned under this reform bill was that the king should accept the German constitution elaborated by the Frankfort parliament. Frederick, alleging the danger of acting without the concurrence of Prussia, refused, and dissolved the diet. The public demonstration at Dresden in favour of the Frankfort constitution was prohibited on May 2, 1849. The people seized the town and barricaded the streets; Dresden was almost destitute of troops; and the king fled to the Königstein. The rebels then appointed a provisional Government, consisting of Tzschirner, Heubner and Todt, though the true leader of the insurrection was the Russian Bakunin. Meanwhile Prussian troops had arrived to aid the Government, and after two days' fierce street fighting the rising was quelled. The bond with Prussia now became closer, and Frederick entered with Prussia and Hanover into the temporary "alliance of the three kings"; but in 1850 he accepted the invitation of Austria to send deputies to the restored federal diet at Frankfort. The first chamber immediately protested against this step, and refused to consider the question of a pressing loan. The king retorted by dissolving the diet and summoning the old estates abolished in 1848. Beust became minister for both home and foreign affairs in 1852, and under his guidance the policy of Saxony became more and more hostile to Prussia and friendly to Austria.

The sudden death of the king in 1854 left the throne to his brother John whose name is known in German literature as a translator and annotator of Dante. His brother's ministers remained but their views gradually became somewhat liberalized with the spirit of the times. Beust, however, still retained his federalistic and philo-Austrian views. When war was declared between Prussia and Austria in 1866, Saxony took the side of Austria. On the conclusion of peace Saxony lost no territory, but had to pay a war indemnity of 10,000,000 thalers, and was compelled to enter the North German Confederation.

Franchise.—During the peace negotiations Beust had resigned and entered the Austrian service, and on Nov. 15 the king in his speech from the throne announced his intention of being faithful to the new Confederation as he had been to the old. On Feb. 7, 1867, a military convention was signed with Prussia which placed the army under the king of Prussia. The postal and telegraph systems were also placed under the control of Prussia, and the representation of the Saxon crown at foreign courts was merged in that of the Confederation. A new electoral law reformed the Saxon diet by abolishing the old distinction between the various "estates" and lowering the qualification for the franchise; the result was a Liberal majority in the lower house and a period of civil and ecclesiastical reform. John was succeeded in 1873 by his elder son Albert (1832–1902) who had added to his military reputation during the war of 1870. Under this prince the course of politics in Saxony presented little of general interest, except perhaps the spread of the doctrines of Social Democracy, which was especially remarkable in Saxony. The number of Social Democratic delegates in a diet of 80 members rose from 5 in 1885 to 14 in 1895. So alarming did the growth appear, that the other parties combined, and on March 28, 1896, a new electoral law was passed, introducing indirect election and a franchise based on a triple division of classes determined by the amount paid in direct taxation. This resulted in 1901 in the complete elimination of the Socialists from the diet. On June 7, 1902, King Albert died, and was succeeded by his brother as King George. An extraordinary situation had been created by the electoral law of 1896. This law had in effect secured the misrepresentation of the mass of the people in the diet, the representation of the country population at the expense of that of the towns, of the interests of agriculture as opposed to those of industry. The result was displayed in the elections of 1903 to the German imperial parliament, when, under the system of universal suffrage, of 23 members returned 22 were Social Democrats. This led to proposals for a slight modification in the franchise for the Saxon diet (1904), which were not accepted. In the elections of 1906, however, only 8 of the Social Democrats succeeded in retaining their seats. In 1907 the Government announced their intention of modifying the electoral system in Saxony by the adding of representation for certain professions to that of the three classes of the electorate. This was, however, far from satisfying the parties of the extreme Left, and the strength of Social Democracy in Saxony was even more strikingly displayed in 1909 when, in spite of plural voting, under a complicated franchise, 25 Socialist members were returned to the Saxon diet.

King George died on Oct. 15, 1904, and was succeeded by his son as King Frederick Augustus III., under whom the conflict about the constitution continued. The Left demanded a reform of the first chamber, the upper house, which should break the

predominance of the agrarians in that house and allow to commerce, industry and handicrafts a greater influence. This was reinforced in 1917 by the agitation of the extreme Left in the diet for the early conclusion of peace.

The Revolution.—On Oct. 26, 1918 the cabinet gave place to a more liberal Government under Dr. Heinze. On Nov. 9, 1918, the revolution broke out, on Nov. 10 the republic was proclaimed, and King Frederick Augustus abdicated on Nov. 13. A cabinet of commissaries of the people (*Volksbeauftragte*), composed exclusively of Independent Socialists, first held power, but was succeeded by a Government of Majority Socialists. A new republican constitution was adopted on Nov. 1, 1920. The revolutionary agitation remained active in Saxony throughout 1919, 1920 and 1921. Max Hölz, the most famous guerrilla leader of the Communists was at last defeated and captured early in 1921. In 1923 the strong revolutionary feeling of the Saxons was shown by the proceedings of the Zeigner ministry which depended upon an alliance of Socialists and Communists. It was expelled from office by the Reich Government who occupied the country with troops and replaced the ministry by a coalition of the German People's Party, Democratic Party and right-wing Socialists.

The chief authority for the early history of Saxony is Widukind, whose *Res gestae Saxonicae* is printed, together with the works of other chroniclers, in the *Monumenta Germanica historica, Scriptores.* Collections which may be consulted are: *Codex diplomaticus Saxoniae regiae* (Leipzig, 1862–79); the *Archiv für die sächsische Geschichte,* edited by K. von Weber (Leipzig, 1862–79); the *Bibliothek der sächsische Geschichte und Landeskunde,* edited by G. Buchholz (Leipzig, 1903); and the *Bibliographie der Sächsischen Geschichte* (Leipzig, 1918, *et sqq.,* published by the *Sächsische Kommission für Geschichte*). *See* GERMANY, *bibliography.*

SAXONY, province of, one of the provinces of Prussia, consists mainly of what was formerly the northern part of the kingdom of Saxony, which was ceded to Prussia in 1815, also comprises part of the former duchy of Magdeburg and other districts, the connection of which with Prussia is of earlier date. The area of the province is 9,758 sq.m. For the former kingdom *see* SAXONY, REPUBLIC OF. It is bounded west by Hesse-Nassau, Hanover and Brunswick, north by Hanover and Brandenburg, east by Brandenburg and Silesia, and south by the Republic of Saxony and by Thuringia. It is, however, very irregular in form, entirely surrounding parts of Brunswick and Thuringia, and itself possessing several exclaves, while the northern portion is almost severed from the southern by the Free State of Anhalt.

The major part belongs to the great North-German plain, but the western and south-western districts include parts of the Harz, with the Brocken, its highest summit, and of the Thuringian Forest. About nine-tenths of Prussian Saxony belongs to the basin of the Elbe; the chief feeders of which within the province are the Saale, with its tributary the Unstrut, and the Mulde, but a small district on the west drains into the Weser.

Saxony is on the whole the most fertile province of Prussia and excels all the others in its produce of wheat and beetroot for sugar, but the nature of its soil is very unequal. The best crop-producing districts lie near the base of the Harz Mountains, such as the "Magdeburger Börde" (between Magdeburg and the Saale) and the "Goldene Aue," and rich pasture lands occur in the river valleys, but the sandy plains of the Altmark, in the north part of the province, yield but a scanty return.

Wheat and rye are exported in considerable quantities. The beetroot for sugar is grown chiefly in the district to the north of the Harz, as far as the Ohre, and on the banks of the Saale; and the amount of sugar produced is nearly as much as that of all the rest of Prussia together. Flax, hops and oil-seeds are also cultivated, and large quantities of excellent fruit are grown at the foot of the Harz and in the valleys of the Unstrut and the Saale. The market-gardening of Erfurt and Quedlinburg is well known throughout Germany. The province is comparatively poor in timber, though there are some fine forests in the Harz and other hilly districts. Cattle-rearing is carried on with success in the river valleys, and more goats are met with here than in any other part of Prussia.

The chief rock-salt mines and brine springs are at Stassfurt, Schönebeck and Halle; potash is mined at Stassfurt (*q.v.*). Lignite deposits extend from Oschersleben by Kalbe to Weissenfels; lignite is also found in the neighbourhood of Aschersleben, Bitterfeld and Wittenberg. The copper mines are found chiefly in the Harz district. The other mineral resources include silver, pit-coal, pyrites, alum, plaster of Paris, sulphur, alabaster and several varieties of good building-stone. Numerous mineral springs occur in the Harz.

In addition to the production of sugar the most important industries are the manufactures of cloth, leather, iron and steel wares, chiefly at Erfurt, Suhl and Sömmerda; spirits at Nordhausen, chemicals at Stassfurt and Schönebeck, and starch. Beer is also brewed extensively. Trade is facilitated by the great waterway of the Elbe as well as by a complete system of railways. The chief articles are wool, grain, sugar, salt, lignite and the principal manufactured products named above.

The population of the province of Saxony in 1925 was 3,279,187, an average of 336 persons to the square mile. The bulk of the inhabitants are of unmixed German stock, but many of those in the east part have Wendish blood in their veins.

Prussian Saxony is divided into the three government districts of Magdeburg, Merseburg and Erfurt. The principal towns are Magdeburg, Halle, Erfurt, Halberstadt, Nordhausen, Mühlhausen, Aschersleben, Weissenfels and Zeitz. The university of Halle holds high rank among German seats of learning.

SAXOPHONE, a modern hybrid musical instrument invented by Adolphe Sax, having the clarinet mouthpiece with single reed applied to a conical brass tube. In general appearance the saxophone resembles the bass clarinet, but the tube of the latter is cylindrical and of wood; both instruments are doubled up near the bell, which is shaped somewhat like the flower of the gloxinia. The mouthpiece in both is fixed to a curved tube at right angles to the main bore. In the case of the saxophone, however, owing to its conical bore, the quality of tone materially differs from that of the clarinet. The reed mouthpiece in combination with a conical tube allows the performer to give the ordinary harmonic series unbroken, which means in practice that the octave or second member of the harmonic series is first overblown. The saxophone is therefore one of the class known as octave instruments. The fundamental note given out by the tube when the lateral holes are closed is that of an open organ pipe of the same length, whereas when, as in the clarinet family, the reed mouthpiece is combined with a cylindrical bore, the tube behaves as though it were closed at one end, and its notes are an octave lower in pitch. Hence the bass clarinet to give the same note as a bass saxophone would need to be only half as long. The quality of tone of this family of instruments is inferior to that of the clarinets and has affinities with that of the harmonium. According to Berlioz it had kinship also with the timbre of the 'cello and cor anglais, with, however, a brazen tinge. The saxophone has not enjoyed much favour hitherto with high-class composers, though Richard Strauss scored for a quartet of the instruments in his Sinfonia Domestica. In military bands, however, it has proved of great service while in recent years it has acquired extraordinary vogue as a leading member of the jazz orchestra.

SAY, JEAN BAPTISTE (1767–1832), French economist, was born at Lyons, on Jan. 5, 1767, of a Protestant family, who had fled from France after the Revocation of the Edict of Nantes, but had returned in the 18th century. Intending to follow a commercial career, Say first entered the house of an English merchant, and was later employed in the office of a life assurance company in France. His attention having been called to *The Wealth of Nations,* however, he began to study economics, and in 1789 published his first pamphlet. In 1803 he published his principal work *Traité d'économie politique.* His views being displeasing to Napoleon, he was dismissed from the post of tribune, to which he had been elected in 1799. He built a spinning mill, and devoted himself to the industry and to the revision of his book, of which the second edition appeared in 1814. In the same year he was sent by the French Government to study the economic conditions of Great Britain. The results of his observations appeared in a tract, *De l'Angleterre et des Anglais,* and in the corrected edition of the *Traité* (1817). A chair of industrial economy

was founded for him in 1819 at the Conservatoire des Arts et Métiers. In 1831 he was made professor of political economy at the Collège de France, and in 1828–30 he published his *Cours complet d'économie politique pratique*. At the revolution of 1830 he was named a member of the council-general of the department of the Seine, but found it necessary to resign. He died at Paris on Nov. 15, 1832.

Say's writings occupy vols. ix.–xii. of Guillaumin's *Collection des principaux économistes*. Among them are *Olbie, où essai sur les moyens de reformer les moeurs d'une nation* (1800); *Catéchisme d'économie politique* (1815); *Petit Volume contenant quelques aperçus des hommes et de la société, lettres à Malthus sur différens sujets d'économie politique* (1820); *Épitomé des principes de l'économie politique* (1831). A volume of *Mélanges et correspondance* was published posthumously by his son-in-law, Chas. Comte, author of the *Traité de législation*.

The last edition of the *Traité d'économie politique* which appeared during the life of the author was the 5th (1826); the 6th, with the author's final corrections, was edited by the eldest son, Horace Emile Say, himself known as an economist, in 1846. The work was translated into English by C. R. Prinsep (1821), and into German, by C. Ed. Morstadt (1818 and 1830). *See* also A. Liesse, *Jean Baptiste Say* (Paris, 1901).

SAY, JEAN BAPTISTE LÉON (1826–1896), French statesman and economist, the grandson of J. B. Say (*q.v.*) and the son of Horace Émile Say (1794–1860), was born in Paris on June 6, 1826. Descended from a long line of distinguished economists, Léon Say established his reputation by his brilliant criticisms of Haussmann's financial administration of the Seine, published in the *Journal des Débats* of which he was one of the proprietors. On taking his seat in the Assembly of 1871 for the Seine, he was chosen as reporter of a commission on the state of the national finances. The statements which he published attracting the attention of Thiers he appointed Say prefect of the Seine (June 5), and in December 1872 promoted him minister of finance. This was a remarkable tribute from Thiers, who, as a protectionist, was opposed to Say's free trade views. After the fall of Thiers (May 1873), Say held office in the Buffet ministry, although in profound disagreement with its leaders, and was minister of finance under Dufaure and Jules Simon, in the Dufaure ministry of Dec. 1877, and in the Waddington ministry till Dec. 1879. During this period, in which he was practically the autocratic ruler of the French finances, he directed the payment of the war indemnity with consummate skill, completing it long before the prescribed time.

Say's general financial policy was to ameliorate the incidence of taxation and to enrich the country, and therefore the Treasury, by removing all restrictions on internal commerce. He accordingly reduced the rate of postage, repealed the duties on many articles of prime utility, such as paper, and fought strongly, though unsuccessfully, against the system of *octrois*. In 1880 he visited England to negotiate a commercial treaty between France and England, but the presidency of the Senate falling vacant, he was elected to it on May 25, having meanwhile secured a preliminary understanding. In Jan. 1882 he became minister of finance in the Freycinet cabinet, which was defeated in the following July on the Egyptian question. Say's influence waned before the attacks of Socialism and the revival of protectionism, against which Say vainly organized the *Ligue contre le renchérissement du pain*. He had, however, a large share in the successful opposition to the income-tax. In 1889 he quitted the Senate to enter the Chamber as member for Pau, in the belief that his efforts for Liberalism were more urgently needed in the popular assembly. Throughout his career he was an indefatigable writer and lecturer on economics, and in both capacities exerted a wide influence. Special mention must be made of his work, as editor and contributor, on the *Dictionnaire des finances* and *Nouveau Dictionnaire d'économie politique*.

Say's style was easy and lucid, and he was often employed in drawing up important official documents, such as the famous presidential message of Dec. 1877. He was for many years a prominent member of the Académie des Sciences Morales et Politiques, and in 1886 succeeded to Edmond About's seat in the Académie Française. He died in Paris on April 21, 1896. A selection of his most important writings and speeches has since been published in four volumes under the title of *Les Finances de la France sous la troisième république* (1898–1901).

See Georges Michel, *Léon Say* (Paris, 1899); Georges Picot, *Léon Say, notice historique* (Paris, 1901), with a bibliography.

SAY, a town on the right bank of the river Niger in 13° 4′ N. and 2° 30′ E. In the agreement of 1890 between Great Britain and France for the delimitation of their respective spheres of influence in West Africa, Say was taken as the western end of an imaginary line which ran eastward to Barrua on Lake Chad. By the convention of 1898 Say and a considerable tract of territory south and east of the town were ceded to France. The district of Say covers 18,500 square kilometres and has 69,000 inhabitants; after having formed part of the colony of the Upper Volta, it was again attached in 1927 to that of Nigeria (*q.v.*).

SAYAD, a descendant of Ali, the son-in-law of Mohammed, by Fatima, Mohammed's daughter. Many of the Pathan tribes in the North-West Frontier Province of India, such as the Bangash of Kohat and the Mishwanis of the Hazara border, claim Sayad origin. The apostles who completed the conversion of the Pathans to Islam were called Sayads if they came from the west, and Sheikhs if they came from the east; hence doubtless many false claims to Sayad origin. In Afghanistan the Sayads have much of the commerce in their hands, as their holy character allows them to pass unharmed where other Pathans would be murdered.

The Sayads gave a short-lived dynasty to India, which reigned at Delhi during the first half of the 15th century. Their name again figures in Indian history at the break up of the Mogul empire, when two Sayad brothers created and dethroned emperors at their will (1714–1720).

SAYAN MOUNTAINS, in Central Asia, forming the eastern continuation of the Sailughem or Altai range, stretching from 89° E. to 106° E. They are the border-ridge between the plateau of N.W. Mongolia and Siberia. The geology is imperfectly known; the mountains are of the Hercynian age. The general elevation is 7,000 to 9,000 ft.; peaks, consisting largely of granites and metamorphic rocks, reach 10,000 ft. and 11,450 ft., *e.g.*, in Munko Sardyk; and the principal passes lie at 6,000 to 7,500 ft. above the sea, *e.g.*, Muztagh 7,480 ft., Mongol 6,500 ft., Tenghyz 7,480 ft. and Obo-sarym 6,100 ft. In 92° E. the system is pierced by the Bei-kem or upper Yenisei, and in 106° E., it terminates above the depression of the Selenga-Orkhon valley. From the Mongolian plateau the ascent is gentle, but from the plains of Siberia it is much steeper, despite the fact that the range is masked by a broad belt of subsidiary ranges, *e.g.*, the Usinsk, Oya, Tunkun, Kitoe and Byelaya ranges. Between the breach of the Yenisei and the Kosso-gol (lake) in 100° 30′ E. the system bears also the name of Yerghik-taiga. The flora is poor, although the higher regions carry good forests of larch, pitch pine, cedar, birch and alder, with rhododendrons and species of *Berberis* and *Ribes*. Lichens and mosses clothe many of the boulders that are scattered over the upper slopes.

SAYBROOK, a town of Middlesex county, Connecticut, U.S.A., on Long Island sound, at the mouth of the Connecticut river; served by the New York, New Haven and Hartford railroad and steamboat lines. Pop. (1930), 2,381. It is a beautiful place, with several old buildings, notably the mansion built about 1783 by Capt. Elisha Hart. Deep River, the principal village, has manufactures of ivory and bone and various other articles. In the adjoining town of Old Saybrook is Fenwick, the smallest borough in the State, with a population in 1920 of 13. The first settlement on Saybrook point was made late in 1635 (forestalling by a few weeks an attempted settlement by the Dutch) by John Winthrop, for a company with a grant from the Earl of Warwick, of which Lord Saye and Sele, Lord Brooke, Sir Richard Saltonstall, John Pym and John Hampden were the largest shareholders. A palisade across the narrowest part of the neck and a fort were built, and the names of the two principal proprietors were combined to make a name for the settlement. In 1644 the proprietors' rights were sold to Connecticut. The Collegiate School of Connecticut, established here in 1701 and moved to New Haven in 1716, was the foundation of Yale university. In 1708 a Congregational Synod met here and drew up the Saybrook platform of church discipline, which continued in full force until 1784. Say-

brook was the home of David Bushnell (1742–1824) who in 1776 devised a submarine torpedo and a tortoise-shaped diving boat ("the American Turtle"), which were tried against the British without success in the Revolutionary War.

SAYCE, ARCHIBALD HENRY (1845–), British Orientalist, was born at Shirehampton on Sept. 25, 1845, son of the Rev. H. S. Sayce, vicar of Caldicot. He was educated at Bath, and at Queen's college, Oxford, becoming a fellow in 1869. From 1891 to 1919 he was professor of Assyriology at Oxford. Although his conclusions have been modified (*e.g.*, in chronology and transliteration) by the work of other scholars (see, *e.g.*, BABYLONIA AND ASSYRIA), it is impossible to overestimate his services to Oriental scholarship. He travelled widely in the East. There has been a strong tendency to revert to the views which he advanced on the question of the Hittites in his early Oxford lectures. He was a member of the Old Testament Revision company (1874–84); deputy professor of comparative philology in Oxford (1876–90); Hibbert lecturer (1887); Gifford lecturer (1900–02).

Among his more important works are: *Assyrian Grammar for Comparative Purposes* (1872); *Principles of Comparative Philology* (1874); *Babylonian Literature* (1877); *Introduction to the Science of Language* (1879); *Monuments of the Hittites* (1881); *Herodotus i.–iii.* (1883); *Patriarchal Palestine* (1895); *The Egypt of the Hebrews and Herodotus* (1895); *Early History of the Hebrews* (1897); *Israel and the Surrounding Nations* (1898); *Babylonians and Assyrians* (1900); *Egyptian and Babylonian Religion* (1903); *Archaeology of the Cuneiform Inscr.* (1907). He also contributed important articles to the 9th, 10th and 11th editions of the *Encyclopædia Britannica* and edited a number of Oriental works. *See* also his *Reminiscences* (1923).

SAYE AND SELE, WILLIAM FIENNES, 1ST VISCOUNT (1582–1662), was the only son of Richard Fiennes, 7th Baron Saye and Sele, and was descended from James Fiennes, Lord Saye and Sele, who was lord chamberlain and lord treasurer under Henry VI. and was beheaded by the rebels under Jack Cade on July 4, 1450. Fiennes was educated at New College, Oxford; he succeeded to his father's barony in 1613, and in parliament opposed the policy of James I., undergoing a brief imprisonment for objecting to a benevolence in 1622, and he showed great animus against Lord Bacon. In 1624, he was advanced to the rank of a viscount. In the early parliaments of Charles I. he was in Clarendon's words "the oracle of those who were called Puritans in the worst sense, and steered all their counsels and designs." His energies found a new outlet in helping to colonize Providence Island, and in interesting himself in other and similar enterprises in America. Although Saye resisted the levy of ship-money, he accompanied Charles on his march against the Scots in 1639; but, with only one other peer, he refused to take the oath binding him to fight for the king to "the utmost of my power and hazard of my life." When the Civil War broke out, however, Saye was on the committee of safety, was made lord-lieutenant of Gloucestershire, Oxfordshire and Cheshire, and, raising a regiment, occupied Oxford. He was a member of the committee of both kingdoms; was mainly responsible for passing the self-denying ordinance through the House of Lords; and in 1647 stood up for the army in its struggle with the parliament. In 1648, both at the treaty of Newport and elsewhere, Saye was anxious that Charles should come to terms, and he retired into private life after the execution of the king, becoming a privy councillor again upon the restoration of Charles II. He died at his residence, Broughton Castle near Banbury, on April 14, 1662. On several occasions Saye outwitted the advisers of Charles I. by his strict compliance with legal forms. He was a thorough aristocrat, and his ideas for the government of colonies in America included the establishment of an hereditary aristocracy. Saybrook (*q.v.*) in Connecticut is named after Viscount Saye and Lord Brooke.

SAYERS, TOM (1826–1865), English pugilist, was born at Brighton on May 25, 1826. By trade a bricklayer, he began his career as a prize fighter in 1849 and won battle after battle, his single defeat being at the hands of Nat Langham in Oct. 1853. In 1857 he gained the championship. His fight with the American, John C. Heenan, the Benicia Boy, a much heavier man than himself, is perhaps the most famous in the history of the English prize ring. It took place at Farnborough on April 17, 1860, and lasted 2 hr. 6 min., 37 rounds being fought. After Sayers's right arm had been injured the crowd pressed into the ring and the fight was declared a draw; £3,000 was raised by public subscription for Sayers, who withdrew from the ring. He died on Nov. 8, 1865. The champion was 5 ft. 8½ in. in height and his fighting weight was under 11 stone. An account of the fight between Sayers and Heenan is given by Frederick Locker-Lampson in *My Confidences* (1896).

SAYRE, a borough of Bradford county, Pennsylvania, U.S.A., on the Susquehanna river at the mouth of the Chemung, 17 m. S.E. of Elmira and just south of the New York State line. It is served by the Lehigh Valley railroad, inter-urban trolleys and motor-bus lines. Pop. (1920) 8,078 (91% native white); 1930, Federal census 7,902. Adjoining Sayre are the Pennsylvania boroughs of Athens and South Waverly (4,384 and 1,251 respectively in 1920) and the New York village of Waverly (*q.v.*); the four municipalities are practically one industrial community. Sayre was founded in 1880 and incorporated in 1891. It was named for Robert Heysham Sayre (1824–1907), chief engineer of the railroad for many years.

SAYYID AHMAD KHAN, SIR (1817–1898), Mohammedan educationist and reformer, was born at Delhi, India, in 1817. He belonged to a family which had come to India with the Mohammedan conquest, and had held important offices under the Mogul emperors. Although his imperfect acquaintance with English prevented his attainment of higher office than that of a judge of a small cause court, he earned the title of the recognized leader of the Mohammedan community. To the British he rendered loyal service, and when the mutiny reached Bijnor in Rohilkand in May 1857 the British residents owed their lives to his courage and tact. Sayyid Ahmad established a translation society, which became the Scientific Society of Aligarh, and encouraged the study of western life and letters. In 1873 he founded the Mohammedan Anglo-Oriental College at Aligarh. He stimulated a similar educational activities in Karachi, Bombay and Hyderabad. Thus he effected a revolution in the attitude of Mohammedans towards modern education. He was made K.C.S.I. and became a member of the legislative councils of India and Allahabad, and of the education commission. He died at Aligarh on March 2, 1898.

See Lieut.-Colonel G. F. I. Graham, *The Life and Work of Sir Saiyad Ahmed Khan* (1885).

SAZONOV, SERGHEI DMITRIEVICH (1866–1927), Russian statesman, was born in the province of Ryazan, July 29, 1866, the son of a landed proprietor, and educated at the Alexandrovsky Lyceum, St. Petersburg (Leningrad), a high school for the sons of noblemen destined mainly for the civil service. Having occupied various diplomatic posts in Rome and served six years in the Russian Embassy in London he was promoted, in 1906, to be Minister-Resident at the Vatican, where his engaging manners, frankness and taste for ecclesiastical affairs enabled him to make great headway. In 1909 he entered the Ministry of Foreign Affairs as coadjutor to Izvolsky, whom he succeeded as Minister in 1910—an appointment ascribed to the influence of his brother-in-law, Stolypin.

Sazonov's line of action was definitely traced for him by the European situation on the one hand and by the limitation of his rôle to that of confidential secretary to the Emperor on the other. His chief functions were to parry Austria's fitful thrusts at Serbia, to curb Serbia's explosive impatience, buoying her up with hopes of a vast legacy to fall due on the death of the Emperor Francis Joseph, and to bespeak the help of England, Italy, Rumania (to whom he also held out hopes of a legacy) and Bulgaria in the coming struggle. These tasks exceeded his powers, and his abortive Near-Eastern policy did not prevent Russia's ruinous collapse during the World War. Yet if his work was not to prove permanent he carried it out with considerable skill, and defended himself ably in his memoirs against the charge that he was seeking to precipitate a World War; although he admitted knowledge of the fact that Hartwig, in Belgrade, was working against his avowed aims. Meanwhile, Sazonov genuinely worked for present peace, to gain time for Stolypin's far-reaching domestic reforms and to allow Russia to consolidate her insecure

domestic and military situation.

The arrangements come to during the Tsar's visit to Potsdam (Nov. 4–5 1910) and the Kaiser's return visit to Wolfsgarten (Nov. 11) respecting the Baghdad railway, North Persia and the maintenance of Turkey, eased the strain, but failed to dispel the atmosphere of mistrust. Sazonov was suspected of a lack of straightforwardness by the Kaiser. Russia's diplomatic representatives abroad were largely to blame for this, and in particular the rashness or awkwardness of ambassador Charykov in Constantinople, who secretly proposed to guarantee that city to Turkey and protect her from all attacks by the Balkan States in return for the freedom of the Straits. Other covert moves also lent colour to the charges of underhand dealing. For example, on the conclusion of the Balkan Alliance of 1912, Sazonov decided to seek Germany's help in overawing the Balkan States and thus preserving peace. He accordingly arranged an interview between the Tsar and the Kaiser at Baltischport on July 4–5 1912, which was followed by a three days' exchange of views between the German Chancellor and the members of the Russian Govt. in St. Petersburg. Yet he concealed from Germany the existence of the Balkan Alliance which had been communicated to him. Sazonov next repaired to London, Paris and Berlin and the Great Powers authorised him and Berchtold to announce their determination to uphold the *status quo*, so that if the Balkan States broke the peace their victory would be fruitless. The veto was successfully ignored by the Balkan Powers, and a European crisis was the result. Sazonov, on this occasion, behaved with moderation. He kept a tight hand on Serbia, obliged her to content herself with a railway harbour on the Albanian coast, a railway connection and the secret assurance that her "promised land" lay within the dual monarchy.

He was next employed in drafting, in collaboration with Bethmann Hollweg, a scheme of reforms for Armenia (Nov. 5, 1913). Immediately afterwards, a fresh conflict with Germany arose over the despatch of General Liman von Sanders to Constantinople. Sazonov gave vent to his dissatisfaction in unusually strong terms, but on the Kaiser ordering Liman to lay down the command of the first Turkish army corps, while retaining his other functions, Nicholas II. let the matter drop. Sazonov then drafted a memorandum to the Tsar on Russia's claim to the freedom of the Straits (Nov. 1913) and three months later (Feb. 21, 1914) convened a council of political and military experts to discuss the ways and means of realising the scheme in case of a European war. But the military experts announced that in the plans of campaign no such side-problems could be included.

On learning of the delivery of the Austro-Hungarian ultimatum to Serbia on July 24, 1914, Sazonov appealed unsuccessfully to Austria to extend the time limit, and advised Serbia to accept all demands except those concerning the sovereign rights of Serbia. Meanwhile, Russia adopted the military measures known as "premobilisation" (July 25), the Tsar and Sazonov planning a partial mobilisation to follow in case Serbia should be attacked. But the General Staff objected that it had no plan ready for a transition from partial to general mobilisation, and that as war seemed unavoidable the latter was imperative. Sazonov still insisted on waiting; meanwhile Berchtold declared war against Serbia (July 28), whereupon Sazonov (in the night of July 28–29) advised the Tsar to sign the order.

A belated telegram, however, from the Kaiser adjuring him to preserve peace for the sake of the monarchic principle moved the Tsar to withdraw the order for general, and substitute that for partial, mobilisation. This command was obeyed in words but the military experts having convinced Sazonov that it would be suicidal, the Minister next morning (July 30) presented himself to the Tsar and obtained his consent to the radical measure advocated by the General Staff. On the following morning this order was posted up in St. Petersburg and the catastrophe, already inevitable, broke loose.

During the War Sazonov countered all influences tending to the abandonment of the struggle by Russia, but he followed the Tsar's lead in demanding first the opening of the Straits and the internationalisation of Constantinople and later on the annexation of the Turkish capital. The hostility of Turkey and Bulgaria impeded assistance from the Allies, whereupon Sazonov made a bid for the help of the Poles in the shape of a Home Rule scheme, but the proposal was scouted in Court circles and he was dismissed from his post. Thus ended his career. His fall was gently broken by his appointment as Ambassador to Great Britain, but before he reached his destination the revolution of March 1917 had deposed the Tsar. Sazonov, however, was willing to represent the Government that had thrust aside his imperial master but it too was suddenly swept away. He was next appointed Minister for Foreign Affairs by Admiral Kolchak; but after 1920 he retired into private life, settling at Versailles, where he occupied himself in writing his memoirs. These appeared in English in 1928 under the title "Fateful Years." They were attacked, especially in Germany, on the ground of insincerity. (*See* the work *Rings um Sazonov:* 1928.) Sazonov died at Nice, Dec. 23, 1927.

SBEITLA (anc. *Sufetula*), a ruined city of Tunisia, 66 m. S.W. of Kairawan. The chief ruin is the Forum, 238 ft. by 198 ft., having three small and one large entrance. The great gateway is a fine monumental arch in fair preservation, with an inscription to Antoninus Pius. Facing the arch, their rear walls forming one side of the enclosure, are three temples, connected with one another by arches, and forming one design. The length of the entire façade is 118 ft. The principal chamber of the central temple, which is of the Composite order, is 44 ft. long; those of the side temples, in the Corinthian style, are smaller. The walls of the middle temple are ornamented with engaged columns; those of the other buildings with pilasters. The porticos have been repaired, and run round the other three sides of the enclosure, which is still partly paved. The other ruins include baths, remains of a theatre, an amphitheatre, a triumphal arch of Diocletian, two churches of the priest Servas and the bishop Bellator, a chapel of the bishop Jucundus (411–419), a still serviceable bridge which also carried an aqueduct, and several square Byzantine forts.

The early history of Sufetula is preserved only in certain inscriptions. Under Antoninus and Marcus Aurelius it was a flourishing city, the district, now desolate, being then very fertile and covered with forests of olives. It was partly rebuilt during the Byzantine occupation and became a centre of Christianity. At the Arab invasion it was the capital of the exarch Gregorius.

See A. Merlin, *Forum et églises de Sufetula* (1912).

SCABIES or **ITCH,** a skin disease due to an animal parasite, the *Acarus* or *Sarcoptes scabiei* (*see* MITE), which burrows under the epidermis at any part of the body, but hardly ever in the face or scalp of adults; it usually begins at the clefts of the fingers, where its presence may be inferred from several scattered pimples, which will probably have been torn at their summits by the scratching of the patient, or have been otherwise converted into vesicles or pustules. The remedy is soap and water, and sulphur ointment.

SCABIOUS, the common name for several European flowers. The common or field scabious (*Knautia arvensis*) and the devil's-bit scabious (*Scabiosa succisa*) belong to the teazel family (Dipsacaceae). The flowers are aggregated together to form a head. The sheep's-bit scabious (*Jasione montana*) belongs to the bell-flower family (Campanulaceae) and is a quite different plant. It resembles the common scabious, however, in having the flowers aggregated together into a head.

SCAEVOLA, the name of a famous family of ancient Rome, the most important members of which were:—

1. GAIUS MUCIUS SCAEVOLA, a legendary hero, who volunteered to assassinate Lars Porsena when he was besieging Rome. He reached Porsena's tent, but slew his secretary by mistake. Before the royal tribunal Mucius declared that he was one of 300 noble youths who had sworn to take the king's life, and that he had been chosen by lot to make the attempt first. Threatened with death or torture, Mucius thrust his right hand into the fire blazing upon an altar, and held it there until it was consumed. The king, deeply impressed and dreading a further attempt upon his life, ordered Mucius to be liberated, made peace with the Romans and withdrew his forces. Mucius was rewarded with a grant of land beyond

the Tiber, known as the "Mucia Prata" in the time of Dionysius of Halicarnassus, and received the name of Scaevola ("left-handed"). The story is presumably an attempt to explain the name Scaevola (Livy ii. 12; Dion. Halic. v. 27–30). The Mucius of the legend is described as a patrician; the following were undoubtedly plebeians.

2. Publius Mucius Scaevola, Roman orator and jurist, consul 133 B.C. during the time of the Gracchan disturbances. He was not opposed to moderate reforms, and refused to use violence against Tiberius Gracchus. After the murder of Gracchus, however, he expressed his approval of the act. He was an opponent of the younger Scipio Africanus, for which he was attacked by the satirist Lucilius (Persius i. 115; Juvenal i. 154). In 130 he succeeded his brother Mucianus as *pontifex maximus.* During his tenure of office he published a digest in 80 books of the official annals kept by himself and his predecessors. Cicero frequently mentions him as a lawyer of repute, and he is cited several times in the Digest. He was also a famous player at ball and the game called Duodecim Scripta; after he had lost a game, he was able to recall the moves and throws in their order.

See A. H. J. Greenidge, *History of Rome.*

3. Quintus Mucius Scaevola, son of (2), usually called *"Pontifex Maximus,"* to distinguish him from (4), consul in 95 B.C. with L. Licinius Crassus the orator. He and his colleague brought forward the *lex Licinia Mucia de civibus regundis* which closed Roman citizenship to the allies in future, and was largely responsible for the Social War. After his consulship Scaevola was governor of the province of Asia, and dealt severely with the tax-farmers. In honour of his memory the Greeks of Asia set aside a day for the celebration of festivities and games called Mucia. He was subsequently appointed *Pontifex Maximus,* and, in accordance with custom, dispensed free legal advice, which was extensively sought, even by men of the standing of Servius Sulpicius. He regulated the priestly colleges, and insisted on observance of the traditional ritual, though he himself believed that religion was only for the uneducated. He was proscribed by the Marian party, and in 82, when the younger Marius, after his defeat by Sulla at Sacriportus, gave orders for the evacuation of Rome and the massacre of the chief men of the opposite party, Scaevola, while attempting to reconcile the opposing factions, was slain at the altar of Vesta and his body thrown into the Tiber. He had already escaped an attempt made upon his life by Gaius Fimbria at the funeral of the elder Marius in 86.

Scaevola was the founder of the scientific study of Roman law and the author of a systematic treatise on the subject, in eighteen books, frequently quoted and followed by subsequent writers. It was a compilation of legislative enactments, judicial precedents and authorities, from older collections, partly also from oral tradition. A small handbook called Ὅροι (*Definitions*) is the oldest work from which any excerpts are made in the *Digest,* and the first example of a special kind of judicial literature (*libri definitionum* or *regularum*). It consisted of short rules of law and explanations of legal terms and phrases. A number of speeches by him, praised by Cicero for their elegance of diction, were in existence in ancient times.

4. Quintus Mucius Scaevola (*c.* 159–88 B.C.), uncle of (3), from whom he is distinguished by the appellation of *"Augur."* He was instructed in law by his father, and in philosophy by the Stoic Panaetius of Rhodes. In 121 he was governor of Asia. Accused of extortion on his return, he defended himself successfully. In 117 he was consul. He was a great authority on law, and at an advanced age he gave instruction to Cicero and Atticus. He had a high appreciation of Marius, and refused to vote for Sulla's motion declaring him a public enemy. Scaevola is one of the interlocutors in Cicero's *De oratore, De amicitia* and *De republica.*

For the legal importance of the Scaevolas, *see* A. Schneider, *Die drei Scaevola Ciceros* (Munich, 1879), with full references to ancient and modern authorities.

SCAFELL (pronounced and sometimes written Scaw Fell), a mountain of Cumberland, England, in the Lake District. The name is specially applied to the southern point (3,162 ft. in height) of a certain range or mass, but Scafell Pike, separated from Scafell by the steep narrow ridge of Mickledore, is the highest point in England (3,210 ft.). The ridge continues north-east to Great End (2,984 ft.), which falls abruptly to a flat terrace, on which lies Sprinkling Tarn. The range thus defined may be termed the Scafell mass. North-west from the Pike the lesser height of Lingmell (2,649 ft.) is thrown out, and the steep flank of the range sweeps down to the head of Wasdale. On the east an even steeper wall, with splendid crags, falls to Eskdale. Above Mickledore ridge Scafell rises nearly sheer, with bold clefts.

SCAFFOLD or **SCAFFOLDING,** properly a platform or stage, particularly one of a temporary character erected for viewing or displaying some spectacle. The most general modern application of the word, however, refers to the temporary frames and platforms erected or suspended at convenient heights to afford easy access to work of construction and repair.

A scaffold, in its simplest form, may be a single plank supported by trestles, or it may be the extremely complicated construction necessary to render every part of a large cathedral or similar building accessible.

Up to a comparatively recent date scaffolds were invariably constructed of timbers bound together with ropes, but now many forms of patent scaffolding and fixing devices are available. The more general adoption of steel-framed buildings has contributed largely towards the development of *suspended scaffolding.* The steel members themselves, supplemented by ladders, provide the only scaffolding necessary in the erection of the frame, and since the steel work is practically completed before the wall filling and facing is commenced, it is more convenient and economical to suspend a single platform—that may extend along the whole face of the building if required, and capable of being raised as the work proceeds—from cantilevers fixed to the top members of the frame, than it is to erect a poled scaffold over the whole face of the building.

Timber Scaffolds.—The ordinary type of timber scaffolding comprises the following:—standards, ledgers, putlogs, braces, scaffold boards and lashings. The standards, ledgers and braces are usually tapering poles (the stripped trunks of young fir trees), about 15 to 35 ft. in length and 3½ to 5 in. in diameter at the butt.

The putlogs are of riven birch, 5 to 6 ft. long and 3 in. in section. Scaffold boards are of spruce, 8 to 12 ft. long, 9 in. wide by 1½ in. thick, with the ends bound by hoop iron to obtain strength and security. The ends of the hoop iron should be turned into saw cuts in the edges of the wood to prevent injury to the workmen while handling the boards.

Until recently the lashings were, in nearly every case, made of jute or hemp fibres, white Manila hemp being the best and strongest. Flexible wire cords are now used to a considerable extent for lashings. These cords are about ¼ in. in diameter and are sufficiently long for every form of scaffold junction. They are made of several strands of small gauge wire, one end of the cord being finished with a metal cap or sleeve to prevent the strands from spreading, the other end being turned around a metal eye piece and securely bound or spliced. Scaffold wedges are unnecessary with wire cords.

Chain ties and tightening blocks are frequently used in the place of cord lashings and require less time for fixing. Such a form of scaffold fixing was used in the scaffolding erected for the reconstruction of Buckingham palace, and in many other important works, and proved to be satisfactory.

Bricklayer's Scaffold.—In erecting a bricklayer's scaffold, the standards are placed upright at a distance of 5 ft. from the face of the wall and from 6 to 9 ft. apart; the lower ends of the standards being held in position by the method best suited to the nature of the site. Thus, the ends may be placed in barrels of earth or sand, they may be placed on a timber sole plate and held in position by nailed fillets; or they may be sunk a foot or two into the ground. The ledgers are fixed horizontally along the inner faces of the standards at vertical intervals of 5 feet. The putlogs are placed 3 or 4 ft. apart, perpendicular to the face of the wall, one end of each putlog resting on the ledger, the other end passing into a recess left, or made, in the wall for that purpose. The scaffold boards are laid on the putlogs and parallel to the face of the wall. At the position where the end joints between the boards occur, two putlogs are placed a few inches

apart to obviate the necessity for lapping the ends of the boards.

Scaffolds of this type should always have diagonal braces fixed across the faces of the standards to avoid risk of failure by side racking, and the scaffold must be prevented from falling away from the face of the wall by ties or bridles through the window openings. The third possible cause of failure, the buckling of the standards, is guarded against in scaffolds supporting heavy loads by having the whole or lower part of the scaffold "double poled." All scaffolds should have guard planks and guard rails fixed to the outer standards.

As the work is carried up the boarding and many of the putlogs are removed to the stage above, some putlogs, however, being left tied to the lower ledgers to stiffen the scaffold. In the case of thick walls a scaffold is required inside as well as outside the building, and when this is the case the two structures are tied together and stiffened by short connecting poles through the window and door openings.

Mason's Scaffold.—The mason requires an independent scaffold. He may not rest the inner ends of his putlogs in the wall as the bricklayer does, for this would disfigure the stonework, hence another and parallel framework of standards and ledgers is placed within a few inches of the wall-face upon which to support them. The two portions are tied together with cross braces, and the whole of the timbering is made capable of taking heavier weights than are required in the case of the bricklayer.

Masons' scaffolds upon which banker work is done are usually of sawn material bolted together; the arrangement of the rectangular members corresponding to that in the ordinary type of scaffold.

Metal or Tubular Scaffold.—This type of scaffolding was used during the process of erection of Bush house, Aldwych, Devonshire house, Piccadilly and many other important buildings in London and the provinces, and must now be noticed in any reference work on scaffolding.

The special advantages claimed for tubular scaffolding are:—It is easily transported; since 12 feet is the maximum length of any member a great quantity may be stored in an ordinary truck. Its strength is beyond question, it is fireproof and practically indestructible. It is easily introduced into narrow or tortuous entrances, and may be erected with great rapidity and little labour. It is not affected by climatic conditions, is neat and compact when erected and is light and efficient for slung scaffolds.

Tubular scaffolding consists of sections of steel tubes, about 2 in. in diameter and of various lengths, with various forms of clips and couplings, base plates and patent putlogs.

The putlogs are of oak reinforced with steel, the steel projecting beyond the wood to allow it to be inserted and wedged into the brickwork joints when necessary. Thus putlog holes are not required to be left or made in the wall surfaces. The standards are not placed more than 8 feet apart for ordinary scaffolds, and not more than 6 feet apart for masons' scaffolds. The diagonal bracing is fixed by special swivel couplers.

Suspended Scaffolding.—Where the nature of the building will permit of its use suspended scaffolding has many very important advantages. Thus, in high steel framed buildings the lower floors may be occupied before the upper ones are completed. The scaffold platform may be kept at the position in which the work is always at bench height. The space immediately below the scaffold is clear of obstructions. The scaffold platform is flexible and its height may be varied along its length, within certain limits, to suit special conditions.

This form of scaffolding was used in Adelaide House, London, E.C.; the Lewis Building, Birmingham; Messrs. C. and A. Modes Ltd., Liverpool, and many other equally large and important buildings, and has proved to be safe, convenient and economical. The complete scaffold is made up of a number of units or sections.

Each section has a machine or winch at each corner, the supporting cables being wound or unwound about the machine drum by a device specially designed to ensure safety while raising or lowering the platform.

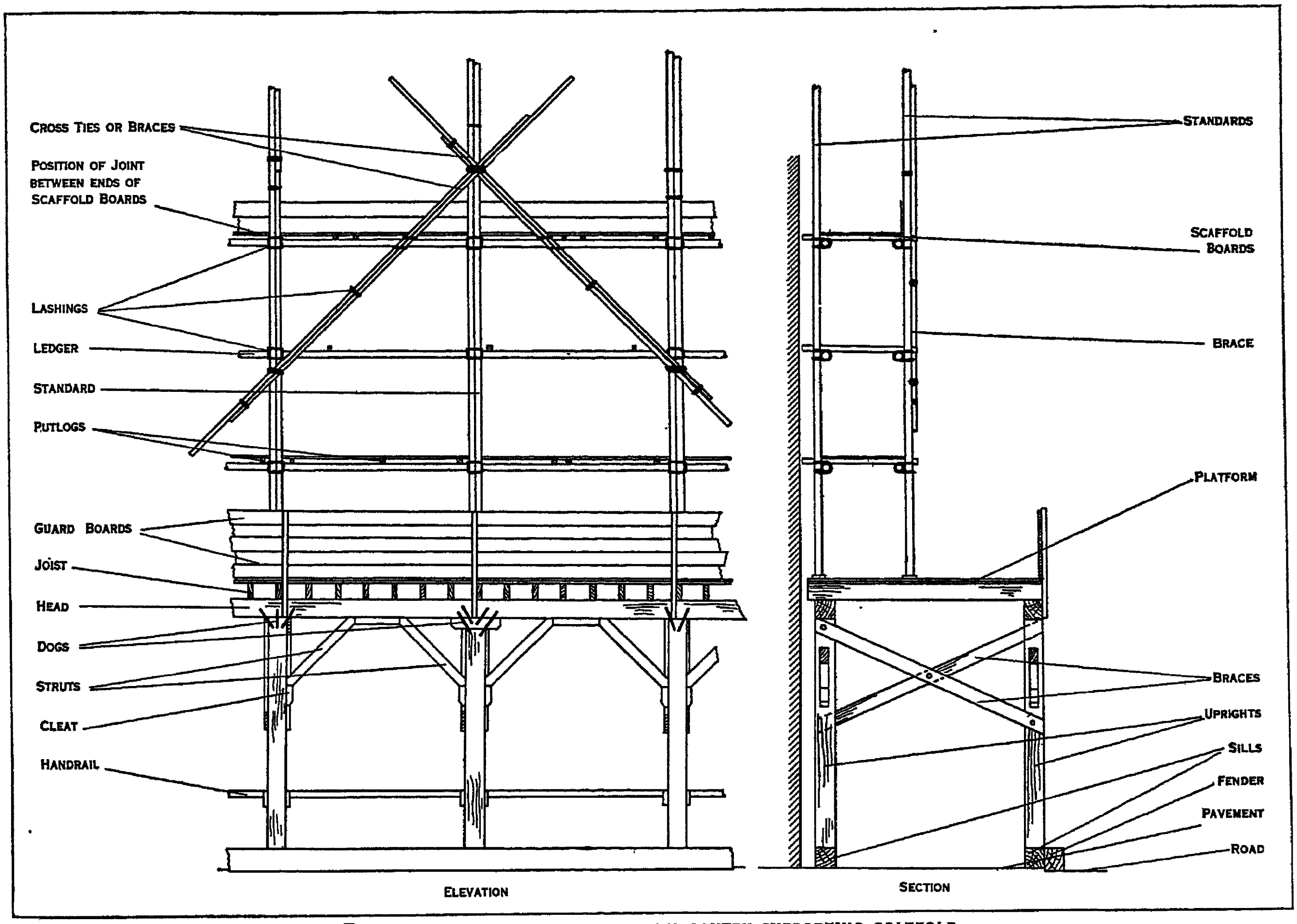
Gantries.—"Gantry" is the term applied to a staging of squared timber used for the easy transmission of heavy material. The name has, however, come to be used generally for strong stagings of squared timber whether used for moving loads or not. Taking the general meaning of the term, gantries may be divided into three classes: (1) Gantries supporting a traveller; (2) Travelling gantries, in which the whole stage moves along rails placed on the ground: (3) Elevated platforms which serve as a base upon which to erect pole scaffolding.

The two former of this type of structure are now little used. Many more or less permanent timber gantries exist in goods yards and similar places but modern methods of handling and hoisting materials have rendered the old type of traveller gantry almost obsolete.

The form of fixed staging or platform gantry which is used over a public pavement is indispensable for conducting building operations in large towns where it is important to keep the footway clear and to safeguard pedestrians who are using the footway in front of the building site. They consist of two sets of standards, sill and head, one set being erected close to the building and the other about 8 or 10 ft. away. These stages are formed of square timber, framed and braced in a similar manner to gantries designed to support a traveller, but, instead of external shores or braces the uprights are braced across to each other, care being taken to fix the braces at such a height as to allow free passage beneath them. Joists are placed across from head to head, and a double layer of scaffold boards is laid to form the floor, the double thickness being necessary to prevent materials dropping through the joints upon the heads of passers-by. When the gantry abuts on the road, a heavy timber fender splayed at each end should be placed so as to ward off the traffic. At the level of the platform a fanguard is often thrown out for a distance of about 6 ft. or more and closely boarded to protect the public from falling materials and the workmen from accident.

Derrick Towers.—Derrick "gantries" or "towers" are skeleton towers of heavy timbers erected in a central position on a site to support a platform at such a height as to enable an electric or steam power derrick crane placed upon it to clear the highest portions of the building. The crane revolves upon a base through nearly three parts of the circumference of a circle, and in addition to this the jib of the crane is capable of an "up and down" motion which enables it to command any spot within a radius of three-quarters of the length of the jib. For a single crane, a derrick tower with three legs is built, and the crane is placed over one of these, stayed back to the other two and then counterbalanced by heavy weights. Each leg is usually from 6 ft. to 10 ft. square on plan, the "king" leg (that is, the leg supporting the crane) being larger than the "queen" legs. The three legs are placed from 20 to 30 ft. apart in the form of an equilateral or isosceles triangle. When two cranes are used, as is the case when important operations are to be conducted over the entire area of a circle, a four-legged square derrick tower is constructed, and a crane set upon a platform over each of two opposite legs. The ground upon which it is proposed to erect the towers must be well chosen for its solidity, or specially prepared to receive the towers. The foundation usually consists of a platform of 9-in. by 3-in. deals under each leg. The corner posts may be of three 9-in. by 3-in. deals bolted together, but those for the king leg may advantageously be larger. They are connected at every 8 or 10 ft. of their height by means of cross pieces or transoms from 7″ by 2″ to 9″ by 3″ in size, and each bay thus formed is filled in on all four sides with diagonal bracing of the same or slightly smaller timber. Up the centre of the king leg, from the bottom to the top, is carried an extra timber to take the weight of the crane. It may be a balk of whole timber, 12 or 14 in. square, or may consist of deals bolted together up to 16 in. square. This central member must be well braced and strutted from the four corners to resist any tendency to bending.

When the towers have reached the desired height the king leg is connected to each of the queen legs by a trussed girder; the two queen legs may be connected with each other either by a similar trussed girder or by a single timber which is supported by struts from the supporting legs to shorten the span and give rigidity. For the connecting girders a balk of timber reaching from king to



ELEVATION AND SECTION OF PLATFORM GANTRY SUPPORTING SCAFFOLD

queen legs is placed on each of the two topmost transoms, which may be from 4 to 8 ft. apart, the depth of the top bays often being modified to the required depth of the connecting beams. Upright struts are fixed at intervals of about 5 ft. between the two balks, which are also connected by long iron bolts and cross braces filled into each bay. The top balks project 6 or 10 ft. beyond the king leg and form the support for a working platform of deals. Struts are thrown out from the sides of the leg to support the ends of the balks. Upon the platform are laid two "sleepers" of balk timber extending from beneath the bed of the crane and passing over the centre of each queen leg. The "mast," a vertical member composed either of a single timber or two pieces strutted and braced, is erected upon the revolving crane bed, and the "jib," which is similar in construction to the mast, is attached to the base of the latter by a pivoted hinge. The jib is raised and lowered by a rope fixed near the end of the jib and running to the engine by way of a pulley wheel at the top of the mast. The rope or chain used for lifting the materials passes over a pulley at the end of the jib and thence to the winch over a pulley at the top of the mast. In the operation of lifting it is obvious that a great strain is put upon the mast and a considerable overturning force is exerted by the leverage of the weight lifted at the end of the jib. To counter-balance this, two timber "stays" or "guys" are taken from the mast head, one to the centre of each queen leg, and there secured. From these points two heavy chains are taken down the centre of each queen leg and anchored to the platform at their bases, which are each loaded with a quantity of bricks, stone or other heavy material equal in weight to at least twice any load to be lifted by the crane. A coupling screw link should be provided in the length of each anchor chain, so that it may be kept taut. The coupling screws should be placed in an accessible place near the ground, where they may easily be seen and tightened when necessary. The legs of the structure should be cross braced with each other to resist twisting tendencies due to wind pressure and swinging of the load, either by ties of steel bars with tightening screws, or, as is more usual, with diagonally placed scaffold-pole or squared-timber braces secured to the framework.

In the case of a three-towered gantry it is necessary to ballast only the two queen legs. Weighting of the king leg is unnecessary. With a square gantry having four legs, all should be weighted, and in calculating the ballast necessary for the crane towers the weight of the engine should be considered. Access to the platform is obtained by ladders fixed either inside or outside one of the queen legs. With the exception of the boards forming the working platform, which are usually spiked down, the timbers of a tower gantry should all be connected by screw bolts and nuts.

In steel-framed buildings the derrick tower is unnecessary, the revolving jib, base and engine being supported by the steel work and raised to succeeding heights as the work proceeds.

Swinging scaffolds or cradles, used in connection with painting, renovating and light repair work consists of light rigidly framed platforms suspended from cantilever supports. They are capable of being raised or lowered by the occupants of the cradle by means of block and fall tackle. A newer type of cradle is a modified form of the suspended scaffolding already described, the raising and lowering being done by machines attached direct to the metal frames which hold the platform and guard rails, instead of by "block and fall."

Scaffolding for Chimneys.—Tall chimney shafts may be erected by internal scaffolding only, or by a combination of external and internal staging. The latter method is often adopted when the lower part of the shaft is designed with ornamental brickwork, string courses, panels, etc., and it is important that this work should be carefully finished. An external scaffold is therefore carried up until plain work not more than 2 or $2\frac{1}{2}$ bricks thick is reached, when the remainder can be completed by "overhand"

work from an internal scaffold. The offsets made in the brickwork on the inside are used to support the timbering. For the repair of tall chimneys, light ladders are erected one above the other by a steeplejack and his assistants, each being lashed to the one below it and secured to the brickwork by dog-hooks driven in the joints. When the top of the chimney is reached balk timbers are raised by pulleys and laid across the top. From these are swung cradles from which the defective work is made good. If the work or weather demand a more stable scaffold, a light but strong framework of putlogs held together with iron bolts is fixed on each side of the shaft with iron holdfasts, and a platform of boards is laid upon them. For circular chimneys pieces of timber cut to a curve are clamped with iron to the putlogs to prevent them from bending when the bolts connecting the two frames are screwed up.

See J. F. Hurst, *Tredgold's Carpentry;* A. G. H. Thatcher, *Scaffolding;* C. F. Mitchell, *Building Construction;* G. Ellis, *Modern Practical Carpentry.*

SCALA NUOVA (Turk. *Kush-Adasi*), also known as New Ephesus, a well-protected harbour on the west coast of Asia Minor and a kasa in the vilayet of Smyrna, opposite Samos. The site of the ancient Marathesium is close by. Pop. (1927) 14,715.

SCALE, in music, signifies any selected sequence of notes, or intervals, dividing up the octave. Thus it may consist entirely of semitones (chromatic scale); or entirely of whole tones (tonal scale); or partly of tones and partly of semitones, as in the ordinary diatonic scales, major and minor, of Western music. Our familiar major diatonic scale, represented by the white notes on the pianoforte beginning with C, consists of five tones and two semitones, with the semitones falling between the 3rd and 4th and the 7th and 8th notes.

SCALE INSECT, the name given to insects belonging to the family *Coccidae* of the order Hemiptera (*q.v.*). The females are inert wingless creatures usually with reduced legs and antennae, while the males are provided with a single pair of wings and have the legs and antennae well developed. Scale insects include a number of serious plant-pests, among the most injurious being the San José scale, the mussel scale, the fluted scale and certain of the mealy bugs. On the other hand, other species have a commercial value, notably the cochineal insect (*q.v.*), the lac insect (*q.v.*) and the so-called ground pearls (*q.v.*).

SCALES: *see* WEIGHING MACHINES.

SCALIGER, the Latinized name of the great Della Scala family. (*See* VERONA.) It has also been borne by two scholars of extraordinary eminence.

1. **Julius Caesar Scaliger** (1484–1558) was, according to his own account, a scion of the house of La Scala, born in 1484 at the castle of La Rocca on the Lago de Garda. At the age of twelve his kinsman the emperor Maximilian placed him among his pages. He remained for seventeen years in the service of the emperor, distinguishing himself as a soldier and as a captain. But he was unmindful neither of letters, nor of art, which he studied under Albrecht Dürer. In 1512 at the battle of Ravenna, where his father and elder brother were killed, he displayed prodigies of valour, and received the highest honours of chivalry, but no substantial reward, from his imperial cousin. After a brief employment by the duke of Ferrara, he entered (1514) as a student at the university of Bologna, where he remained until 1519. The next six years he passed in Piedmont, as a guest of the family of La Rovère, until a severe attack of rheumatic gout brought his military career to a close. Henceforth his life was wholly devoted to study. In 1525 he accompanied M. A. de la Rovère, bishop of Agen, to that city as his physician. Such is the outline of his own account of his early life. It was not until after his death that his son's enemies first alleged that he was the son of Benedetto Bordone, an illuminator or school-master of Verona; that he was educated at Padua, where he took the degree of M.D.; and that his story of his life and adventures before arriving at Agen was a tissue of fables. (*See* below *ad fin.*)

The remaining thirty-two years of his life were passed almost wholly at Agen, in the full light of contemporary history. At his death in 1558 he had the highest scientific and literary reputation of any man in Europe. A few days after his arrival at Agen he fell in love with Andiette de Roques Lobejac, and at forty-five he married Andiette, who was then sixteen. The marriage, of which there were fifteen children, was one of almost uninterrupted happiness. In 1531 he printed his first oration against Erasmus, in defence of Cicero and the Ciceronians. It is a piece of vigorous invective, displaying an astonishing command of Latin, and much brilliant rhetoric, but full of vulgar abuse, and completely missing the point of the *Ciceronianus* of Erasmus. The second is even more abusive, and less successful. The orations were followed by a prodigious quantity of Latin verse, which appeared in successive volumes in 1533, 1534, 1539, 1546 and 1547; of these, a friendly critic, Mark Pattison, is obliged to approve the judgment of Huet, who says, "par ses poésies brutes et informes Scaliger a déshonoré le Parnasse." A brief tract on comic metres (*De comicis dimensionibus*) and a work *De causis linguae Latinae*—the earliest Latin grammar on scientific principles and following a scientific method—were his only other purely literary works published in his lifetime. His *Poetice* appeared in 1561 after his death.

His scientific writings are all in the form of commentaries, and it was not until his seventieth year that (with the exception of a brief tract on the *De insomniis* of Hippocrates) he published any of them. In 1556 he printed his *Dialogue* on the *De plantis* attributed to Aristotle, and in 1557 his *Exercitationes* on the work of Jerome Cardan, *De subtilitate.* His other scientific works, *Commentaries* on Theophrastus' *De causis plantarum* and Aristotle's *History of Animals,* left in a more or less unfinished state, were not printed until after his death. His *Exercitationes* upon the *De subtilitate* of Cardan (1557) is the book by which Scaliger is best known as a philosopher. We are astonished at the encyclopaedic wealth of knowledge which the *Exercitationes* display, at the vigour of the author's style, at the accuracy of his observations, but are obliged to agree with G. Naudé that he has committed more faults than he has discovered in Cardan, and with Charles Nisard that his object seems to be to deny all that Cardan affirms and to affirm all that Cardan denies. Yet Leibniz and Sir William Hamilton recognized him as the best modern exponent of the physics and metaphysics of Aristotle. He died at Agen on Oct. 21, 1558.

2. **Joseph Justus Scaliger** (1540–1609), the greatest scholar of his day, was the tenth child of J. C. Scaliger. Born at Agen in 1540, he was sent when twelve years of age, with two younger brothers, to the college of Guienne at Bordeaux. An outbreak of the plague in 1555 caused the boys to return home, and for the next few years Joseph was his father's constant companion and amanuensis. Julius daily dictated to his son from eighty to a hundred lines of Latin verse, and sometimes more. Joseph was also required each day to write a Latin theme or declamation, though in other respects he seems to have been left to his own devices. He learned from his father to be an acute observer, never losing sight of the actual world, and aiming not so much at correcting texts as at laying the foundation of historical criticism.

After his father's death, he spent four years at the university of Paris, where he began the study of Greek under Turnebus. At the same time he taught himself. He read Homer in twenty-one days, and then went through all the other Greek poets, orators and historians, forming a grammar for himself as he went along. From Greek, at the suggestion of G. Postel, he proceeded to attack Hebrew, and then Arabic; of both he acquired a respectable knowledge, though not the critical mastery which he possessed in Latin and Greek. In 1563 Jean Dorat recommended him to Louis de Chastaigner, the young lord of La Roche Pozay, as a companion in his travels. A close friendship sprang up between the two young men, which remained unbroken till the death of Louis in 1595. The travellers first went to Rome. Here they found Marc Antoine Muretus, who had been a great favourite and occasional visitor of Julius Caesar at Agen. After visiting Italy, the travellers passed to England and Scotland. Scaliger formed an unfavourable opinion of the English. Their inhuman disposition, and inhospitable treatment of foreigners especially impressed him. He was also disappointed in finding few Greek manuscripts and few learned men. It was not until much later that he became intimate

with Richard Thompson and other Englishmen. In the course of his travels he had become a Protestant. In 1570 he proceeded to Valence to study jurisprudence under Cujas, the greatest living jurist. Here he remained three years.

The massacre of St. Bartholomew induced him to retire to Geneva, where he was appointed a professor in the academy. In 1574 he returned to France, and made his home for the next twenty years with Chastaigner. Of his life during this period we have interesting details and notices in the *Lettres françaises inédites de Joseph Scaliger,* edited by M. Tamizey de Larroque (Agen, 1881). During this period he published the books which showed that with him a new school of historical criticism had arisen. In his editions of the *Catalecta* (1575), of Festus (1575), of Catullus, Tibullus and Propertius (1577), he was the first to lay down and apply sound rules of criticism and emendation, and to change textual criticism from a series of haphazard guesses into a "rational procedure subject to fixed laws" (Pattison). But it was reserved for his edition of Manilius (1579), and his *De emendatione temporum* (1583), to revolutionize all the received ideas of ancient chronology—to show that ancient history is not confined to that of the Greeks and Romans, and that the historical narratives and fragments of Persia, Babylonia, Egypt and Palestine, and their several systems of chronology, must be critically compared, if any true and general conclusions are to be reached. It is this which places Scaliger immeasurably above any of his contemporaries. His commentary on Manilius is really a treatise on the astronomy of the ancients, and it forms an introduction to the *De emendatione temporum,* in which he examines by the light of modern and Copernican science the ancient system as applied to epochs, calendars and computations of time.

In the remaining twenty-four years of his life he at once corrected and enlarged the basis which he had laid in the *De emendatione.* With incredible patience, sometimes with a happy audacity of conjecture which itself is almost genius, he succeeded in reconstructing the lost *Chronicle* of Eusebius—one of the most precious remains of antiquity, and of the highest value for ancient chronology. This he printed in 1606 in his *Thesaurus temporum,* in which he collected, restored and arranged every chronological relic extant in Greek or Latin. When in 1590 Lipsius retired from Leyden, the university resolved to obtain Scaliger as his successor. He declined their offer. The next year it was renewed. It was made clear that lecturing would not be required of him, and he would be entirely his own master. About the middle of 1593 he started for Holland, where he passed the remaining thirteen years of his life. He was treated with the highest consideration. His rank as a prince of Verona was recognized. His literary dictatorship was unquestioned. From his throne at Leyden he ruled the learned world; a word from him could make or mar a rising reputation; and he was surrounded by young men eager to listen to and profit by his conversation. He encouraged Grotius when only a youth of sixteen to edit Capella; Daniel Heinsius, from being his favourite pupil, became his most intimate friend.

But Scaliger had made numerous enemies. He hated ignorance, but he hated still more half-learning, and most of all dishonesty in argument or in quotation. His pungent sarcasms were soon carried to the persons of whom they were uttered, and his pen was not less bitter than his tongue. Nor was he always right. He trusted much to his memory, which was occasionally treacherous. The Jesuits, who aspired to be the source of all scholarship and criticism, perceived that the writings and authority of Scaliger whose historical methods had discredited many of their claims were the most formidable barrier in their way. It was the day of conversions. Muretus in the latter part of his life professed the strictest orthodoxy; J. Lipsius had been reconciled to the Church of Rome; Casaubon was supposed to be wavering; but Scaliger was known to be hopeless, and as long as his supremacy was unquestioned the Protestants had the victory in learning.

After several scurrilous attacks by the Jesuit party, in 1607 a new and more successful attempt was made. Scaliger's weak point was his pride. In 1594, in an evil hour for his happiness and his reputation, he published his *Epistola de vetustate et splendore gentis Scaligerae et J. C. Scaligeri vita.* In 1607 Gaspar Scioppius, then in the service of the Jesuits, whom he afterwards so bitterly libelled, published his *Scaliger hypobolimaeus* ("the Supposititious Scaliger"). The main argument of the book is to show the falsity of Scaliger's pretensions to be of the family of La Scala, and of the narrative of his father's early life. To Scaliger the blow was crushing. Whatever the case as to Julius, Joseph had undoubtedly believed himself a prince of Verona, and in his *Epistola* had put forth with the most perfect good faith, and without inquiry, all that he had heard from his father. His reply, *Confutatio fabulae Burdonum,* was not a success. Scaliger undoubtedly exposes many pure lies and baseless calumnies; but he could not establish the family's supposed lineage. Scioppius was wont to boast that his book had killed Scaliger. It certainly embittered the remainder of his life. The *Confutatio* was his last work. Five months after it appeared, on Jan. 21, 1609, he died.

Of Joseph Scaliger the standard biography is that of Jacob Bernays (Berlin, 1855). *See* also his *Autobiography, with selections from his letters etc.,* trs. with introd. by G. W. W. Robinson (1927). *See* also J. E. Sandys, *History of Classical Scholarship,* ii. (1908), 199–204. For the life of J. C. Scaliger *see* the letters edited by his son, and his own writings, which are full of autobiographical matter.

SCALLOP. The popular name for a genus (*Pecten*) of edible marine molluscs belonging to the class Lamellibranchia. Nearly 300 living species of scallops are known and are found in all seas, from high latitudes to the tropics. The "scallop-shell of quiet" (Sir W. Raleigh) was worn as a badge by mediaeval pilgrims.

Pecten is placed in the second order (Filibranchia) of the Lamellibranchia along with *Arca* (the ark shell), *Mytilus* (mussels) and *Margaritana* (the pearl oyster). This group is characterized by the possession of gills in which the filaments are doubled on themselves, forming reflected lamellae (*see* LAMELLIBRANCHIA) and are joined together by ciliated disks, and by the highly developed byssus. In *Pecten* the foot is rudimentary and the animal is more or less sedentary, the byssus serving to fasten it down to the sea-bottom. The edges of the mantle are provided with highly developed eyes.

The common scallop of the British Isles (*Pecten opercularis*) is usually found in beds on a bottom composed of shell-débris with a little mud. Some of the largest beds are in the Firth of Forth, between Fleetwood and the Isle of Man, off Douglas and Weymouth. These beds are usually in water of 5–20 fathoms, though individual specimens are occasionally taken from much deeper water. Representatives of the sub-genus *Pseudoamussium* are found at greater depths (*e.g., P. neoceanicus* in 2,084 fathoms in the Pacific ocean).

See W. J. Dakin, "Pecten," *Mem. Liverpool Mar. Biol. Comm., xvii.* (1909); M. Küpfer *Die Sehorgane . . . der Pecten-arten.* (Zürich, 1916). (G. C. R.)

SCALP, in anatomy, the covering of the top of the head from the skin to the bone.

The skin of the scalp is thick and contains a large number of hair follicles. The arteries are remarkable for their tortuosity, which is an adaptation to so movable a part; for their anastomosing across the middle line with their fellows of the opposite side, an arrangement which is not usual in the body; and for the fact that, when cut, their ends are held open by the dense fibrous tissue in which they lie, so that bleeding is more free in the scalp than it is from arteries of the same size elsewhere in the body.

The veins do not follow the twists of the arteries but run a straight course; there is often a considerable distance between an artery and its companion vein. Accompanying the veins are the larger lymphatic vessels. From the forehead the lymphatics accompany the facial vein and usually reach their first gland in the submaxillary region, so that in the case of a poisoned wound of the forehead sympathetic swelling or suppuration would take place below the jaw. From the temple the lymphatics drain into a gland lying just in front of the ear, while those from the region behind the ear drain into glands lying close to the mastoid process. In the occipital region a small gland (or glands) is found about a third of the distance from the external occipital protuberance to the tip of the mastoid process (*see* SKULL).

The nerve supply of the scalp in its anterior part is from the fifth cranial or trigeminal nerve (*see* NERVES, CRANIAL); behind

the ear the scalp is supplied with sensation by the great auricular and the small occipital (*see* NERVES, SPINAL), while behind these, and reaching as far as the mid line posteriorly, the great occipital is distributed.

Beneath the skin and fibrous tissue lies the *epicranium,* formed by the two fleshy bellies of the occipito-frontalis muscle and the flattened tendon or aponeurosis between them. Of these two bellies the anterior (*frontalis*) is the larger, and, when it acts, throws the skin of the forehead into transverse puckers. The much smaller (*occipitalis* or posterior) belly usually merely fixes the aponeurosis for the frontalis to act, though some people have the power of alternately contracting the two muscles and so wagging their scalps backward and forward as monkeys do.

Deep to the epicranium is a layer of very lax areolar tissue constituting a lymph space and allowing great freedom of movement to the more superficial layers; it was this layer which was torn through when a Red Indian scalped his foe. So lax is the tissue here that any collection of blood or pus is quickly distributed throughout its whole area, and, owing to the absence of tension as well as of nerves, very little pain accompanies any such effusion.

The deepest layer of the scalp is the *pericranium* or the external periosteum of the skull bones. This, until the sutures of the skull close in middle life, is continuous with the dura mater which forms the internal periosteum, and for this reason any subpericranial effusion is localized to the area of the skull bone over which it happens to lie. Moreover, any suppurative process may extend through the sutures to the meninges of the brain.

(F. G. P.)

SCALPING. The common term for the practice of removing, as a trophy, a portion of the skin, "shell" or "sheath," with hair attached, from an enemy's head. The custom was not unknown to the Old World, as it was mentioned by Herodotus as practised by the Scythians. It has been regarded, however, as a prevalent one among the American Indians, yet, contrary to the general belief, not all the tribes practised it by any means. Extended researches by Friederici indicate that in North America it was confined originally to a limited area in eastern United States and the lower St. Lawrence region, about equivalent to the territory held by the Iroquois and Muskhogean tribes and their neighbours. The custom was absent from New England and much of the Atlantic coast region, and was unknown until comparatively recent times throughout the interior and the Plains area; it was not practised on the Pacific coast, in the Canadian North-west nor in the Arctic region, nor anywhere south of the United States with the exception of an area in the Gran Chaco country of South America. Throughout most of America the early trophy was the head itself. The spread of the scalping practice over the greater part of central and western United States was stimulated by scalp-bounties offered by the colonial and more recent governments, the scalp itself being superior to the head as a trophy by reason of its lighter weight and greater adaptability to display and ornamentation.

The operation of scalping was painful, but by no means fatal. The impression that it was fatal probably arose from the fact that the scalp was usually taken from the head of a slain enemy as a trophy of his death, but among the Plains tribes the attacking warrior frequently strove to overpower his enemy and scalp him alive, to inflict greater agony before killing him; and frequently also a captured enemy was scalped alive and permitted to return to his people as a direct defiance and as an incitement to retaliation. The part taken was usually a small circular patch of skin at the root of the scalp-lock just back of the crown. The scalp-lock itself was the small hair braid which hung from the back of the head, as distinguished from the larger side braids. When opportunity offered, the whole top skin of the head, with the hair attached, was removed, to be divided later into smaller locks for decorating the clothing of warriors. The operation was performed by making a quick knife stroke around the head of a fallen enemy, followed by a strong tug of the scalp-lock. The scalper was not necessarily he who had killed the victim; nor was the number of scalps, but rather the number of *coups* (*i.e.,* "strokes" or acts of bravery in battle), the measure of the warrior's prowess. The fresh scalp was sometimes offered with prayer as a sacrifice to the sun, the water or some other divinity. When preserved for a time, as was most usual, the scalp was cleaned of the loose flesh and then stretched by means of sinew cords around the circumference within a hoop about six inches in diameter, tied at the end of a rod. When dry the skin side was painted either entirely red, or one half red and the other half black, and the hair was usually carefully braided and embellished with various ornaments. It was carried thus by the women in the triumphal scalp or victory dance on the return of a successful war-party to the home camp, and then, having served its first purpose, was retained as a bridle pendant by the warrior, deposited with the tribal "medicine," or thrown away in some secluded spot. This may be regarded as the typical treatment; but scalp customs varied from tribe to tribe, as likewise did the associated beliefs and rites. The custom is involved with that of decapitation, the severing of parts of the body, such as fingers, etc., as war trophies, and the shrinking of the heads of enemies as among the Jivaro Indians of Ecuador.

See G. Friederici, *Skalpieren und ähnliche Kriegsgebräuche in Amerika* (Brunswick, 1906), with extended bibliography, and summarized in *Ann. Rep. Smithsonian Inst. for 1906* (Washington, 1907).

(F. W. H.)

SCAMMONY, a plant, *Convolvulus Scammonia,* native to the countries of the eastern Mediterranean basin; it grows in bushy waste places, from Syria in the south to the Crimea in the north, its range extending westward to the Greek islands, but not to northern Africa or Italy. It is a twining perennial, bearing flowers like those of the field or corn bindweed, *Convolvulus arvensis,* and having irregularly arrow-shaped leaves and a thick fleshy root. The dried juice, "virgin scammony," obtained by incision of the living root, has been used in medicine as *scammonium,* but the variable quality of the drug has led to the employment of *scammoniae resina,* which is obtained from the dried root by digestion with alcohol. The active principle is the glucoside scammonin or jalapin, $C_{34}H_{56}O_{16}$; it is a powerful purgative.

SCAMOZZI IONIC ORDER, in architecture, a type of Ionic order in which the capital has all four faces identical, with the volutes meeting at an angle in the corners, and at the centre rolling down into the top of the echinus, instead of being connected by a band above the echinus. There is usually a rosette or flower in the centre of each face of the capital, on top of the echinus, and the abacus or top slab is concave-sided as in the Corinthian order. It receives its name from the late Renaissance architect Vincenzo Scamozzi (1552–1616), who was once thought to have invented it, although there are Roman precedents, such as the temple of Saturn at Rome (early 4th century). *See* ORDER.

SCANDAL, disgrace, discredit, shame, caused by the report or knowledge of wrongdoing, hence defamation or gossip, especially malicious or idle; or such action as causes public offence or disrepute. A particular form of defamation was *scandalum magnatum,* "slander of great men," words, that is, spoken defaming a peer spiritual or temporal, judge or dignitary of the realm. Action lay for such defamation under the statutes of 3 Edw. I. c. 34, 2 Rich. II. c. 5, and 12 Rich. II. c. 11 whereby damages could be recovered, even in cases where no action would lie, if the defamation were of an ordinary subject, and that without proof of special damage. These statutes, though long obsolete, were only abolished in 1887 (Statute Law Revision Act).

SCANDINAVIAN CIVILIZATION. At the close of the Ice Age climatic conditions at last allowed man to enter Scandinavia; but authorities differ as to when this occurred, suggestions varying from 10,000 B.C. to 6,000 B.C.

Epipalaeolithic Period.—The earliest civilizations belong to the so-called Epipalaeolithic Period, of which two stages are at present recognised in Denmark, called after their type-stations the Maglemose and Ertebolle Periods. The former is that of a race of fishermen who lived on the shores of the Baltic while it was still a great fresh-water lake (called by geologists Ancylus lake); at Maglemose were found many tools of bone, horn and stone: the most typical being the barbed harpoon of bone or

horn and a chipped flint axe known as the tranchet. Pottery was not found. In the following period (Ertebolle) a rise in sea-level had allowed the sea to flow into the Baltic (this is called by geologists the Littorina sea). The typical remains of this age are usually found in vast rubbish-heaps or kitchen-middens (kjøkkenmøddinger). Bone and horn tools and other objects, *e.g.*, combs were still used, but flint was now the most important material. Pottery had come into use, the commonest form being a wide-mouthed bulging jar with pointed base. It is probable that in Norway and Sweden similar settlements existed, at present less fully known; for instance, remains at Nøstvet in Norway and at Limhamn in Sweden resemble and may be contemporary with those at Ertebolle. With the exception of the dog, domestic animals were unknown at this period, and agriculture was not practised.

Neolithic Period.—In the remoter districts of Norway and Sweden the epipalaeolithic people retained their primitive mode of life for a long time, untouched by the more advanced, neolithic civilizations developing to the south of them.

Our knowledge of these neolithic civilizations is almost entirely gathered from a study of the burial customs of the period. Such dwellings as are known are simple circular mud huts, containing few remains but animal bones, etc. All the more important graves of this period in Scandinavia are megalithic structures, a chronological sequence of three types being recognised (corresponding to Montelius' Periods II., III. and IV.). The earliest form of tomb was the *Dolmen* (*q.v.*), a small chamber enclosed by three or more rude upright stones, roofed by a single great stone slab, and often still partially covered by a mound. These graves, which usually contained several unburnt bodies, are not very richly furnished, but are characterized by the thin-butted axe (so-called celt) of flint, usually ground and polished, and by pottery, mostly ornamented flasks and vases. From these came the *Passage Grave* (*Chamber-Tomb*), a more elaborate structure in which a large megalithic chamber was approached by a passage walled and roofed with stone slabs. Such tombs are often of great size; a typical example figured by Du Chaillu, at Axvalla Heath, near Lake Venern, Vestergotland, Sweden, has a chamber 32×9 ft. and a passage 20 ft. long. These communal tombs sometimes contained as many as 100 skeletons, unburnt, and numerous associated objects. Some of the most typical are the thick-butted axe of flint, sometimes ground and polished; the perforated stone axe; transverse arrowheads and arrowheads with triangular section; oval, thick-butted daggers of chipped flint; amber beads; and pottery, usually angular or round bottomed bowls. The Passage Grave then degenerated into the *Long Stone Cist*. These graves also contained numerous skeletons, but are scantily furnished, the typical objects being a lunate knife of chipped flint and a beautiful, handled dagger, perhaps the finest achievement of any flint-workers. The pottery was poor and undecorated.

The civilization of the megalith-builders indicates a highly organized society of traders and farmers. Remains of domestic animals (horse, sheep, swine, cattle and dog) and traces of the cultivation of grain (barley, wheat and flax) are found round their huts; animal bones are also found in the mounds covering the tombs. Trade is proved by the occurrence of objects of Scandinavian origin in Britain (*e.g.*, perforated axes and thick-butted dagger-blades of Scandinavian workmanship in graves of the Beaker Period) and in central Europe (*e.g.*, necklaces of Baltic amber in Aunjetitz graves) and vice versa. The graves are most thickly distributed round the coastal districts of Denmark and Sweden, only in the latest (Long Stone Cist) period spreading to Norway and inner Sweden.

Contemporary with the megalithic burials a custom existed (chiefly in Jutland, S. Sweden and some of the Danish Islands) of burying each person in a small separate grave; several of these being covered by one barrow and found at different levels in it, either sunk in the earth, on the ground level or actually in the mound (bottom graves, ground graves and upper graves). These graves have pottery beakers and elaborate perforated stone axes, usually called battle axes. Axes and pottery of this type are widely distributed in Europe and these graves conceivably represent the entrance into Scandinavia of another race, who ultimately merged with the megalith-builders, since in the Long Stone Cist period there is little distinction between the furniture of the megalithic and of the separate graves.

Duration of Neolithic and Bronze Periods.—Prof. Gordon Childe, surveying the various estimates of the duration of the neolithic period in Scandinavia, suggests the following dates: Dolmen Period (Montelius Period II.), 2500–2200 B.C.; Passage-grave Period (Montelius Period III.), 2200–1650 B.C.; Long Stone Cist Period (Montelius Period IV.), 1650–1500 B.C. The last period belongs technically to the Bronze Age, since small objects of metal are occasionally found (copper and bronze pins and gold ear-rings).

Owing to the necessity of importing the metal the Bronze Age began late in Scandinavia; it probably lasted almost until the beginning of the Christian era. Here again much information is derived from burials, but hoards of objects are also of great importance. The dwelling-sites are imperfectly known.

Montelius, in his chronological classification of the Scandinavian Bronze Age, distinguishes two main periods, an Earlier and a Later, each having three subdivisions; but for a general survey the division into two periods is sufficient; the first probably ending about 1000 B.C., the second lasting till a few centuries before the Christian Era.

Earlier Bronze Period.—The sequence of metal types was much the same as in the rest of northern Europe. (*See* British Museum Guide, *Bronze Age*, Evolution of the Axe, Spear and Sword.) Early in the period the forms were simple, the flat and flanged axe and small knife being the commonest tools; at this time stone was probably in much commoner use than metal. But before long the innate craftsmanship of the Scandinavian asserted itself, and bronze weapons and ornaments were evolved unequalled in northern Europe for utility and elegance. That these were not importations is proved by the discovery of moulds in which such objects were cast and by the difference in technique between these objects and those of other countries.

The typical weapons were: Axes, of various forms, as, the palstave, the socketed and perforated axe; spears with riveted sockets; daggers and swords. The rapier or thrusting type of sword common throughout Europe in the middle Bronze Age was little used, being early replaced before A.D. 1000 by the heavier broad sword (leaf-shaped type), which came into use at an earlier date than in, *e.g.*, Britain. Some archaeologists hold that this type which was widely distributed through Europe, was actually evolved in Scandinavia by smiths who were, through the amber trade with Southern Europe, acquainted with the Italian bronze-handled dagger; others believe that Hungary was the place of origin. Some of the Scandinavian swords have a cast bronze hilt, others a hilt of wood or horn, etc., riveted in slabs on to a flanged bronze tang. The only defensive weapon which has survived is the circular bronze buckler, but such authorities as hold that the famous rock-carvings are of Bronze Age date deduce from these that horned helmets were worn. If the later phase of the Scandinavian Bronze Age was contemporary with the British Early Iron Age, these may well have taken the form of the bronze helmet in the British Museum found in the River Thames.

Personal ornaments were now for the first time abundant. These are usually of bronze but sometimes of gold. They include: Finger-rings, bracelets and torcs of various forms (coiled wire, cast or hammered); tutuli, *i.e.*, conical bosses apparently attached to the belt; pins, frequently disc-headed or with hanging ornaments; and brooches.

Both weapons and ornaments were commonly decorated at this time with incised designs, sometimes of chevrons, etc., but most often of spirals. This spiral ornament is often so marvellously regular as to suggest that some mechanical means was employed.

The distribution of finds suggests that there was at this time a considerable population throughout Southern Scandinavia.

The dead were at this period disposed unburnt in coffins, sometimes in the form of small stone cists but sometimes of wood, roughly hewn from a single tree-trunk. Some of these tree-trunk

burials are of great interest as giving examples of the clothing worn. An oak coffin in a barrow (called Treenhøi) at Havdrup in Ribe, Denmark, contained a male skeleton with all his clothes preserved. These were: a high round cap, a wide mantle, a kind of kilt and two small fragments of leg-coverings, all of woven wool, and the remains of leather shoes. The inside of the mantle and a woollen belt which confined the kilt were fringed. A woollen shawl was rolled up to make a pillow. At the left side of the body was a sword in a sheath, and at the foot a wooden box containing a smaller box in which were another cap, a horn comb and a bronze razor. The whole contents of the grave was wrapped in an untanned hide. A complementary find at Borum-Eshoi, near Arhus, also in an oak coffin, produced a woman's dress, consisting of a long under-robe and a sleeved bodice both of woven wool, a cap of netted worsted, a tasseled belt woven of wool and cowhair, and a large mantle of woven wool and cowhair. Another cap was found in the grave, which also contained a bronze brooch, a horn comb, a finger-ring, two bracelets, a torc, three tutli and a horn-handled bronze dagger.

Later Bronze Period.—In this period cremation became general. The burnt bones were at first put in small stone cists, a number being often found under one mound; later the remains were placed in pottery urns, often still placed in cists; sometimes they were simply laid in the ground and covered with a stone. The pottery was usually in the form of plain jars and bowls, sometimes handled. Tomb furniture, especially weapons, became scantier. There is no visible break with the earlier period in the type of weapons; but gradually a new type of decoration was employed, and new kinds of household objects, ornaments, etc., were introduced. These include ornamented bronze vessels of various forms, often for hanging; a new kind of knife (so-called razor); and many personal ornaments. These are decorated with repoussé as well as with incised ornament, sometimes in the form of degenerate spirals, sometimes circles, and frequently wavy ribbon patterns and curves suggesting roughly drawn boats with bird's head terminals. Many of these were imported, being of Italian design; others are local imitations. The ornament is also foreign, being typical of the Hallstatt (earliest Iron Age) civilization of central Europe. The sword pommels are also of Hallstatt types. This period, therefore, although definitely part of the Bronze Age, was strongly influenced by the Iron Age of central and southern Europe, being contemporary with the Hallstatt Period.

At the close of this period a few iron objects of La Tène type, such as swords and brooches, occur in cremation graves otherwise indistinguishable from those of the Bronze Age, and represent the beginning of the use of iron in Scandinavia, probably dating in the first century or two B.C.

Rock Carvings.—On rocks in some districts of Sweden and Norway numerous crude carvings exist, representing scenes of fighting, husbandry, seafaring, etc. If, as most people believe, these belong to the Bronze Age, they throw a flood of light on the daily life of the time. But their dates are as yet unproved.

BOG FINDS

Although Scandinavia was always outside the Roman Empire the influence of that power was strongly shown in contemporary Scandinavian civilization. Very many objects of Roman manufacture were imported, often of good quality, showing that Scandinavia was prosperous and traded freely with the continent. Large numbers of Roman coins have been found, especially in the island of Gotland. Native art shows strong Roman influence.

At this time iron was of course in general use. Much information about the period is derived from hoards found in peat-bogs at Thorsbjerg, Vimose, Nydam and other sites in Jutland and Schleswig. These are supposed to be votive offerings following a battle. The weapons are remarkably fine, and include swords, single and double-edged, and damascened (the double-edged types having hilts resembling the Roman form); spears of various patterns, ornamented and sometimes inlaid on the blade; axes, socketed and perforated; chain-mail; helmets, one of silver; and shield-bosses. Tools of all kinds were found; also personal ornaments. Perhaps the most important find was that of a clinker-built boat 75 ft. long, at Nydam, built of oak and probably dating in the III. century A.D.; another of red pine was found.

Migration Period.—After the collapse of the Roman Empire in the west in the V. century A.D. Scandinavian civilization developed gradually in harmony with the Teutonic civilizations to the south of it and in England. Again little is known of the houses of the period; the majority seem to have been four-sided huts. Burials are the chief source of information. Both inhumation and cremation were practised; the tomb furniture was rich, especially in personal ornaments and square-headed and cruciform brooches. These and other ornaments were decorated in a new style common to Scandinavia and the rest of Teutonic Europe at this period, consisting partly of geometric designs, spirals, stars, etc., and partly based on conventionalized and disintegrating animal forms, executed in a variety of techniques. The materials were sometimes bronze, occasionally silver and sometimes gold; the latter was most freely used in Sweden. In Gotland inlaid garnet ornament was popular, a technique which unlike the animal ornament occurs only sporadically in northern Europe. An ornament peculiar to Scandinavia was the bracteate, a disc-shaped gold pendant derived from barbarous copies of late Roman and Byzantine coins. The commonest weapons were the spear and shield. Swords, single and double edged, were not uncommon. Glass and wooden vessels as well as pottery are found.

Viking Period.—In the VIII. century the northern peoples, who had hitherto when restive contented themselves with local warfare and commercial ventures abroad, began to engage in piratical forays overseas. These were at first mere plundering raids resembling those of the Anglo-Saxons on the frontiers of the moribund Roman Empire in the III. and IV. centuries; but (like these) led ultimately to wide-spread colonization in England, northern France, Ireland, Scotland, the Faroes, the Orkneys, Shetland, Sicily and Russia; and to the discovery of Iceland, Greenland and America and the colonization of the two former. Their raids were pushed into almost every corner of Europe and they visited Asia Minor and North Africa.

We are fortunate in being able to examine in detail typical vessels in which they adventured, owing to their custom of burying the dead in their ships, under barrows; and it is not an exaggeration to say that all the finer developments of the sailing-ship were founded on their lines. A typical small war-vessel of the period was found at Gokstad, near Sandefjord in south Norway, and what might be described as a royal pleasure-vessel at Oseberg. Both contained a complete outfit; in the first were the chief's arms, horses, etc.; in the second the queen's bed, sledges, vessels, ornaments, etc. Lest anyone should doubt the seaworthiness of these vessels an exact model of the Gokstad ship was built and sailed across the Atlantic in 1893 and afterwards shown at the Chicago exhibition; it proved an able sea-boat.

In the Sagas, which provide a fund of information about life in those days (*see* SAGA) the affection of the Vikings for their ships is clearly shown, and they are often referred to by poetical names, such as Sea-skates, Elk of the Fjords, Horse of the Gull's Track, Raven of the Sea, etc.

Apart from warfare, farming was the chief occupation of the Vikings, and for this purpose slaves (thralls) were largely employed; but even kings took an active part in this pursuit. Ale-drinking, story-telling and games occupied the winter, every household having its winter store of dried meat and fish and home-brewed ale. Hospitality was practised on the grandest scale. The vivid description in the sagas of life in the halls of the northmen has been verified by excavation, "Fire-Halls" being found resembling mediaeval tithe-barns.

Typical antiquities of the period are found wherever the Vikings settled. Since paganism prevailed until about A.D. 1000 in Norway and Iceland and even later in Sweden, tomb furniture was abundant in the earlier period. There was a great variety of burial customs; both inhumation and cremation were practised and the latter was not confined to the less elaborate tombs; it gradually died out, however, before the spread of Christianity. Men

were often buried with a complete outfit of weapons, horse, dogs, harness, etc.; and not infrequently were buried in their boats; women had personal ornaments, household gear, etc. Boat burials were rare in Denmark, and in place of the big ship burials important persons were buried in wooden tomb chambers under mounds.

As might be expected, continual fighting led to the development of far more efficient weapons than had hitherto been known. Although the spear, used for both throwing and thrusting, still played an important part, the axe now reached an importance not seen since the Bronze Age; and the beautiful horned forms evolved (*cf.* Bayeux Tapestry) attest the skill of the Viking blacksmith. Splendid swords are found in the graves, frequently inlaid with gold and silver. Defensive weapons are represented by the shield, helmet and coat of ring-mail (*byrnja*). From the numerous descriptions in the Sagas we gather that a Viking's weapons were his most esteemed possessions; like the ships they are frequently described in such terms as:—for the sword, the Ice of Battle, the Dog of the Helmet, the Viper of the Host, etc.; for the spear, the Snake of the Attack, the Shooting Serpent, etc.; for the axe, the Witch of the Shield, the Wolf of the Wound; for arrows, the Bird of the Sling, the Twigs of the Corpse, etc.; for shields, the Burgh of the Swords, the Moon of Battle; for the *byrnja,* Gray clothes of Odin, the Woof of the Spear, etc. They also had personal names, as Magnus Barefoot's sword Legbiter, Skarphedin's axe, Ogress of War; and Harald Hardrada's byrnja, Emma.

Most objects are covered with decoration, the style of which at first derived from that of the end of the Migration Period (Vendel Style, conventionalized animal forms; but as a result of foreign intercourse, especially with Ireland and the Carolingian Empire, a new style of a hybrid character developed towards the close of the 8th century. Very good examples of this "Gripping beast" style are to be seen in the Oseberg Find. In the 10th century the Gripping beast style was overshadowed by the Jellinge style, in which animal forms are treated more naturalistically. This style, which in some ways resembles the Vendel style, is usually regarded as the outcome of Irish, English and Carolingian influence. The Jellinge style gave place for a time during the early 11th century to that of Ringerike, characterized by pure interlacing and conventionalized foliage, the animal motive being negligible; but later the interlaced animal of the Jellinge style reappeared in the Urnes style, at the close of which native Scandinavian art was overwhelmed by the bastard Romanesque of the Christian era.

Bibliography.—For the earlier period (Stone Age to end of Iron age) see *Reallexikon der Vorgeschichte* (ed. by Max Ebert, Berlin 1927), vol. ix., article entitled "Nordischer Kreis," with exhaustive bibliographies. Many of the works mentioned there (*e.g.,* Montelius, *Kulturgeschichte Schwedens* (Leipzig, 1906), Rygh, *Norske Oldsager* (Christiania, 1885), Gustafson, *Norges Oldtid* (Christiania, 1906), etc., deal also with the later period (Iron Age to end of Viking period). Consult besides O. Almgren, *Die ältere Eisenzeit Gotlands* (Stockholm, 1923); C. Engelhardt, *Denmark in the Early Iron Age* (London, 1886); J. Mestorf, *Urnenfriedhöfe in Schleswig-Holstein* (Hamburg, 1886) and *Vorgeschichtliche Alterthümer aus Schleswig-Holstein* (Hamburg, 1885); B. Salin, *Die altgermanische Thierornamentik,* trans. by Mestorf (Stockholm, 1904); Baldwin Brown, *Arts in Early England,* vols. iii., iv. and v. (London, 1915); P. B. du Chaillu, *The Viking Age* (London, 1889); H. Shetelig, *Vestlandske Graver fra Jernalderen* (Bergen, 1912); H. Shetelig, Hj. Falk and A. W. Brøgger, *Osebergfundet* (Oslo, 1920–28); J. Brøndsted, *Early English Ornament* (Copenhagen, 1924); J. Petersen, *Vikingetidens Smykker* (Stavanger Museum, 1927). *See* also *Bergens Museums Aarbog* (Bergen), *Aarsberetninger fra Foreningen til norske Fortidsmindesmaerkers Bevaring* (Oslo), *Aarböger for nordisk Oldhynkighed* (Copenhagen), *Antiqvarisk Tidskrift för Sverige* (Stockholm), the *Manadsblad* of the *Kgl. Vitterhets Historie och Antiqvitets Akademie* (Stockholm), *Fornvännen,* published since 1906 by the same society; *Svenska Fornminnesforeningens Tidskrift* (Stockholm), *Videnskapsselskapetskrifter* (since 1925); *Skrifter utgit av det Norske Videnskaps-Akademi i Oslo* (Stockholm). The guides to Scandinavian museums, the British Museum guides and *London and the Vikings* by W. M. Wheeler (London Museum, 1926) should also be consulted.
(T. C. L.; M. O'R.)

SCANDINAVIAN LANGUAGES. Closely allied languages are and have been spoken by the Teutonic population in Scandinavia, and by the inhabitants of the countries that have been wholly or partially peopled from it, in Sweden, except where Finnish and Lappish prevail; in southern Russia (government of Kerson), a village colonized from Dagö; Norway, except where peopled by Finns and Lapps; Denmark, with the Faeroes, Iceland and Greenland, and the northern half of Slesvig Nord. Scandinavian dialects were also spoken for varying periods in the following places: Norwegian in certain parts of Ireland (A.D. 800–1250) and northern Scotland, in the Isle of Man (800–1450), the Hebrides (800–1400), the Shetland Islands (800–1800), and the Orkneys (800–1800), Danish in the whole of Slesvig Nord, in the north-eastern part of England (the Danelagh, *q.v.,* 875–1175), and in Normandy (900–1100 or a little longer); Swedish in Russia (862–1300 or a little longer); Icelandic in Greenland (985–*c.* 1450).

The Teutonic population existed in Scandinavia before the Christian era, and it is only from the beginning of that era that we get any information concerning the language of the old Scandinavians, which by that time had spread over Denmark and great parts of southern and middle Sweden and of Norway, and had reached Finland (at least Nyland) and Estonia. The language appears to have been fairly homogeneous throughout the whole territory, and as the mother of the younger Scandinavian tongues has been named the primitive Scandinavian (*urnordisk*) language. The words borrowed during the first centuries of the Christian era by the Lapps from the inhabitants of central Sweden and Norway, and by the Finns from their neighbours in Finland and Estonia, and partly from their Gothic neighbours in Russia and the Baltic provinces, and preserved in Finnish and Lappish down to our own days, denoted chiefly utensils belonging to a fairly advanced stage of culture and amount to several hundreds, with a phonetic form of a very primitive stamp. These words and those mentioned by contemporary Roman and Greek authors are the oldest existing traces of any Teutonic language, but throw little light on the nature of the original northern tongue. The primitive northern runic inscriptions, the oldest upon the utensils found at Vi in Slesvig Nord and Thorsbjerg in Denmark, dating back to about A.D. 250–300, together with the ms. fragments of Ulfilas' Gothic translation of the Bible, about 200 years later in date, constitute the oldest genuine monuments of any Teutonic tongue.

Although very brief, and not yet thoroughly interpreted, these primitive Scandinavian inscriptions enable us to determine with some certainty the relation which the language in which they are written bears to other languages. Thus it belongs to the Teutonic family of the Indo-European stock of languages, of which it constitutes an independent and individual branch. Its nearest relation being the Gothic, these two branches were formerly sometimes taken together under the general denomination *Eastern Teutonic,* as opposed to the other Teutonic idioms (German, English, Dutch, etc.), then called *Western Teutonic.*

Before the beginning of the so-called Viking period (since about A.D. 800) the primitive Scandinavian language had undergone a considerable transformation, and at this epoch the primitive Scandinavian language must be considered as no longer existing. The centuries A.D. 700–1000 form a period of transition as regards the language as well as the alphabet which it employed. The language of inscriptions dating from about A.D. 800 not only differs widely from the original Scandinavian, but also exhibits dialectical peculiarities suggesting the existence of a Danish-Swedish language as opposed to Norwegian. These differences are unimportant and the Scandinavians still considered their language as one and the same throughout Scandinavia, and named it *Dǫnsk tunga,* Danish tongue. But when Iceland was colonized (*c.* 900), chiefly from western Norway, a separate (western) Norwegian dialect gradually sprang up, at first differing slightly from the mother-tongue. At the definitive introduction of Christianity (about A.D. 1000), the language had been differentiated in runic inscriptions and in the literature which was then arising, into four different dialects, and Swedish and Danish (*eastern Scandinavian*) and Icelandic and Norwegian (*western Scandinavian,* or northern tongue) are very nearly related to each other. The most

important differences between the two branches, as seen in the oldest preserved documents, are (1) in E. Scand. for fewer cases of "Umlaut," (2) E. Scand. "Brechung" of *y* into *iu* (or *io*) before *ng(w)*, *nk(w)*; (3) in E. Scand. *mp, nk, nt* are in many cases not assimilated into *pp, kk, tt;* (4) in E. Scand. the dative of the definite plural ends in *-umin* instead of W. Scand. *-onom*; (5) in E. Scand. the simplification of the verbal inflectional endings is much farther advanced, and the passive ends in *-s(s)* for *-sk*. In several of these points, and indeed generally speaking, the western Scandinavian languages have preserved the more primitive forms, which also are found in the oldest eastern Scandinavian runic inscriptions, dating from a period before the beginning of the literature, as well as in many modern eastern Scandinavian dialects. Leaving out of account the Icelandic dialects and those of the Faeroes, each of which constitutes a separate group, the remainder may be thus classified:—

1. **West Norwegian Dialects**—spoken on the western coast of Norway between Langesund and Molde.
2. **North Scandinavian**—the remaining Norwegian and the Swedish dialects of Uppland, Västmanland, Dalarna, Norrland, Finland, and Russia.
3. The dialects on the island of Gotland.
4. **Middle Swedish**—spoken in the rest of Sweden, except the southernmost parts (No. 5).
5. **South Scandinavian**—spoken in the greater part of Småland and Halland, the whole of Skåne, Blekinge, and Denmark, and the Danish-speaking part of Slesvig Nord. This group is distinctly divided into three smaller groups—the dialects of southern Sweden (with the island of Bornholm), of the Danish islands, and of Jutland (and Slesvig Nord).

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SCANDIUM, one of the rare-earth metals. The discovery of its oxide, *scandia*, by L. F. Nilson in 1879 was of the greatest scientific interest, because this oxide and the other compounds of scandium have properties corresponding with those predicted by D. Mendeleyev in 1869 for the derivatives of a hypothetical element, ekaboron, which was then needed to fill a gap in the periodic classification of the chemical elements. (*See* PERIODIC LAW.) The metal itself, symbol Sc, atomic number 21, atomic weight 45·1, has not been isolated, but its oxide is found combined in the following minerals: thortveitite (Sc_2O_3, 42%) from Saetersdalen, Norway, wiikite from Impilako, Finland (Sc_2O_3, 1·2%), ytherbite (gadolinite) and orthite, and in many tin ores and wolframites. Spectroscopic observations show that scandium is relatively abundant in the sun and stars. Scandia forms many salts with inorganic and organic acids which are generally colourless. Scandium acetylacetone, $Sc[(CH_3{\cdot}CO)_2CH]_3$, crystallises from organic solvents in colourless, prismatic needles, melts at 188° C and may be distilled unchanged under 8–10 mm. pressure.

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(G. T. M.)

SCAPA FLOW, an expanse of sea, in the south of the Orkneys, bounded by Pomona on the north, Burray and South Ronaldshay on the east and south-east, and Hoy on the west and south-west. The area contains seven small islands and is about 15 m. in length from north to south, and about 8 m. in mean breadth. There are two chief exits—one, 7 m. in length and 2 m. in mean breadth, into the Atlantic Ocean by Hoy Sound, and the other, 3½ m. in length by 2 m. in mean breadth, into the North Sea by Holm Sound.

Admiral Jellicoe chose Scapa Flow in preference to the Cromarty Firth as the chief naval base of the British fleet in the World War, but in Aug. 1914 everything had to be improvised, guns being landed from the ships to strengthen the defences. Scapa Flow thus gradually assumed the aspect of a great naval station. The German ships surrendered in Nov. 1918 were interned in Scapa Flow, where on June 21, 1919 all the battleships and battle cruisers, with the exception of the battleship "Baden" and five light cruisers, were scuttled by their German crews. Three light cruisers and some smaller vessels were beached.

Naval Aspects.—Scapa Flow now has an historic interest which would never have been attached to it save for the World War. As the main base of the Grand Fleet throughout the earlier period of the war it was a strategic position of great importance. Long before August 1914 it had been used by the ships of the Home or Channel fleets on periodical visits to northern waters, because its roomy and well-sheltered waters provided at one and the same time a good anchorage and an excellent practice ground. In the Admiralty war plans it was the intention that the main fleet should work from this base and control the North Sea, while a smaller fleet based on Portland would watch the English Channel. The Grand Fleet, as it was afterwards called, moved to Scapa Flow during the latter days of July 1914 and it was therefore at its war station at the outbreak of hostilities, but at that time this anchorage was far from being secure against attack by submarines, and in the early days numerous scares arose in the fleet that enemy submarines had actually penetrated into the harbour. In point of fact no German submarine ever did achieve the dangerous passage into the Flow. Apart from the defences which were eventually established, the very strong currents across the entrance made navigation under water especially risky. One enemy submarine was destroyed in the outer approaches in November 1914, and four years later, after the mutiny in the German fleet, one of their submarines manned entirely by officers, perished in a last despairing effort to achieve success.

All channels to Scapa Flow, except the Hoxa and Hoy entrances, were fairly effectively blocked by sinking old ships in them. A submarine obstruction was placed in the Hoy entrance, while the fleet used the Hoxa sound, which was also protected and closely patrolled. In addition to these obstructions, the gun defences were materially increased, while facilities for maintenance were improved by the addition of a small floating dock for destroyers and the provision of a number of repair and supply ships.

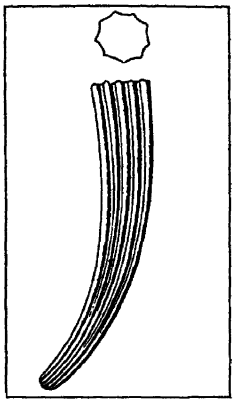
Although Scapa Flow had many advantages, the fleet felt the want of a fully equipped dockyard nearer than those in the south of England, and this in due course was met by sending a large floating dock to Invergordon in the Cromarty Firth, while the work on the newly-started dockyard at Rosyth on the Firth of Forth was pressed forward as rapidly as possible. With the completion of the outer defences of the latter, the greater part of the Grand Fleet was eventually moved south to join the battle cruisers which had been based on the southern port since December 1914.

The Flow was, nevertheless, to witness one final dramatic scene, when on June 21, 1919, the most important units of what had been the German High Sea Fleet, interned in its waters, were scuttled and abandoned by their crews. The situation which made this possible has often been misunderstood and attributed to some laxity on the part of the British ships on guard. In fact it was impossible for the latter to prevent what was done. In spite of the protests of Britain's naval representatives, her allies would not agree to her definitely taking over the German vessels; they were therefore interned and not surrendered, which meant that they retained the officers and crews which had navigated them across the North Sea, and were only under such distant observation that it was impossible to detect the preconcerted and simultaneous opening of under-water valves which led to their sinking. The Germans were evidently intent on avoiding the humiliation of seeing their best ships under the flag of a foreign navy, but it must have been a poor consolation that their last resting-place should have been in the very waters from which the fleet which had over-awed them throughout the war was wont to set forth. They were, moreover, compelled to pay dearly for their breach of faith by having to surrender other tonnage. By 1928 a number of the ships had been raised by a British firm and broken

up to be sold as scrap iron, and the work was still continuing.

Scapa Flow is visited from time to time by the British Atlantic Fleet, but with the exception of the salvage work it has largely sunk back to the peaceful conditions prevalent there before the World War. (E. A.)

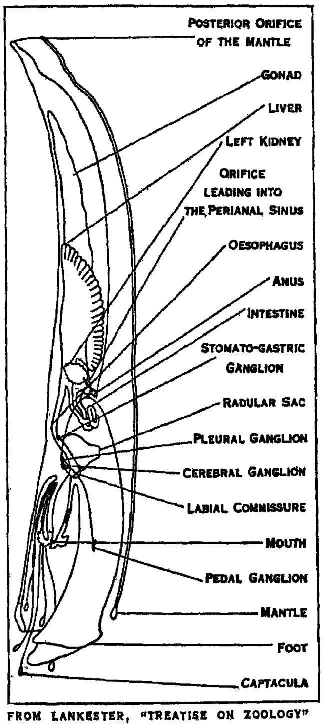
SCAPHOPODA. A group of marine invertebrate animals popularly called elephant's tusk shells and constituting a class of the Mollusca (*q.v.*). They are represented by 12 genera (of which *Dentalium* is the most familiar), and over 300 species, and are the smallest molluscan class. Their structure is quite distinct from that of other molluscs. They are bilaterally symmetrical, elongate animals in which the right and left edges of the mantle are joined in the mid-ventral line except at the anterior and posterior ends. The visceral mass is thus enclosed in a tubular sheath open at both ends. The shell secreted by the mantle is correspondingly tubular and with anterior and posterior orifices. The head is imperfectly developed and bears numerous long filaments. The foot is cylindrical and the animal is devoid of gills.



FROM PILSBRY, "MANUAL OF CONCHOLOGY"

FIG. 1.—SHELL OF DENTALIUM ELEPHANTINUM
Above, a cross-section outline of the tusk-like shell

The Scaphopoda are exclusively marine. The foot is adapted for digging and burrowing into sand, in which they lie with the posterior extremity of the shell projecting from the surface. They were originally placed in the same class (Acephala) as the Lamellibranchia; but beyond the conformation of the mantle and the digging foot there is no close resemblance to that group, whereas their possession of a radula, mandible and buccal bulb and of a stomatogastric system in their nervous organization point to affinities with the Gastropoda.

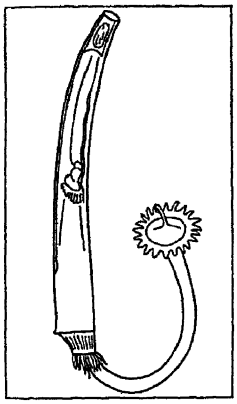


FROM LANKESTER, "TREATISE ON ZOOLOGY"

FIG. 2.—DIAGRAM OF ORGANIZATION OF DENTALIUM, LEFT SIDE VIEW
The Dentaliidae are characterised by the conical shaped foot, and the curvature of the shell

External Form.—The shell of *Dentalium* is able to contain the whole animal and is elongate, conical and slightly curved. There are two apertures in all the Scaphopod shells, a larger anterior one from which the foot projects and a smaller posterior one. The hinder end bearing this orifice is kept clear of the sand and thus admits water for respiration, and allows the excreta and faeces to be discharged when the animal is buried. The mantle-cavity is continuous from one end of the body to the other. The head and foot lie at the anterior end, the former above the latter. The head is cylindrical and bears two lobes beset with long filaments (captacula). These are mainly sensory but also serve to capture the small organisms on which the animal feeds. The foot is elongated and capable of considerable extension. Its expansible end is of great service in digging.

Internal Anatomy.—All Scaphopoda have a well-developed buccal mass with mandible and radula. From the oesophagus the food passes into the stomach, which is little differentiated and receives the ducts of a bilobed liver and a pyloric caecum. The intestine is provided with an anal gland. The circulation and respiratory system is extremely simple. The heart is rudimentary and there are no proper blood vessels. There are no specialized respiratory organs (gills) and the blood is oxygenated in the inner surface of the mantle. There are two kidneys in the mid-ventral region of the body which open to the exterior, one on each side of the anus. The nervous system consists of the same pairs of ganglia with their commissures as in the Gastropoda. The cerebral and pleural ganglia are joined to the pedal ganglia by a long connective. These animals have only three kinds of sensory organs—the captacula, apparently tactile and olfactory, the subradular organ, probably an organ of taste; and the organs of balance (otocysts), situated in the foot. The sexes are separate. The ovary and the testis are unpaired and open into the right kidney, as in the aspidobranchiate Gastropoda.

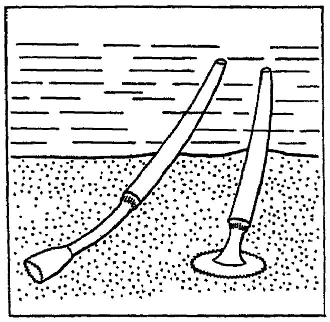


FROM JUTTINGS, "TIERWELT DER NORD- UND OSTSEE"

FIG. 3.—SIPHONODENTALIUM LOFOTENSE, SHOWING EXPANDED FOOT AND ANTERIOR END OF SHELL

Development.—This has been studied in *Dentalium*. The eggs are laid singly and segmentation is unequal and irregular. A gastrula arises through invagination, as in most Mollusca, and subsequently develops into a floating trochophore larva. A veliger stage succeeds and after five or six days the velum (girdle of cilia) atrophies and the young *Dentalium* abandons its floating life and starts to creep about on the sea-bottom. Interesting experiments have been done on this form. (*See* EXPERIMENTAL EMBRYOLOGY.)

Bionomics, Evolution, Etc.—The Scaphopoda are sedentary and live in the adult stage on the sea-bottom, into the surface layers of which they burrow and usually remain with part of the shell projecting from the surface. They are carnivorous and feed upon such small animals as Foramenifera, young bivalves, etc. The majority live in fairly deep water and (*e.g.*) in the North sea are entirely absent in the littoral zone. *Dentalium peruvianum* has been found at a depth of 2,235 fathoms (U.S.S. "Albatross"). They have a practically cosmopolitan distribution. The earliest representatives of the class appear in the Middle Silurian, some 285 fossil species being known.



FROM JUTTINGS, "TIERWELT DER NORD- UND OSTSEE"

FIG. 4.—DIAGRAM OF THE LOCOMOTION OF SIPHONODENTALIUM LOFOTENSE
(Left) foot closed, (right) foot expanded

BIBLIOGRAPHY.—The most important papers up to 1906 are cited by P. Pelseneer in Lankester's *Treatise on Zoology* (Pt. v. *Mollusca*). *See* also:—T. van Benthem Jutting, "Die Tierwelt der Nord-und Ostsee" IX. c. 1926; J. Henderson, "A Monograph of the North American Scaphopod Molluscs," *United States National Museum*, Bull. iii. 1920. (G. C. R.)

SCAPOLITE, a group of rock-forming minerals, which are silicates of aluminium with calcium or sodium but containing more or less chlorine, carbonate or sulphate radicals. The scapolites (Gr. σκᾶπος, rod, λίθος, stone) must be regarded as variable isomorphous mixtures of the following five components:

Ma $=3NaAlSi_3O_8{\cdot}NaCl$—chloride-marialite
MaS$=3NaAlSi_3O_8{\cdot}Na_2SO_4$—sulphate-marialite
MaC$=3NaAlSi_3O_8{\cdot}Na_2CO_3$—carbonate-marialite
MeC$=3CaAl_2Si_2O_8{\cdot}CaCO_3$—carbonate-meionite
MeS$=3CaAl_2Si_2O_8{\cdot}CaSO_4$—sulphate-meionite

It seems not improbable that in marialite, NaCl, etc., may be replaced to a limited extent by KOH, and in meionite $CaCO_3$, etc., be similarly replaced by CaF_2. The close relation which this group of minerals bears to the plagioclase felspars is apparent in the formulae indicated above. The scapolites crystallize in the tetragonal system, the crystals being prismatic hemihedral. The dominant cleavage is (100). The hardness is 5–6, while the sp.gr. varies with the composition, pure chloride marialite 2·560 carbon-

ate-meionite 2·772. The colour is usually white or grey. Between the end members, marialite and meionite, there are mixtures which have been given definite names. These include dipyre and mizzonite, and may, as in the case of the plagioclase felspars, be arbitrarily fixed as follows:

Marialite $Ma_{100} \rightarrow Ma_{80}$
Dipyre $Ma_{80}Me_{20} \rightarrow Ma_{50}Me_{50}$
Mizzonite $Ma_{50}Me_{50} \rightarrow Ma_{20}Me_{80}$
Meionite $Ma_{20}Me_{80} \rightarrow Me_{100}$

The scapolites show varying resistance to acids, the meionite-rich members being most readily attacked, CO_2 being released by HCl-HF mixtures from the carbonate meionite, while marialite is only slightly attacked. None of the scapolites have as yet been synthesized. They are destroyed by fusion, the lime-rich members giving plagioclase felspar on cooling. The commonest alteration products are calcite kaolin, white mica and zeolites. The scapolites are essentially metamorphic minerals, appearing very commonly in metamorphosed limestones.

Well-developed glassy crystals of scapolite occur in the ejected blocks of limestone of Monte Somma, Vesuvius, and large crystals occur in the apatite deposits of Bamle, southern Norway, where they arise from alteration of plagioclase felspar in gabbro. The mode of occurrence of scapolite is referred to in detail below.

(C. E. T.)

Scapolite Rocks.—According to their genesis the scapolite rocks fall naturally into four groups.

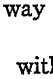
1. The scapolite limestones and contact rocks. As silicates rich in lime, it is to be expected that these minerals will be found where impure limestones have been crystallized by contact with an igneous magma. Even marialite (the variety richest in soda) occurs in this association, being principally obtained in small crystals lining cavities in ejected blocks of crystalline limestone at Vesuvius and the craters of the Eifel in Germany. Mizzonite and meionite are far more common at the contacts of limestone with intrusive masses. The minerals which accompany them are calcite, epidote, vesuvianite, garnet, wollastonite, diopside and amphibole. The scapolites are colourless, flesh-coloured, grey or greenish; occasionally they are nearly black from the presence of very small enclosures of graphitic material. They are not in very perfect crystals, though sometimes incomplete octagonal sections are visible; the tetragonal cleavage, strong double refraction and uniaxial interference figure distinguish them readily from other minerals. Commonly they weather to micaceous aggregates, but sometimes an isotropic substance of unknown nature is seen replacing them. In crystalline limestones and calc-silicate rocks they occur in small and usually inconspicuous grains mingled with the other components of the rock. Large, well-formed crystals are sometimes found in argillaceous rocks (altered calcareous shales) which have suffered thermal metamorphism. In the Pyrenees there are extensive outcrops of limestone which are penetrated by igneous rocks described as ophites (varieties of dolerite) and lherzolites (peridotites). At the contacts scapolite occurs in a great number of places, both in the limestones and in the calcareous shales which accompany them.

2. In many basic igneous rocks, such as gabbro and dolerite, scapolite replaces felspar by a secondary or metasomatic process. Some Norwegian scapolite-gabbros (or diorites) examined microscopically furnish examples of every stage of the process. The chemical changes involved are really small, one of the most important being the assumption of a small amount of chlorine in the new molecule. Often the scapolite is seen spreading through the felspar, portions being completely replaced, while others are still fresh and unaltered. The felspar does not weather, but remains fresh, and the transformation resembles metamorphism rather than weathering. It is not a superficial process, but apparently takes place at some depth under pressure, and probably through the operation of solutions or vapours containing chlorides. The basic soda-lime felspars (labradorite to anorthite) are those which undergo this type of alteration. Many instances of scapolitization have been described from the ophites (dolerites) of the Pyrenees. In the unaltered state these are ophitic and consist of pyroxene enclosing lath-shaped plagioclase felspars; the pyroxene is often changed to uralite. When the felspar is replaced by scapolite the new mineral is fresh and clear, enclosing often small grains of hornblende. Extensive recrystallization often goes on, and the ultimate product is a spotted rock with white rounded patches of scapolite surrounded by granular aggregates of clear green hornblende: in fact the original structure disappears.

3. In Norway scapolite-hornblende rocks have long been known at Oedegården and other localities. They have been called spotted gabbros, but usually do not contain felspar, the white spots being entirely scapolite while the dark matrix enveloping them is an aggregate of green or brownish hornblende. In many features they bear a close resemblance to the scapolitized ophites of the Pyrenees. It has been suggested that the conversion of their original felspar (for there can be no doubt that they were once gabbros, consisting of plagioclase and pyroxene) into scapolite is due to the percolation of chloride solutions along lines of weakness, or planes of solubility, filling cavities etched in the substance of the mineral. Subsequently the chlorides were absorbed, and *pari passu* the felspar was transformed into scapolite. But it is found that in these gabbros there are veins of a chlorine-bearing apatite, which must have been deposited by gases or fluids ascending from below. This suggests that a pneumatolytic process has been at work, similar to that by which, around intrusions of granite, veins rich in tourmaline have been laid down, and the surrounding rocks at the same time permeated by that mineral. In the composition of the active gases a striking difference is shown, for those which emanate from the granites are mainly fluorine and boron, while those which come from the gabbro are principally chlorine and phosphorus. In one case the felspar is replaced by quartz and white mica (in greisen) or quartz and tourmaline (in schorl rocks); in the other case scapolite is the principal new product. The analogy is a very close one, and this theory receives much support from the fact that in Canada (at various places in Ottawa and Ontario) there are numerous valuable apatite vein-deposits. They lie in basic rocks such as gabbro and pyroxenite, and these in the neighbourhood of the veins have been extensively scapolitized, like the spotted gabbros of Norway.

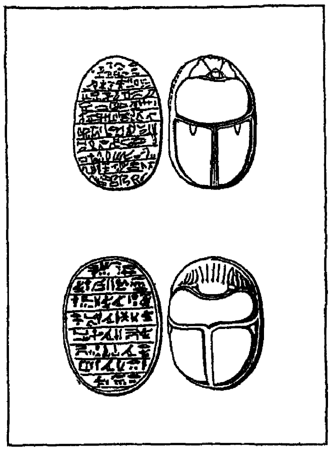
4. In many parts of the world metamorphic rocks of gneissose character occur containing scapolite as an essential constituent. Their origin is often obscure, but it is probable that they are of two kinds. One series is essentially igneous (orthogneisses); usually they contain pale green pyroxene, a variable amount of felspar, sphene, iron oxides. Quartz, rutile, green hornblende and biotite are often present, while garnet occurs sometimes; hypersthene is rare. They occur along with other types of pyroxene gneiss, hornblende gneiss, amphibolites, etc. In many of them there is no reason to doubt that the scapolite is a primary mineral. Other scapolite gneisses equally metamorphic in aspect and structure appear to be sedimentary rocks. Many of them contain calcite or are very rich in calc-silicates (wollastonite, diopside, etc.), which suggests that they were originally impure limestones. The frequent association of this type with graphitic-schists and andalusite-schists makes this correlation in every way probable.

(J. S. F.)

SCARAB (Lat. *scarabaeus*, connected with Gr. κάραβος), literally a beetle, and derivatively an Egyptian symbol in the form of a beetle. The Egyptian hieroglyph  pictures a dung beetle (*Scarabaeus sacer*), which lays its egg in a ball of dung, and may be seen on sandy slopes in hot sunshine compacting the pellet by pushing it backward uphill with its hind legs and allowing it to roll down again, eventually reaching a place of deposit. Whatever the Egyptians may have understood by its actions, they compared its pellet to the globe of the sun. The beetle is common on both shores of the Mediterranean; the Egyptian name was *kheperer, kheperi*, and the sign spelt the verb *khōpi(r)* meaning "become" and perhaps "create," also the substantive "phenomenon" or "marvel." The insect was sacred to the sun-god in his form *khepēri* at Heliopolis, and has been found mummified. A colossal scarabaeus of granite in the British Museum probably came from the temple of Heliopolis. The scarabaeus was much used in Egyptian religions, appearing sometimes with outstretched wings or with a ram's head and horns as the vivifying

soul. It is often seen in this guise on coffins of the New Kingdom and later, when it also became the custom to place in the bandages of the mummy a large stone scarab engraved with a chapter of the Book of the Dead. This chapter, the 64th, identified the object with the heart of the deceased and conjured it not to betray him in the judgment before Osiris. A winged scarab might also be laid on the breast; and later a number of scarabs were placed about the body. These are often of hard stone and of fine workmanship. Another and even more important class of Egyptian antiquities is in the form of scarabs, pierced longitudinally for a swivel or for threading, and having the bases flat and engraved with designs. These were intended principally for seals, but might also be used as beads or ornaments. They are thus found, engraved or plain, strung on necklaces, and amethyst scarabs with plain bases are common articles of Middle Kingdom jewellery. But the employment of scarabs as seals is proved by the impressions found on sealed documents of the Middle and New Kingdom, on several occasions the impressed clay seals alone have been found hardened and preserved by the fire which had destroyed the archives themselves. The seal type of scarabaei is extremely abundant, and the designs engraved beneath them show endless variety. Some have inscriptions carefully executed, but frequently corrupted by illiterate copying until they became meaningless. The inscriptions are sometimes "mottoes" having reference to places, deities, etc., or containing words of good omen or friendly wishes, *e.g.*, "Memphis is mighty for ever," "Ammon protecteth," "Mūt give thee long life," "Bubastis grant a good New Year," "May thy name endure and a son be born thee." Such are of the New Kingdom or later. Names and titles of officials appear, most commonly in the Middle Kingdom.

Historically the most valuable class is of those which bear royal names, ranging from Senusret I. of the XIIth Dynasty to the end of the XXVIth Dynasty. Certain great kings are commemorated on scarabs of periods long subsequent to them. Thus Cheops (Khufu), of the IVth Dynasty, appears on examples of the latest Pharaonic age, scarabs having been unknown in his time, and Tuthmosis III. is found at all times after the XVIIIth Dynasty. But after the XIIth Dynasty the royal names are of contemporary workmanship, and the differences of style and pattern make it possible to group unknown kings with those who are known historically; the names of the Hyksos kings have been principally recovered from collections of scarab-seals. Scarab-shaped seals are traceable as far back as about the VIth Dynasty. They became abundant under the XIIth and continued until almost the end of the native rule. As seals they took the place of the earlier cylinders and "button-seals." Considering the life-history of the scarabaeus and its meaning as a hieroglyph, it may well be that the scarab impressing the clay had a symbolic significance; however that may be, the oval form was well adapted for seal-stones and for the bezels of finger rings. In this situation the scarabs were often mounted with a rim of gold or silver round the edge. Rings of stone, glass or metal, with engraved bezels of the same material, and eventually Greek gem rings, gradually displaced them.



FROM PETRIE, "SCARABS AND CYLINDERS" (HAZELL, WATSON & VINEY)
EGYPTIAN HEART SCARABS OF THE 18TH DYNASTY

A series of exceptionally large scarabs was engraved in the reign of Amenophis III., *c.* 1450 B.C., all being inscribed with his name together with that of Queen Tiye and her parentage. At present five varieties are known. The simplest commemorates his queen and the north and south limits of his empire; another dated in the first year, a great battue of wild cattle; the third, the arrival of the princess Gilukhipa of Mitanni in the tenth year; the fourth (many specimens), the number of lions slain by the king down to his tenth year; the last, the cutting of the lake of Zarukhe in the eleventh year.

Egyptian scarabs were carried by trade to most of the islands and shores of the eastern Mediterranean and to Mesopotamia. The Greeks, especially in their Egyptian colony of Naucratis (*q.v.*), imitated them in soft paste. The finest Etruscan gems of the 6th and 5th centuries B.C. are in the form of scarabs, perhaps suggested by the Egyptian. The forgers of antiquities have carried on a brisk trade in scarabs for more than a century.

See P. E. Newberry, *Scarabs* (London, 1906); Hall, *Catalogue of Scarabs, British Museum,* i. (1913); Petrie, *Scarabs;* also art. GEM, especially for later scarabaeoid gems. (F. LL. G.; H. R. H.)

SCARAMOUCH, properly a buffoon, used later colloquially for a ne'er-do-well. The name was that of a stock character in 17th century Italian farce, *Scaramuccia* (*i.e.*, literally "skirmish"), who, attired usually in a black Spanish dress, burlesquing a "don," was beaten by Harlequin for his boasting and cowardice.

SCARBOROUGH, a municipal borough in the North Riding of Yorkshire, England, 231 m. N. of London and 42 m. N.E. of York by the L.N.E. railway. Pop. (1931) 41,791. It is situated on the N.E. coast of Yorkshire, where a hammer-like peninsula of high land projects eastwards, separating the North and South Bays. The modern town fringes both bays and extends a considerable distance inland. The peninsula is crowned by a 12th century castle, but such a natural stronghold was occupied earlier. The remains of a Roman signalling station were excavated here in 1925, and during the excavations, relics of a bronze age village were discovered. The site had long been abandoned when the Romans came and erected there one of a series of signalling stations to aid in the defence of Britain against Saxon raiders. It was built about 370–395, not as an object of defence but as a watch tower.

After the Roman occupation, the site lay waste until about 1,000 when a chapel was built within the partly ruined walls of the Roman tower, and this was probably destroyed when Harold Hardrada of Norway sacked and burnt the town in 1066. The Roman remains were cleared when the castle was first built in stone in 1148–68 to replace an earlier Norman structure, probably of wood. The present ruins include a lofty Norman keep, and the dyke or moat on the landward side, which was simply a ditch, making the approach on this side more difficult. A wall with towers also protects the castle in this direction. Near the landward side of the dyke is the church of St. Mary, occupying the site of a Cistercian monastery of 1198. It is transitional Norman and Early English with later additions.

History.—Although there is no mention of Scarborough in the Domesday Survey, the remains of Roman roads leading to the town indicate that it was, in early times, a place of importance. It was a "walled city" in 1181, when granted its first charter, which gave the burgesses all liberties in the same way as the citizens of York. The strength of the castle was greatly increased by Henry II., and a new chapel was completed on the site of the old one in 1189. Henry III., in 1253, granted that a court of pleas should be held at Scarborough by the justices who went to hold common pleas at York; he also gave the corporation a gild merchant and granted a yearly fair, which was originally held on the sands. During his reign the Barbican, Causeway, and present gateways of the castle were built and the whole was made an impregnable fortress. The Scots came to Scarborough in 1318, and took and burned the town, but the castle proved too strong for them. The town was taken away from the burgesses by Edward II., but was restored to them by Edward III. in 1327, and a charter of 1356 confirms the privileges of the borough.

By the charter of 1485, Richard III. appointed that the town should be governed by a mayor, a sheriff, and twelve aldermen and that, together with the mayor of Whallesgrave, it should be a county of itself. On the death of Richard III., however, it took no effect and the corporation retained its old mode of government; a mayor was not appointed until 1684. When Henry VIII. passed the Act for the Suppression of the monasteries, the people of Yorkshire unsuccessfully besieged Scarborough castle, which was held for the king. It was repaired during the reign of Elizabeth. During the Civil War, the Royalists held the town and

castle, which were besieged by the Parliamentary forces in 1644. The town was taken in 1645 and after twelve months the castle fell to the Parliamentarians. It underwent another siege in 1648 after Scarborough revolted to the king, and after three months it surrendered and the castle was ordered to be demolished. This was done by blowing down the north-western front with gunpowder in 1650. During the rebellion of 1745, the castle was partly repaired.

The development of Scarborough as a watering place dates from 1620, when two mineral springs were discovered. They are now contained in the garden of the Spa house near the shore of the South Bay, but are relatively unimportant. West of Scarborough lie the high moors intersected by narrow well wooded valleys and to the south lies the Vale of Pickering. Scarborough is thus a tourist centre as well as a seaside resort, and annual sports festivals provide an additional attraction. The harbour, enclosed by piers and divided into two basins, lies on the south side of the castle peninsula. It is dry at low tide, but it accessible at spring tides to vessels of 13 ft. draught, and is largely used by fishing boats. There is also a floating dock for the repair of ships, and a scheme to meet the growing demand for the improvement of the harbour, was begun in 1927. Accommodation has also been made for "fishing-girts." The fishing industry is now less important than at one time. Jet was formerly an important manufacture. The main sea-coast road from Whitby via Scarborough to Bridlington has been improved and the New Valley Bridge built.

Scarborough was shelled by German cruisers in 1914, when the castle was damaged, the coast guard station was struck and the barracks were destroyed. It was also visited by enemy submarines in 1917.

Two members were returned to parliament from 1295–1885, when the number was reduced to one. It now forms part of the Scarborough and Whitby Parliamentary division. (M. K. M.)

SCARIFIER: *see* CULTIVATING MACHINERY.

SCARLATTI, ALESSANDRO (1659–1725), Italian musical composer, was born in Sicily in 1659. He is generally said to have been a pupil of Carissimi in Rome, and he probably had some connection with northern Italy, since his early works show the influence of Stradella and Legrenzi. The production at Rome of his opera *Gli Equivoci nell' amore* (1679) gained him the protection of Queen Christina of Sweden, and he became her maestro di capella. In February 1684 he became maestro di capella to the viceroy of Naples, and here he produced a long series of operas, remarkable chiefly for their fluency. In 1702 he left Naples and did not return until the Spanish domination had been superseded by that of the Austrians. In the interval he enjoyed the patronage of Ferdinand III. of Tuscany, for whose private theatre near Florence he composed operas, and of Cardinal Ottoboni, who made him his maestro di capella, and procured him a similar post at the church of S. Maria Maggiore in Rome (1703). After visiting Venice and Urbino in 1707, he took up his duties at Naples again in 1708, and remained there until 1717. It was at the Teatro Capranica in Rome that he produced some of his finest operas (*Telemaco*, 1718; *Marco Attilio Regolo*, 1719; *Griselda*, 1721), as well as some noble specimens of church music, including a mass for chorus and orchestra, composed in honour of St. Cecilia for Cardinal Acquaviva in 1721. His last work on a large scale appears to have been the unfinished serenata for the marriage of the prince of Stigliano (1723); he died at Naples on the 24th of October 1725.

Scarlatti's music forms the most important link between the tentative "new music" of the 17th century and the classical school of the 18th, which culminated in Mozart. His early operas (*Gli Equivoci nel sembiante* [1679]; *L' Honestà negli amori* [1680]; *Pompeo* [1683], containing the well-known airs "O cessate di piagarmi" and "Toglietemi la vita ancor," and others down to about 1685) retain the older cadences in their recitatives. By 1686 he had definitely established the "Italian overture" form (second edition of *Dal male il bene*), and had abandoned the ground bass and the binary air in two stanzas in favour of the ternary or *da capo* type of air. His best operas of this period are *La Rosaura* (1690, printed by the *Gesellschaft für Musikforschung*), and *Pirro e Demetrio* (1694), in which occur the songs "Rugiadose, odorose," "Ben ti sta, traditor." *Mitridate Eupatore*, composed for Venice in 1707, contains music far in advance of anything that Scarlatti had written for Naples, both in technique and in intellectual power. The later Neapolitan operas are *L'Amor volubile e tiranno* (1709); *La Principessa fedele* (1712); *Tigrane*, 1715.

Scarlatti's claim to remembrance rests on the fact that he practically created the language of classical music. He extended the old forms, and filled them with melody unrivalled for purity and serenity, based on a far-reaching foundation of modern harmony and tonality, combined with great power of thematic development.

SCARLATTI, DOMENICO (1685–1757), eldest son of Alessandro Scarlatti, also a composer, was born at Naples on the 26th of October 1685. Presumably he studied first under his father, but he was in all probability also a pupil of Gaetano Greco. In 1704 he remodelled Pollaroli's *Irene* for performance at Naples. In 1709 Domenico entered the service of Marie Casimire, queen of Poland, then living in Rome, and composed several operas for her private theatre. He was Maestro di Cappella at St. Peter's from 1715 to 1719, and in the latter year came to London to direct his opera *Narciso* at the King's Theatre. In 1720 or 1721 he went to Lisbon, where he taught music to the princess Magdalena Theresia. He was at Naples again in 1725, but in 1729 went to Madrid as music master to the princess, who had married into the Spanish royal house. He is supposed to have died in 1757.

Modern Printed Editions.—Clementi's *Practical Harmony* (4 vols., 1815); Czerny's edition; J. H. Farrenc, *Le Trésor des pianistes* (21 vols., 1861–72). *See* Grove's *Dictionary of Music and Musicians* (1928).

SCARLET FEVER or **SCARLATINA,** names applied indifferently to an acute infectious disease, characterized by high fever, accompanied with sore throat and a diffuse red rash upon the skin. This fever appears to have been first accurately described by Sydenham in 1676, before which period it had evidently been confounded with smallpox and measles. It is generally believed that the disease is caused by haemolytic streptococci. Klein in 1885 isolated a streptococcus which he termed the streptococcus scarlatinae. The scarlatinal throat is the chief habitat of the organism, though it has been found both by Klein and other observers in the discharges from the ears of scarlet fever patients. Mervyn Gordon also isolated from cases the streptococcus conglomerulatus. It is possible that septic cases of scarlet fever are the result of a mixed infection. The serum of patients has been found to contain agglutins to streptococci from cases of erysipelas, septicaemia and puerperal fever, as well as to the streptococci scarlatinae. F. B. Mallory in 1904 published his discovery of "protozoonlike" bodies in the cells of the epidermis. Other observers have found them in the skin of fatal cases, but failed to find them in the living. The contagion of scarlet fever takes place from a previous case either by the skin during the early stages of the disease or by the nasal or aural discharges of a patient. It may be conveyed by any article of clothing or furniture or by any person that has been in contact with a scarlet fever patient. Infectivity may also take place through a contaminated milk supply, as in the Marylebone epidemic, 1885. Klein here found a disorder in cows which he considered analogous to scarlatina and communicable to man.

The period of incubation in scarlet fever may be as short as one or two days, but in most instances it is probably less than a week. The invasion of this fever is generally sudden, consisting in rigors, vomiting and sore throat, together with a rapid rise of temperature and increase in the pulse. About twenty-four hours later the characteristic eruption appears. It is first seen on the neck, chest, arms and hands, but quickly spreads all over the body, although it is not distinctly marked on the face. This rash consists of minute thickly-set red spots, which coalesce to form a general diffuse redness, in appearance not unlike that produced by the application of mustard to the skin. In ordinary cases the rash takes about two days to come out, then begins to fade, and by the end of a week from its first appearance it is usually gone.

The severity of a case is in some degree measured by the copiousness and brilliancy of the rash, except in the malignant varieties, where there may be little or no eruption. The tongue, which at first was furred, becomes about the fourth or fifth day denuded of its epithelium and acquires the peculiar "strawberry" appearance characteristic of this fever. The interior of the throat is red and swollen, especially the uvula, soft palate and tonsils, and much secretion exudes from the inflamed surface. There is also tenderness and slight swelling of the glands under the jaw. In favourable cases the fever departs with the disappearance of the eruption and convalescence sets in with peeling of the cuticle, which first shows itself about the neck, and proceeds slowly over the entire body. Where the skin is thin the desquamation is in the form of fine branny scales; but where it is thicker, as about the hands and feet, it comes off in large pieces, which sometimes assume the form of casts of the fingers or toes. The duration of this process is variable, but it is rarely complete before the end of six or eight weeks, and not unfrequently goes on for several weeks beyond that period. It is during this stage that complications are apt to appear.

Scarlet fever shows itself in certain well-marked varieties, of which the following are the chief:—

1. **Scarlatina Simplex** is the most common form; the symptoms are moderate, and the case usually runs a favourable course. In some instances evidences of the disease are so slight that they escape observation and only become known by the patient infecting another person or subsequently suffering from some of the complications associated with it.

2. **Septic Scarlatina** or **Scarlatina Anginosa** is a more severe form, particularly as regards the throat symptoms. The rash may be well marked or not, but it is often slow in developing and in subsiding. There is intense inflammation of the throat, the tonsils, uvula and soft palate being swollen and ulcerated, or bearing membranous patches not unlike those of diphtheria, while the lymphatic glands in the neck are enlarged and indurated and often suppurate. This form of the disease is marked by great exhaustion and the gradual development of acute septicaemia, with sweating, albuminuria, delirium and septic rash. Some of these cases bacteriologically show the presence of B. diphtheria.

3. **Toxic Scarlatina (Scarlatina Maligna).** In this form the gravity of the condition is due to intense poisoning. The attack sets in with great violence and the patient sinks from the very first. The rash either does not come out at all or is of the slightest amount and of livid rather than scarlet appearance, while the throat symptoms are often not prominent. A further example of a malignant form is occasionally observed in cases where the rash, which had previously been well developed, suddenly recedes, and convulsions or other nervous phenomena and rapid death supervene.

The complications and effects of scarlet fever are among the most important features in this disease, although their occurrence is exceptional. The most serious is inflammation of the kidneys, which is specially apt to appear during convalescence. In a large number of instances it comes on insidiously. One of the most prominent symptoms is swelling of the eyelids. The urine is diminished in quantity, smoky or red from the presence of blood and contains a large quantity of albumen and casts. Mucopurulent rhinorrhoea and rheumatism are other complications. One of the commonest is suppuration of the ears due to extension of the inflammatory process from the throat along the Eustachian tube into the middle ear. This often leads to permanent ear-discharge, with deafness from the disease affecting the inner ear and temporal bone; the condition is dangerous from its proximity to the brain. Other maladies affecting the heart, lungs, pleura, etc., occasionally arise in connection with scarlet fever, but are of less occurrence than those previously mentioned.

Treatment.—In the treatment of scarlet fever, one of the first requirements is isolation of the case, to limit spread of the disease. In convalescence, inunction of the body with carbolized oil (1 in 40) and the frequent use of a bath containing soda, are to be recommended. It is seldom that a patient who has suffered from scarlet fever can safely go about before the expiry of eight weeks, while the period may be considerably prolonged, should any nasal or aural discharge continue. As to general management in favourable cases little is required beyond careful nursing and feeding. The treatment of kidney complications is that of acute Bright's disease. A hot-air bath or wet pack is often useful. When otorrhoea is present the canal must be kept as aseptic as possible. The ears should be carefully syringed every four hours with an antiseptic solution and dried, and a little iodoform inserted into the meatus. Complications such as mastoid disease require special treatment.

Serumtherapy.—Dr. Besredka prepared a serum from the blood of fatal cases, and in the serum prepared at the Pasteur Institute some twenty separate strains of streptococci are used. In using serums, early and large dosage is necessary. Palmirski and Zebrowski prepared a serum from the streptococcus conglomerulatus, which was used with success in the children's hospital at Warsaw. For the Dick method of intradermal inoculation *see* MEDICAL RESEARCH.

SCARLETT, SIR JAMES YORKE (1799–1871), British general, was the second son of the 1st Baron Abinger. Educated at Eton and Trinity College, Cambridge, he entered the army in 1818, and in 1830 became major in the 5th Dragoon Guards. From 1836 until 1841 he was Conservative M.P. for Guildford. In 1840 he obtained the command of his regiment, which he held for nearly fourteen years. In the Crimean War the 5th Dragoon Guards formed part of the Heavy Cavalry Brigade (of which Scarlett was appointed brigadier); it was sent to the Black Sea in 1854, and suffered very heavily from cholera in the camps of Varna. At Balaklava the Heavy Brigade achieved a magnificent success against the Russian cavalry, and had the brigadier (who in the previous charge had been in the thickest of the mêlée) been allowed to advance as he wished, might have converted the disastrous charge of the Light Brigade into a substantial success. (*See* BALACLAVA and CRIMEAN WAR.) For his services on this day Scarlett was promoted major-general, and in 1855 was made K.C.B. After a short absence in England he returned to the Crimea with the local rank of lieutenant-general to command the British cavalry. Scarlett commanded the cavalry at Aldershot until 1860, was adjutant-general of the army from 1860 to 1865, and was commander at Aldershot 1865–70. He died in 1871.

SCARPANTO: *see* KARPATHOS.

SCARRON, PAUL (1610–1660), French poet, dramatist, novelist and husband of Madame de Maintenon, was baptized on the 4th of July 1610. His father, of the same name, was a member of the *parlement* of Paris. Paul the younger became an *abbé* when he was nineteen, and in 1633 entered the service of Charles de Beaumanoir, bishop of Le Mans, with whom he travelled to Rome in 1635. Finding a patron in Marie de Hautefort, he became a well-known figure in literary and fashionable society. An improbable story is told on the authority of La Beaumelle (*Mémoires . . . de Mme. de Maintenon*) that—when in residence at his canonry of Le Mans—he once tarred and feathered himself as a carnival freak and, being obliged to take refuge from popular wrath in a swamp, was crippled from rheumatism. What is certain is that Scarron, after having been in perfect health for nearly thirty years, passed twenty more in a state of miserable deformity and pain. His head and body were twisted, and his legs became useless. He bore up against his sufferings with invincible courage, though his circumstances were further complicated by a series of lawsuits with his stepmother over his father's property, and by the poverty and misconduct of his sisters, whom he supported. Scarron returned to Paris in 1640, and in 1643 appeared a *Recueil de quelques vers burlesques,* and in the next year *Typhon ou la gigantomachie.* At Le Mans he had conceived the idea of the *Roman comique,* the first part of which was printed in 1651. In 1645 was performed the comedy of *Jodelet, ou le maître valet,* the name of which was derived from the actor who took the principal part. *Jodelet* was the first of many French plays in which the humour depends on the valet who takes the part of master, an idea that Scarron borrowed from the Spanish. After a short visit to Le Mans in 1646, he returned to Paris, and worked hard for the bookseller Quinet, calling his works his *"marquisat de*

Quinet." He had also a pension from Fouquet, and one from the queen, which was withdrawn because he was suspected of Frondeur sentiments. When Mazarin received the dedication of *Typhon* coldly, Scarron changed it to a burlesque on the minister. In 1651 he definitely took the side of the Fronde in a *Mazarinade*, a violent pamphlet. He now had no resources but his "*marquisat.*"

In his early years he had been something of a libertine. In 1649 a penniless lady of good family, Céleste Palaiseau, kept his house in the Rue d'Enfer, and tried to reform the gay company which assembled there. But in 1652, sixteen years after he had become almost entirely paralysed, he married a girl of much beauty and no fortune, Françoise d'Aubigné, afterwards famous as Madame de Maintenon (*q.v.*). Scarron had long been able to endure life only by the aid of constant doses of opium, and he died on the 6th of October 1660.

Scarron's work is very abundant and very unequal. The piece most famous in his own day, his *Virgile travesti* (1648–1653), is now thought a somewhat ignoble waste of singular powers for burlesque. But the *Roman comique* (1651–1657) is a work the merit of which is denied by no competent judge. Unfinished, and a little desultory, this history of a troop of strolling actors is almost the first French novel, in point of date, which shows real power of painting manners and character, and is singularly vivid. It is in the style of the Spanish picaresque romance, and furnished Théophile Gautier with the idea and with some of the details of his *Capitaine Fracasse*. Scarron also wrote some shorter novels: *La Précaution inutile,* which inspired Sedaine's *Gageure imprévue; Les Hypocrites,* to which *Tartuffe* owes something, and others. Of his plays *Jodelet* (1645) and *Don Japhet d'Arménie* (1653) are the best.

The most complete edition of his works is by La Martinière, 1737 (10 vols., Amsterdam). The *Roman comique* and the *Énéide travestie* were edited by Victor Fournel in 1857 and 1858. Among the contemporary notices of Scarron, that contained in the *Historiettes* of Tallemant des Réaux is the most accurate. The most important modern works on the subject are *Scarron et le genre burlesque* (1888) by Paul Morillot; a biography by J. J. Jusserand in English, prefixed to his edition of *The Comical Romance and other tales by Paul Scarron, done into English by Tom Brown of Shifnal, John Savage and others* (2 vols., 1892); and *Paul Scarron et Françoise d'Aubigné d'après des documents nouveaux* (1894) by A. de Boislisle.

SCAUP, the wild-fowler's abridgement of SCAUP-DUCK, a diving duck (*Nyroca marila*), so called "because she feeds upon *scaup, i.e.,* broken shell-fish." It is an abundant bird round the coasts of most of the northern hemisphere; it repairs inland in spring to breed in Iceland, Lapland, Siberia, and the fur countries of America. The scaup-duck has considerable likeness to the pochard (*q.v.*), both in habits and appearance; but it more generally affects salt water, and the head of the male is black, glossed with green; in North America, a second species smaller than the ordinary one is also found, the lesser scaup, *N. affinis.* The female scaup-duck can be distinguished from the female pochard by her broad white face.

SCAURUS, MARCUS AEMILIUS, was the son of Marcus Aemilius Scaurus (*c.* 163–88 B.C.), who was curule aedile, praetor and consul in 115, censor in 109, and in charge (104) of the corn supply at Ostia. The father belonged to the moderate aristocratical party, and was frequently in difficulties with extremists on either side. Though not a great orator, his speeches were weighty and impressive. The son served during the 3rd Mithradatic War (74–61 B.C.) as quaestor to Pompey, by whom he was sent to Judaea to settle the quarrel between Hyrcanus and Aristobulus. Scaurus decided in favour of the latter, who was able to offer more money. On his arrival in Syria, Pompey reversed the decision, but, ignoring the charge of bribery brought against Scaurus, left him in command of the district. An incidental campaign against Aretas, king of the Nabataeans, was ended by the payment of 300 talents by Aretas to secure his possessions. This agreement is represented on coins of Scaurus. As curule aedile in 58, Scaurus celebrated the public games on a scale of magnificence never seen before. The show included many animals never before seen in Rome, and a wooden theatre was erected to hold 80,000 spectators. In 56 Scaurus was praetor, and in the following year governor of Sardinia. On his return to Rome (54) he was accused of extortion in his province. Cicero and five others (amongst them the famous Q. Hortensius) undertook his defence, and, although there was no doubt of his guilt, he was acquitted. During the same year, however (according to some, two years later, under Pompey's new law), Scaurus was condemned on a charge of illegal practices as a candidate for the consulship, and was exiled.

See Josephus, *Antiq.* xiv. 3–5, *Bell. Jud.* i. 7; Appian, *Syr.* 51, *Bell. civ.* ii. 24; Pliny, *Nat. Hist.* xxxvi. 24; Cicero, *Pro Sestio,* 54, fragments of *Pro Scauro,* numerous references in the *Letters;* Asconius, *Argumentum in Scaurum. See* also, for both the above, AEMILIUS (Nos. 140, 141) in Pauly-Wissowa's *Realencyclopädie der classischen Altertumswissenschaft,* i. pt. 1. (1894), and Smith's *Dictionary of Greek and Roman Biography, s.v.* Scaurus.

SCAVENGER, now one who cleans the streets, removes refuse, generally a workman employed by the local public health authority (*see* DESTRUCTORS; REFUSE DISPOSAL).

SCAVENGER'S DAUGHTER (corruption of Skevington's or Skeffington's Daughter), an instrument of torture in use during the 16th century in England. It was invented by Sir W. Skevington, lieutenant of the Tower in the reign of Henry VIII. It consisted of a wide iron hoop which by means of screws was tightened round the victim's body until the blood was forced from the nose and ears, and sometimes from the hands and feet.

SCEPTICISM means in Greek philosophical (σκέπτομαι) usage to hesitate, to reflect, to examine, to consider pros and cons, to be unable to arrive at a decision or to rest content with surmise. Strictly defined, it is the denial of the possibility of knowing reality; that is to say, the human mind, by its very constitution, can never comprehend the ultimate nature of things. But this meaning belongs to the rarefied region of pure theory; so much so that complete denial has been the exception even among professional thinkers. Hence the historical importance of the less stringent, even popular usage. For, in general acceptation, scepticism suggests denial of current or customary beliefs. Its assault is by no means confined to theology, as is often supposed.

Taken thus as a repudiation of traditional or authoritative views, it tallies with the stricter philosophical definition in that historically, scepticism has flourished most during periods of transition when attacks upon previous systematic (or even common sense) constructions were rife. Obvious examples are furnished by the assaults of the Sophists upon the Greek cosmologists; of Pyrrho and his pupils upon the followers of Plato and Aristotle; of the Middle and New Academies upon Chrysippus and the Stoics; of Sextus Empiricus upon all the principles of Graeco-Roman thought; of Montaigne upon scholasticism; of Glanvil upon the crusted Aristotelians of the Oxford schools; of Locke upon certain aspects of Cartesianism; of Hume upon Locke and the doctrine of representative perception; of Kant upon natural theology; of L. Feuerbach upon Hegel; of agnostics upon the theological interpretation of nature and man; of Nietzsche upon the practical postulates of European Christendom; and of Pragmatism upon Idealism.

ANCIENT PERIOD

For philosophical thought and practical life alike, scepticism presupposes the existence of theories and socio-political situations which lay themselves open to attack. Accordingly, in the western world, it dates (*c.* 440 B.C.) from the Greek Sophists (*q.v.*) who not only impugned current cosmological speculations, but also impeached the ethical judgments peculiar to the Hellenic "city-state," Athens particularly. Their scepticism was general rather than systematic, political as well as theoretical. Hence, the most thoroughgoing and persistent scepticism known to us arose with the profound changes wrought by Alexander the Great, the decline of the Hellenic type of civil polity, and the gradual exhaustion of original thought during the Roman Republic and Empire. Pyrrho of Elis (*c.* 300 B.C.), whose name furnishes the synonym for philosophical scepticism; his pupil, Timon of Phlius (*c.* 250 B.C.); Carneades (*c.* 150 B.C.), above all Aenesidemus (*c.* A.D. 50) and Sextus Empiricus (*c.* A.D. 200) are the prominent

figures. During the interval between the Sophists and Timon, scepticism was stayed by the personality of Socrates, and by the constructive systems of Plato and Aristotle.

Scepticism, as a distinct school, begins with Pyrrho of Elis, who maintained that knowledge of things is impossible and that we must assume an attitude of reserve (ἐποχή). The Pyrrhonists were consistent enough to extend their doubt even to their own principle of doubt. They thus attempted to make their scepticism universal, and to escape the reproach of basing it upon a fresh dogmatism. Mental imperturbability (ἀταραξία) was the result to be attained by cultivating such a frame of mind. The happiness or satisfaction of the individual was the end which dominated this scepticism as well as the contemporary systems of Stoicism and Epicureanism, and the three Schools agree that it consists in tranquillity or self-centred indifference. It is men's opinions or unwarranted judgments about things, say the sceptics, which betray them into desire, and painful effort and disappointment. From all this the man who abstains from judging one state to be preferable to another is delivered. But, as complete inactivity would have been synonymous with death, it appears to have been admitted that the sceptic, while retaining his consciousness of the complete uncertainty enveloping every step, might follow custom in daily affairs.

Sextus Empiricus presented the sceptical arguments clearly, with special reference to Stoic materialism. Since later scepticism up to Hume's day went no further, it may be well to summarize the ten characteristic ways of procedure (tropes) formulated, possibly, with Aristotle's list of categories in mind. Desirous of disabling assent to any dogmatic view Sextus, following Aenesidemus, tries to show why a criterion of truth is impossible. It is to be remembered that the common effort of the dogmatic schools was to bestow the boon of independent tranquillity upon men. To this end they presumed some knowledge of the nature of the world, which played the part of an external support. Thus, for example, the Stoics taught that sensations produce modifications within the mind, and these, in turn, represent or symbolize objects. The presentations ("phantasies" or images) are "affections occurring in the soul, revealing both themselves and that which caused them." The sceptics held such doctrines to be unnecessary and impossible. Sensations or ideas, being states of individual subjectivity, men can know nothing save their own inward experiences. Hence the intent of the "tropes." (1) Animals differ in their modes of perception, because they differ in the development of their senses. (2) Men similarly differ from each other. (3) The sense-organs differ, so that objects perceived by this or that sense present contrasted aspects. Did we possess more senses, unknown aspects of objects might appear. (4) The moods of precipients differ, and make it impossible to discern which affords true information about objects. (5) Objects differ according to their distance and position—the stick seems bent when thrust into water. (6) The organs of sense-perception constitute a medium through which the object must be perceived; hence objects cannot be known directly. (7) The modes of objects, never the objects themselves, appear to us. (8) Everything in the external world is relative, not merely to the percipient, but to everything else. (9) Associations are of such a nature that we see things in false perspective, stressing the unfamiliar, for instance, and accepting the familiar without question. (10) Consideration of mankind shows that customs, opinions, manners, institutions, laws and beliefs are of the most diverse; even in the essential matter of right and wrong, no universal standard exists. Allowing that such qualities as truth, capacity to appeal to sensibility, and intelligibility are intrinsic to objects, it follows that "(1) nothing is self-evident, for if things were certain of themselves men would not differ about them; (2) nor can anything be made certain by proof; because we must either arrive in the process at something self-evident or involve ourselves in an endless regress." Accordingly, it is out of the question to argue from "signs" to things signified, and cause as an effective component of phenomena disappears. To be beyond reach of fear or doubt or other disturbance, a man must retire into himself. Such is the theory. For the rest, he might (often did) acquiesce practically in the Roman conviction of "manifest destiny," to which Carneades would have allowed a measure of probability.

TRANSITION

The changes and disturbances which accompanied the dissolution of the Roman Empire, the gradual formation thereafter of a new philosophical synthesis within the Church, and lack of contact with Greek thought prevented for centuries anything like a revival of ancient scepticism. The *Sic et Non* of Abelard (d. 1142) with its list of contradictories about 158 questions, recalls the outlook of the "tropes," but there is no reason to regard them as sources; the same may be said of the critical subtleties of Occam (d. 1347). During the Italian Renaissance revolts against dogma and clericalism appeared, but no systematic scepticism. Nor can it be affirmed that French scepticism thereafter, although its debt to the Greek schools is obvious, became definitely systematic. Montaigne (1533–92), a practical sceptic in his attack upon abuses, diffused an atmosphere of inquiry; so did Charron (1541–1603) in his philosophy of living and appeal to natural reason. Sanchez, in his *Tractatus de multum nobili et prima universali scientia quod nihil scitur* (*A Treatise on the Noble and High Science of Nescience,* 1581), with its derivation of knowledge from the senses; and la Mothe-le-Vayer (1586–1672), who calls Sextus Empiricus "our beloved sceptic," paved the way for Bayle's *Dictionnaire historique et critique* (1697), a quarry for contradictions calculated to set natural reason and supernatural revelation by the ears. Bayle maintained that the dubiety of knowledge points to renunciation of inquiry and acceptance of revelation. In a word, be reason what it may, the authority of faith in its own sphere remains unimpaired. Hence we have a form of Christian scepticism, either genuine or assumed as a precaution.

PASCAL

The typical and most eminent example of the Christian sceptic is Pascal (1623–62). The form of the *Pensées* forbids the attempt to evolve from their detached utterances any coherent system. For, though he says "Pyrrhonism is the truth," "he who flouts philosophy is the veritable philosopher," or, again, "Abase thyself, helpless reason; be silent, thou imbecile nature," other passages recognize the validity of reason in its proper place. But what he everywhere emphatically denies is the possibility of reaching by the unassisted reason a satisfactory theory of things. Man is a hopeless enigma to himself, till he sees himself in the light of revelation as a fallen creature. The Fall alone explains the nobleness and the meanness of humanity. Christ is the only solution in which the baffled reason can rest. These are the two points on which Pascal's thought turns. Far from being able to sit in judgment upon the mysteries of the faith, reason is unable to solve its own contradictions without aid from a higher source.

HUME

Hume is the most illustrious and typical of modern sceptics. His scepticism is sometimes placed, as by Kant, in his distrust of our ability and right to pass beyond the empirical sphere. But it is essential to the sceptical position that reason be dethroned within experience as well as beyond it, and this is undoubtedly the result at which Hume arrives. The *Treatise* (1739–40) is a *reductio ad absurdum* of the principles of Lockianism, inasmuch as these principles, when consistently applied, leave the structure of experience entirely "loosened" (to use Hume's own expression), or cemented together only by the irrational force of custom. Hume's scepticism thus really arises from his thoroughgoing empiricism. Starting with "particular perceptions" or isolated ideas let in by the senses, he never advances beyond these "distinct existences." Each of them exists on its own account; it is what it is, but it contains no reference to anything beyond itself. The very notion of objectivity and truth therefore disappears. Hume's analysis of the conceptions of a permanent world and a permanent self reduces us to the sensationalistic relativism of the Greek Sophist, Protagoras. He expressly puts this forward in various passages as the conclusion to which reason conducts us. The fact that the conclusion is in "direct and total

opposition" to the apparent testimony of the senses is a fresh justification of philosophical scepticism. For, indeed, scepticism with regard to the senses is considered in the *Enquiry* (1748) to be sufficiently justified by the fact that they lead us to suppose "an external universe which depends not on our perception," whereas "This universal and primary opinion of all men is soon destroyed by the slightest philosophy." Scepticism with regard to reason, on the other hand, depends on an insight into the irrational character of the relation which we chiefly employ, viz., that of cause and effect. It is not a real relation in objects, but rather a mental habit of belief engendered by frequent repetition or custom. This point of view is applied in the *Treatise* universally. All real connection or relation, therefore, and with it all possibility of an objective system, disappears; it is, in fact, excluded by Hume from the outset, for "the mind never perceives any real connection among distinct existences."

KANT

The system of Kant, or rather that part of his system expounded in the *Critique of Pure Reason* (1781), though expressly distinguished by its author from scepticism, has been included by many writers in their survey of sceptical theories. The difference between Kant, with his system of pure reason, and any of the thinkers passed in review is obvious; and his limitation of reason to the sphere of experience suggests in itself the title of agnostic or positivist rather than that of sceptic. Yet, if we go a little deeper, there is substantial justification for the view which treats agnosticism of the Kantian type as essentially sceptical in its foundations and in its results. For criticism not only limits our knowledge to a certain sphere, but denies that our knowledge within that sphere is real; we never know things as they actually are, but only as they appear to us. This doctrine of relativity really involves a condemnation of our knowledge (and of all knowledge), because it fails to realize an impossible and self-contradictory ideal. The man who impeaches the knowing faculties because of the fact of relation which they involve, is pursuing the phantom of an apprehension which, as Lotze expresses it, does not apprehend things, but is itself things; he is desiring not to know but to be the things themselves. If this dream or prejudice be exploded, then the scepticism originating in it—and a large proportion of recent sceptical thought does so originate—loses its basis. The prejudice, however, which meets us in Kant is, in a somewhat different form, the same prejudice which is found in the "tropes" of antiquity—what Lotze calls the "inadmissible relation of the world of ideas to a foreign world of objects." For, as he rightly points out, whether we suppose idealism or realism to be true, in neither case do the things themselves pass into our knowledge. No standpoint is possible from which we could compare the world of knowledge with such an independent world of things, in order to judge of the conformity of the one to the other. But the abstract doubt "whether, after all, things may not be quite other in themselves than that which by the laws of our thought they necessarily appear" is a scepticism which, though admittedly irrefutable, is as certainly groundless. No arguments can be brought against it, simply because the scepticism rests on nothing more than the empty possibility of doubting. This holds true, even if we admit the "independent" existence of such a world of things. But the independence of things may with much greater reason be regarded as itself a fiction or prejudice. The real "objective" to which our thoughts must show conformity is not a world of things in themselves, but the system of things as it exists for a perfect intelligence. Scepticism is deprived of its persistent argument if it is seen that, while our individual experiences are to be judged by their coherence with the context of experience in general, experience as a whole does not admit of being judged by reference to anything beyond itself.

THE 19TH CENTURY

During the 19th century, the methods of measurement and enumeration, coming down from Newton and Leibniz, were applied in many spheres with such success that, by 1850, a new scepticism, in the shape of positivism unaware of its own dogmas, acquired vogue. This was the heyday of materialism. The natural universe, with "matter" as *substratum* came to be viewed as a given changeless system wherein everything followed from an irreversible cosmic order. The spiritual must be accounted merely a side-issue, devoid of intrinsic reality. On this scheme gravitation, electricity, magnetism and other forces were paraded as properties of "matter"—all else betrayed the taint of illusion or, to be plain, superstition. The hidden postulate—that nothing is valid save sense-perception—inevitably led to dogmatism. Hence types of scepticism arose successively, agnosticism being the earliest, while, very gradually during the final quarter of the 19th century, more rapidly during the first quarter of the 20th, the theological aspect of the issue fell in shadow, thanks to unprecedented extension of natural knowledge and profound socio-economic changes.

The Reign of Law.—The mechanical conception of nature ruled between 1850 and 1870. The atomic theory, reverting to implications as old as Democritus, the theorem of the conservation of energy when energy was accounted a purely mechanical principle, the early hypotheses of physiology after the enunciation of the cell-theory, and the doctrine of evolution thrust into physical categories, lent seeming authority to the uniformity of "matter" as the whole import of the uniformity of nature. The "reign of law," reducing all phenomena to motion, appeared to warrant an ultimate philosophy bound to oust "Romantic" sentimentalism. Experiential test had established calculable truths; therefore, it alone could guarantee the truth. In short, Hume's view, that nothing is valid save sense-perception, came to be identified with the system of actual science.

Agnosticism in Theology.—Meanwhile Protestant theology, notably in Germany, beset by opposition between inward faith and historical criticism, was fain to fall back upon abstract subjectivity. Nature, conceived as a vast automatic mechanism, betrays no spiritual purpose; and the corporate witness of the Christian consciousness down the ages, being deprived of divine intimation by positivist history, had become "naturalized" similarly. The contradiction between Reason and Faith seemed irremediable when Nature and the Church and the Scriptures could furnish no decisive guidance. Hence, relying upon a negative interpretation of Kant, Albrecht Ritschl (1822–88) and his disciples distinguished sharply between "scientific" and "religious" experience, denied theological validity to the former, and found the latter purely in the attitude of the believer to the object of his belief. This attitude is determined by the psychical facts of sin, recognition of forgiveness, and conviction of restoration of the will to goodness, which, taken together, furnish sufficient evidence of the historical person of Jesus as a divine revelation, and the necessary antecedent of a God Who can reconcile. Thus, no matter what natural science and "scientific" history may conclude, these "value-judgments" of inward consciousness remain quite unaffected. So far as the believer is concerned, there is neither reign of natural law nor immanent development within human history. "Things-in-themselves" being inscrutable, have no bearing upon individual conviction, which is a practical affair justified by results. "The redemption of man by the surrender of his own will to the will of the Whole" becomes irrelevant, because the Whole and its will have disappeared. So, as in ancient scepticism, man is the measure of all things, seeing that judgments of faith are "only intelligible as the expression of the personal self-certainty of the human spirit which is in some way morally determined." Religion is no theory, but a practice "utilized by the living person as a means to his own ends." In short, religion is conserved at the price of objective truth. Later developments seem to show that this position has not been maintained with its pristine rigour.

Current forms of scepticism bear intimate relation to discoveries in the natural sciences and psychology, to the perspective induced by the historical outlook, and to social displacements accompanied by the development of anti-intellectualism. A summary (and therefore partial) statement follows:—

Physiologism.—Things are external to us in space. Hence, the physiological conditions antecedent to perception interpose a veil between us and objects and direct knowledge is ruled out. Again,

the cerebro-spinal states on which perception depends may as well be effects of disturbances within the organism as of stimuli from without. Evidently, this view assumes the existence of objects out of relation to consciousness and also that one part of knowledge is valid, disclosing, as it does, reasons for the dubiety of perception.

Psychologism.—Granted that the mind is merely a "natural object," it is conditioned by time no less than by space. But reference to past time presupposes memory, and to future time anticipation. Psychologically, both are untrustworthy; therefore man is confined to the specious present. In any case, whatever may be said for knowledge derived from the past, the future baffles penetration; even "laws of nature" may alter or lapse, and it would seem to follow that all experiential conjunctions are casual. Scepticism of this kind involves the dogma that hypotheses as to uniformity are inadmissible, and that objective "fact," other minds included, is at best a perilous inference. It may be added that Behaviourism is dogmatic rather than sceptical, being a subtle recrudescence of materialism.

Historicism.—This is sometimes treated as if it were identical with naturalism; that is, given an evolving series, discovery of origins suffices for "explanation," not merely of "species," but also of "values" in the spiritual and social life. The underlying assumptions are too plain to require comment. Thus, in its sceptical drift, Historicism rather implies that, on review of the past all opinions and, equally, their practical consequences, in institutions, etc., can be shown to have been bemused by hopeless diversity of judgment. In particular, thinkers who profess to decide fundamentals, exhibit irremediable contradiction. It is absurd, then, to claim that ultimates are capable of settlement. This view involves a negative dogma, by denying the possibility of progressive insight—hypothesis can never rise to theory. The process of phenomena, each member its own witness, hides aught that may lie behind.

Pragmatism.—In so far as it embodies an emphatic protest against certain types of philosophy, pragmatism cannot be identified with scepticism off-hand. But, being a species of geneticism, it favours sceptical tendencies. "Logical forms and structures are distinctions within the process of reflective and experimental enquiry." If so, all "laws" must be judged evanescent. On this score, pragmatic geneticism and futurism are anti-intellectual. Notwithstanding, they embrace belief in the creative function of an evolutionary process (Bergson), and justify the voluntaristic creed of modernism (Blondel). Even so, the reason for the validity of the hypothesis is made secondary to other considerations. Consequences are good, because subserving happiness, etc., and not true, because in agreement with a *ratio essendi.* Hence the sceptical thrust. Truth is relative to individual activity which happens to be in continuous process of transmutation. Thus, truth can never be more than the best relevant or temporary adjustment; hence, all questions about the truth must be reckoned artificial. Coming in at the death, intellect can but offer bad reasons for manifest effects. Meantime, it were prudent, perhaps, to regard pragmatism rather as a search for a technique by a generation eager to formulate new values than as bare scepticism. Taken thus, it employs dogmas of its own—reality on the make in linear progress, for example. Nevertheless it is the symptomatic philosophy of a period of disintegration, often doubtful whether the "world-spirit" be for it or against it, and seeking a criterion in "social utility."

CONCLUSION

Of a scepticism which professes to doubt the validity of every reasoning process and every operation of all our faculties it is, of course, as impossible as it would be absurd to offer any refutation. This absolute scepticism, indeed, can hardly be regarded as more than empty words; the position which they would indicate is not one which has ever existed. In any case, such scepticism is at all times sufficiently refuted by the imperishable and justifiable trust of reason in itself. The real function of scepticism in the history of philosophy is relative to the dogmatism which it criticizes. And, as a matter of fact, it has been seen that many so-called sceptics were rather critics of the effete systems which they found cumbering the ground than actual doubters of the possibility of knowledge in general. And even when a thinker puts forward his doubt as absolute it does not follow that his successors are bound to regard it in the same light. The progress of thought may show it to be relative, as when the nerve of Hume's scepticism is shown to be his thoroughgoing empiricism, or when the scepticism of the *Critique of Pure Reason* is traced to the unwarrantable assumption of things-in-themselves. When the assumptions on which it rests are proved to be baseless, the particular scepticism is also overcome. In like manner, the apparent antinomies on which such a scepticism builds will be found to resolve themselves for a system based on a deeper insight into the nature of things. The serious thinker will always repeat the words of Kant that, in itself, scepticism is "not a permanent resting-place for human reason." Its justification is relative and its function transitional.

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SCÈVE, MAURICE (1500?–1564), French poet, was born at Lyons, where his father practised law. Besides following his father's profession he was a painter, architect, musician, and poet. He was the centre of the Lyonnese group who elaborated the theory of spiritual love, derived partly from Plato and partly from Petrarch, which was enunciated in Antoine Héroet's *Parfaicte Amye.*

Scève's chief works are *Délie, objet de plus haulte vertu* (1544); two eclogues, *Arion* (1536) and *La Saulsaye* (1547), and *Le Microcosme* (1562), an encyclopaedic poem beginning with the fall of man. *Délie* (an anagram for *l'idée*) set the fashion of a series of poems addressed to a mistress real or imaginary, followed by Ronsard in *Cassandre* and by Du Bellay in *Olive.* For the Lyonnese school of which Scève was the leader *see* LABÉ, LOUISE.

See Pernetti, *Recherches pour servir à l'histoire de Lyon* (1757); E. Bourciez, *La Littérature polie et les moeurs de cour sous Henri II.* (1886); F. Brunetière, "Un Précurseur de la Pléiade, Maurice Scève," in his *Études critiques,* vol. vi. (1899).

SCHACHT, HJALMAR (1877–), German financier, was born at Tingleff, near Flensburg, on Jan. 22, 1877. After studying political economy, he became secretary of the *Handelsvertragsverein* (Trade Agreements League) 1901–03, and was then deputy director of the Dresden Bank until 1916. From 1916 to 1923 he was a member of the board of the Nationalbank für Deutschland, afterwards the Darmstädter und Nationalbank. He was appointed president of the German Reichsbank in Dec.

1923. In 1924 he collaborated in the conference of London and the deliberations of the Dawes Committee and in 1929 he was the chief German representative on the expert committee which sat in Paris to attempt the settlement of the reparations question. Dr. Schacht also established the Gold Bank of issue (*Goldnotenbank*).

SCHADOW, a family of German artists.

I. Johann Gottfried Schadow (1764–1850), sculptor, was born in Berlin, where his father was a poor tailor. His first teacher was an inferior sculptor, Tassaert, patronized by Frederick the Great, but with the aid of his father-in-law Schadow was able later to study in Rome. In 1788 he returned to Berlin to succeed Tassaert as court sculptor and secretary to the Academy. Over half a century he produced some two hundred works. His earlier work, including a portrait statue of Frederick playing the flute and the charming group of the crown-princess Louise and her sister, was notable for its directness and naturalness in an age of artificiality. For a long time Schadow stood out against the classicist movement, becoming engaged in a controversy with Goethe on the subject; but the forces against him were too strong, and his Rostock monument to Blücher, supervised by Goethe, represents the great field marshal in a lion's skin and toga after the affected manner of the day. He died in Berlin in 1850.

Two fine examples of his classical sculpture are the Quadriga on the Brandenburger Tor and the allegorical frieze on the façade of the Royal Mint in Berlin. Thirty church monuments and memorial works are enumerated. Besides the Blücher monument he executed one of Frederick the Great at Stettin and that of Luther at Wittenberg. His busts number over a hundred, and include 17 colossal heads in the Valhalla at Ratisbon. He also wrote treatises on the proportions of the human figure, on national physiognomy, etc.

II. His eldest son Rudolph Schadow (1786–1822), sculptor, was born in Rome and at first studied with his father in Berlin. In 1810 he went to Rome and was befriended by Canova and Thorwaldsen. He showed great versatility, producing now a figure of Paris, now a girl spinning, and, after becoming a convert to Roman Catholicism, statues of John the Baptist and of the Virgin and Child. In England he executed bas-reliefs for the duke of Devonshire and the marquis of Lansdowne. For the king of Prussia he modelled a colossal group of "Achilles with the body of Penthesilea." He died in Rome in 1822.

III. Friedrich Wilhelm Schadow (1789–1862), painter, was the second son of Johann Gottfried. He was born in Berlin on Dec. 6, 1789. In 1810 he went with his elder brother Rudolph to Rome, where he became a leading German pre-Raphaelite. With his friend Overbeck and others he also joined the Roman Catholic church. Together with Cornelius, Overbeck and Veit, Schadow received a commission from the Prussian consul, General Bartholdi, to decorate a room in his house on the Pincian Hill with frescoes of "Joseph and his Brethren," the two scenes executed by Schadow being the "Bloody Coat" and "Joseph in Prison." In 1819 Schadow became a professor in the Berlin Academy, and in 1826 was appointed director at Düsseldorf, where he entirely re-organized the Academy and made it a centre of Christian art to which students flocked from all sides. In 1859, after a reaction against Schadow's sacerdotal style had set in, the Naturalist party succeeded in deposing him. He died at Düsseldorf on March 19, 1862. His most important work is the "Wise and Foolish Virgins" (1842) at the Staedel Institute, Frankfurt.

SCHAFF, PHILIP (1819–1893), American theologian and church historian, was born at Chur, Switzerland, on Jan. 1, 1819. He was educated at the gymnasium of Stuttgart, and at the universities of Tübingen, Halle and Berlin, where he became *Privatdozent* in 1842. In 1843 he became professor of church history and biblical literature in the German Reformed Theological seminary of Mercersburg, Pennsylvania. On his journey he stayed six months in England and met Pusey and other Tractarians. His inaugural address on *The Principle of Protestantism,* delivered in German at Reading (Pa.), in 1844, and published in German and in an English version by J. W. Nevin (1845), by its Neander-like view that Romanism and Protestantism were only stages in the divinely appointed development of the Christian Church, caused him to be tried for heresy. Schaff's broad views strongly influenced the German Reformed Church. His *History of the Apostolic Church* (in German, 1851; in English, 1853) and his *History of the Christian Church* (1858–92) were standard works. In 1870 he became a professor at the Union Theological seminary, holding successively several different chairs till his resignation in the spring of 1893. He died in New York city on Oct. 20, 1893. The English Bible Revision committee in 1870 requested him to form a co-operating American committee, of which he became president in 1871. He also was a founder of the American Society of Church History (1888) and president until his death. He strove earnestly to promote Christian unity and union; his last labours being in behalf of the Parliament of Religions held at the Chicago World's Fair. He remains one of the foremost of American theological scholars, both through the quality and the remarkable quantity of his work. He edited the American translation and revision of Lange's *Bibelwerk* (1864–80), the great Schaff-Herzog *Encyclopaedia of Religious Knowledge* (1884); the first 7 volumes of the Nicene and Post-Nicene Church Fathers in English (1886–94); the *International Illustrated Commentary on the New Testament* (1879–82) and the *International Revision Commentary* (1881–84), as far as the Epistle to the Romans. His *Bibliotheca symbolica ecclesiae universalis: the Creeds of Christendom* (1877) was a pioneer work in English in the field of symbolics. He was the author also of literary essays, biographies and other works.

See his *Life* (1897) by his son, David Schley Schaff.

SCHAFFHAUSEN, the most northerly Swiss canton, lying almost wholly north of the Rhine, which, in part, separates it from the cantons of Zürich and Thurgau. On the other sides it is surrounded by Baden, portions of which separate the canton into three detached portions; the largest is the region near the chief town, Schaffhausen. Southwards, the small lowland isolated district of Rüdlingen and Buchberg was purchased in 1520, and Zürich, in 1798, ceded a slightly more extensive eastward tract around the old town of Stein. The territory contains two tiny Baden "enclaves," of which the village of Büsingen and the small tract of land surrounding it is the larger and more important. The total area of the canton is (1923–24 determinations) 115 sq.m., of which the high proportion of 95·3% are classed as "productive" (forests covering 45·5 sq.m., and vineyards 1·3 sq.m.). The dominant land feature is the plateau of Randen—Hohe Randen summit 2,998 ft., is on the northern boundary—sloping gently southwards to the Rhine and intersected by short glens such as Klettgau (west of Schaffhausen) which carry intermittent water torrents. The Rhine 1½ m. below the capital is a stream 370 ft. wide, interrupted by the famous falls (Laufen), which, though of small height (60 ft.), are of considerable grandeur; they are exploited for hydro-electric power. The capital is an important railway junction. It is on the main line from Constance to Basle which traverses the canton, and also has normal railway linkages with Friedrichshafen (Lake of Constance), and Zürich (2 lines). Schleitheim (north-west) is connected to it by a light railway. In 1920 the population was 50,428, of whom 48,258 were German-speaking, 1,611 were Italian-speaking and 339 were French-speaking, while 39,294 were Protestants, 10,768 Catholics and 51 Jews. The inhabitants are devoted chiefly to agriculture and to vine growing; its well managed forests are also a considerable source of revenue. The manufacture of watches and jewellery is also assuming considerable importance. Schaffhausen (pop. 21,650) is the only large town. Neuhausen (6,450) near the Rhine falls has an important aluminium works. There are six administrative districts containing 36 communes. The Cantonal Constitution dates from 1876. The legislature (*Grossrat*) is composed of 78 members elected (by the system of absolute majority) for four years in the proportion of one to every 600 residents. The executive (*Regierungsrat*) of five members is also elected for four years by a popular vote, as are the two members of the Federal *Ständerat* and the three members of the Federal *Nationalrat.* Since 1876, any 1,000 electors have the right of "initiative," both for legislative projects and for the revision of the Cantonal Constitution. Since 1895 the "obligatory referendum" for all legislative projects and financial resolutions has prevailed. Taxation is light, for the public cantonal property, *e.g.,* forests, is the most

considerable in Switzerland and the area is particularly prosperous.

The canton, admitted into the Confederation in 1501, arose from acquisitions made at various dates by the town; the chief of these were the outlying estates of the ecclesiastical foundations suppressed at the time of the Reformation. Of historical interest in this connection is the little town of Stein-am-Rhein (pop. 2,113) with its Benedictine monastery (1005–1526)—now restored to form a museum of antiquities—and Hohenklingen—the castle of the feudal lords of Stein—towering above it.

SCHAFFHAUSEN, Fr. *Schaffhouse,* the capital of the Swiss canton of that name, situated on rising ground above the right bank of the Rhine, and 31 m. by rail W. of Constance. In 1920 it had 20,064 inhabitants (18,872 German-speaking), while there were 14,023 Protestants, 5,811 Roman Catholics, and 39 Jews. The estimated population (1928) was 21,650. The spot is first mentioned in 1045, "Villa Scafhusun," while in 1050 we hear of the "ford" there across the Rhine.

About 1050 the counts founded here the Benedictine monastery of All Saints, which henceforth became the centre of the town. Perhaps as early as 1190, certainly in 1208, it was an imperial free city, while the first seal dates from 1253. The powers of the abbot were gradually limited and in 1277 the emperor Rudolf gave the town a charter of liberties. The Habsburgs held the town from 1330 to 1415, its freedom being finally purchased in 1418, while from 1411 the trade gilds ruled the town. In 1454 it made an alliance with six of the Swiss confederates, by whom it was received as an "ally," being finally admitted a full member in 1501. The Reformation was adopted in 1524, finally in 1529. The town suffered much in the Thirty Years' War from the passage of Swedish and Bavarian troops.

Schaffhausen is a city of contrasts, mediaeval architecture of the true Swabian type and modern manufactures mingling curiously together. The chief ancient building in the town is the *Münster* (now Protestant) of All Saints, formerly a Benedictine monastery. It was consecrated in 1052, and is a specimen of the sternest and plainest Romanesque. Close to it is deposited the famous 15th-century bell that suggested Schiller's *Song of the Bell* and the opening of Longfellow's *Golden Legend.* The castle of Unnoth, above the town, dates in its present form from the second half of the 16th century.

There are a number of factories in the town, while at Neuhausen, its suburb, are aluminium, as well as railway rolling stock works. Industrial development has been furthered by the works for the utilization of the forces in the Rhine, now the property of the town; since 1900 they have been worked by electricity.

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SCHAFFNER, JAKOB (1875–   ), Swiss novelist and story-writer, was born at Basel on Feb. 14, 1874, was educated in a charity school, and worked as a shoemaker until his 30th year. He won the Schiller prize for his novel *Johannes* (1922). Schaffner is a master of the short story, as may be seen in *Die Goldene Fratze* (1912), *Verhängnisse* (1927), and *Föhnwind* (1928). He has also published an unconventional and lively *History of Switzerland* (1915), a volume advocating various political and social reforms, and a collection of poems (*Der Kreislauf;* 1927). Schaffner's style is marked by freshness, geniality, imagination and humour, often recalling Gottfried Keller (*q.v.*). He is, perhaps, at his best in dealing with the world of toil and machinery familiar to him from his own early experience.

SCHAPPE. A term denoting a particular type of yarn spun from "schappe" waste silk from which the natural gum, termed sericin has not been entirely removed or discharged either by "boiling-off" by the English system of "degumming" raw silk, or by the alternative Continental system of fermentation, known as "schapping." The waste silk so treated is soft and lustrous, with the fine silk filaments free from each other, yet retaining some of their natural gum. Schappe silk varies from a white to a bright yellow tone according to the amount of gum still present.

Schappe also denotes a particular type of silk fabric sold under that trade-name and produced from two-ply "schappe" spun silk yarn which, before bleaching, has a somewhat yellow tone owing to the presence of the natural gum. A schappe silk fabric is a fairly strong and firm texture of medium weight, woven on the principle of the plain calico weave, but having a slightly fine ribbed effect somewhat similar to that of a fine "poplin" (*q.v.*) texture but with the ribs or cords much less pronounced. This fine ribbed effect is developed by employing warp yarn of finer denier or counts than that of the weft, and also by inserting a greater number of warp threads than picks of weft, per inch, in the fabric. Thus, one example of "schappe" silk fabric contains 104 warp threads of 52's/2, and 72 picks of 40's/2 weft, per inch.

These denominations of yarn counts are equivalent to 52's and 40's counts of single cotton yarn respectively. They are produced by folding and doubling together two silk threads each of 50 denier silk (approximately) to produce the 52's/2 silk thread, and two threads each of 65 denier silk (approximately) to produce the 40's/2 silk thread. (H. N.)

SCHARLIEB, DAME MARY DACOMB (1845–   ), British surgeon, born in London on June 18, 1845, daughter of William Candler Bird. She was educated privately, and married a barrister practising in India. She entered the medical college at Madras, receiving its diploma in 1878, and afterwards studied at the London School of Medicine for Women. In 1883 she returned to Madras where she became lecturer in midwifery and gynaecology at the Medical College, and examiner at the university. In 1888 she took her London M.D. and from 1887 to 1902 was surgeon at the New Hospital for Woman, being senior surgeon from 1889. In 1887 she was appointed lecturer on forensic medicine to the Royal Free Hospital, in 1889 lecturer on midwifery, and in 1902 chief gynaecologist. She retired from these posts in 1909, in 1917 was made C.B.E., and in 1926 D.B.E. She was a member of the royal commission on Venereal Diseases (1913–16).

She wrote a number of works on medical subjects; her *Reminiscences* appeared in 1924.

SCHARNHORST, GERHARD JOHANN DAVID VON (1755–1813), Prussian general, was born at Bordenau near Hanover, on Nov. 12, 1755. In 1778 he received a commission in the Hanoverian service. He designed, and in part published, a *Handbuch für Offiziere in den anwendbaren Theilen der Kriegswissenschaften.* He also published in 1792 his *Militärische Taschenbuch für den Gebrauch im Felde.* His first campaign was that of 1793 in the Netherlands, in which he served under the duke of York with distinction. In 1794 he took part in the defence of Menin and commemorated the escape of the garrison in his *Vertheidigung der Stadt Menin* (Hanover, 1803), which, next to his paper *Die Ursachen des Glücks der Franzosen in Revolutionskrieg,* is his best-known work. Shortly after this he was promoted major and employed on the staff of the Hanoverian contingent.

In 1801 he entered the service of the king of Prussia, who gave him a patent of nobility, and the rank of lieutenant-colonel. Scharnhorst was employed at the War Academy of Berlin, where he had Clausewitz (*q.v.*) as one of his pupils, and he was the founder of the Berlin Military Society. In the mobilizations and precautionary measures of 1804 and 1805, and in the war of 1806, Scharnhorst was chief of the general staff (lieutenant-quartermaster) of the duke of Brunswick, and received a slight wound at Auerstedt. He attached himself to Blücher in the last stages of the disastrous campaign, was taken prisoner with him at the capitulation of Ratkau, and, being shortly exchanged, bore a prominent part in the leading of L'Estocq's Prussian corps which served with the Russians. For his services at Eylau, he received the order *pour le mérite.*

Educated in the traditions of the Seven Years' War, Scharnhorst had by degrees divested his mind of antiquated forms of war, and come to realise that a "national" army and a policy of fighting decisive battles alone responded to the political and strategical situation created by the French Revolution. The

steps by which he converted the professional long-service army of Prussia, wrecked at Jena, into the national army as we know it to-day, based on universal service, were slow and laboured. He was promoted major-general a few days after the peace of Tilsit, and placed as the head of a reform commission, to which were appointed Gneisenau, Grolman, Boyen and others. Stein himself became a member of the commission and secured for Scharnhorst free access to the king by causing him to be appointed aide-de-camp-general. But Napoleon's suspicions were quickly aroused, and the king had repeatedly to suspend or to cancel the reforms recommended. By direct application to Napoleon, Scharnhorst evaded the decree of Sept. 26, 1810, commanding all foreigners to leave the Prussian service forthwith, but when in 1811–1812 Prussia was forced into an alliance with France against Russia and despatched an auxiliary army to serve under Napoleon's orders, Scharnhorst left Berlin on unlimited leave of absence. In retirement he wrote his *Über die Wirkung des Feuergewehrs* (1813). But the retreat from Moscow at last sounded the call to arms for the new national army of Prussia. Scharnhorst was recalled to headquarters, and was made chief of staff to Blücher. The first battle, Lützen or Gross-Görschen, was a defeat, but a very different defeat from those which Napoleon had hitherto been accustomed to inflict. Scharnhorst was wounded, and died from the effects of his wound on June 8, at Prague, where he had been sent to negotiate with Schwarzenberg and Radetzky for the armed intervention of Austria.

See C. von Clausewitz, *Über das Leben und den Charakter des General v. Scharnhorst;* a life by M. Lehmann (Leipzig, 1886–88, an important work in two volumes); also Max Jähns, *Gesch. der Kriegswissenschaften,* iii. 2,154; Weise, *Scharnhorst und die Durchführung der allgemeinen Wehrpflicht* (1892); A. von Holleben, *Der Frühjahrsfeldzug, 1813* (1905).

SCHAUMBURG-LIPPE, a republic since November, 1918, and a constituent State of the German Republic. It consists of the western half of the old countship of Schaumburg, and is surrounded by Westphalia, Hanover and Hesse-Nassau. Area, 131 sq.m. Its northern extremity is occupied by a lake named the Steinhuder Meer. The southern part is hilly (Wesergebirge), but the remainder consists of a fertile plain. Besides husbandry, the inhabitants practise yarn-spinning and linen-weaving, and the coal-mines of the Bückeberg, on the south-eastern border, are very productive. The great bulk of the population is Lutheran. The capital is Bückeburg, and Stadthagen is the only other important town. The constitution dates from Feb. 24, 1922, but has since been amended. The Landtag consists of 15 members.

SCHEELE, KARL WILHELM (1742–1786), Swedish chemist, was born at Stralsund, the capital of Pomerania, which then belonged to Sweden, on Dec. 19, 1742. He studied the elements of chemistry during his apprenticeship to an apothecary in Gothenburg, with whom he stayed for eight years. In 1770 he settled at Uppsala, where he made the personal acquaintance of Bergman (*q.v.*). A friendship soon sprang up between the two men, and it has been said that Scheele was Bergman's greatest discovery. In 1775, the year in which he was elected into the Stockholm academy of sciences, he left Stockholm for Köping, a small place on Lake Malar, where he became proprietor of a pharmacy. He found time for an extraordinary amount of original research, and every year he published two or three papers, most of which contained some discovery or observation of importance. His unremitting work, it is said, especially at night, induced a rheumatic attack which brought about his death on May 19, 1786.

Scheele's record as a discoverer of new substances is probably unequalled, in spite of his poverty and lack of ordinary laboratory conveniences. His first paper was published in 1770 in conjunction with his friend Retzius; it dealt with the isolation of tartaric acid from cream of tartar. (*See* ANTIMONY.) The analysis of manganese dioxide in 1774 led him to the discovery of chlorine and baryta, to the description of various salts of manganese itself, including the manganates and permanganates, and to the explanation of its action in colouring and decolourizing glass. In 1775 he investigated arsenic acid and its reactions, discovering arsine and "Scheele's green" (copper arsenite). (*See* ARSENIC.) Papers, published in 1776 were concerned with quartz, alum and clay and with the analysis of *calculus vesicae* from which for the first time he obtained uric acid. In 1777 Scheele prepared sulphuretted hydrogen, and noted the chemical action of light on silver compounds and other substances. (*See* SULPHUR.) In 1778 he proposed a new method of making calomel and powder of algaroth, and he got molybdic acid from mineral *molybdaena nitens* which he carefully distinguished from ordinary molybdena (plumbago or black lead of commerce). In the following year he showed that plumbago consists essentially of carbon, and he published a record of estimations of the proportions of oxygen in the atmosphere, which he had carried on daily during the whole of 1778—three years before Cavendish. In 1780 he proved that the acidity of sour milk is due to what was afterwards called lactic acid; and by boiling milk sugar with nitric acid he obtained mucic acid.

His next discovery, in 1781, was in connection with the mineral scheelite (calcium tungstate), from which he obtained tungstic acid. In 1782 he published some experiments on the formation of ether, and in 1783 examined the properties of glycerine, which he had discovered seven years before. About the same time in the course of some work on Prussian blue he described the composition, properties and compounds of prussic acid, and even ascertained its smell and taste, quite unaware of its poisonous character. In the last years of his life he returned to the vegetable acids, and investigated citric, malic, oxalic and gallic acids (*qq.v.*). His only book, on *Air and Fire,* was published in 1777, but was written some years before. The manuscript was in the hands of the printers in 1775, and most of the experimental work for it was done before 1773. One of the chief observations recorded in it is that the atmosphere is composed of two gases—one which supports combustion and the other which prevents it. The former, "fire-air," or oxygen, he prepared from "acid of nitre," from saltpetre, from black oxide of manganese, from oxide of mercury and other substances, and there is little doubt but that he obtained the gas two years before Priestley. Owing to the delay in the publication of his results he is rarely given credit for this discovery. Scheele remained in favour of the phlogiston theory (*see* CHEMISTRY: *History of*) until his death; he apparently thought that hydrogen, which he had obtained by the action of certain acids on iron or zinc was pure *phlogiston.*

A list of Scheele's papers is given in Poggendorff's *Biographisch-litterarisches Handwörterbuch* (Leipzig, 1863). They were collected and published in French as *Mémoires de chymie* (Paris, 1785–88); in English as *Chemical Essays,* by Thomas Beddoes (1786); in Latin as *Opuscula,* translated by Schäfer, edited by Hebenstreit (Leipzig, 1788–89); and in German as Sämtliche Werke (ed. by Hermbstadt, 1793). The work on *Air and Fire* appeared in German at Leipzig and Uppsala in 1777, and again in 1782; in English (ed. by J. R. Forster 1780); and in French (ed. by Dietrich, 1781). *See* W. A. Tilden, *Famous Chemists* (1921).

SCHEELITE, a mineral consisting of calcium tungstate; $CaWO_4$. It was early known as "tungsten" (meaning in Swedish, "heavy stone"), and is the mineral in which K. W. Scheele discovered tungstic acid, hence the name scheelite. Well-developed crystals are not frequent; they usually have the form of acute tetragonal bipyramids, but compact and granular masses are much more abundant. The colour is usually yellowish white or brownish, the crystals sometimes transparent to translucent; the lustre vitreous to adamantine. The hardness is 4·5, the specific gravity 6·0. Molybdenum is usually present, replacing an equivalent amount of tungsten; and in a green variety known as "cuproscheelite" part of the calcium is replaced by copper.

Scheelite usually occurs with topaz, fluor, apatite, wolframite, etc., in tin-bearing veins, and wolfram is often more or less altered to scheelite. Good crystals come from Traversella in Piedmont; massive forms from Carrock Fell, Cumberland; the Riesengebirge in Germany and Czechoslovakia; and Corrèze, France. But the largest known deposits, of great commercial value as an ore of tungsten, are found in California, near Atolia and Randsburg, San Bernardino and Kern counties; and near Bishop, Inyo county: there tungsten-bearing granite magma has invaded highly calcareous rocks, so that scheelite is formed instead of wolfram.

SCHEER, REINHARD (1863–1928), German admiral, was born at Oberkirchen, Hesse-Nassau, on Sept. 30, 1863. After

serving in Cameroon and East Africa, in 1903 he was given command of the 1st torpedo division. In 1910 he became chief-of-staff of the High Sea Fleet under Von Holtzendorff, and in 1913 became commander of a battle squadron. At the outbreak of the World War he was stationed at Kiel with his squadron. Scheer introduced many important improvements in submarine tactics. In Jan. 1916 he was placed in command of the German High Sea Fleet, which he led at the battle of Jutland. On July 2, 1918, he succeeded Von Holtzendorff as chief of the Admiralty Staff. On Nov. 14, 1918, he was placed on the retired list, and took up residence in Weimar, where he died on Nov. 25, 1928. Scheer's account of the battle of Jutland appears in his book *Deutschlands Hochseeflotte im Weltkriege* (1920).

SCHEFFEL, JOSEPH VIKTOR VON (1826–1886), German poet and novelist, was born at Karlsruhe on Feb. 16, 1826. He studied at Munich, Heidelberg and Berlin, entered the State judicial service, and for four years (1848–52) held an official position at Säckingen. Here he wrote his poem *Der Trompeter von Säckingen* (1853), a romantic and humorous tale which immediately gained extraordinary popularity. It has reached more than 250 editions. In 1854 he quitted the Government service and settled at Heidelberg, with the intention of joining the teaching staff of the university. His studies were interrupted by eye-disease, and he went to live on the Lake of Constance. There he elaborated the plan of his famous historical romance *Ekkehard* (1857), the scene of which is laid in the monastery of St. Gall in the 10th century; (Eng. trans. by S. Delffs, Leipzig 1872). The first ideas for this work he got from the *Monumenta Germaniae*. In 1901 *Ekkehard* had reached the 179th edition. Scheffel next returned to Heidelberg, and published *Gaudeamus, Lieder aus dem Engeren und Weiteren* (1868), a collection of joyous and humorous songs, the matter for which is taken partly from German legends, partly from historical subjects. Scheffel was custodian (1857–59) of the library of Prince Egon von Fürstenberg at Donaueschingen; he eventually settled at Karlsruhe, in which city he died on April 9, 1886.

Scheffel's *Gesammelte Werke* have been published in 6 vols. (1907). *See* A. Ruhemann, *Joseph Victor von Scheffel* (1887); G. Zernin, *Erinnerungen an Joseph Victor von Scheffel* (1887); J. Prölss, *Scheffels Leben und Dichten* (1887); L. von Kobell, *Scheffel und seine Frau* (1901); E. Boerschel, *J. V. von Scheffel und Emma Heim* (1906).

SCHEFFER, ARY (1795–1858), French painter of Dutch extraction, was born at Dort on Feb. 10, 1795, the son of a painter of German origin. After his father's death his mother, also an artist, took him to Paris and placed him in the studio of Guérin. Scheffer had little sympathy with the direction given to the Romantic movement by its most conspicuous representatives, Delacroix or Géricault, and made various tentative efforts—"Gaston de Foix" (1824), "Suliot Women" (1827)—before he found his own path, which is essentially classicist. With charm and facility of composition, his colour was earthy, and his sentiment somewhat vapid. He turned to Byron and Goethe, selecting from Faust a long series of subjects which had an extraordinary vogue. Among his most notable works are the "St. Augustin and St. Monica" in the Louvre and the "Francesca da Rimini" in the Wallace collection. He died at Argenteuil on June 15, 1858.

See Vitet's notice (1861) prefixed to Bingham's publication of works of A. Scheffer; A. Etex, *Ary Scheffer* (1859); Mrs. Grote, *Life of A. Scheffer* (1860).

SCHEIDEMANN, PHILIPP (1865–), German politician, was born at Kassel July 26, 1865. In 1903 he entered the *Reichstag* as deputy for Kassel, and in the course of the World War became leader of the Majority Socialists. He voted for the government's war credits and supported its policy up to 1917, when he was associated with Erzberger in the "Peace Resolution" of July 19, 1917, which demanded "peace without annexation or indemnities." He was already exercising influence in German internal politics and was frequently consulted by Bethmann Hollweg. In June 1918 he became vice-president of the *Reichstag*, and on Oct. 3 Secretary of State without portfolio in Prince Max of Baden's Cabinet. On Nov. 9 Scheidemann proclaimed the German Republic from the buildings of the *Reichstag*. On Nov. 10 he was one of the three Majority Socialists who formed the first Provisional Government of the Republic. Although violently attacked by the Spartacists and Minority Socialists as a "counter revolutionary," he undoubtedly helped to save his country from bloodshed and anarchy, and on Feb. 8, 1919, was elected president of the first republican ministry of the *Reich* by the Constituent Assembly at Weimar. On June 20, 1919, he vehemently opposed signing the Treaty of Versailles and resigned when a majority of the Government decided to sign. He then resumed the leadership of the Majority Socialists in the National Assembly and subsequently in the republican *Reichstag*. His reminiscences in *Der Zusammenbruch* (1921) are supplemented by *The Making of New Germany* (1929). (*See* also GERMANY: *Political History*.)

SCHELDT (Fr. *Escaut*, Flem. *Schelde*), a river rising near Catelet in France, entering Belgium near Bleharies in Hainaut, and flowing past Tournai, Oudenarde, Ghent and Termonde till it reaches Antwerp. Some distance below Antwerp, in front of the island Beveland, where the river divides into two channels, respectively north and south of the island, both banks belong to Holland. Of the two channels named, the southern, De Hout, which reaches the sea at Flushing, is used for ocean commerce. The Scheldt has a length of 250 m., of which, by a skilful arrangement of locks, not less than 207 m. are navigable. Its breadth is 500 metres at Antwerp and 1,200 metres where it leaves Belgium. The principal tributaries are the Lys, the Dender and the Rupel. By the treaty of Munster in 1648 the Dutch obtained the right to close the Scheldt to navigation, and they clung tenaciously to it for over two centuries. In 1839 on the final dissolution of the kingdom of the Netherlands, Holland gave definite form to this right by fixing the toll, and by obtaining the assent of the powers to the arrangement which fettered the trade of Antwerp. In 1863 after long negotiations Belgium bought up this right—each of the powers interested in the trade contributing its quota—and the navigation of the Scheldt was then declared free. For the subsequent history of the Scheldt question *see* HOLLAND: *History* and BELGIUM: *History*.

SCHELLING, FRIEDRICH WILHELM JOSEPH VON (1775–1854), German philosopher, was born on Jan. 27, 1775 at Leonberg, a small town of Württemberg. He was educated at the cloister school of Bebenhausen, near Tübingen, where his father, an able Orientalist, was chaplain and professor, and entered the theological seminary at Tübingen at 16. Among his (elder) contemporaries were Hegel and Hölderlin. He shared in the revolutionary sentiments common among his fellow-students, and was suspected of being the author of a German version of the Marseillaise. In 1792 he graduated. Meanwhile he was a close student of Kant, Fichte and Spinoza, more especially of Fichte. Schelling had no sooner grasped the leading ideas of Fichte's amended form of the critical philosophy than he put together his impressions of it in his *Über die Möglichkeit einer Form der Philosophie überhaupt* (1794). The more elaborate work, *Vom Ich als Princip der Philosophie, oder über das Unbedingte im menschlichen Wissen* (1795), while remaining within the limits of the Fichtean idealism, exhibits a tendency to give the Fichtean method a more objective application and to amalgamate with it Spinoza's more realistic view.

After two years as tutor to two youths of noble family, Schelling was called as extraordinary professor of philosophy to Jena, the centre of the poets and philosophers of the Romantic School, in midsummer 1798. He had already contributed articles and reviews to the *Journal* of Fichte and Niethammer; had written the *Briefe über Dogmatismus und Kriticismus* (1796), a critique of the ultimate issues of the Kantian system, and *Neue Deduction des Naturrechts* (1797), which to some extent anticipated Fichte's treatment in the *Grundlage des Naturrechts*. His studies of physical science bore rapid fruit in the *Ideen zu einer Philosophie der Natur* (1797), and the treatise *Von der Weltseele* (1798). The philosophical renown of Jena was at its height during the years (1798–1803) of Schelling's residence. His intellectual sympathies united him closely with some of the most active literary tendencies of the time. With Goethe he was on excellent terms, but he was repelled by Schiller's less expansive disposition. In Schelling, essentially a self-conscious genius, eager and rash, yet with unde-

niable power, the Romanticists hailed a personality of the true Romantic type. With August Wilhelm Schlegel and his wife Caroline, herself the embodiment of the Romantic spirit, Schelling's relations were intimate, and a marriage between Schelling and Caroline's young daughter, Auguste Böhmer, was vaguely contemplated by both. Auguste's death in 1800 (due partly to Schelling's rash confidence in his medical knowledge) drew Schelling and Caroline together, and Schlegel having removed to Berlin, a divorce was, apparently with his consent, arranged. On June 2, 1803, Schelling and Caroline were married, and with the marriage Schelling's life at Jena came to an end.

From 1803 to 1806 Schelling was professor at the new university of Würzburg. During this time he broke both with Fichte and Hegel. He embroiled himself with his colleagues and also with the Government. In Munich, to which he removed in 1806, he found a quiet residence. A position as State official, at first as associate of the academy of sciences and secretary of the academy of arts, afterwards as secretary of the philosophical section of the academy of sciences, gave him ease and leisure. Without resigning his official position he lectured for a short time at Stuttgart, and during seven years at Erlangen (1820–27). In 1809 Caroline died, and three years later Schelling married one of her closest friends, Pauline Gotter, in whom he found a faithful companion.

During the long stay at Munich (1806–41) Schelling's literary activity seemed gradually to come to a standstill. The "Aphorisms on Naturphilosophie" contained in the *Jahrbücher der Medicin als Wissenschaft* (1806–08) are for the most part extracts from the Würzburg lectures; and the *Denkmal der Schrift von den göttlichen Dingen des Herrn Jacobi* was drawn forth by the special incident of Jacobi's work. The only writing of significance is the "Philosophische Untersuchungen über das Wesen der menschlichen Freiheit," which appeared in the *Philosophische Schriften*, vol. i. (1809), and which carries out, with increasing tendency to mysticism, the thoughts of the previous work, *Philosophie und Religion.* In 1815 appeared the tract *Über die Gottheiten zu Samothrake,* ostensibly a portion of a great work, *Die Weltalter,* frequently announced as ready for publication, of which no great part was ever written. The dominance of Hegel in the German schools appears to have silenced Schelling. It was only in 1834, after the death of Hegel, that, in a preface to a translation by H. Beckers of a work by Cousin, he expressed in writing the antagonism in which he stood to the Hegelian and to his own earlier conceptions of philosophy. The antagonism certainly was not new; it was evidenced in the Erlangen lectures on the history of philosophy (*Sämt. Werke,* x. 124–125) of 1822, and Schelling had already begun the treatment of mythology and religion which in his view constituted the true positive complement to the negative of logical or speculative philosophy. The writings of Strauss, Feuerbach and other members of the Hegelian Left had alarmed the religious element. Frederick William IV. invited him to Berlin in 1841, and made him Prussian privy councillor and member of the Berlin Academy, in the hope that he would lecture at the university and counteract the Hegelians. But these were too strongly entrenched. In 1845 he ceased to lecture. No authentic information as to the nature of the new positive philosophy was obtained till after his death (at Bad Ragaz, on Aug. 20, 1854), when his sons began the issue of his collected writings with the four volumes of Berlin lectures: vol. i. *Introduction to the Philosophy of Mythology* (1856); ii. *Philosophy of Mythology* (1857); iii. and iv. *Philosophy of Revelation* (1858).

Schelling indicated the turning points of his philosophical career as follows:—(1) the transition from Fichte's method to the more objective conception of nature—the advance, in other words, to *Naturphilosophie;* (2) the definite formulation of that which implicitly, as Schelling claims, was involved in the idea of *Naturphilosophie,* viz., the thought of the identical, indifferent, absolute substratum of both nature and spirit, the advance of *Identitätsphilosophie;* (3) the opposition of negative and positive philosophy, an opposition which is the theme of the Berlin lectures, though its germs may be traced back to 1804. Only what falls under the first and second of the divisions so indicated can be said to have discharged a function in developing philosophy; only so much constitutes Schelling's philosophy proper.

Nature and spirit, *Naturphilosophie* and *Transcendentalphilosophie,* stand as two relatively complete, but complementary parts of the whole. Schelling, who sought the reconciliation of differences moved towards the conception of the uniting basis of which nature and spirit are manifestations, forms or consequences. For this common basis, however, he found at first only the negative expression of indifference. The identity, the absolute, which underlay all difference, all the relative, is to be characterized simply as *neutrum,* as absolute undifferentiated self-equivalence. Spinoza appeared to Schelling as the thinker whose form of presentation came nearest to his new problem. The *Darstellung meines Systems,* and the more expanded and more careful treatment contained in the lectures on *System der gesammten Philosophie und der Naturphilosophie insbesondere* given in Würzburg, 1804 (published in the *Sämtliche Werke,* vol. vi. pp. 131–576), are thoroughly Spinozistic in form, and to a large extent in substance. They are not without value, indeed, as extended commentary on Spinoza. But Schelling does not succeed in bringing his conceptions of nature and spirit into any vital connection with the primal identity, the absolute indifference of reason. No true solution could be achieved by resort to the mere absence of distinguishing, differencing feature. The absolute was left with no other function than that of removing all the differences on which thought turns. The criticisms of Fichte, and more particularly of Hegel (in the "Vorrede" to the *Phänomenologie des Geistes*), point to the fatal defect in the conception of the absolute as mere featureless identity.

In all his later writings Schelling strove to amend the conception of absolute reason as the ultimate ground of reality. He sought to give to this absolute a *character,* to make of it something more than empty sameness, and to clear up the relation in which the actuality or apparent actuality of nature and spirit stood to the ultimate real. He had already (in the *System der ges. Phil.*) sought an amalgamation of the Spinozistic conception of substance with the Platonic view of an ideal realm. Things—nature and spirit—have an actual being. They exist not merely as logical consequence or development of the absolute, but have a stubbornness of being in them. The actuality of things is a defection from the absolute, and their existence compels a reconsideration of our conception of God. There must be recognized in God as a completed actuality, a dim, obscure ground or basis, which can only be described as not yet being, but as containing in itself the impulse to externalization, to existence. It is through this ground of Being in God Himself that we must find explanation of that independence which things assert over against God. From this position Schelling was led on to the further statements that not in the rational conception of God is an explanation of existence to be found, but that God is to be conceived as act, as will, as something over and above the rational conception of the Divine. Hence the stress laid on will as the realizing factor, in opposition to thought, a view in which Schelling is a precursor of Schopenhauer and Von Hartmann, and on the ground of which he has been recognized by the latter as the reconciler of idealism and realism. Finally, then, there emerges the opposition of negative, *i.e.,* merely rational philosophy, and positive, of which the content is the real evolution of the divine as it has taken place in fact and in history, and as it is recorded in the varied mythologies and religions of mankind. Not much satisfaction can be felt with the exposition of either as it appears in the volumes of Berlin lectures.

Bibliography.—Schelling's works were collected and published by his sons, in 14 vols. (1856–61). The individual works appeared as follows:— *Über die Möglichkeit einer Form der Philosophie überhaupt* (Tübingen, 1794); *Ideen zu einer Philosophie der Natur* (Leipzig, 1797, ed. 1803); *Von der Weltseele* (Hamburg, 1798), 3rd ed., 1809); *Erster Entwurf eines Systems der Naturphilosophie* (Jena, 1799); *Einleitung zu seinem Entwurf der Naturphilosophie* (*ib.*, 1799); *System des transcendentalen Idealismus* (Tübingen, 1800); *Bruno, oder über das göttliche und natürliche Prinzip der Dinge* (1802, ed., 1843); *Vorlesungen über die Methode des akademischen Studiums* (Tübingen, 1803, ed. Braun, 1907); *Über das Verhältniss der bildenden Künste zu der Natur* (Munich, 1807); *Über die Gottheiten von Samothrake* (Stuttgart, 1815). His Munich lectures were published by A. Drews (Leipzig, 1902). For the life good materials are to be found in

Aus Schelling's Leben in Briefen (3 vols., 1869–70), containing a sketch by his son. The biography in Kuno Fischer's *Gesch. der neueren Philosophie,* vol. vii. (3rd ed., 1902) is complete and admirable. *See* further *Schelling als Persönlichkeit. Briefe, Reden, Aufsätze,* ed. Otto Braun (1908), who also wrote *Schellings geistige Wandlungen in den Jahren 1800–1810* (1906); Rosenkranz, *Schelling* (1843); L. Noack, *Schelling und die Philosophie der Romantik* (2 vols., 1859); G. A. C. Frantz, *Schelling's Positive Philosophie* (3 vols., 1879–80); Watson, *Schelling's Transcendental Idealism* (1882); Groos, *Die reine Vernunftwissenschaft. Systematische Darstellung von Schellings . . . Philosophie* (1889); E. von Hartmann, *Schelling's philos. System* (1897); Delbos, *De posteriore Schellingii philosophia quatenus Hegelianae doctrinae adversatur* (1902); Koeber, *Die Grundprinzipien der Schellingschen Naturphilosophie* (1882); G. Mehlis, *Schellings Geschichtsphilosophie in den Jahren 1799–1804* (1907); H. Sueskind, *Der Einfluss Schellings auf die Entwicklung von Schleiermachers System* (1909); A. Kohut, *König Maximilian von Bayern und der Philosoph F. W. J. von Schelling* (Leipzig, 1914); D. H. Kerler, *Die Fichte-Schelling'sche Wissenschaftslehre* (Ulm, 1917); H. Ehrenberg, *Drei Bücher vom deutschen Idealismus, Fichte, Schelling, Hegel* (3 pts., Munich, 1923–25); G. Stefansky, *Das hellenischdeutsche Weltbild. Einleitung in die Lebensgeschichte Schellings* (bibl., Bonn, 1925).

(R. A.; X.)

SCHENECTADY (skĕ-nek′tạ-dĭ), a city of New York, U.S.A., the county seat of Schenectady county; 16 m. N.W. of Albany, on the Mohawk river. It has an airport, and is served by the Delaware and Hudson, the New York Central, the West Shore and electric railways. Pop. (1920) 88,723 (23% foreign-born white, over half from Italy, Poland and Germany); and 95,692 in 1930. The city has a fine site of 10·34 sq.m., 230 ft. above sea-level, in a beautiful and fertile region. It is a place of much historic interest, and has many examples of quaint Dutch colonial and early American architecture. St. George's Episcopalian church was built in 1762. The fine "Great Western Gateway" bridge (opened 1926) connects the highways east and south of the river with those north and west. A wide crosstown boulevard has been constructed (completed 1924) over the abandoned bed of the Erie canal. Union college was incorporated in 1795. The chapel was built in 1924 by public subscription as a memorial to the Union boys who died in the World War. The assessed valuation of property for 1927 was $191,642,280.

According to tradition Schenectady stands on the site of the chief village of the Mohawk Indians, and its name is of Indian origin. In 1661 Arendt Van Corlaer (or Curler), a cousin of the patroon Killian Van Rensselaer and manager of his manor, with 14 other residents of Rensselaerwyck, bought a tract here from the Indians, established a settlement, and in 1670 extended their territory to embrace about 128 square miles. The price was "600 hands of good Whyte Wampum, six Koates of Duffels, 30 Barres of Lead, and nine Bagges of Powder." Many of the early settlers were well-to-do and brought their slaves with them. For many years the settlement was reputed the richest in the colony. In 1690 (Feb. 9) a force of French and Indians surprised the village, burning it, killing 60 of the inhabitants and carrying 30 into captivity. About 1700 there was an influx of English settlers. Schenectady was chartered as a borough in 1765 and as a city in 1798. From the close of the Revolution to the opening of the Erie canal (1825) it was a lively river port, and boat-building was one of its chief industries. Railways to Albany and to Saratoga (the first in the State) were opened in 1831 and 1832. The manufacture of locomotives began in 1848. In 1850 the population was 8,921; in 1880 it was 13,655. Rapid development dates from the establishment in 1886 of the Edison Machine Works, which became a unit of the Edison General Electric Company in 1889 and the largest plant of the General Electric Company on its organization in 1892. The General Electric Company has here its general offices, research laboratories, broadcasting station (WGY) and largest manufacturing works, covering 645 ac. and comprising 350 buildings with 6,500,000 sq.ft. of floor space. The list of distinguished scientists who have been connected with the Schenectady plant includes W. R. Whitney, Irving Langmuir (*q.v.*), W. D. Coolidge and C. P. Steinmetz (*q.v.*). From 19,902 in 1890 the population of the city grew to 72,826 in 1910. The value of its manufactures in 1927 was $99,402,269.

SCHERER, EDMOND HENRI ADOLPHE (1815–1889), French theologian, critic and politician, was born in Paris on April 8, 1815. After a course of legal studies he spent several years in theological study at Strasbourg, where he graduated doctor in theology in 1843, and was ordained. He held a theological chair in a Protestant seminary at Geneva for a brief period, but developed liberal opinions on religious matters, and eventually settled in Paris as a journalist. He at once attracted attention by brilliant critical work, at first chiefly on great foreign writers, contributed to the *Revue des deux mondes.* He was elected municipal councillor at Versailles in 1870, deputy to the National Assembly for the department of Seine-et-Oise in 1871 and senator in 1875. He supported the Republican party. Scherer was for many years one of the ablest contributors to *Le Temps.* He was a frequent visitor to England, and took a lively interest in English politics and literature. He died at Versailles on March 16, 1889.

Among his works are: *Études critiques sur la littérature contemporaine* (1863–89), *Études critiques de littérature* (1876), *Diderot* (1880), *La Démocratie et la France* (1883), *Études sur la littérature au XVIIIe siècle* (1891).

SCHERER, WILHELM (1841–1886), German philologist and historian of literature, was born at Schönborn in Lower Austria on April 26, 1841. He studied at Vienna and afterwards at the university under the Germanist, Karl Viktor Müllenhoff (1818–84), and became *Privatdozent* for German language and literature in the university in 1864, and in 1868 professor. He was subsequently professor at Strasbourg (1872) and Berlin (1877). He died at Berlin on Aug. 6, 1886.

His first great work was *Zur Geschichte der deutschen Sprache* (1868, 3rd. ed., 1890), a history of the German language with special reference to phonetic laws. Scherer's best-known work is his history of German literature, *Geschichte der deutschen Literatur* (1883; 10th ed., 1905; Eng. trans. by Mrs. F. C. Conybeare, 1883; new ed. 1906).

See V. Basch, *Wilhelm Scherer et la philologie allemande* (1889), and the article by Eduard Schröder in *Allgemeine deutsche Biographie.*

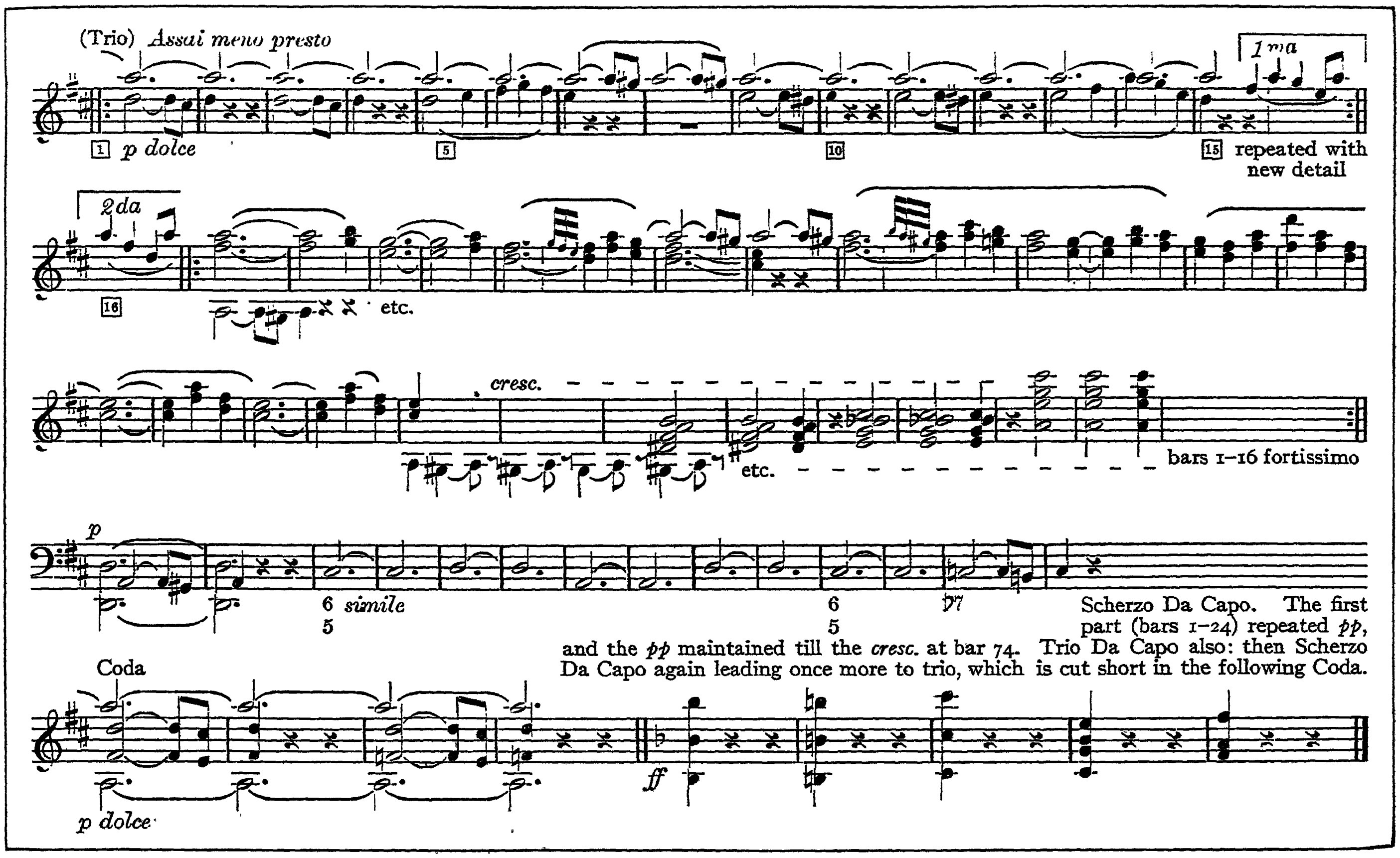
SCHERZO (Italian for "a joke"); in music, a quick movement evolved from the minuet and used in the position thereof in the sonata forms (*q.v.*). The term is also used as a mere character name. Haydn first used it and its adverb scherzando, for the middle movement of an early sonata in C sharp minor, and afterwards in place of the minuet in the set of six quartets known sometimes as "Gli Scherzi," and sometimes as the "Russian quartets" (op. 33). He never used the term again, though his later minuets are often in a very rapid *tempo* and sometimes on a larger scale than any of the earlier scherzos of Beethoven. Haydn wished to see the minuet made more worthy of its position in large sonata works; but he did not live to appreciate (though he might possibly have heard) the fully-developed scherzos of his pupil, Beethoven.

The formal essence of the minuet and trio lies in their combination of melodic forms with an exact *da capo* of the minuet after the trio. No other movement in the sonata has leisure for so purely decorative a symmetry. Beethoven's typical scherzos purposely exaggerate this quality. He does not follow Mozart's example of minuets with two trios, for the style of his mature scherzos is so continuous that a second trio would give it an elaborate *rondo* character unlike that of a dance-movement. But after Beethoven's scherzo has run through the stages of scherzo, trio and scherzo *da capo,* it goes through the same trio and *da capo* again; and then tries to do so a third time, as if it could not find a way out; so that it has to be abruptly stopped. Modern players and listeners are impatient of these grotesque repetitions; but the art-form is true to its own nature, and we should be the better for leisure to understand it. Apart from the wonderful little A flat bagatelle—No. 7 of the set written at the age of 15 and published (presumably with extensive revision) as op. 33—Beethoven first used the double repetition in his 4th symphony (with a shortening of the last *da capo*); and his last example is in the C sharp minor quartet (op. 131).

The scherzo of the 9th symphony is so enormous that its main body differs from a complete first movement of a sonata only in its uniformity of texture and its incessant onrush, which not even the startling measured pauses and the changes from 4-bar to 3-bar

Outline of SCHERZO of Beethoven's 7th Symphony.

(The phrasing given here is the most natural; but any phrasing whatever will prove that the themes change their accents in the course of the movement.)



rhythm can really interrupt. Beethoven directs as many repetitions of its subsections as possible, and his coda consists of an attempt to begin the trio again, dramatically cut short. The scherzo of the C minor symphony was originally meant to go twice round; and a certain pair of superfluous bars, which caused controversy for 30 years after Beethoven's death, were due simply to traces of the difference between the *prima volta* and *seconda volta* being left in the score.

Beethoven does not use the title of scherzo unless the music is humorous. Thus in the sonata in E flat (op. 31, No. 3) it is applied to a sonata-form lively movement which is technically the slow movement, while the following slow minuet is the dance-movement. The second movement of the F major quartet (op. 59, No. 1) is a unique example of scherzo-style in a most elaborate sonata-form.

Perhaps this gigantic movement may have been the inspiring source of the Mendelssohnian scherzo, one of the most distinct new types of movement since Beethoven, and quite independent of the notion of an alternating trio. The scherzos in Mendelssohn's *Midsummer Night's Dream* music, in the Scotch symphony and in the string quartets in E minor and E flat major (op. 44, Nos. 2 and 3) are splendid examples. Even Berlioz shows their influence in the "Queen Mab" scherzo of his *Roméo et Juliette*.

Of Brahms' scherzos there are several distinct types, ranging from a quiet allegretto and trio in melodic forms to the sonata-form *Presto giocoso* of the 4th symphony, which within seven minutes accomplishes the most powerful scherzo since Beethoven. Every degree of lyric beauty and dramatic passion is comprised in the various movements that Brahms puts into the position of scherzo in his sonata works.

Chopin produced a new type of independent scherzo; obviously inspired by Beethoven, but with a slightly macabre tendency of his own, except in the very diffuse and light 4th scherzo. The majority of classical scherzos are in a quick triple time with only one countable beat to a bar; and this custom is the last vestige of the derivation of the scherzo from the minuet.

Of modern scherzos there is nothing specific to be said; the term still applies to lively intermediate movements in cyclic instrumental works, and is otherwise a mere character-name.

(D. F. T.)

SCHEVENINGEN (Schā′nĭng-ẹn), fishing port and watering-place, Holland, on the North sea, province of South Holland, about 2 m. N. of The Hague, of which it is now a suburb. It is situated in the dunes at the extremity of the woods which separate it from The Hague. The development of Scheveningen as a fashionable seaside resort dates from modern times, but the fishing village is of ancient origin and once stood farther seaward. To prevent coast erosion a stone wall was built along the sea front in 1896–1900, and below this lies the fine sandy beach stretching for miles on either side. The first bathing establishment here dates from 1818, and was also the first in Holland. There is a large harbour for the fishing fleet.

SCHIAPARELLI, GIOVANNI VIRGINIO (1835–1910), Italian astronomer and senator of the kingdom of Italy, was born on March 14, 1835, at Savigliano in Piedmont. He entered Turin university in 1850, and graduated in 1854. Two years later he went to Berlin to study astronomy under Encke, and in 1859 was appointed assistant observer at Pulkova, a post which he resigned in 1860 for a similar one at Brera, Milan. On the death of Francesco Carlini (b. 1783) in 1862, Schiaparelli succeeded to the directorship, which he held until 1900. He died at Milan on July 4, 1910.

Schiaparelli possessed exceptional powers as an observer—his first discovery was of the asteroid Hesperia in 1861—and his considerable mathematical ability is shown in his papers. In 1866 he showed the connection between meteor streams and cometary orbits, giving, in particular, the identity of the orbits of the Perseids and Comet III., 1862, and of the Leonids and Comet I., 1866. These discoveries were subsequently amplified in his *Le Stelle cadenti* (1873) and in his *Norme per le osservazioni delle stelle cadenti dei bolidi* (1896). He observed double stars, and the results of his measures are published in 2 vols., the first containing those made between 1875–85, and the second those between

1886–1900. He made extensive studies of Mercury, Venus and Mars. In 1877 he observed on Mars the peculiar markings, which he called *canali,* the nature and origin of which is still controversial. (*See* MARS.) From his observations of Mercury and Venus he concluded that these planets rotated on their axes in the same time as they revolved about the sun. On his retirement he turned to the astronomy of the Hebrews and Babylonians; his earlier results are given in his *L' Astronomia nell' antico Testamento* (1903), which has been translated into English and German, whilst later ones are to be found in various journals, the last being in *Scientia* (1908).

SCHICHAU, FERDINAND (1814–1896), German engineer and shipbuilder, was born at Elbing, the son of a smith and ironworker, on Jan. 30, 1814. He started works of his own at Elbing in 1834, and was soon employing some 8,000 men. He began by making steam engines, hydraulic presses and industrial machinery, and, by concerning himself with canal work and river or coast improvement, came to the designing and construction of dredgers, in which he was the pioneer (1841), and finally to the building of ships.

His "Borussia," in 1855, was the first screw-vessel constructed in Germany. Schichau began to specialize in building torpedo-boats and destroyers (at first for the Russian Government) at an early date. From 1873 he had the co-operation of Carl H. Ziese, who married his daughter. Ziese introduced compound engines into the first vessels built by Schichau for the German navy, the gunboats "Habicht" and "Möwe," launched in 1879, and also designed in 1881 the first triple-expansion machinery constructed on the continent, supplying these engines to the torpedo-boats built by Schichau for the German navy in 1884, the first of some 160 that by the year 1909 were provided by the Elbing yards. Torpedo-boats were also built for China, Austria and Italy. Meanwhile Elbing had become insufficient for the increased output demanded. In 1889 Schichau established a floating dock and repairing shops at Pillau, and soon afterwards, by arrangement with the Government, started a large yard at Danzig. He died on Jan. 23, 1896.

SCHICKELE, RENÉ (1883–), Alsatian writer, was born in Oberehnheim, Alsace, Aug. 4, 1883. He was educated in Zabern and Strasburg, and afterwards lived in Paris and Berlin. His first works were poetic; they include the volumes *Sommernächte* (1902), *Der Ritt ums Leben* (1906), *Mein Herz mein Land* (1915). His first prose work was *Der Fremde* (1907). He has also written dramas, which are of less importance; but *Hans im Schnakenloch* (1916) was performed in both Paris and Berlin during the War. Schickele is essentially an Alsatian in both style and thought. He blends in his work, which unites warmth with strength in a remarkable degree, the essence of the Germanic and the Latin cultures. His life has been largely a revolt against the crushing of Alsace's individuality by either German or French. Before the World War he was in revolt against Germany. During the War, against which he protested strongly, he lived in Switzerland; but later he made his home in Germany, in the Black Forest. The most remarkable novels of his maturity are *Wir wollen nicht sterben* (1922), *Maria Capponi* (1925, English trans. 1928), and *Blick auf die Vogesen* (1927).

SCHIEDAM, a town and river port of Holland, in the province of South Holland, on the Schie, near its confluence with the Maas, and a junction station 3 m. W. of Rotterdam by rail. Pop. (1927), 43,263. The public buildings of interest are the Groote or Janskerk, the old Roman Catholic church, the synagogue, the town hall, the exchange, the concert-hall and a ruined castle. Schiedam is famous as the seat of a great gin manufacture, which, carried on in more than three hundred distilleries, gives employment besides to malt-factories, cooperages and cork-cutting establishments, and supplies sufficient yeast to form an important article of export.

SCHIFF, JACOB HENRY (1847–1920), American banker and philanthropist, was born at Frankfort-on-Main, Germany, Jan. 10, 1847. He studied in the schools of Frankfurt and for a time worked in a bank. In 1865 he went to New York city and organized the brokerage firm of Budge, Schiff and Co. In 1875 he was taken into the firm of Kuhn, Loeb and Co., and, on Loeb's retirement in 1885, took his place. In 1897 his house assisted E. H. Harriman in reorganizing the Union Pacific Railway, and in 1901 aided him in his struggle with James J. Hill and J. P. Morgan for the control of the Northern Pacific Railway. In his later years he gave much personal attention to charities. He was a founder and president of the Montefiore Home for chronic invalids, New York city. In 1903 he presented a Semitic museum building to Harvard university. He died in New York city Sept. 25, 1920.

SCHILL, FERDINAND BAPTISTA VON (1776–1809), Prussian soldier, was born in Saxony. Entering the Prussian cavalry at the age of twelve, he was still a subaltern of dragoons when he was wounded at the battle of Auerstädt. At Kolberg he played a very prominent part in the celebrated siege of 1807. After the peace of Tilsit he was given the command of a hussar regiment. In 1809 the political situation in Europe appeared to Schill to favour an attempt to liberate his country from the French domination. Leading out his regiment from Berlin under pretext of manoeuvres, he raised the standard of revolt, and marched for the Elbe. At Dodendorf (May 5, 1809) he had a brush with the Magdeburg garrison, but was soon driven northwards, where he hoped to find British support. With little more than his original force Schill was surrounded by 5,000 Danish and Dutch troops in the neighbourhood of Wismar. He escaped by hard fighting (action of Damgarten, May 24) to Stralsund. The Danes and Dutch soon hemmed him in, and by sheer numbers overwhelmed the defenders (May 31). Schill himself was killed.

See L. K. C. von Liliencron, *Schilliana* (2 vols., 1810); Haken, *Ferdinand von Schill* (Leipzig, 1824); Bärsch, *Ferdinand von Schill's Zug und Tod* (Leipzig, 1860), and *F. von Schill, ein Charakterbild* (Potsdam, 1860); Francke, *Aus Stralsunds Franzosenzeit* (1890).

SCHILLER, JOHANN CHRISTOPH FRIEDRICH VON (1759–1805), German poet, dramatist and philosopher, was born at Marbach on the Neckar, on Nov. 10, 1759. His father, Johann Kaspar (1723–96), was an army-surgeon, and the vicissitudes of his profession entailed a constant change of residence; but at Lorch and at Ludwigsburg, where the family was settled for longer periods, the child was able to receive a regular education. In 1773 the duke Karl Eugen of Württemberg claimed young Schiller as a pupil of his military school at the "Solitude" near Ludwigsburg, where he was obliged to devote himself to law. On the removal of the school in 1775 to Stuttgart, he was, however, allowed to take up medicine. The strict military discipline of the school lay heavily on Schiller, and intensified the spirit of rebellion, which burst out in the young poet's first tragedy. In 1776 some specimens of Schiller's lyric poetry had appeared in a magazine, and in 1777–78 he completed his drama, *Die Räuber.* In 1780 he left the academy qualified to practise as a surgeon, and was at once appointed by the duke as doctor to a regiment garrisoned in Stuttgart. His discontent found vent in the passionate lyrics of this period. Meanwhile *Die Räuber,* which Schiller had been obliged to publish at his own expense, appeared in 1781 and made an impression on his contemporaries hardly less deep than Goethe's *Götz von Berlichingen,* eight years before. The strength of this remarkable tragedy lay, in spite of its inflated tone and exaggerated characterization, in the sure dramatic instinct with which it is constructed and the directness with which it gives voice to the most pregnant ideas of the time. In this respect, Schiller's *Räuber* is one of the most vital German dramas of the 18th century. In January 1782 it was performed in the Court and National Theatre of Mannheim, Schiller himself having stolen secretly away from Stuttgart in order to be present. The success encouraged him to begin a new tragedy, *Die Verschwörung des Fiesco zu Genua,* and he edited a lyric *Anthologie auf das Jahr 1782,* to which he was himself the chief contributor. A second surreptitious visit to Mannheim came, however, to the ears of the duke; he had Schiller put under a fortnight's arrest, and forbade him to write any more "comedies" or to hold intercourse with any one outside Württemberg. Schiller resolved on flight, and took advantage of some court festivities in Sept. 1782 to put his plan into execution. He hoped in the first instance for material support from the theatre in

Mannheim and its intendant, W. H. von Dalberg; but nothing but rebuffs and disappointments were in store for him. He did not even feel secure against extradition in Mannheim, and after several weeks spent mainly in the village of Oggersheim, where his third drama, *Kabale und Liebe,* was in great part written, he found a refuge at Bauerbach in Thuringia, in the house of Frau von Wolzogen, the mother of one of his former schoolmates. Here *Kabale und Liebe* was finished and *Don Carlos* begun. In July 1783 he received a definite appointment for a year as "theatre poet" in Mannheim, and here both *Fiesco* and *Kabale und Liebe* were performed in 1784. In the latter play Schiller's powers as a realistic portrayer of people and conditions familiar to him are seen to best advantage. Although Schiller failed to win an established position in Mannheim, he added to his literary reputation by the publication of the beginning of *Don Carlos* (in blank verse) in his journal, *Die rheinische Thalia* (1785). He had also the opportunity of reading the first act of the new tragedy before the duke of Weimar at Darmstadt in Dec. 1784.

In April 1785 Schiller accepted the invitation of four unknown friends—C. G. Körner, L. F. Huber, and their *fiancées* Minna and Dora Stock—with whom he had corresponded, to pay a visit to Leipzig. He spent a happy summer mainly at Gohlis, near Leipzig, his jubilant mood being reflected in the *Ode an die Freude;* and in September of the same year he followed his new friend Körner to Dresden. As Körner's guest in Dresden and at Loschwitz on the Elbe, Schiller completed *Don Carlos,* wrote the dramatic tale, *Der Verbrecher aus verlorener Ehre* (1786), and the unfinished novel, *Der Geisterseher* (1789). Körner's interest in philosophy also induced Schiller to turn his attention to such studies, the first results of which he published in the *Philosophische Briefe* (1786). *Don Carlos,* meanwhile, appeared in 1787, and added to Schiller's reputation as a poet. It was unfortunate, however, that in seeking a model for this higher type of tragedy he turned rather to the classic theatre of France than to the English drama.

A new chapter in Schiller's life opened with his visit to Weimar in July 1787. Goethe was then in Italy, and the duke of Weimar was absent; but the poet was kindly received by Herder and Wieland. Not very long afterwards he made the acquaintance at Rudolstadt of the family von Lengefeld, the younger daughter of which subsequently became his wife. Meanwhile the preparation for *Don Carlos* had interested Schiller in history, and in 1788 he published the first volume of his chief historical work, *Geschichte des Abfalls der vereinigten Niederlande von der spanischen Regierung.* It obtained for him, on the recommendation of Goethe, a professorship in the university of Jena, and in Nov. 1789 he delivered his inaugural lecture. Schiller's other historical writings comprise a *Sammlung historischer Memoires* and *Geschichte des dreissigjährigen Krieges* (1791–93). The latter is written for a wider public than his first history, but the narrative is dramatic and vivid and the portraiture is sympathetic.

Before, however, this work was finished, Schiller had turned from history to philosophy. A year after his marriage he had been stricken down by severe illness, from the effects of which he was never completely to recover; financial cares followed, which were relieved unexpectedly by the generosity of the hereditary prince of Holstein-Augustenburg, who conferred upon him a pension of 1,000 talers a year for three years. Schiller devoted the leisure of these years to the study of philosophy. In the summer of 1790 he had lectured in Jena on the aesthetics of tragedy, and in the following year he studied carefully Kant's *Kritik der Urteilskraft,* which had just appeared and appealed powerfully to Schiller's mind. The influence of these studies is to be seen in several essays, as well as in his correspondence with his friend Körner. Here Schiller arrives at his definition of beauty, as "Freiheit in der Erscheinung," which marked the beginning of a new stage in the history of German aesthetic theory. *Über Anmut und Würde,* published in 1793, was a further contribution to the elucidation and widening of Kant's theories; and in the eloquent *Briefe über die ästhetische Erziehung des Menschen* (1795), Schiller proceeded to apply his new standpoint to the problems of social and individual life. These remarkable letters were published in *Die Horen,* a new journal, founded in 1794, which was the occasion for his gaining the friendship of Goethe. An immediate outcome of the new friendship was Schiller's admirable treatise, *Über naive und sentimentalische Dichtung* (1795–96). Here Schiller applied his aesthetic theories to that branch of art which was most peculiarly his own, the art of poetry; it is an attempt to classify literature in accordance with an a priori philosophic theory of "ancient" and "modern," "classic" and "romantic," "naïve" and "sentimental"; and it sprang from the need Schiller himself felt of justifying his own "sentimental" and "modern" genius beside the "naïve" and "classic" tranquillity of Goethe's.

For Schiller himself this was the bridge that led back from philosophy to poetry. Under Goethe's stimulus he won fresh laurels in that domain of philosophical lyric which he had opened with *Die Künstler;* and in *Das Ideal und das Leben, Die Macht des Gesanges, Würde der Frauen,* and *Der Spaziergang,* he produced masterpieces of reflective poetry. These poems appeared in the *Musenalmanach,* a new publication which Schiller began in 1796. Here were also published the *Xenien* (1797), a collection of distichs by Goethe and Schiller, in which the two friends avenged themselves on their critics. The *Almanach* of the following year was even more noteworthy, for it contained a number of Schiller's most popular ballads, *Der Ring des Polykrates, Der Handschuh, Ritter Toggenburg, Der Taucher, Die Kraniche des Ibykus* and *Der Gang nach dem Eisenhammer; Der Kampf mit dem Drachen* following in 1799, and *Das Lied von der Glocke* in 1800. As a ballad poet, Schiller's popularity has been hardly less great than as a dramatist; his bold and simple outlines, his terse dramatic characterization appealed directly to the popular mind. The supreme achievement of the last period of Schiller's life was the series of master dramas which he gave to the world between 1799 and 1804. Just as *Don Carlos* had led him to the study of Dutch history, so now his occupation with the history of the Thirty Years' War supplied him with the theme of his trilogy of *Wallenstein* (1798–99). The plan of *Wallenstein* was of long standing, and it was only towards the end, when Schiller realized the impossibility of saying all he had to say within five acts, that he decided to divide it into three parts, a descriptive prologue, *Wallensteins Lager,* and the two dramas *Die Piccolomini* and *Wallensteins Tod.* Without entirely breaking with the classic method he had adopted in *Don Carlos, Wallenstein* shows how much Schiller's art had benefited by his study of Greek tragedy; the fatalism of his hero is a masterly application of an antique motive to a modern theme. The success of *Wallenstein,* with which Schiller passed at once into the front rank of European dramatists, was so encouraging that the poet resolved to devote himself with redoubled ardour to dramatic poetry. Towards the end of 1799 he took up his residence permanently in Weimar, not only to be near his friend, but also that he might have the advantage of visiting regularly the theatre of which Goethe was director.

Wallenstein was followed in 1800 by *Maria Stuart,* a tragedy, which, in spite of its great popularity in and outside of Germany, is not one of his best. Finer in every way is the "romantic tragedy," *Die Jungfrau von Orleans* (1801). The resplendent mediaeval colouring of the subject, the heroic character of Joan of Arc, gave Schiller an admirable opportunity for the display of his rich imagination and rhetorical gifts; and by an ingenious alteration of the historical tradition he was able to make the drama a vehicle for his own moral idealism. Between this drama and its successor, *Die Braut von Messina,* Schiller translated and adapted to his classic ideals Shakespeare's *Macbeth* (1801) and Gozzi's *Turandot* (1802). With *Die Braut von Messina* (1803) he experimented with a tragedy on purely Greek lines, this drama being as close an approximation to ancient tragedy as its mediaeval and Christian *milieu* permitted. The introduction of a chorus detracted from the value of the tragedy for the theatre, but it appealed particularly to Schiller's genius. In the poet's last completed drama, *Wilhelm Tell* (1804), he once more, as in *Wallenstein,* chose a historical subject involving wide issues. *Wilhelm Tell* is the drama of the Swiss people; its subject is less the personal fate of its hero than the struggle of a nation to free itself from tyranny. It was an attempt to win for the German drama a new field, to

widen the domain of dramatic poetry. Besides writing *Tell*, Schiller had found time in 1803 and 1804 to translate two French comedies by Picard, and to prepare a German version of Racine's *Phèdre*; and in the last months of his life he began a new tragedy, *Demetrius*, which gave promise of being another step forward in his poetic achievement. But *Demetrius* remains a fragment of hardly two acts.

Schiller died at Weimar on May 9, 1805. His last years were darkened by constant ill-health; and indeed it is marvellous that he was able to achieve so much. A visit to Leipzig in 1801, and to Berlin in 1804, were the chief outward events of his later years. He was ennobled in 1802. Schiller's art, with its broad, clear lines, its unambiguous moral issues, and its enthusiastic optimism, has appealed with peculiar force to the German people, especially in periods of political despondency. But since the re-establishment of the German empire in 1871 there has been a certain waning of his popularity, the Germans of to-day realizing that Goethe more fully represents the aspirations of the nation. In point of fact, Schiller's genius lacks that universality which characterizes Goethe's; as a dramatist, a philosopher, an historian, and a lyric poet, he was the exponent of ideas which belong essentially to the Europe of the period before the French revolution.

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(J. G. R.)

SCHILTBERGER, JOHANN or **HANS** (1381–1440?), German traveller and writer, was born of a noble family in 1381, probably at Hollern near Lohof, half way between Munich and Freising. In 1394 he joined the suite of Lienhart Richartinger, and went off to fight under Sigismund, king of Hungary (afterwards emperor), against the Turks on the Hungarian frontier. At the battle of Nicopolis (Sept. 28, 1396) he was wounded and taken prisoner; Sultan Bayezid I. (*Ilderim*) then took him into his service as a runner (1396–1402). During this time he accompanied Ottoman troops to Asia Minor and Egypt. On Bayezid's overthrow at Angora (July 20, 1402), Schiltberger passed into the service of Bayezid's conqueror Timur: he now visited Samarkand, Armenia and Georgia. After Timur's death (Feb. 17, 1405) his German runner became a slave of various successors. He next accompanied Chekre, a Tatar prince living in Abu Bekr's horde, on an excursion to Siberia, of which name Schiltberger gives us the first clear mention in west European literature. He followed Chekre in his attack on the Old Bulgaria of the middle Volga. Wanderings in south-east Russia; visits to Sarai, the old capital of the Kipchak Khanate on the lower Volga and to Azov or Tana, still a trading centre for Venetian and Genoese merchants; travels in the Crimea, Circassia, Abkhasia and Mingrelia; and finally escape (from the neighbourhood of Batum) followed; he lay hid at Constantinople for a time, then returned to his Bavarian home (1427) by way of Kilia, Akkerman, Lemberg, Cracow, Breslau and Meissen. After his return he became a chamberlain of Duke Albert III.

Schiltberger's *Reisebuch* contains not only a record of his own experiences and a sketch of various chapters of contemporary Eastern history, but also an account of countries and their manners and customs. First come the lands "this side" of Danube, where he had travelled; next follow those between the Danube and the sea, which had now fallen under the Turk; then the Ottoman dominions in Asia; last come the regions from Trebizond to Russia and from Egypt to India. Schiltberger is perhaps the first writer of Western Christendom to give the true burial place of Mohammed at Medina; he contributed to fix Prester John, at the close of the middle ages, in Abyssinia.

Four mss. of the *Reisebuch* exist: (1) at Donaueschingen in the Fürstenberg library, No. 481; (2) at Heidelberg, university library, 216; (3) at Nuremberg, city library, 34; (4) at St. Gall, monast. library, 628 (all of 15th century, the last fragmentary). The work was first edited at Augsburg, *c.* 1460; four other editions appeared in the 15th century, and six in the 16th; in the 19th the best were K. F. Neumann's (Munich, 1859), P. Bruun's (Odessa, 1866, with Russian commentary, in the *Records of the Imperial University of New Russia*, vol. i.), and V. Langmantel's (Tübingen, 1885); "Hans Schiltbergers Reisebuch," in the 172nd volume of the *Bibliothek des literärischen Vereins in Stuttgart*. *See* also the English (Hakluyt Society) version, *The Bondage and Travels of Johann Schiltberger . . .*, trans. by Buchan Telfer with notes by P. Bruun (1879); C. R. Beazley, *Dawn of Modern Geography* (1897, etc.) iii. 356–378, 550.

SCHINZNACH, a small spa in the canton of Aargau (Switzerland). It is situated 3 m. from Brugg, in the lower valley of the river Aar, at the south-west foot of the small but steep, well-wooded hill mass of Wülpelsburg (1,683 ft. altitude). The village (1,165 ft. alt.; pop. *c.* 1,200) is famed for its strongly sulphurous and saline medicinal springs (90°–95° F) and, during the period May to September, annually, it is much patronized, principally by French visitors. Other popular spas, such as Müllingen and Birmenstorf, lying eastward in the valley of the river Reuss, are in its immediate vicinity. The Wülpelsburg is crowned by the ruins of an 11th century castle. Tradition claims that the count of Altenburg discovered his strayed hawk (Ger. *habicht*) on the hill summit, and the naturally defended site resulted in its selection for the erection of the Castle of Habichtsburg—the first important stronghold of the subsequently famous Habsburg dynasty of Austria.

SCHISM, a division, especially used of a formal separation from a church or religious body; a sect, or church formed by such separation. The dispute which led to the separation of the Latin and Greek Churches is known as the "Great Schism." *See* HERESY and for the "Great Schism" *see* PAPACY and CHURCH HISTORY.

SCHISTOSOMIASIS: *see* BILHARZIASIS.

SCHISTS, in petrology, metamorphic rocks which have a fissile character (Gr. σχίζειν, to split); in all there is at least one mineral which crystallizes in platy forms (*e.g.* mica, talc, chlorite, haematite), or in long blades or fibres (anthophyllite, tremolite, actinolite, tourmaline), and, when these have a well marked parallel arrangement in definite bands or folia, the rock will break far more easily along the bands than across them. The platy minerals have a perfect cleavage parallel to their flat surfaces, while the fibrous often have two or more cleavages following their long axes; hence a schistose rock may split not only by separation of the mineral plates from one another but also by cleavage of the parallel minerals through their substance.

Schists in the common acceptance of the term are completely recrystallized rocks; fissile slates, shales or sandstones, in which the sedimentary structures are little modified by recrystallization, are not included in this group by English petrologists, though the French *schistes* and the German *Schiefer* are used to designate also rocks of these types. The differences between schists and gneisses are that the latter have less highly developed foliation, are, as a rule, more coarse-grained, and contain far more quartz and felspar—two minerals which rarely assume platy or acicular forms, and hence do not lead to fissility in the rocks in which they are important constituents. Schists, as a rule, are found in regions composed mainly of metamorphic rocks, *e.g.*, the Central Alps, Himalayas and other mountain ranges, Saxony, Scandinavia, the Highlands of Scotland and N.-W. Ireland. They are typical products of "regional" metamorphism, and are in most cases

older than the fossiliferous sedimentary rocks. Transitions between schists and normal igneous or sedimentary rocks are often found. The Silurian mica-schists of Bergen are fossiliferous; in the Alps it is believed that even Mesozoic rocks pass laterally into mica-schists and calc-schists. These changes have probably been produced by the operation of heat, pressure and folding. Igneous rocks also may be converted readily into schists (*e.g.*, serpentine into talc-schist, dolerite into hornblende-schist) by the same agencies.

There are two great groups, viz., schists derived from (*a*) sedimentary and (*b*) igneous rocks, or, as they have been called, the "paraschists" and the "orthoschists." The first is the more important and includes some of the commonest metamorphic rocks. In the paraschists, though fossils are exceedingly rare, sedimentary structures such as bedding and the alternation of laminae of fine and coarse deposit may frequently be preserved; the foliation is often parallel to the bedding, but may cross it obliquely or at right angles, or the bedding may be folded and contorted while the foliation maintains a nearly uniform orientation. When the foliation is undulose or sinuous the rocks are said to be crumpled, and have wavy splitting surfaces instead of nearly plane ones. The development of foliation in shaly rocks is undoubtedly closely akin to the production of cleavage in slates.

The sedimentary schists or paraschists have three great subdivisions, the mica-schists (*q.v.*) and chlorite-schists (which correspond in a general way to shales or clay rocks) the calc-schists (impure limestones) and the quartz-schists (metamorphosed sandstones). The chlorite-schists are often of igneous derivation, such as ash-beds or fine lavas which have been metamorphosed. Many of them contain large octahedra of magnetite. Others are probably sedimentary rocks, especially those which contain much muscovite. Calc-schists are usually argillaceous limestones in which a large development of biotite or phlogopite has occasioned foliation. Often they contain quartz and felspar, sometimes pyroxene, amphibole, garnet or epidote. Pure limestones do not frequently take on schistose facies. The quartz-schists consist of quartz and white mica, and are intimately related to quartzites. Many of them have been originally micaceous or felspathic sandstones. We may mention also graphitic-schists containing dark scaly graphite (often altered forms of carbonaceous shales), and haematite-schists which may represent beds of ironstone.

The orthoschists are white mica-schists produced by the shearing of acid rocks, such as felsite and porphyry. Some of the "porphyroids" which have grains of quartz and felspar in a finely schistose micaceous matrix are intermediate between porphyries and mica-schists of this group. Still more numerous are orthoschists of hornblendic character (hornblende-schists) consisting of green hornblende with often felspar, quartz and sphene (also rutile, garnet, epidote or zoisite, biotite and iron oxides). These are modified forms of basic rocks such as basalt and dolerite. Every transition can be found between perfectly normal ophitic dolerites and typical hornblende-schists, and occasionally the same dike or sill will provide specimens of all the connecting stages. A few hornblende-schists are metamorphosed gabbros; others have developed from dikes or sills of lamprophyre. Under extreme crushing these basic rocks may be converted into dark biotite-schists, or greenish chlorite-schists. Tremolite-schist and anthophyllite-schist are in nearly all cases the representatives of the ultra-basic igneous rocks such as peridotite in regions of high metamorphism. Talc-schists are of the same category. They are soft and lustrous, with a peculiarly smooth feel. They are also known as the products of metamorphism of siliceous dolomitic limestones.

SCHLEGEL, AUGUST WILHELM VON (1767–1845), German poet, translator and critic, was born on Sept. 8, 1767, at Hanover, where his father, Johann Adolf Schlegel (1721–1793), was a Lutheran pastor. He was educated at the Hanover gymnasium and at the university of Göttingen. Having spent some years as a tutor in the house of a banker at Amsterdam, he went to Jena, where, in 1796, he married Karoline Michaelis, the widow of the district medical officer Böhmer and in 1798 was appointed extraordinary professor. Here he began his translation of Shakespeare, which was ultimately completed, under the superintendence of Ludwig Tieck, by Tieck's daughter Dorothea and Graf W. H. Baudissin. This rendering is one of the best poetical translations in German, or indeed in any language. At Jena Schlegel contributed to Schiller's periodicals the *Horen* and the *Musenalmanach;* and with his brother Friedrich he conducted the *Athenaeum,* the organ of the Romantic school. He also published a volume of poems, and carried on a rather bitter controversy with Kotzebue. The brothers were the leaders of the new Romantic criticism. A volume of their joint essays appeared in 1801 under the title *Charakteristiken und Kritiken.* In 1802 Schlegel went to Berlin, where he lectured on art and literature; and in the following year he published *Ion*, a tragedy in Euripidean style, which gave rise to a suggestive discussion on the principles of dramatic poetry. This was followed by *Spanisches Theater* (2 vols., 1803–1809), in which he presented admirable translations of five of Calderon's plays; and in another volume, *Blumensträusse italienischer, spanischer und portuguesischer Poesie* (1804), he gave translations of Spanish, Portuguese and Italian lyrics. In 1807 he attracted much attention in France by an essay in the French language, *Comparaison entre la Phèdre de Racine et celle d'Euripide,* in which he attacked French classicism from the standpoint of the Romantic school. His lectures on dramatic art and literature (*Über dramatische Kunst und Literatur,* 1809–1811), which have been translated into most European languages, were delivered at Vienna in 1808.

Meanwhile, after a divorce from his wife Karoline, in 1804, he travelled in France, Germany, Italy and other countries with Madame de Staël, who owed to him many of the ideas which she embodied in her work, *De l'Allemagne.* In 1813 he acted as secretary to the crown prince of Sweden. Schlegel was made a professor of literature at the university of Bonn in 1818, and during the remainder of his life occupied himself chiefly with oriental studies, although he continued to lecture on art and literature, and in 1828 he issued two volumes of critical writings (*Kritische Schriften*). In 1823–1830 he published the journal *Indische Bibliothek* (3 vols.) and edited (1823) the *Bhagavad-Gīta* with a Latin translation, and (1829) the *Rāmāyana.* These works mark the beginning of Sanskrit scholarship in Germany. After the death of Madame de Staël Schlegel married (1818) a daughter of Professor Paulus of Heidelberg; but this union was dissolved in 1821. He died at Bonn on May 12, 1845. As an original poet Schlegel is unimportant, but as a poetical translator he has rarely been excelled.

In 1846–47 Schlegel's *Sämtliche Werke* were issued in twelve volumes by E. Böcking. There are also editions by the same editor of his *Œuvres écrites en français* (3 vols., 1846), and of his *Opuscula Latine scripta* (1848). Schlegel's Shakespeare translations have been often reprinted; the edition of 1871–72 was revised with Schlegel's mss. by M. Bernays. *See* M. Bernays, *Zur Entstehungsgeschichte des Schlegelschen Shakespeare* (1872); R. Genée, *Schlegel und Shakespeare* (1903); J. Koerner, *Romantiker und Klassiker. Die Brüder Schlegel in ihren Beziehungen zu Schiller und Goethe* (1924); Schlegel's Berlin lectures of 1801–04 were reprinted from ms. notes by J. Minor (1884). A selection of the writings of both A. W. and Friedrich Schlegel, edited by O. F. Walzel, will be found in Kürschner's *Deutsche Nationalliteratur,* 143 (1892). *See* especially R. Haym, *Romantische Schule,* and the article in the *Allg. deutsche Biographie* by F. Muncker.

SCHLEGEL, FRIEDRICH VON (1772–1829), German poet, critic and scholar, was the younger brother of August Wilhelm von Schlegel. He was born at Hanover on March 10, 1772. He studied law at Göttingen and Leipzig, but ultimately devoted himself entirely to literary studies. He published in 1797 the important book *Die Griechen und Römer*, which was followed by the suggestive *Geschichte der Poesie der Griechen und Römer* (1798). Goethe and Schiller looked to the Greeks for form and objectivity; Schlegel's hellenism was romantic and lyrical. At Jena, where he lectured as a *Privatdozent* at the university, he contributed to the *Athenäum* the aphorisms and essays in which the principles of the Romantic school are most definitely stated. This journal formed the centre for the first group of romanticists at Jena. Here also he wrote *Lucinde* (1799), an unfinished romance, which is interesting as an attempt to transfer to practical ethics the Romantic demand for complete individual freedom, and *Alarcos*, a

tragedy (1802) in which, without much success, he combined romantic and classical elements. In 1802 he went to Paris, where he edited the review *Europa* (1803), lectured on philosophy and carried on oriental studies, some results of which he embodied in *Über die Sprache und Weisheit der Indier* (1808).

In the same year in which this work appeared, he and his wife Dorothea (1763–1839), a daughter of Moses Mendelssohn, joined the Roman Catholic Church, and from this time he became more and more opposed to the principles of political and religious freedom. In 1809 he was appointed imperial court secretary at the headquarters of the archduke Charles at Vienna; later he was councillor of legation in the Austrian embassy at the Frankfort diet, but in 1818 he returned to Vienna. Meanwhile he had published his collected *Gedichte* (1809) and two series of lectures, *Über die neuere Geschichte* (1811) and *Geschichte der alten und neuen Literatur* (1815). After his return to Vienna from Frankfort he edited *Concordia* (1820–23), and began the issue of his *Sämtliche Werke*. He also delivered lectures, which were republished in his *Philosophie des Lebens* (1828) and in his *Philosophie der Geschichte* (1829). He died on Jan. 11, 1829, at Dresden.

Friedrich Schlegel's wife, Dorothea, was the author of an unfinished romance, *Florentin* (1801), a *Sammlung romantischer Dichtungen des Mittelalters* (2 vols., 1804), a version of *Lother und Maller* (1805), and a translation of Madame de Staël's *Corinne* (1807–08)—all of which were issued under her husband's name.

Friedrich Schlegel's *Sämtliche Werke* appeared in 10 vols. (1822–25); a 2nd ed. (1846) in 15 vols. His *Prosaische Jugendschriften* (1794–1802) have been edited by J. Minor (1882, 2nd ed. 1906); there are also reprints of *Lucinde*, and F. Schleiermacher's *Vertraute Briefe über Lucinde, 1800* (1907). *See* I. Rouge, *F. Schlegel et la genèse du romantisme allemand* (1904) and *Erläuterungen zu F. Schlegels Lucinde* (1905); M. Joachimi, *Die Weltanschauung der Romantik* (1905); W. Glawe, *Die Religion F. Schlegels* (1906); E. Kircher, *Philosophie der Romantik* (1906); R. Volpers, *Friedrich Schlegel als politischer Denker und deutscher Patriot* (1917). On Dorothea Schlegel *see* J. M. Raich, *Dorothea von Schlegel und deren Söhne* (1881); F. Diebel, *Dorothea Schlegel als Schriftsteller im Zusammenhang mit der romantischen Schule* (1905).

SCHLEIERMACHER, FRIEDRICH DANIEL ERNST (1768–1834), German theologian and philosopher, was the son of a Prussian army chaplain of the Reformed confession, and was born on Nov. 21, 1768 at Breslau. He was educated in a Moravian school at Niesky in upper Lusatia, and at the Moravian seminary at Barby near Halle. Reluctantly his father permitted him to enter the university of Halle, which had already (1787) abandoned pietism and adopted the rationalist spirit of Wolf and Semler (*see* RATIONALISM). But though Schleiermacher left the Moravians he retained their intense religious spirit, and the years spent in their schools affected the whole course of his development. In his own life he reconciled personal emotional religion with a modified adoption of the Kantian critical philosophy. In 1796 he became chaplain to the Charité Hospital in Berlin. He was at that time profoundly affected by German Romanticism, as represented by his friend Friedrich Schlegel. This is evidenced by his *Confidential Letters* on Schlegel's *Lucinde* (*Vertraute Briefe über Schlegel's "Lucinde,"* 1801; ed. 1835; by Jonas Fränkel, 1907; R. Frank, 1907), as well as by his relation to Eleonore Grunow, the wife of a Berlin clergyman. Meantime he studied Spinoza and Plato, and was profoundly influenced by both, though he was never a Spinozist; he made Kant more and more his master, though he departed on fundamental points from him, and finally remodelled his philosophy; with some of Jacobi's positions he was in sympathy, and from Fichte and Schelling he accepted ideas, which in their place in his system, however, received another value and import. Schleiermacher was, in fact, a great eclectic. The literary fruit of this period of intense fermentation was his *Reden über die Religion* (1799; ed. Göttingen, 1906), and his "new year's gift" to the new century, the *Monologen* (1800; ed. 1902). In the first book he drew a sharp line between religion on the one hand and ethics and knowledge on the other. Religion is a matter of immediate intuition, he argued, whatever its manifestations and the dogmas with which it may be cloaked. In the *Monologen* he developed his ethical manifesto, in which he proclaimed his ideas as to the freedom and independence of the spirit; and as to the relation of the mind to the world of sense and imperfect social organizations. In these essays he emphasized individual personal development.

From 1802 to 1804, Schleiermacher was pastor in the little Pomeranian town of Stolpe. These years were full of literary work. He relieved Friedrich Schlegel entirely of his nominal responsibility for the translation of Plato, which they had together undertaken (vols. 1–5, 1804–10; 3rd. ed., 1855–61; vol. 6, *Repub.* 1828; 2nd ed., 1855–62); he was also occupied with *Grundlinien einer Kritik der bisherigen Sittenlehre* (1803; 2nd ed. 1834), the first of his strictly critical and philosophical productions. In the year 1804 Schleiermacher went as university preacher and professor of theology to Halle, where he remained until 1807. There he wrote his dialogue the *Weihnachtsfeier* (1806; 4th ed. 1850), which stands midway between his *Reden* and his great dogmatic work, *Der christliche Glaube*.

After the battle of Jena he returned to Berlin (1807), where he was appointed pastor of the Trinity church. The next year he married the widow of his friend Willich. At the foundation of the Berlin university (1810), he received a theological chair, and shortly afterward became secretary to the Academy of Sciences. Schleiermacher threw himself into the movement for national independence, acquiring a name and place in his country's annals with Arndt, Fichte, Stein and Scharnhorst. He shared in the reorganization of the Prussian church, and advocated, unsuccessfully, the union of the Lutheran and Reformed churches. In the *Kurze Darstellung des theologischen Studiums* (1811; 2nd ed. 1830), he sought to do for theology what he had done for religion in his *Reden*. His chief theological work *Der christliche Glaube nach den Grundsätzen der evangelischen Kirche* (1821–22; 2nd ed., greatly altered, 1830–31; 6th ed., 1884) is a classic, and has been described as the greatest theological work produced by Protestantism since the Reformation. Schleiermacher's aim was to reform Protestant theology by means of the fundamental ideas of the *Reden*, to put an end to the unreason and superficiality of both supernaturalism and rationalism, and to deliver religion and theology from a relation of dependence on perpetually changing systems of philosophy. His claim of the right of the church to frame its own liturgy in opposition to the arbitrary dictation of the state brought upon him fresh troubles. He felt himself more and more isolated in Berlin. But he continued his translation of Plato and prepared a new and greatly altered edition of his *Christliche Glaube*, anticipating the latter in two letters to his friend Lücke (in the *Studien und Kritiken*, 1829), in which he defended his theological position generally and his book in particular. He continued his defence against Hengstenberg's party on the one hand and the rationalists von Cölln and D. Schulz on the other, protesting against both subscription to the ancient creeds and the imposition of a new rationalistic formulary. He died, after a few days' illness, on Feb. 12, 1834.

Philosophical System.—Schleiermacher maintained that the world and God are distinct, but correlative, and neither can be conceived without the other. The world without God would be "chaos," and God without the world an empty "phantasm." But though God is transcendent and unknowable he is immanent in the world. In self-consciousness God is present as the basis of the unity of our nature in every transition from an act of knowledge to an act of will, and vice versa. As far as man is the unity of the real and the ideal, God is in him. He is also in all things, inasmuch as in everything the totality of the world and its transcendental basis is presupposed by virtue of their being and correlation. The unity of our personal life amidst the multiplicity of its functions is the symbol of God's immanence in the world, though we may not conceive of the Absolute as a person. Though He may not be conceived as the absolute cause of the world, the idea of absolute causality as symbolized in it may be taken as the best approximate expression of the contents of the religious consciousness. The unbroken connection of cause and effect throughout the world becomes thus a manifestation of God. God is to be sought only in ourselves and in the world. He is completely immanent in the universe. It is impossible that His causality should

have any other sphere than the world, which is the totality of being. "No God without a world, and no world without God." The divine omnipotence is quantitatively represented by the sum of the forces of nature, and qualitatively distinguished from them only as the unity of infinite causality from the multiplicity of its finite phenomena. Throughout the world—not excepting the realm of mind—absolute necessity prevails. As a whole the world is as good and perfect as a world could possibly be, evil being only the necessary limitation of individual being.

Ethics.—In his earlier essays Schleiermacher pointed out the defects of ancient and modern ethical thinkers, particularly of Kant and Fichte, favouring only Plato and Spinoza. His own ethics connects the moral world by a deductive process with the fundamental idea of knowledge and being; it offers a view of the entire world of human action; it presents an arrangement of the matter of the science which tabulates its constituents after the model of the physical sciences; and it supplies a sharply defined treatment of specific moral phenomena in their relation to the fundamental idea of human life as a whole. Schleiermacher defines ethics as the theory of the nature of the reason, or as the scientific treatment of the effects produced by human reason in the world of nature and man. The ontological basis of ethics is the unity of the real and the ideal, and the psychological and actual basis of the ethical process is the tendency of reason and nature to unite in the form of the complete organization of the latter by the former. The end of the ethical process is that corporeal nature may become the perfect symbol and organ of mind. Conscience, as the subjective expression of the presupposed identity of reason and nature in their bases, guarantees the practicability of our moral vocation. Nature is preordained or constituted to become the symbol and organ of mind, just as mind is endowed with the impulse to realize this end. But the moral law must not be conceived under the form of an "imperative"; it differs from a law of nature only as being descriptive of the fact that it ranks the mind as conscious will above nature. Strictly speaking, the antitheses of good and bad and of free and necessary have no place in an ethical system, but simply in history, which is obliged to compare the actual with the ideal; but as far as the terms "good" and "bad" are used in morals they express the rule or the contrary of reason, or the harmony of the contrary of the particular and the general. The idea of "free" as opposed to necessary expresses simply the fact that the mind can propose to itself ends, though a man cannot alter his own nature. In contrast to Kant and Fichte and modern moral philosophers Schleiermacher assigned pre-eminent importance to the doctrine of the *summum bonum,* or highest good. It represents in his system the aim of the entire life of man, supplying the ethical view of the conduct of individuals in relation to society and the universe, and therewith constituting a philosophy of history at the same time. Moral functions cannot be performed by the individual in isolation but only in relation to the family, the state, the school, the church, and society—all forms of human life which ethical science finds to its hand and leaves to the science of natural history to account for. Duties are divided with reference to the principle that every man make his own the entire moral problem and act at the same time in an existing moral society. This condition gives four general classes of duty: duties of general association or duties with reference to the community (*Rechtspflicht*), and duties of vocation (*Berufspflicht*)—both with a universal reference, duties of the conscience (in which the individual is sole judge), and duties of love or of personal association. It was only the first of the three sections of the science of ethics—the doctrine of moral ends—that Schleiermacher handled with approximate completeness. In his *Christian Ethics* he dealt with the subject from the basis of the Christian consciousness instead of from that of reason generally; the ethical phenomena dealt with are the same in both systems, and they throw light on each other, while the Christian system treats more at length and less aphoristically the principal ethical realities—church, state, family, art, science and society.

Religious System.—From Leibniz, Lessing, Fichte, Jacobi and the Romantic school Schleiermacher had imbibed a profound mystical view of human personality. The ego, the person, is an individualization of universal reason; and the primary act of self-consciousness is the first conjunction of universal and individual life. Thus every person becomes a specific and original representation of the universe. While therefore we cannot, as we have seen, attain the idea of the supreme unity of thought and being by either cognition or volition, we can find it in our own personality, in immediate self-consciousness or (which is the same in Schleiermacher's terminology) feeling. Feeling in this higher sense (as distinguished from "organic" sensibility), which is the minimum of distinct antithetic consciousness, the cessation of the antithesis of subject and object, constitutes likewise the unity of our being, in which the opposite functions of cognition and volition have their permanent background of personality and their transitional link. Having its seat in this central point of our being, or indeed consisting in the essential fact of self-consciousness, religion lies at the basis of all thought and action. In his earlier days he called it a feeling or intuition of the universe, consciousness of the unity of reason and nature, of the infinite and the eternal within the finite and the temporal. In later life he described it as the feeling of absolute dependence, or, as meaning the same thing, the consciousness of being in relation to God. As in every affection of our being by individual phenomena we are brought into contact with the whole universe, we are brought into contact with God at the same time as its transcendental cause. This religious feeling is not knowledge in the strict sense, as it is purely subjective or immediate; but it lies at the basis of all knowledge. The so-called natural as distinguished from positive religion, or the religion of reason, is a mere abstraction. All religions are positive, or their characteristics and value are mainly determined by the manner in which the world is conceived. But these varying conceptions with their religious meaning become religiously productive only in the souls of religious heroes, who are the authors of new religions, mediators of the religious life, founders of religious communities. For religion is essentially social, and everywhere forms churches, the necessary organs of its highest life. The specific feature of Christianity is its mediatorial element, its profound feeling of the striving of the finite individual to reach the unity of the infinite whole, and its conception of the way in which Deity deals with this effort by mediatorial agencies, which are both divine and human. Its adherents are conscious of having been delivered by Christ from a condition in which their religious consciousness was overridden by the sense-consciousness of the world and put into one in which everything is subordinated to it. The mediator is now the Christian church, but in the case of Jesus, its originator, it was an entirely new and original factor in the process of religious development, and in so far, like every new and higher stage of being, a supernatural revelation. The appearance of the Saviour in human history is therefore as a divine revelation neither absolutely supernatural nor absolutely beyond reason, and the controversy of the 18th century between the rationalists and supernaturalists rests on false grounds, leads to wrong issues, and each party is right and wrong (*see* Rationalism). As regards Christian theology, it is not its business to establish a system of objective truth, but simply to present in a clear connected form a given body of Christian faith as the contents of the Christian consciousness. Dogmatic theology is a connected accurate account of the doctrine held at a particular time in a given section of the Christian church. But such doctrines as constitute no integral part of the Christian consciousness—*e.g.*, the doctrine of the Trinity—must be excluded from the theological system of the evangelical theologian. As regards the relation of theology and philosophy, it is not one of dependence or of opposition, but of complete independence, equal authority, distinct functions and perfect harmony.

The marked feature of Schleiermacher's thought in every department is the effort to combine the antithetic conceptions of other thinkers. He is realistic and idealistic, individualistic and universalistic, monistic and dualistic, sensationalist and intellectualist, naturalist and supernaturalist, rationalist and mystic, gnostic and agnostic. Apart from the positive and permanent value of the higher unities which he succeeds in establishing, the suggestiveness of his discussions of the great points at issue in all the principal fields of human thought, unsatisfactory as many of

his positions may be considered, make him one of the most instructive of modern thinkers. And, since the focus of his almost universal thought and inquiry and of his rich culture was religion and theology, he must be regarded as the classical representative of modern effort to reconcile science and philosophy with religion and theology, and the modern world with the Christian church.

Schleiermacher's collected works were published in three sections: (1) Theological (11 vols.); (2) Sermons (10 vols., ed. 1873–74, 5 vols.); (3) Philosophical and Miscellaneous (9 vols., 1835–64). His *Pädagogische Schriften* were separately published by Platz (3rd ed., 1902). Of lives the best are his own correspondence; *Aus Schleiermachers Leben in Briefen*, by W. Dilthey (1858–63, in 4 vols., Eng. trans. by Rowan); *Leben Schleiermachers* by Dilthey (vol. i., 1870, the period from 1768–1804); *Friedrich Schleiermacher, ein Lebens- und Charakterbild*, by D. Schenkel (Elberfeld, 1868); a selection of the letters by M. Rade (Jena, 1906). *See* also E. von Willick, *Aus Schleiermachers Hause, Jugenderinnerungen seines Stiefsohnes* (1909). The accounts and critiques of his philosophy, ethics and theology are numerous; some of the most valuable are: J. Schaller, *Vorlesungen über Schleiermacher* (Halle, 1844); G. Weisenborn, *Darstellung und Kritik der Schleiermacher'schen Glaubenslehre* (1849); F. Vorländer, *Schleiermachers Sittenlehre* (Marburg, 1851); W. Bender, *Schleiermachers Theologie mit ihren philosophischen Grundlagen* (1876–78); O. Ritschl, *Schleiermachers Stellung zum Christentum in seinen Reden über die Religion* (1888); and *Schleiermachers Theorie von der Frömmigkeit* (1897); O. Kirn, *Schleiermacher und die Romantik* (1895); H. Bleek, *Die Grundlagen der Christologie Schleiermachers* (1898); M. Fischer, *Schleiermacher* (1899); Lülmann, *Das Bild des Christentums bei den grossen deutschen Idealisten* (1901), and *Schleiermacher der Kirchenvater des 19. Jahrhunderts* (1907); Stephan, *Die Lehre Schleiermachers von der Erlösung* (1901); Theile, *Schleiermachers Theologie und ihre Bedeutung für die Gegenwart* (1903); G. Thimme, *Die religionsphilosophischen Prämissen der Schleiermacher'schen Glaubenslehre* (1901); H. Sueskind, *Der Einfluss Schellings auf die Entwicklung von Schleiermachers System* (1909); F. Kattenbusch, *Von Schleiermacher zu Ritschl* (1903); E. Cramaussel, *La Philosophie religieuse de Schleiermacher* (1909). Full bibliography in Überweg, *Grundriss der Gesch. der Philosophie*, Bd. 4 (1923).

(J. F. Sm.; X.)

SCHLESWIG, town and capital of the Prussian province of Schleswig-Holstein on the narrow arm of the sea called the Schlei, 30 m. to the N.W. of Kiel on the railway from Hamburg to Flensburg. Pop. (1925) 18,683. The town consists mainly of a single street, 3½ m. long, forming a semicircle round the Schlei. The church of St. Peter (1100), renewed in the Gothic style in the 15th century, contains a fine carved oak reredos by Hans Brüggemann. The former commercial importance of the town has disappeared, and the Schlei now affords access to small vessels only. Fishing, tanning, flour-milling and gardening are the chief industries.

History.—Schleswig (ancient forms *Sliesthorp, Sliaswic, i.e.,* the town or bay of the Slia or Schlei) seems to have been already a place of importance in the 9th century, as a medium of trade between the North Sea and the Baltic. The first Christian church was built here by Ansgarius (d. 865), and it became the seat of a bishop about a century later. The town, which obtained civic rights in 1200, also became the seat of the dukes of Schleswig, but its commerce gradually dwindled owing to the rivalry of Lübeck, the wars in which the district was involved, and the silting up of the Schlei. At the partition of 1544 the old castle of Gottorp, built in 1160 for the bishop, became the seat of the Gottorp line of the Schleswig-Holstein family, which remained here till expelled by the Danish king Frederick IV. in 1713. From 1731 to 1846 it was the seat of the Danish governor of the duchies. For later history *see* Schleswig-Holstein Question.

SCHLESWIG-HOLSTEIN, a province in the north-west of Prussia, formed out of the once Danish duchies of Schleswig, Holstein and Lauenburg, and bounded west by the North Sea, north by Denmark, east by the Baltic Sea, Lübeck and Mecklenburg, and south by the lower course of the Elbe (separating it from Hanover). It thus consists of the southern half of the Cimbric peninsula, and forms the connecting link between Germany and Denmark. As a result of the plebiscite taken in accordance with the Treaty of Versailles in 1920, the Northern Zone of the existing German province of Schleswig-Holstein was restored to Denmark, while the Southern Zone remained part of German territory. The new boundary line runs just north of Sylt, south of Tønder and north of Flensburg. In addition to the mainland, which decreases in breadth from south to north, the province includes several islands, the most important being Fehmarn in the Baltic, and Heligoland, Sylt and Föhr in the North Sea. The total area of the province is 5,815 sq.m.

The more ancient geological formations are scarcely met with in Schleswig-Holstein. The contrast between the two coast-lines of the province is marked. The Baltic coast has generally steep well-defined banks and is irregular, being pierced by numerous long and narrow inlets (*Föhrden*) which often afford excellent harbours. The North Sea coast is low and flat, and its smooth outline is interrupted only by the estuary of the Eider and the peninsula of Eiderstedt. Dunes or sand-hills, though rare on the protected mainland, occur on Sylt and other islands, while the small flat islands called *Halligen* require protection by dykes.

The climate of Schleswig-Holstein is mainly determined by the proximity of the sea, and the mean annual temperature, varying from 45° in the north to 49° in the south, is rather higher than is usual in the same latitude. Rain and fog are frequent, but the climate is on the whole healthy. The Elbe forms the southern boundary of Holstein for 65 m., but the only river of importance within the province is the Eider, which rises in Holstein, and after a course of 120 m. falls into the North Sea, forming an estuary 3 to 12 m. in breadth. It is navigable from its mouth as far as Rendsburg, which is on the Kaiser Wilhelm (Kiel-Elbe) canal, which intersects Holstein. There are numerous lakes in north-east Holstein, the largest of which are the Plöner See (12 sq.m.) and the Selenter See (9 sq.m.).

The ordinary cereals are all cultivated with success and there is generally a considerable surplus for export. Rape is grown in the marsh lands and flax on the east coast, while large quantities of apples and other fruit are raised near Altona for the Hamburg and English markets. The marsh lands afford admirable pasture, and great numbers of cattle are reared for export. The Holstein horses are also in request, but sheep-farming is comparatively neglected. Bee-keeping is a productive industry. The hills skirting the bays of the Baltic coast are generally pleasantly wooded, but the forests are nowhere of great extent except in Lauenburg. The fishing in the Baltic is productive; Eckernförde is the chief fishing station in Prussia. The oysters from the beds on the west coast of Schleswig are widely known under the misnomer of "Holstein natives." The mineral resources are almost confined to a few layers of rock-salt near Segeberg. The more important industrial establishments, such as iron foundries, machine works, tobacco and cloth factories, are mainly confined to the large towns, such as Altona, Kiel and Flensburg. The shipbuilding of Kiel and other seaports, however, is important. The commerce and shipping of Schleswig-Holstein, stimulated by its position between two seas, as well as by its excellent harbours and waterways, are much more prominent than its manufactures. Kiel is one of the chief seaports of Prussia, while oversea trade is also carried on by Altona and Flensburg. Schleswig is the official capital of the province, but Altona and Kiel are the largest towns. The main exports are grain, cattle, horses, fish and oysters, in return for which come timber, coal, salt, wine and colonial produce.

The population of the province in 1925 was 1,529,909. Among the Germans the prevalent tongue is Low German, but the North Frisians on the west coast of Schleswig and the North Sea islands still speak a Frisian dialect, which, however, is dying out. The peninsula of Angeln, between the Gulf of Flensburg and the Schlei, is supposed to have been the original seat of the English, and observers profess to see a striking resemblance between this district and the counties of Kent and Surrey. The peasants of Dithmarschen in the south-west retain many of their ancient peculiarities. The language boundary between Danish and German now practically coincides with the political boundary. The chief educational institution in Schleswig-Holstein is the university of Kiel.

SCHLESWIG-HOLSTEIN QUESTION, the name given to the whole complex of diplomatic and other issues arising in the 19th century out of the relations of the two "Elbe duchies," Schleswig and Holstein, to the Danish Crown on the one hand

and the German Confederation on the other, which came to a crisis with the extinction of the male line of the reigning house of Denmark by the death of King Frederick VII. on Nov. 15, 1863. The central question was whether the two duchies did or did not constitute an integral part of the dominions of the Danish Crown, with which they had been more or less intimately associated for centuries. This involved the purely legal question, raised by the death of the last common male heir to both Denmark and the duchies, as to the proper succession in the latter, and the constitutional questions arising out of the relations of the duchies to the Danish crown, to each other, and of Holstein to the German Confederation. There was also the national question: the ancient racial antagonism between German and Dane, intensified by the tendency, characteristic of the 19th century, to the consolidation of nationalities. Lastly, there was the international question: the rival ambitions of the German powers involved, and beyond them the interests of other European States, notably that of Great Britain, in preventing the rise of a German sea-power in the north.

Early History.—From time immemorial the country north of the Elbe had been the battle-ground of Danes and Germans. Danish scholars point to the prevalence of Danish place-names far southward into the German-speaking districts as evidence that at least the whole of Schleswig was at one time Danish, *i.e.*, place-names according to popular usage, not the official names given in German maps (*e.g.*, Haderslev for Hadersleben. See *La Question du Slesvig*, p. 61 *seq.*, "Noms de lieux"). German scholars claim it, on the other hand, as essentially German. That the duchy of Schleswig, or South Jutland (Sönderjylland), had been from time immemorial a Danish fief was, indeed, not in dispute, nor was the fact that Holstein had been from the first a fief of the Germano-Roman empire. The controversy in the 19th century raged round the "indissoluble" union of the two duchies, the principle of which had been secured by the Charter of Ribe, signed by the Danish King Christian I., in 1460, after his election by the respective estates as count of Holstein and duke of Schleswig. The "Eider Danes" (*i.e.*, the party at Copenhagen which aimed at making the Eider, the southern boundary of Schleswig, the frontier of the Danish kingdom proper) claimed Schleswig as an integral part of the Danish monarchy, which, on the principle of the union, involved the retention of Holstein also; the Germans claimed Holstein as a part of Germany and, therefore, on the same historic principle, Schleswig also.

The Congress of Vienna, instead of settling the questions involved in the relations of the duchies of Denmark once for all, sought to stereotype the old divisions in the interests of Germany. In 1806, after the dissolution of the Holy Roman empire, the duchies had been virtually incorporated in Denmark. This settlement was reversed by the Congress, and while Schleswig remained as before, Holstein and Lauenburg were included in the new German Confederation. The opening up of the Schleswig-Holstein question thus became sooner or later inevitable. The Germans of Holstein, influenced by the new national enthusiasm evoked by the War of Liberation, resented more than ever attempts to treat them as part of the Danish monarchy and, encouraged by the sympathy of the Germans in Schleswig, tried to reassert in the interests of Germanism the old principle of the unity of the duchies. The political atmosphere, however, had changed at Copenhagen also; and their demands were met by the Danes with a nationalist temper as intractable as their own. Affairs were ripe for a crisis, which the threatened failure of the common male heirs to the kingdom and the duchies precipitated.

CRISIS OF 1848–49

When Christian VIII. succeeded his father Frederick VII. in 1839 the elder male line of the house of Oldenburg was on the point of extinction, the king's only son and heir having no children. To German opinion the solution of the question of the succession seemed clear enough. The Crown of Denmark could be inherited by female heirs; in the duchies the Salic law had never been repealed and, in the event of a failure of male heirs to Christian VIII., the succession would pass to the dukes of Augustenburg. Danish opinion, on the other hand, clamoured for a royal pronouncement proclaiming the principle of the indivisibility of the monarchy and its transmission intact to a single heir, in accordance with the royal law. To this Christian VIII. yielded so far as to issue in 1846 letters patent declaring that the royal law in the matter of the succession was in full force so far as Schleswig was concerned. As to Holstein he stated that he could not give so clear a decision, but the principle of the independence of Schleswig and of its union with Holstein were expressly reaffirmed. An appeal against this by the estates of Holstein to the German diet received no attention. The revolutionary year 1848 brought matters to a head. On Jan. 28, Christian VIII. proclaimed a new constitution which, while preserving the autonomy of the different parts of the country, incorporated them for common purposes in a single organization. The estates of the duchies replied by demanding the incorporation of Schleswig-Holstein, as a single constitutional state, in the German Confederation. Frederick VII., who had succeeded his father at the end of January, declared (March 4) that he had no right to deal in this way with Schleswig, and, yielding to the Eider-Danish party, withdrew the rescript of January (April 4) and announced to the people of Schleswig (March 27) the promulgation of a liberal constitution under which the duchy, while preserving its local autonomy, would become an integral part of Denmark.

Prussian Intervention.—Meanwhile the duchies had broken out into insurrection; a provisional Government had been established at Kiel; and the duke of Augustenburg had hurried to Berlin to secure the assistance of Prussia in asserting his rights. This was at the very crisis of the revolution in Berlin, and the Prussian Government saw in the proposed intervention in Denmark in a popular cause an excellent opportunity for restoring its damaged prestige. Prussian troops were accordingly marched into Holstein and, the diet having on April 12 recognized the provisional Government of Schleswig and commissioned Prussia to enforce its decrees, General Wrangel was ordered to occupy Schleswig also. Prussia, as the mandatory of Germany, endeavoured to enforce the principle that the states were independent, indissolubly united and hereditary only in the male line. But the Germans had reckoned without the European powers, which were united in opposing any dismemberment of Denmark, even Austria refusing to assist in enforcing the German view.

Convention of Malmoe.—Prussia was now confronted on the one side by the German nation urging her to action, on the other side by the European powers threatening the worst consequences should she persist. Frederick William chose the lesser of two evils and, on Aug. 26, 1848, Prussia signed at Malmoe a convention which yielded practically all the Danish demands. The Holstein estates appealed to the German parliament, but it was soon clear that this had no means of enforcing its views, and the convention was ratified at Frankfort.

The convention was only in the nature of a truce establishing a temporary *modus vivendi*, and the main issues continued to be hotly debated. A conference held in London failed to arrive at a settlement, and on April 3, 1849, the war was renewed. But the European situation, and notably the attitude of the Emperor Nicholas I. of Russia—who looked on Augustenburg as a rebel and Russia as bound in honour to safeguard the interests of the Danish Crown—decided Prussia to conclude peace with Denmark on the basis of the *status quo ante bellum*.

Treaty of Berlin, 1850.—The treaty was signed at Berlin on July 2, 1850. Both parties reserved all their antecedent rights; but for Denmark it was enough, since it empowered the king-duke to restore his authority in Holstein with or without the consent of the German Confederation. Danish troops marched in to coerce the duchies; but, meanwhile, negotiations among the powers continued, and on Aug. 2, 1850, Great Britain, France, Russia and Norway-Sweden signed a protocol, to which Austria subsequently adhered, approving the principle of restoring the integrity of the Danish monarchy. On Jan. 28, 1852, King Frederick VII. issued a royal letter announcing the institution of a unitary State which, while maintaining the fundamental con-

stitution of Denmark, would increase the powers of the estates of the two duchies. This was approved by Prussia and Austria, and by the German federal diet in so far as it affected Holstein and Lauenburg.

The Protocol of London, 1852.—The question of the succession was next approached. The main obstacle to an agreement among the Powers was removed when, on March 31, 1852, the duke of Augustenburg resigned his claim in return for a money payment. Further adjustments followed. After the renunciation by the emperor of Russia (who represented the elder, Gottorp line) and others of their eventual rights, Charlotte, landgravine of Hesse, sister of Christian VIII., and her son Prince Frederick transferred their rights to the latter's sister Louise, who in her turn transferred them to her husband Prince Christian of Glücksburg. This arrangement received international sanction by the protocol signed in London on May 8, 1852, by the five great powers and Norway and Sweden. On July 31, 1853, King Frederick VII. gave his assent to a law settling the crown on Prince Christian, "prince of Denmark," and his heirs male. The protocol of London, while consecrating the principle of the integrity of Denmark, stipulated that the rights of the German Confederation in Holstein and Lauenburg should remain unaffected. It was, in fact, a compromise which satisfied neither the Danes nor the Germans; and when in Oct. 1855, King Frederick issued a parliamentary constitution for the whole monarchy, its legality was disputed by the two German great powers, on the ground that the estates of the duchies had not been consulted, and the diet of the Confederation refused to admit its validity so far as Holstein and Lauenburg were concerned (Feb. 11, 1858).

The question was now once more the subject of international debate; but the situation was no longer so favourable to the Danish view. The Crimean War had crippled Russia, and Nicholas I. was dead. France was prepared to sell the interests of Denmark in the duchies to Prussia in return for "compensations" to herself elsewhere. Great Britain alone sided with the Danes; but the action of British ministers, who realized the danger to British supremacy at sea of the growth of German sea-power in the Baltic, was hampered by the natural sympathy of Queen Victoria and the prince consort with the German point of view[1]. The result was that the German diet, on the motion of Bismarck, having threatened federal intervention (July 29), Frederick VII. abolished the general constitution so far as it affected Holstein and Lauenburg, while retaining it for Denmark and Schleswig (Nov. 6).

CRISIS OF 1863–64

Though even this concession violated the principle of the "indissoluble union" of the duchies, the German diet, fully occupied at home, determined to refrain from further action till the Danish parliament should make another effort to pass a law or budget affecting the whole kingdom without consulting the estates of the duchies. This contingency arose in July 1860, and in the spring of the following year the estates were once more at open odds with the Danish Government. The German diet now prepared for armed intervention; but it was in no condition to carry out its threats, and Denmark decided, on the advice of Great Britain, to ignore it and open negotiations directly with Prussia and Austria as independent Powers. These demanded the restoration of the union between the duchies, a question beyond the competence of the Confederation. Denmark replied with a refusal to recognize the right of any foreign Power to interfere in her relations with Schleswig; to which Austria, anxious to conciliate the smaller German princes, responded with a vigorous protest against Danish infringements of the compact of 1852. Lord John Russell now intervened, on behalf of Great Britain, with a proposal for a settlement of the whole question on the basis of the independence of the duchies under the Danish Crown[2]. This was accepted by Russia and by the German great powers, and Denmark found herself isolated. The international situation, however, favoured a bold attitude, and she met the representations of the powers with a flat defiance. The retention of Schleswig as an integral part of the monarchy was to her a matter of life and death; the German Confederation had made the terms of the protocol of 1852, defining the intimate relations between the duchies, the excuse for unwarrantable interference in the internal affairs of Denmark; and on March 30, 1863, a royal proclamation was published at Copenhagen repudiating the compacts of 1852, and, by defining the separate position of Holstein in the Danish monarchy, negativing the claims of Germany upon Schleswig[3].

Danish Constitution of 1863.—The reply of the German diet was a note to Copenhagen (July 9) demanding, on pain of federal execution, the withdrawal of the proclamation and the grant of a constitution based on the compacts of 1852 or on the British note of Sept. 24, 1862. Instead, King Frederick VII. issued on Sept. 28, 1863, a new constitution for "our kingdom of Denmark-Slesvig," which, encouraged by the hesitating attitude of the German diet, the Danish parliament passed on Nov. 13. Two days later Frederick VII. died.

The "Protocol-King," Christian IX., who now ascended the throne, was in a difficult position. The first act he was called upon to perform was to sign the new constitution. To sign was to violate the terms of the very protocol which was his title to reign; to refuse to sign was to defy the sentiment of his Danish subjects. He chose what seemed the remoter evil, and on Nov. 18 signed the constitution. The news was received in Germany with violent manifestations of anger. Frederick, duke of Augustenburg, son of the prince who in 1852 had renounced the succession to the duchies, now claimed his rights on the ground that he had had no share in the renunciation. In Holstein an agitation in his favour had begun from the first, and this was extended to Schleswig on the terms of the new Danish constitution becoming known. His claim was enthusiastically supported by the German princes and people, and in spite of the negative attitude of Austria and Prussia the federal diet decided to occupy Holstein "pending the settlement of the succession." On Dec. 24 Saxon and Hanoverian troops marched into the duchy in the name of the German Confederation, and supported by their presence and by the loyalty of the Holsteiners the duke of Augustenburg assumed the Government under the style of Duke Frederick VIII.

Attitude of Austria and Prussia.—With this "folly"—as Bismarck roundly termed it—Austria and Prussia, in the teeth of violent public opinion, would have nothing to do, for neither wished to risk a European war. It was clear to Bismarck that the two powers, as parties to the protocol of 1852, must uphold the succession as fixed by it, and that any action they might take in consequence of the violation of that compact by Denmark must be so "correct" as to deprive Europe of all excuse for interference. The publication of the new constitution by Christian IX. was in itself sufficient to justify a declaration of war by the two powers as parties to the signature of the protocol. As to the ultimate outcome of their effective intervention, that could be left to the future to decide. Austria had no clear views. King William wavered between his Prussian feeling and a sentimental sympathy with the duke of Augustenburg. Bismarck alone knew exactly what he wanted, and how to attain it. "From the beginning," he said later (*Reflections*, ii. 10), "I kept annexation steadily before my eyes."

The protests of Great Britain and Russia against the action of the German diet helped Bismarck to persuade Austria that immediate action must be taken. On Dec. 28 a motion was introduced in the diet by Austria and Prussia, calling on the Confederation to occupy Schleswig as a pledge for *the observance by Denmark of the compacts of 1852.* This implied the recognition of the rights of Christian IX., and was indignantly rejected; whereupon the diet was informed that Austria and Prussia would act in the matter as independent European Powers. The agreement between them was signed on Jan. 16, 1864. One article stated

[1]*See* Queen Victoria to Lord Malmesbury, May 1, 1858, in *Letters* (pop. ed., 1908), iii. 280. Compare the letters to Palmerston of June 21, 1849, ii. 222, and June 22, 1850, ii. 279, with Palmerston to Russell, June 23, 1850, and Queen Victoria to Russell, ii. 250.

[2]Note of Sept. 24, 1862. For the diplomatic correspondence on the duchies see *Parl. Papers*, lxxiv. (1863).

[3]For this and later correspondence see *Parl. Papers*, lxiv. (1864) p. 40 *seq.*

that the two Powers would decide only in concert on the relations of the duchies, and that they would in no case determine the question of the succession save by mutual consent.

At this stage, had the Danes yielded to the necessities of the situation and withdrawn from Schleswig under protest, the European Powers would probably have intervened, a congress would have restored Schleswig to the Danish Crown, and Austria and Prussia, as European Powers, would have had no choice but to prevent any attempt upon it by the duke of Holstein. To prevent this possibility Bismarck made the Copenhagen Government believe that Great Britain had threatened Prussia with intervention should hostilities be opened, "though, as a matter of fact, England did nothing of the kind." The cynical stratagem succeeded; Denmark remained defiant; and on Feb. 1, 1864, the Austrian and Prussian forces crossed the Eider.

The Danish War.—An invasion of Denmark itself had not been part of the original programme of the allies; but on Feb. 18 some Prussian hussars, in the excitement of a cavalry skirmish, crossed the frontier and occupied the village of Kolding. Bismarck determined to use this circumstance to revise the whole situation. He urged upon Austria the necessity for a strong policy, so as to settle once for all not only the question of the duchies but the wider question of the German Confederation; and Austria reluctantly consented to press the war. On March 5 a fresh agreement was signed between the Powers, under which the compacts of 1852 were declared to be no longer valid, and the position of the duchies within the Danish monarchy as a whole was to be made the subject of a friendly understanding. Meanwhile, however, Lord John Russell on behalf of Great Britain, supported by Russia, France and Sweden, had intervened with a proposal that the whole question should once more be submitted to a European conference[1]. The German Powers agreed on condition that the compacts of 1852 should not be taken as a basis, and that the duchies should be bound to Denmark by a personal tie only. But the proceedings of the conference, which opened at London on April 25 only revealed the inextricable tangle of the issues involved. Beust, on behalf of the Confederation, demanded the recognition of the Augustenburg claimant; Austria leaned to a settlement on the lines of that of 1852; Prussia, it was increasingly clear, aimed at the acquisition of the duchies. The first step towards the realization of this latter ambition was to secure the recognition of the absolute independence of the duchies, and this Austria could only oppose at the risk of forfeiting her whole influence in Germany. The two Powers, then, agreed to demand the complete political independence of the duchies bound together by common institutions. The next move was uncertain. As to the question of annexation Prussia would leave that open, but made it clear that any settlement must involve the complete military subordination of Schleswig-Holstein to herself. This alarmed Austria, which had no wish to see a further extension of Prussia's already overgrown power, and she began to champion the claims of the duke of Augustenburg. This contingency, however, Bismarck had foreseen and himself offered to support the claims of the duke at the conference if he would undertake to subordinate himself in all naval and military matters to Prussia, surrender Kiel for the purposes of a Prussian war-harbour, give Prussia the control of the projected North Sea Canal, and enter the Prussian Customs Union. On this basis, with Austria's support, the whole matter might have been arranged without—as Beust pointed out (*Mem.* i. 272)—the increase of Prussia's power beyond the Elbe being any serious menace to Austrian influence in Germany. Fortunately, however, for Bismarck's plans, Austria's distrust of Prussia led her to oppose this settlement and at her instigation the duke of Augustenburg rejected it.

Treaty of Vienna, 1864.—On June 25 the London conference broke up without having arrived at any conclusion. On the 24th, in view of the end of the truce, Austria and Prussia had arrived at a new agreement, the object of the war being now declared to be the complete separation of the duchies from Denmark. As the result of the short campaign that followed, the preliminaries of a treaty of peace were signed on Aug. 1, the king of Denmark renouncing all his rights in the duchies in favour of the emperor of Austria and the king of Prussia. The definitive treaty was signed at Vienna on Oct. 30, 1864. By Article XIX., a period of six years was allowed during which the inhabitants of the duchies might "opt" for Danish nationality and transfer themselves and their goods to Denmark; and the right of "indigenacy" was guaranteed to all, whether in the kingdom or the duchies, who enjoyed it at the time of the exchange of ratification of the treaty[2].

[1] *Parl. Papers* (1864), lxv. 124 *seq.* Beust (*Mem.* i. 252) says that Queen Victoria personally intervened to prevent British action in favour of Denmark.

SETTLEMENTS OF 1866 AND 1920

The Schleswig-Holstein Question from this time onward became merged in the larger question of the general relations of Austria and Prussia. So far as Europe was concerned it was settled by the decisive result of the Austro-Prussian war of 1866. (*See* SEVEN WEEKS' WAR.) It survived, however, as between Danes and Germans, though narrowed down to the question of the fate of the Danish population of the northern duchy.

By Article V. of the Treaty of Prague (Aug. 23, 1866) Schleswig was ceded by Austria to Prussia with the reservation that "the populations of the North of Schleswig shall be again united with Denmark in the event of their expressing a desire so to be by a vote freely exercised." But the *plébiscite* never came. Its inclusion in the treaty had been no more than a diplomatic device to save the face of the emperor Napoleon III.; Prussia had from the first no intention of surrendering an inch of the territory she had conquered; the outcome of the Franco-German War made it unnecessary for her even to pretend that she might do so; and by the Treaty of Vienna of Oct. 11, 1878, the clause relating to the *plébiscite* was formally abrogated with the assent of Austria.

To incorporate Schleswig in the German empire, however, was one thing; to absorb its people into the German nation quite another. South Schleswig was already German; but for 50 years Germanism, backed by all the weight of the empire and imposed with the weapons of official persecution, had not held its own in North Schleswig; in spite of an enormous emigration, in 1905, of the 148,000 inhabitants of North Schleswig 139,000 spoke Danish, while of the German-speaking immigrants it was found that more than a third spoke Danish in the first generation; and this in spite of the fact that, from 1864 onward, German had gradually been substituted for Danish in the churches, the schools, and even in the playground. But the scattered outposts of Germanism could hardly be expected to acquiesce without a struggle in a situation that threatened them with social and economic extinction. Fifty years of dominance, secured by official favour, had filled them with a double measure of aggressive pride of race, and the question of the rival nationalities in Schleswig, like that in Poland, remained a source of trouble and weakness within the frontiers of the German empire.

During the years preceding the World War, the efforts to Germanize the Danish inhabitants of Schleswig continued, but only succeeded in strengthening their Danish national consciousness. In Aug. 1914 the effects of this spirit were so feared in Germany that a number of prominent Danes were imprisoned, and during the War the aspirations for union with Denmark were silenced. On the one hand, there was the German censorship, and on the other hand, the Danes themselves in Schleswig did not wish to endanger Denmark's neutrality.

On Oct. 23, 1918, however, H. P. Hanssen, a Danish representative, raised the demand for reunion in the German *Reichstag;* on the same day the Danish *Rigsdag* passed a resolution in favour of a readjustment of the frontier on the principles of nationality. On Nov. 28 the Danish Government communicated its wishes to the Allies, and in Feb. 1919 a united Danish North Schleswig delegation was sent to the Peace Conference in Paris to present the Danish point of view: a plebiscite *en bloc* in North Schleswig (zone 1); a community ballot in Central Schleswig and Flens-

[2] The full text of the treaty is in *La Question du Slesvig,* p. 173 *et seq.*

burg (zone 2) and voting rights to all those born in the voting district. The Peace Treaty, presented May 7, further provided for a plebiscite in a third zone, but this was later dropped.

On the treaty coming into force (Jan. 10, 1920) an international commission took charge of the plebiscite district. Zone 1 gave 75,431 votes for Denmark, 25,329 for Germany (Feb. 10); zone 2, 48,148 votes for Germany, 13,029 for Denmark (March 14). The frontier established by the treaty of July 5, 1920 gave effect to this verdict, and restored to Denmark that part of Schleswig which lies north of the Flensburg fjord, and of a line drawn approximately west from it. On July 7 the executive power in Zone 1 was handed over to Denmark.

Subsequent elections have shown the line to be fairly drawn. The Danish vote polled in Germany in 1924 was 7,700—insufficient to return a Danish representative. The German votes for the *Rigsdag* in 1921 and 1924 totalled 7,500, returning one member under the system of proportional representation. The Treaty of Versailles imposed no special obligations upon Denmark with regard to her German minority, since the Danish constitution offered adequate safeguards; on the same grounds the Danish Government declined the proposal for a special treaty with Germany for reciprocal protection of the minorities, as this might lead to interference by the Government of one country in the affairs of another. The Danish Government, however, offered the German minority every facility to develop its own culture, the school system of North Schleswig being reorganized with this view; parents decide whether they will have their children educated in German or Danish at primary schools, and German private schools receive State grants.

See Sach, *Geschichte der Stadt Schleswig* (Schleswig, 1875); and Jensen, *Schleswig und Umgebung* (Schleswig, 1905).

Bibliography.—The literature on the subject is vast. From the German point of view the most comprehensive treatment is in C. Jansen and K. Samwer, *Schleswig-Holsteins Befreiung* (Wiesbaden, 1897); *see* also H. C. L. von Sybel, *Foundation of the German Empire* (Eng. trans., New York, 1890–91); Bismarck's *Reflections and Reminiscences,* and L. Hahn, *Bismarck* (5 vols., 1878–91). The Danish point of view is ably and moderately presented in *La Question du Slesvig,* a collection of essays by various writers edited by F. de Jessen (Copenhagen, 1906), with maps and documents. (W. A. P.; X.)

SCHLETTSTADT: *see* Sélestat.

SCHLEY, WINFIELD SCOTT (1839–1911), American naval officer, was born at Richfields, near Frederick, Md., on Oct. 9, 1839. He graduated at the United States naval academy in 1860, and during the Civil War was in active service as a lieutenant until July 1863. In 1872–75 he was head of the department of modern languages in the U.S. naval academy. He was promoted commander in 1874; in 1876–79 commanded the "Essex," most of the time in the South Atlantic, and then until Oct. 1883 was inspector of the second lighthouse district. In Feb. 1884, Schley was appointed to command the third Greely relief expedition; and near Cape Sabine on June 22 rescued Greely and six companions. He commanded the "Baltimore" in Rear Admiral George Brown's squadron off the coast of Chile in 1891. He was commissioned commodore on Feb. 6, 1898, and was put in command of the "flying squadron," with the "Brooklyn" as his flagship, for service in the war with Spain. The command of the fleet off Santiago de Cuba was taken from Schley by Acting Rear Admiral W. T. Sampson. In the battle of Santiago on July 3, Schley, in Sampson's absence, was the senior officer. On Aug. 10, Schley was advanced six numbers and was made rear admiral for "eminent and conspicuous conduct in battle." When the Navy department recommended that Sampson be promoted eight numbers and over the head of Schley, who had ranked him for 42 years, there was a bitter controversy, and the Senate did not confirm the promotion. On April 14, 1899, Schley was commissioned rear admiral. In 1901 he retired from active service. At his request, because of the charges made against him in E. S. Maclay's *History of the Navy,* a court of inquiry investigated Schley's conduct before and during the battle of Santiago; in 1901 the court pronounced Schley guilty of delay in locating Cervera's squadron, of carelessness in endangering the "Texas" by a peculiar "loop" movement or turn of the "Brooklyn" which blanketed the fire of other American vessels, and of disobedience to a departmental order of May 25, but it recommended that no action be taken. He died in New York city, on Oct. 2, 1911.

Schley wrote, with James Russell Soley, *The Rescue of Greely* (1885). *See* Schley's *Forty-five Years under the Flag* (1904); "Admiral Schley's Own Story," *Cosmopolitan Magazine,* vol. lii. (1912); and James Parker, *Rear Admiral Schley, Sampson and Cervera* (1910).

SCHLICH, SIR WILLIAM, K.C.I.E., cr. 1909 (1840–1925), British forestry expert, was born at Darmstadt, Germany, on Feb. 28, 1840, and educated there and at the University of Giessen. In 1866 he entered the Indian Forests Department, became conservator of forests in 1871, and 10 years later inspector-general of forests to the Government of India. In 1886 he became a naturalized British subject. He was one of the pioneers of the study of forestry in England, organizing in 1885 the first school at Cooper's Hill, which was transferred to Oxford in 1905. He was appointed professor of forestry at Oxford the same year and retained the post until 1919. Among his books on the subject are: *A Manual of Forestry* (1889–95; new ed., 5 vol., 1925) and *Forestry in the United Kingdom* (1904). He died at Oxford on Sept. 28, 1925.

SCHLIEFFEN, ALFRED, Count von (1833–1913), Prussian soldier, was born on Feb. 28, 1833 in Berlin, of a Pomeranian family, the son of an army officer. He studied at Berlin University and the military academy and served in the war of 1866 against Austria and in that of 1870–71 against France as a general staff officer. In 1891 he was appointed chief of the general staff of the army. He held this position for 15 years, exercising an extraordinary influence on the development of the German general staff and the whole German army. He faced the problem of a war on two fronts, which would have to be waged with a single huge army. He promoted the training of general staff officers in the leading of huge armies, urged on technical equipment, and, finally, he threw all his energies into the effort to equip the army with mobile heavy artillery. He retired in 1907.

On his retirement Schlieffen put his views in writing. He is indeed far better known as an author than as chief of the general staff of the army. He was a disciple of Clausewitz, who in his turn had deduced his doctrine of strategy from Napoleon. Field-marshal von Moltke, whose successor and disciple Schlieffen was, had also based his ideas on Clausewitz, and it was the Napoleon-Moltke strategy that Schlieffen sought to carry on. The essence of their doctrine is that the enemy forces should be not merely defeated but destroyed. To this end it seemed to them necessary that not only the front but the flanks and if possible the rear should be attacked, so that the enemy should be forced to give battle on a reversed front. Schlieffen pushed this system to its logical conclusion. He saw Germany surrounded on all sides by enemies who, together, were far more powerful than herself. It seemed to him that the only salvation lay in opposing one of the enemies with a superior force, inflicting on him a decisive defeat, and then, using a well-developed network of railways and manoeuvring on inner lines, turning upon the other enemy against whom until then a defensive attitude would have been maintained. For this end rapidly decisive blows were needed and his writings aimed at proving such blows to be possible and showing how troops could be handled for that purpose.

With a marked singleness of purpose Schlieffen sought out the appropriate examples in military history and presented them in a new guise. His works are not military history in the accepted sense; he used military history to corroborate his doctrines. His books are definitely instructional. He watched the military-political situation of his own country, and feared, lest the grave hour should find, in the position he had had to leave, a man unequal to the overwhelming task. "A commander-in-chief must be inspired by something superhuman, something supernatural, call it genius or what you will."

Schlieffen died in Berlin on Jan. 4, 1913, but in 1914—seven years after his retirement—he still played his part in the world's history; for on retiring, he had bequeathed to his successor, General Moltke the younger, the plan for deployment against France. This plan embodies his strategic convictions. It is at

once immensely bold and also simple. Only the bare minimum was to remain facing the Russians; in the West the left flank was to be held back and the troops in Alsace were to withdraw behind the Rhine and face attack on the line Metz-Strasbourg. The bulk of the army was to deploy on the right flank and, pivoting on Metz, to drive forward against the line Dunkirk-Verdun. In this way the strongly fortified east front of France would be turned and the French army forced to give battle with a reversed front. Schlieffen intended not to give a recipe for victory, but to indicate the operative idea which, if logically carried out, would make possible the swift decision which alone could save Germany from her doom. The German army commander of 1914 considerably diluted the Schlieffen plan and, particularly in its execution, followed other courses than those pointed to by the dead strategist. And so it was that the inspired scheme of Schlieffen did not bear the fruits which were expected.

How armies are to be handled in the Schlieffen spirit the war on the Eastern front showed. The battle of Tannenberg has very justly been called a super-Cannae, and the campaign of Lodz, the German attack against the Warsaw-Thorn line—the best-conceived operation of the whole War, which was directed solely against the right flank of the Russians—rests upon Schlieffen's ideas. The field marshal's influence on the German leadership in the World War is incontestable, and his lifework cannot be ignored by anyone who intends to study the history of the World War. *See* Graf Schlieffen, *Gesammelte Schriften* (Berlin, 1913); *Cannae,* selection from the above (Berlin, 1925).

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SCHLIEMANN, HEINRICH (1822–1890), German archaeologist, was born on Jan. 6, 1822 at Neu Buckow in Mecklenburg-Schwerin, the son of a poor pastor. He has stated in his autobiography that through all his early years of struggle, when he was successively grocer's apprentice at Fürstenberg, cabin-boy on the "Dorothea" bound for Venezuela, and, after her wreck, office attendant and then book-keeper in Amsterdam, he nourished a passion for the Homeric story and an ambition to become a great linguist. In the end, thanks to an unusually powerful memory and determined energy, he acquired a knowledge of seven or eight tongues besides his own, including ancient and modern Greek. The house of B. H. Schröder of Amsterdam sent him in 1846 to St. Petersburg, where he established a business of his own and embarked in the indigo trade. He made a fortune at the time of the Crimean War, partly as a military contractor. Happening to be in California when made a State of the Union, in 1850, he became and remained an American citizen. After travels in Greece, Tunisia, India, China and Japan, and writing a short sketch of the last two countries, he took his large fortune to Greece in 1868, and proceeded to visit Homeric sites. In an ensuing book—*Ithaka, der Peloponnes, und Troja*—he propounded two theories which he was destined eventually to test in practice, viz., that Hissarlik, not Bunarbashi, was the site of Troy, and that the Atreid graves, seen by Pausanias at Mycenae, lay within the citadel wall. Two years later he took up Calvert's work on the former site, and, convinced that Troy must be on the lowest level, hewed his way down, regardless of the upper strata, wherein lay unseen the remains of which he was really in search. By 1873 he had laid bare considerable fortifications and other remains of a burnt city of very great antiquity, and discovered a treasure of gold jewellery. We now know this city to have belonged to the middle pre-Mycenaean period, long prior to the generation of Homer's Archaeans, but Schliemann far and wide proclaimed it "Troy," and was backed by Gladstone and a large part of the European public. Trying to resume his work in February 1874, he found himself inhibited by the Ottoman government, whose allotted share of the gold treasure had not been satisfactory, and it was not till April 1876 that he obtained a *firman.* During the delay he issued his *Troy and its Remains* (1875), and betook himself to Mycenae. There in August 1876 he began work in the dome-tombs and by the Lion Gate, and opened a large pit just within the citadel. The famous double ring of slabs and certain stone reliefs came to light. Schliemann, thinking it was only a platform levelled as a place of Achaean assembly, paused, and did not resume till November. Then, resolved to explore to the rock, he cleared away some three feet more of earth and stones, and lighted on the five shaft graves which have placed him first among fortunate excavators. A sixth grave was found immediately after his departure. The immense treasure of gold, silver, bronze, fine stone and ivory objects, which was buried with the sixteen corpses in this circle, is worth intrinsically more than any treasure-trove known to have been found in any land, and it revealed once for all the character of a great civilization preceding the Hellenic. The find was deposited at Athens, and gradually cleaned and arranged in the Polytechnic; and the discoverer, publishing his *Mycenae* in English in 1877, had his full share of honours and fame. He had now settled in Athens, where he married a Greek lady, and built two splendid houses, which became centres of Athenian society. In 1878 he dug unsuccessfully in Ithaca, and in the same year and the following resumed work at Hissarlik, and summed up his results in a discursive memoir, *Ilios,* upon which a sequel, *Troja,* issued in 1884, after Wilhelm Dörpfeld, associated in 1882, had introduced some archaeological method into the explorations, was a considerable improvement.

In 1880 and 1881 Schliemann cleared out the ruined dome-tomb of Orchomenus, finding little except remains of its beautiful ceiling; and in 1885, with Dörpfeld, he laid bare the upper stratum on the rock of Tiryns, presenting scholars with a complete ground plan of a Mycenaean palace. This was his last fortunate excavation. While Tsountas, for the Greek Archaeological Society, picked up his work at Mycenae in 1886, and gradually cleared the Acropolis with notable results, Schliemann tried for traces of the Caesareum at Alexandria, of the Palace of Minos at Knossos, in Crete, and of the Aphrodite temple at Cythera (1888); but he was not successful, meeting in the two former enterprises with a local opposition which his wealth was unable to bear down. In 1889 he entertained at Hissarlik a committee of archaeological experts, deputed to examine Bötticher's absurd contention that the ruins represented not a city, but a cremation necropolis; and he was contemplating a new and more extensive campaign on the same site when, in December 1890, he was seized at Naples with an illness which ended fatally on the morning of Christmas Day. (D. G. H.)

SCHLIPPE'S SALT, or sodium thioantimoniate, named after K. F. Schlippe (1799–1867), is prepared by dissolving the calculated quantities of antimony trisulphide, sulphur and sodium hydroxide in water, and evaporating the liquid. The salt, $Na_3SbS_4 \cdot 9H_2O$, crystallizes in large tetrahedra, which are easily soluble in water, and have a specific gravity 1·806. The anhydrous salt melts easily when heated, and in the hydrated condition on exposure to moist air becomes coated with a red film. It combines with sodium thiosulphate to form $Na_3SbS_4 \cdot Na_2S_2O_3 \cdot 20H_2O$.

SCHLÖZER, AUGUST LUDWIG VON (1735–1809), German historian, was born at Gaggstedt, in the county of Hohenlohe-Kirchberg, on July 5, 1735. Having studied theology and oriental languages at the universities of Wittenberg and Göttingen, he went in 1755 as a tutor to Stockholm, and afterwards to Uppsala; and while in Sweden he wrote in Swedish an *Essay on the General History of Trade and of Seafaring in the most Ancient Times* (1758). In 1759 he returned to Göttingen, where he began the study of medicine. From 1761 to 1767 he occupied academic posts in Russia; he then returned to Göttingen, retired from active work in 1805, and died on Sept. 9, 1809.

Schlözer's most important works were his *Allgemeine nordische Geschichte,* 2 vols. (Halle, 1772) and his translation of the Russian chronicler Nestor to the year 980, 5 vols. (Göttingen, 1802–1809).

See Zermelo, *August Ludwig Schlözer* (Berlin, 1875); Wesendonck, *Die Begründung der neuern deutschen Geschichtsschreibung durch Gatterer und Schlözer* (Leipzig, 1876) and F. Frensdorff in *Allgemeine deutsche Biog.* vol. xxxi.

SCHLÜSSELBURG, a town of Russia in the Leningrad Area, in 59° 56′ N., 31° 3′ E., on marshy ground at the point

where the Neva river issues from Lake Ladoga. It has railway and steamer communication with Leningrad and there is a chintz factory. Pop. (1926) 6,317. Opposite the exit of the Neva are two islands, on the larger of which is a fortress, erected after its capture by the army of Peter the Great in 1702. It received its name because Peter considered it the key (Schlüssel) to the sea. After the final defeat of the Swedes in his reign, it was converted into a prison for political offenders, many of whom died as a result of the unhealthy conditions and severe régime. The first prisoners were the wife and daughter of Peter I., the latter of whom died here. Among other famous prisoners were Marshal Dolgoruki, Biron, the Tsar Ivan VI., many of the Dekabrists, the anarchist Bakunin, the Polish patriot Lukassinsky, who spent 37 years in prison and died here, and Lenin's brother, who was hanged here in 1887. Founded by the Novgorodians in 1323, it changed hands many times during the wars between Russia and Sweden, and after its re-capture by the Swedes in 1661 was called Noteborg.

See: *Guide to the Soviet Union* (Moscow, 1925).

SCHMALKALDEN, a town in the Prussian province of Hesse-Nassau, situated on the south-western slope of the Thuringian forest, 30 m. S.W. of Erfurt, on the railway Wernshausen-Zella. Pop. (1925) 10,402. Schmalkalden, which was first mentioned in 874, came wholly into the possession of Hesse in 1583, having been a town since 1335. It has a Gothic parish church, a palace—Schloss Wilhelmsburg—and a Gothic town hall in which the Protestant League of Schmalkalden was concluded in 1531, and also the house in which the articles of Schmalkalden were drawn up in 1537 by Luther, Melanchthon and other reformers. Its industries are chiefly connected with ironwares, but beer, soap and toys are also manufactured.

SCHMIDT, KARL VON (1817–1875), Prussian cavalry general, was born at Schwedt on the Oder, on Jan. 12, 1817, and entered the army in 1834. At the outbreak of the Franco-German War he was still an obscure and perhaps a mistrusted officer, though his grasp of every detail of cavalry work was admitted. But in the cavalry fighting around Mars-la-Tour (Aug. 16), he temporarily led a brigade and was severely wounded. Succeeding to the temporary command of his division on the disablement of its leader, he did brilliant work in the campaign on the Loire, and even in the winter operations towards Le Mans, and earned a reputation second to none amongst the officers and men of his army. After the war he took a leading part in the reorganization of the Prussian cavalry, which in ten years raised its efficiency to a level unexcelled by any other cavalry then in existence. He died at Danzig on Aug. 25, 1875.

SCHMIDT, WILHELM (1868–), Austrian philologist and Roman Catholic priest, was born at Hörde, Westphalia. He held the chair of primitive language and culture in the University of Vienna and devoted himself to the isolation and classification of the Austric family of languages (*see* PHILOLOGY).

SCHNEEBERG, a town of Germany, in the republic of Saxony, in the Erzgebirge, 14 m. S.E. from Zwickau by rail. Pop. (1925) 9,200. It contains a Gothic parish church, dedicated to St. Wolfgang, with an altar-piece by Lucas Cranach the elder, and a school of lace-making. Machine-made lace, embroidery, corsets, shoes and colours are among the chief of its industrial products.

SCHNEIDEMÜHL (Polish *Piła*), the capital town of the Prussian province of Grenzmark on the Cüddow, 60 m. N. of Posen and 145 m. N.E. of Berlin on the main line to Königsberg, and at the junction of lines to Stargard and Thorn. Pop. (1925) 37,507. Schneidemühl has a trade in wood, grain and potatoes, and possesses iron foundries, a brewery and machine-shops, and manufactures cement, starch and bricks. It is the seat of the provincial law courts.

SCHNITZLER, ARTHUR (1862–), Austrian playwright and novelist, was born in Vienna on May 15, 1862. He took a medical degree, and practised for a time as a physician. In 1908 he won the Grillparzer prize. Schnitzler's first and one of his most characteristic pieces was his *Anatol* (1893, Eng. trans. Granville Barker, 1911), a series of dramatic sketches of the love-adventures of a rich young Viennese. Nearly all Schnitzler's gifts are revealed in this series: a limpid style, a strong but never exaggerated sense of humour, an inimitably light touch, and above all, a gift of characterization second to none. Schnitzler understood the charming and frivolous Vienna of his day like no other writer, and his plays and stories are faultless reproductions of that life, so delightful within its limitations. Other plays in the same style are *Liebelei* (1895, Eng. trans. 1914) and *Freiwild* (1896), each striking a more tragic note in the fate of the "sweet little girl" round whom Viennese romance centres, and *Reigen,* a series of dialogues describing Viennese amours in such detail that, although written in 1900, it could only be performed in 1920. The best of his early stories are *Sterben* (1895), describing the decline of a consumptive, and *Leutnant Gustl* (1901), a monologue portraying the kindly but stupid soul of the Austrian subaltern with such deadly accuracy as to involve the author in some unpleasantness. As Schnitzler grew older, he approached his themes with added fervor but less lightness of touch. His one long novel *Der Weg ins Freie* revealed his limitations; limitations still more marked in his long romantic play *Der Junge Medardus* (1920). He continued, however, to produce short stories and plays whose perfection of style and characterization never flagged. Notable are the stories *Die Griechische Tänzerin* (1904), *Casanovas Heimfahrt* (1918, Eng. trans. E. and C. Paul, *Casanova's Homecoming,* 1922) and *Fräulein Else* (1924, Eng. trans. 1925), and the play *Professor Bernhardi* (1913). In his later period, Schnitzler at times left Vienna to deal with such subjects as the life and adventures of Casanova; but he remained happiest in describing his Viennese. His verse, while polished and brilliant, gives less scope to his talents than his prose. His collected works (1918) do not contain many later writings. Among his more recent works are *Beatrice* (Eng. trans. 1926); *Buch der Sprüche und Bedecken* (1927); and *Daybreak* (Eng. trans. 1928).

See J. Kapp *Arthur Schnitzler* (1912), and R. Specht, *Arthur Schnitzler* (1922). (C. A. M.)

SCHNORR VON KAROLSFELD, JULIUS (1794–1872), German painter, was born on March 26, 1794, at Leipzig, where he received his earliest instruction from his father Johann Veit Schnorr (1764–1841), a draughtsman, engraver and painter. At 17 he entered the Academy of Vienna, from which Overbeck and others who rebelled against the old conventional style had been expelled about a year before. In 1818 he followed the founders of the new school of German pre-Raphaelites in the general pilgrimage to Rome. This school of religious and romantic art abjured modern styles and set itself to recover fresco painting and "monumental art." Together with Cornelius, Overbeck and Veit, Schnorr received a commission to decorate the entrance hall of the Villa Massimo with frescoes after Ariosto. His second period dates from 1825, when he left Rome, settled in Munich, entered the service of King Ludwig, and transplanted to Germany the art of wall-painting learnt in Italy.

Schnorr's third period is marked by his "Bible Pictures" or Scripture History in 180 designs. The artist was a Lutheran, and took a broad and unsectarian view which won for his Pictorial Bible ready currency throughout Christendom. It does not, however, bear comparison with Raphael's Bible. Biblical drawings and cartoons for frescoes formed a natural prelude to designs for church windows. Schnorr made designs, carried out in the royal factory, Munich, for windows in Glasgow cathedral and in St. Paul's cathedral, London. He died on May 24, 1872.

SCHOBER, JOHANN (1874–), Austrian politician, was born and educated in Upper Austria, entering the Imperial Austrian police service as a young man, and became the Austrian president of police in 1918, some months before the revolution. On the proclamation of the Austrian republic (Nov. 12, 1918), Schober immediately placed his force at the disposal of the new Government, and by this action and by his moderate conduct in general did much to ensure a peaceful and bloodless change of régime. At the same time, he succeeded in securing the safety of the ex-Imperial family, whose departure from Vienna he supervised. During the two years of social democratic Government which followed, Schober's force was reproached by extremists with being reactionary, quite unjustly, as he aimed at strict

impartiality. His administrative ability, and above all, his conspicuous honesty, gained him the confidence of all moderate opinion in Austria, and especially of the inter-allied missions and advisers.

Largely because he was known to enjoy this confidence it was expected that if he were chancellor, the Allied and Associate Powers would be willing to grant the large loan necessary to restore Austria's chaotic finances, and he was selected to form a non-party ministry in June 1921. He took the first step towards establishing friendly relations between Austria and her neighbours when he concluded the pact of Lana with Czechoslovakia on Dec. 16, 1921 (*see* AUSTRIA). This move aroused the hostility of the pan-Germans, who formed a part of the Government coalition, and resented any pact with Czechoslovakia as putting difficulties in the way of the ultimate *Anschluss* with Germany. They withdrew from the Government coalition. The Christian Socialists were not strong enough to govern alone against the opposition of the Social Democrats. On May 24, 1922 Schober resigned the chancellorship and returned to the post of president of police.

SCHOBERT, JOHANN (*c.* 1720–1767), German composer and harpsichord player, was brought up at Strasbourg but settled in Paris in 1760, where he held an appointment under the Prince de Conti. He was one of the most popular players of the harpsichord of his time, and is praised by Mozart and by Grimm. He left a large number of agreeable "sonatas" for harpsichord, with and without the accompaniment of other instruments; also six "sinfonies" for clarinet and two horns. These were published and much played in London as well as in Paris. A selection is included in vol. xxxix., of *Denkmäler deutscher Tonkunst* (1909).

See also the article *Jean Schobert* by Georges de Saint-Foix in the *Revue musicale* of Aug. 1922.

SCHOFIELD, JOHN MCALLISTER (1831–1906), American soldier, was born at Gerry, Chautauqua county (N.Y.), on Sept. 29, 1831. He graduated at West Point in 1853, served for two years in the artillery, and was an assistant professor of philosophy at West Point in 1855–60. When the Civil War broke out he became a major in a Missouri volunteer regiment and served as chief of staff to Maj.-Gen. Nathaniel Lyon until the death of that officer. In 1864, as commander of the Army of the Ohio, he took part in the Atlanta campaign under Maj.-Gen. W. T. Sherman. In Oct. 1864 he was sent to Tennessee to join Maj.-Gen. G. H. Thomas in opposing Gen. J. B. Hood, and on Nov. 30 he fought with Gen. Hood the desperate indecisive battle of Franklin He was awarded the rank of brigadier-general (Nov. 1864) and the brevet rank of major-general (March, 1865) in the regular army. He co-operated with Sherman in North Carolina in the spring of 1865 with great skill and distinction.

After the war he was sent on a special diplomatic mission to France, on account of the presence of French troops in Mexico. From June 1868 to March 1869 he served as secretary of war under President Andrew Johnson, after the retirement of E. M. Stanton (*q.v.*). From 1876 to 1881 he was superintendent of the Military Academy at West Point, and from 1888 until his retirement in 1895 he was commanding general of the United States Army. He died at St. Augustine (Fla.) on March 4, 1906. Gen. Schofield published *Forty-Six years in the Army* (1897).

SCHOLASTICISM, the name usually employed to denote the most typical products of mediaeval thought, and commonly employed with differing shades of meaning down to modern times when its application has become fixed in accordance with the latest views of modern philosophy. These views are so far-reaching and complicated that the present article will be confined to an historical sketch of Scholasticism merely, and the reader is referred to the bibliography for details of modern publications on the subject.

After the centuries of intellectual darkness which followed upon the closing of the philosophical schools in Athens (529), and the death of Boetius, the last of the ancient philosophers, the first symptoms of renewed intellectual activity appear contemporaneously with the consolidation of the empire of the West in the hands of Charlemagne. He endeavoured to attract to his court the best scholars of Britain and Ireland, and by imperial decree (787) commanded the establishment of schools in connection with every abbey in his realms. Peter of Pisa and Alcuin of York were his advisers, and under their care the opposition long supposed to exist between godliness and secular learning speedily disappeared. Besides the celebrated school of the Palace, where Alcuin had among his hearers the members of the imperial family and the dignitaries of the empire as well as talented youths of humbler origin, we hear of the episcopal schools of Lyons, Orleans and St. Denis, the cloister schools of St. Martin of Tours, of Fulda, Corbie, Fontenelle and many others, besides the older monasteries of St. Gall and Reichenau. These schools became the centres of mediaeval learning and speculation, and from them the name Scholasticism is derived (*cf.* Sandys, *Hist. of Class. Schol.*, i. 471, 1906). They were designed to communicate instruction in the seven liberal arts which constituted the educational curriculum of the middle ages. (*See* TRIVIUM.) The name *doctor scholasticus* was applied originally to any teacher in such an ecclesiastical gymnasium, but gradually the study of dialectic or logic overshadowed the more elementary disciplines, and the general acceptation of "doctor" came to be one who occupied himself with the teaching of logic. The philosophy of the later Scholastics is more extended in its scope; but to the end of the mediaeval period philosophy centres in the discussion of the same logical problems which began to agitate the teachers of the 9th and 10th centuries.

Chronological Limits.—Scholasticism in the widest sense thus extends from the 9th to the end of the 14th or the beginning of the 15th century—from Erigena to Occam and his followers. The belated Scholastics who lingered beyond the last mentioned date served only as marks for the obloquy heaped upon the schools by the men of the new time. Erigena is really of the spiritual kindred of the Neoplatonists and Christian mystics rather than of the typical Scholastic doctors, and, in fact, the activity of Scholasticism is mainly confined within the limits of the 11th and the 14th centuries. It is divisible into two well-marked periods—the first extending to the end of the 12th century and embracing as its chief names Roscellinus, Anselm, William of Champeaux and Abélard, while the second extended from the beginning of the 13th century to the Renaissance and the general distraction of men's thoughts from the problems and methods of Scholasticism. In this second period the names of Albertus Magnus, Thomas Aquinas and Duns Scotus (*q.v.*) represent (in the 13th century and the first years of the 14th century) the culmination of Scholastic thought and its consolidation into system.

Prantl says that there is no such thing as philosophy in the middle ages; there are only logic and theology. The remark overlooks two facts—firstly that the main objects of theology and philosophy are identical, though the method of treatment is different, and secondly that logical discussion commonly leads up to metaphysical problems, and that this was pre-eminently the case with the logic of the Schoolmen. But the saying draws attention to the two great influences which shaped mediaeval thought—the tradition of ancient logic and the system of Christian theology. Scholasticism opens with a discussion of certain points in the Aristotelian logic; it speedily begins to apply its logical distinctions to the doctrines of the church; and when it attains its full stature in St. Thomas it has, with the exception of certain mysteries, rationalized or Aristotelianized the whole churchly system. Or we might say with equal truth that the philosophy of St. Thomas is Aristotle Christianized. The Schoolmen contemplate the universe of nature and man not with their own eyes but in the glass of Aristotelian formulae. Their chief works are in the shape of commentaries upon the writings of "the philosopher" (Aristotle). Their problems and solutions alike spring from the master's dicta—from the need of reconciling these with one another and with the conclusions of Christian theology.

Reason and Authority.—The fact that the channels of thought during the middle ages were determined in this way is usually expressed by saying that reason in the middle age is subject to authority. It has not the free play which characterizes its activity in Greece and in the philosophy of modern times. Its conclusions are predetermined, and the initiative of the individual

thinker is almost confined, therefore, to formal details in the treatment of his thesis. To the church, reason is the handmaid of faith (*ancilla fidei*). But this principle of the subordination of the reason wears a different aspect according to the century and writer referred to. In Scotus Erigena, at the beginning of the Scholastic era, there is no such subordination contemplated, because philosophy and theology in his work are in implicit unity. "Conficitur inde veram esse philosophiam veram religionem, conversimque veram religionem esse veram philosophiam" (*De divina praedestinatione*, Proem). Reason in its own strength and with its own instruments evolves a system of the universe which coincides, according to Erigena, with the teaching of Scripture. For Erigena, therefore, the speculative reason is the supreme arbiter; and in accordance with its results the utterances of Scripture and of the church have not infrequently to be subjected to an allegorical or mystical interpretation. But this is only to say again that Erigena is more of a Neoplatonist than a Scholastic. Hence Cousin suggested in respect of this point a threefold chronological division—at the outset the absolute subordination of philosophy to theology, then the period of their alliance, and finally the beginning of their separation. In other words, we note philosophy gradually extending its claims. Dialectic is, to begin with, a merely secular art, and only by degrees are its terms and distinctions applied to the subject-matter of theology. The early results of the application, in the hands of Berengarius and Roscellinus, did not seem favourable to Christian orthodoxy. Hence the strength with which a champion of the faith like Anselm insists on the subordination of reason. To Bernard of Clairvaux and many other churchmen the application of dialectic to the things of faith appears as dangerous as it is impious. Later, in the systems of the great Schoolmen, the rights of reason are fully established and acknowledged. The relation of reason and faith remains external, and certain doctrines—an increasing number as time goes on—are withdrawn from the sphere of reason. But with these exceptions the two march side by side; they establish by different means the same results. For the conflicts which accompanied the first intrusion of philosophy into the theological domain more profound and cautious thinkers with a far ampler apparatus of knowledge had substituted a harmony. "The constant effort of Scholasticism to be at once philosophy and theology" seemed at last satisfactorily realized. But the further progress of Scholastic thought consisted in a withdrawal of doctrine after doctrine from the possibility of rational proof and their relegation to the sphere of faith. Indeed, no sooner was the harmony apparently established by Aquinas than Duns Scotus began this negative criticism, which is carried much farther by William of Occam. But this is equivalent to a confession that Scholasticism had failed in its task, which was to rationalize the doctrines of the church. The Aristotelian form refused to fit a matter for which it was never intended; the matter of Christian theology refused to be forced into an alien form. The end of the period was thus brought about by the internal decay of its method and principles quite as much as by the variety of external causes which contributed to transfer men's interests to other subjects.

Bibliography.—Besides the numerous works quoted in articles on the individual philosophers, *see* Hauréau, *Histoire de la philosophie scolastique* (2 vols., 1850; revised and expanded in 1870 as *Histoire de la phil. scol.*), Kaulich, *Geschichte d. schol. Philosophie* (1863); Stöckl, *Gesch. der Phil. des Mittelalters* (3 vols., 1864–66); Karl Werner, *Die Scholastik des späteren Mittelalters* (4 vols., 1881–87); and, on a smaller scale, de Wulf's *Histoire de la phil. médiévale* (1900; 5th ed., 1924–25). Supplementary details are given in Hauréau's *Singularités historiques et littéraires* (1861) and in R. L. Poole's *Illustrations of the History of Mediaeval Thought* (1884), while much light is thrown upon the minuter history of the period by the *Chartularium Universitatis Parisiensis* edited by Denifle and Chatelain in 1894, by Hauréau's *Notices et extraits de quelques MS. latins de la Bibliothèque Nationale* (6 vols., 1890–1895) and by the *Beiträge zur Geschichte d. Phil. d. Mittelalters*. The accounts of mediaeval thought by Ritter, Erdmann, Ueberweg and Windelband are very good. There are also notices of the leading systems in Milman's *History of Latin Christianity* (6 vols., 1854–55). The psychology of the Scholastic writers is ably dealt with in Siebeck's *Die Psychologie von Aristoteles bis zu Thomas von Aquino* (1885). Jourdain's *Recherches critiques sur l'âge et l'origine des traductions latines d'Aristote* (1819; 2nd ed. 1843); Rousselot's *Études sur la philosophie dans le moyen âge* (1840–1842), Cousin's Introduction to his *Ouvrages inédits d'Abélard* (1836), and Prantl's *Geschichte der Logik im Abendlande* (4 vols., 1855–1870) are invaluable aids in studying the history of mediaeval thought. For modern views *see* C. Baeumker, *Abhandlungen zur Geschichte der Philosophie des Mittelalters* (1923); G. Ritter, *Studien zur Spätscholastik* (1921, etc.); A. C. A. Schneider, *Die Erkenntnislehre bei Beginn der Scholastik* (1921); H. O. Taylor, *The Mediaeval Mind*, 2 vols. (1925); O. Wichmann, *Die Scholastiker* (1921); N. de Wulf, *Histoire de la philosophie médiévale* (1924, etc.).

SCHOLIUM (to be distinguished from *Scolium*, an after-dinner song), the name given to grammatical, critical and explanatory notes, extracted from existing commentaries and inserted on the margin of the m.s. of an ancient author. These notes were altered by successive copyists and owners of the m.s. and in some cases increased to such an extent that there was no longer room for them in the margin, and it became necessary to make them into a separate work. The name of "the first scholiast" has been given to Didymus of Alexandria (*q.v.*), and the practice of compiling scholia continued till the 15th or 16th century A.D. The word σχόλιον itself is first met with in Cicero (*Ad Att.* xvi. 7). The Greek scholia we possess are for the most part anonymous, the commentaries of Eustathius on Homer and Tzetzes on Lycophron being exceptions. Although frequently trifling, they contain much information not found elsewhere, and are of use for the correction and interpretation of the text. The most important are those on Homer (especially the Venetian scholia on the *Iliad*, discovered by Villoison in 1781 in the library of St. Mark), Hesiod, Pindar, Sophocles, Aristophanes and Apollonius Rhodius; and, in Latin, those of Servius on Virgil, of Acro and Porphyrio on Horace, and of Donatus on Terence.

SCHOMBERG, FRIEDRICH HERMANN (or Frederic Armand), Duke of (*c.* 1615–1690), marshal of France and English general, was born in Dec. 1615 or Jan. 1616, at Heidelberg, the son of Hans Meinard von Schönberg (1582–1616) and Anne Sutton, daughter of the 9th Lord Dudley. He was educated by various friends, among whom was the "Winter King," Frederick V. of the Palatinate, in whose service his father had been. He began his military career under Frederick Henry, prince of Orange, and passed about 1634 into the Swedish service, whence he entered that of France in 1635. After a time he retired to his family estate at Geisenheim on the Rhine, but in 1639 he re-entered the Dutch army, in which he remained until about 1650. He then rejoined the French army as a general officer (*maréchal de camp*), served under Turenne in the campaigns against Condé, and became a lieutenant-general in 1665.

After the peace of the Pyrenees (1659) the independence of Portugal being again menaced by Spain, Schomberg was sent as military adviser to Lisbon with the secret approval of Charles II. of England and Louis XIV., who in order not to infringe the treaty just made with Spain, deprived Schomberg of his French offices. Schomberg won the victory of Montes Claros on June 17, 1665 over the Spaniards under the prince of Parma. He helped to depose the reigning king in favour of his brother Dom Pedro, and then returned to France, became a naturalized Frenchman and bought the lordship of Coubert near Paris. In 1673 he was invited by Charles to England to command the army, but sentiment was so strong against the appointment, as savouring of French influence, that it was not carried into effect. He again entered the service of France. His first operations in Catalonia were unsuccessful owing to the disobedience of subordinates and the rawness of his troops, but he retrieved the failure of 1674 by retaking Bellegarde in 1675. For this he was made a marshal, being included in the promotion that followed the death of Turenne.

The tide had now set against the Huguenots, and Schomberg's merits had been long ignored on account of his Protestantism. The revocation of the edict of Nantes (1685) compelled him to quit France, and he became general-in-chief of the forces of the elector of Brandenburg; at Berlin he was the acknowledged leader of the Huguenot refugees.

Soon afterwards, with the elector's consent, he joined the prince of Orange on his expedition to England in 1688, as second in

command to the prince. The following year he was made a knight of the Garter, was created successively baron, marquis and duke, was appointed master-general of the ordnance, and received compensation for the loss of his French estates, of which Louis had deprived him. In August he commanded the expedition to Ireland against James II. After capturing Carrickfergus he marched unopposed through a country desolated before him to Dundalk, but decided not to risk a battle with his undisciplined troops, and entrenching himself at Dundalk declined to be drawn beyond the circle of his defences. Shortly afterwards pestilence broke out, and when he retired to winter quarters in Ulster his forces were severely shattered. His conduct was criticized in ill-informed quarters, but the facts justified his inactivity. In the spring he began the campaign with the capture of Charlemont, but no advance southward was made until the arrival of William. At the Boyne (July 1, 1690) Schomberg gave his opinion against the determination of William to cross the river in face of the opposing army. In the battle he commanded the centre, and while riding through the river without his cuirass to rally his men, was surrounded by Irish horsemen and instantly killed. He was buried in St. Patrick's cathedral, Dublin.

His eldest son Charles, the second duke in the English peerage, died in 1693 of wounds received at the battle of Marsaglia.

The most important work on Schomberg's life and career is Kazner's *Leben Friedrichs von Schomberg oder Schönberg* (Mannheim, 1789). The military histories and memoirs of the time should also be consulted.

SCHOMBURGK, SIR ROBERT HERMANN (1804–1865), British traveller, was born at Freiburg, Prussian Saxony, on June 5, 1804, the son of a Protestant minister. In 1829 he went to the United States and in 1830 to Anegada, one of the Virgin Isles. He surveyed the island at his own expense. In 1835 he was entrusted by the Royal Geographical Society with the conduct of an exploring expedition to British Guiana, in the course of which he discovered the Victoria Regia lily. In 1841 he returned to Guiana to survey the colony and fix the boundary, which was known as the "Schomburgk Line." (*See* British Guiana and Venezuela.) On his return to England he was knighted. In 1848 he was appointed British consul to St. Domingo, and, in 1857, British consul to Bangkok, meanwhile continuing his geographical surveys. He retired from the public service in 1864, and died at Berlin on March 11, 1865. He wrote *Description of British Guiana* and a *History of Barbados.*

SCHÖNBEIN, CHRISTIAN FRIEDRICH (1799–1868), German chemist, was born at Metzingen, Swabia, on Oct. 18, 1799, and died at Sauersberg, near Baden Baden, on Aug. 29, 1868. After studying at Tübingen and Erlangen, he taught chemistry and physics, first at Keilhau, Thuringia, and then at Epsom, England, but most of his life was spent at Basel, where he began to lecture on chemistry and physics in 1828 and was appointed full professor in 1835. His name is chiefly known in connection with ozone (*q.v.*), which he discovered in 1840, and with guncotton (*see* Explosives), which he prepared and applied as a propellant in fire-arms early in 1846. He also worked on the passivity of iron, the properties of hydrogen peroxide and catalysis. He was a most prolific writer, 364 papers appearing under his name in the Royal Society's *Catalogue.*

Many of his letters together with a life will be found in G. W. A. Kahlbaum's *Monographien aus der Geschichte der Chemie,* vols. iv. and vi. (1899 and 1901).

SCHÖNBERG, ARNOLD (1874–), Austrian composer, was born in Vienna on Sept. 13, 1874. He began to study violin and 'cello at an early age and to compose chamber music. In musical theory he was practically self-taught. His earlier works include songs, the string sextet, *Verklärte Nacht* op. 4 (revised later for string orchestra with six soloists), the symphonic poem, *Pelléas et Mélisande,* and the *Gurrelieder,* a ballad cycle for chorus and full orchestra (first produced in Vienna 1912–3), written under the influence of the Wagner tradition. Schönberg then came into touch with Kokoschka and other leaders of the new movement in art and literature, and entered upon an experimental period in which he put romanticism behind him and went back to Bach and the earlier polyphonic writers for inspiration. With the 2nd chamber symphony and particularly the 2nd string quartet (1908), into the last two movements of which he introduces a soprano part to words by Stephan George, he definitely breaks away from tradition; and with the piano pieces op. 11 his mature period may be said to begin, although he continues to strike out new paths with each successive work. In 1911 he went to live in Berlin and in the same year produced his *Harmonielehre* (*see* Harmony), a revised edition of which was published in 1922.

An eventful performance was that of *Pierrot Lunaire* in Berlin the following year with Albertine Zehme in the spoken part. This cycle of twenty-one ("three times seven") poems for recitation with piano, flute, clarinet, violin, and violoncello in constantly changing combinations, is, after the *Gurrelieder,* his best known work. In 1918, having returned to Vienna, Schönberg founded there a society for private musical performances. A revival of *Die glückliche Hand* op. 18 at Breslau in 1928 aroused much interest. This dramatic piece, which is in effect a monodrama, with dumb secondary characters and a chorus, is in spite of its early date perhaps the most daring of Schönberg's experiments and that in which his psychology finds its clearest expression. He both wrote the libretto and ordered every detail of the staging. Essentially a pioneer, he has never made concessions to the ordinary listener, but the tenseness and extreme compression of this work make quite unprecedented demands on the concentrative powers of his audiences. In all his later writing the combination of a tersely dramatic and fragmentary style with complete atonality leaves an impression of complication and strain: he is nevertheless sincerely striving towards simplicity and compactness, and his reversion to a smaller or chamber orchestra has led to a general adoption of this medium by younger composers. He has also adopted a simplified method of scoring, in which duplication of parts is avoided and the whole is compressed on to a few staves.

Other important works are: 6 songs with orchestra op. 8 (1911); chamber symphony for 15 solo instr. op. 9 (1912); *Melodramen* op. 21; serenade for clarinet, bass clarinet, mandoline, guitar, three strings and (low) male voice op. 24 (1924); pianoforte suite op. 25; quintet for wind instr. op. 26. *See* E. Wellesz, *Arnold Schönberg* (1924); Paul Bekker, *Kritische Zeitbilder* (1921).

SCHÖNEBECK, a town of Germany, in the province of Prussian Saxony, on the left bank of the Elbe, 9 m. S. of Magdeburg by the railway to Halle and Leipzig. Pop. (1925) 21,409. It contains manufactories of chemicals, machinery, bicycles, rubber, explosives and various other articles, but is chiefly noted for its extensive salt works. There is a harbour on the Elbe here, and a brisk trade is carried on in coal, grain and timber.

SCHÖNEBERG, a suburb of Berlin, Germany, which it adjoins on the south-west. Pop. (1925) 239,042. The foundation of Alt-Schöneberg is ascribed to Albert the Bear, margrave of Brandenburg, in the 12th century, while Neu-Schöneberg was founded by Frederick the Great in 1750 to accommodate some Bohemian weavers exiled for their religion. Its chief manufactures are railway material, cigars, soap, paper and chemicals.

SCHONGAUER (or Shön), **MARTIN** (*c.* 1445–1491), engraver and painter of the early German school. His father was a goldsmith named Caspar, a native of Augsburg, who had settled at Colmar, where the chief part of Martin's life was spent. Schongauer established at Colmar a very important school of engraving, out of which grew the "little masters" of the succeeding generation, and a large group of Nuremberg artists. As a painter, Schongauer was a follower of the Flemish Roger van der Weyden, and his painting closely resembles both in splendour of colour and exquisite minuteness of execution, the best works of contemporary art in Flanders. The only picture which can with certainty be attributed to him, is a magnificent altar-piece in the church of St. Martin at Colmar, dated 1473, representing the Virgin and Child before a hedge of roses. Schongauer was the first painter who was also an engraver, and his work contributed much to the development of engraving. He produced a large number of beautiful engravings, which were largely sold, not only in Germany, but also in Italy, England, France and Spain. His subjects are always religious; 113 prints from copper by his hand

are known; they are signed with his monogram M+S. Among the most beautiful of Schongauer's engravings are the series of the "Passion" and the "Death and Coronation of the Virgin," and the series of the "Wise and Foolish Virgins." All are remarkable for their treatment of line, their brilliant touch, and their chromatic force. Some, such as the "Death of the Virgin" and the "Adoration of the Magi" are richly-filled compositions of many figures, treated with much largeness of style in spite of their minute scale. He died in Breisach in 1491.

The British Museum possesses a fine collection of Schongauer's prints. Fine facsimiles of his engravings have been produced by Armand-Durand with text by Duplessis (Paris, 1881).

See A. V. Bartsch, *Peintre Graveur* (1803–21); A. Waltz, *Bibliographie* (Colmar, 1903); Seidlitz, *Repertorium* VII. (1884); Wendland, *Martin Schongauer als Kupferstecher* (1907); Arthur M. Hind, *History of Engraving and Etching* (1923).

SCHÖNHERR, KARL (1867–), Austrian dramatist, was born at Axams, Tyrol, Feb. 24, 1867. He first wrote dialect poems of an unassuming nature and short stories, but in 1897 he turned his attention to drama and the stage with the *Judas von Tirol,* which he remodelled in 1927. Schönherr stood midway between realism and symbolism and expressed himself in a vigorous and original style. His accomplished technique, applied frequently to peasant or medical life, enabled him to evolve successful dramas with a very limited number of characters. In his pieces, quite elementary and simple emotions and the problems and crises arising out of them are presented with inexorable consistency. His most famous drama, *Glaube und Heimat* (1910), dealing with the time of the Counter-Reformation, and also *Der Weibsteufel* (1915) have aroused religious controversy. Schönherr's other important works include *Die Bildschnitzer* (1900); *Erde* (1908); *Volk in Not* (1915); *Frau Suitner* (1916); *Vivat academia* (1922); *Es* (1923); *Hungerblockade* (1925). Most of his dramas were first produced in the Burgtheater and in the Deutsches Volkstheater in Vienna. His tales and sketches, *Caritas* and *Aus meinem Merkbuch,* express much the same trend of thought and motif as his dramas. He won the Schiller Prize in 1908 and the Grillparzer Prize in 1911, 1917, and 1920. His *Gesammelte Werke* began to appear in 1927. *See* monographs by Sedlmaier (1920), Lederer (1925), and Bettelheim (1927).

SCHOOL ADMINISTRATION IN THE UNITED STATES differs from that in most other nations in that it is less centralized. While it is common to speak of the American public school system, legally at least there is no such organization. Education in the United States, in all its branches, and from kindergarten to university, has been left by the Federal Constitution to the different States to provide and manage as they see fit. There is no national legislation relating to the subject, aside from that concerning the Federal aid granted to the States for certain specific purposes. One finds in the city of Washington a U.S. commissioner of education, appointed by the President and confirmed by the Senate, who has a small office force, collects statistics as to the progress of education in the States and in other lands, answers inquiries and offers advice when asked to do so, but in reality an officer without power, even within the Federal district. Each State is responsible for the maintenance of a State system of public instruction. Still more, due to the large liberty in matters of instruction and control allowed counties, cities, towns and districts within the different States, there are wide variations in the schools maintained by the different local governing school boards. School administration then divides itself into three main headings—State, county and city.

State School Administration.—Throughout all the history of the relations of the Federal Government to the States, in the matter of public education, Congress, since the beginning of the nation under the Federal Constitution, in 1789, has dealt entirely with the governments of the States. Each of the States has in turn developed a State school system, and in time has built up a body of legislative enactments relating to education known as the State School Law, or the State School Code. Dealing at first with only the essential outlines of a school system, and elementary rather than secondary education, the school law for each of the States has, since the '90s, experienced a marked development and expansion. As a result one finds to-day, for each of the States, a large and important body of laws—naturally more detailed in some States than in others—relating to the organization, administration, supervision and financing of a complete system of public instruction for the State.

The management of the schools of any city or school district within a State may be placed by law in the hands of locally-elected school officers, and much liberty of action may be granted to these local officials by the State school code, but the schools nevertheless exist to carry out a State purpose, as expressed in the State Constitution and the State school law. The local governing authorities act as agents for the State and can do only those things which the school law permits. Throughout all the educational history of America it has been the State that has ordered that children shall be educated, advantages extended, standards raised and taxation for education increased.

As the chief representative of each State school system one finds an appointed or in a few cases an elected State board of education, and an elected or an appointed State superintendent of public instruction or State commissioner of education. The plan followed in approximately one-fourth of the States is the appointment of a lay State board of education of from seven to nine members, for relatively long terms, to act as a legislative control and policy-determining body for the school system of the State, and for this board then to select and appoint a State commissioner of education to act as its chief executive officer.

The State board of education in the best organized States acts in the name of the State as a board for general control of the State school system in its larger aspects, and for the enforcement of the provisions of the State school law. It selects, on the recommendation of its chief executive officer, educational experts to exercise supervisory administrative control over the different divisions of the State school system—elementary schools, secondary schools, child welfare, vocational education, school buildings, etc.; exercises general oversight of the work in vocational education and vocational rehabilitation, maintained in part by Federal aid grants; often controls in large part the training and certification of teachers; determines the broad educational policies to be pursued by the State; and enacts rules and regulations for the government of its executive officers and, to a limited extent, the schools of the State as well. Such a board of control is primarily a legislative body, leaving the execution of policies and the carrying out of decisions arrived at to the executive officers it employs.

County and Local Administration.—The county is used more or less everywhere as a unit for school administration, except in the New England States. The town in New England and the analogous township in the North Central States also are used as units for school administrative control. The city as a unit is found everywhere, and the school district, in the sense of a small rural area under the control of an elected board of three local school trustees, is found by the thousands in approximately three-fourths of the States. Long experience has demonstrated the inefficiency and wastefulness of the little school district, and the tendency everywhere is to limit their powers and to abolish them for some larger unit of school control. Approximately one-fourth of the States have already made this transition, and have only county and city school districts beneath the State, while another fourth of the States have made important progress in this direction. The ultimate outcome of the process is that the State, for subordinate administrative control, becomes organized into only as many school districts as there are counties and cities in the State, with each county and each city under a separate representative board for school control. In a very few of the States the city has even been made a part of the county organization. For each county and each city the people then elect a small lay board of education, which in turn elects its own executive officer—county or city superintendent of schools—and exercises control over the schools in its jurisdiction as required by the State school law and the rules and regulations of the State board of education. The result of such a transformation, where effected, has been to abolish thousands of little independent school districts, and to

substitute in their stead from 25 to 100 county school districts, and an approximately equal number of city school districts. One classification then provides for the education of rural and village children, and the other for the education of the children who live in cities.

With the reorganization of all the district and village schools of a county into one county unit for educational administration, supervision and finance; the election by the people of one lay county board of education to select the educational experts and to determine the larger questions of policy and educational procedure for the schools of the county; and the reorganization and redirection of rural and village education so as to meet modern educational needs, with independent organization for the cities only because of their size and the diversity of their educational problems, an efficient State educational system is being evolved. The school affairs of any large commonwealth have grown into a large and very important business undertaking, costing the people millions of dollars each year, and the direction of this business is being placed under a form of administration dictated by the best American experience in educational and corporation control. The form of subordinate educational organization, then, which any State has evolved determines, to a large extent, the effectiveness of the educational system it maintains.

Major State Administrative Problems.—The present tendency is toward a centralization of administration, with a more or less clear demarcation between State and *locus* powers and duties in matters of school control. In such matters as statistical and financial returns State uniformity naturally is to be prescribed. In all such matters as minimum length of term, types of schools to be maintained, sanitary standards, maximum rates for taxation for school support, standards for the training and certification of teachers, minimum salary laws, compulsory attendance and child-labour laws, it is clearly the duty of the State to determine the minimum standards which shall be permitted. Still more, from time to time, as changing needs and conditions may seem to require, it is clearly the duty of the State to raise these minima. To do these things successfully involves a carefully thought out educational policy which looks to a series of progressive changes and the securing of results over a period of time.

In carrying out a constructive State educational policy a number of distinctively State educational problems call for careful consideration. These group themselves about the nature and extent of State oversight and control; the proper division of powers and functions, as between the State and its subordinate units; the provision of adequate professional supervision for all schools; the best subordinate unit or units for local administration; proper methods in taxation for education, and the apportionment of school funds; the scope of the educational system to be maintained; the large social and educational problems surrounding rural and village education; vocational training; part-time, extension, and adult education; the material equipment of schools; health and sanitary control; the training of teachers, both before and after beginning service; salary schedules, tenure and pensions; the protection of the child; and the relation of the State to non-State educational agencies.

City School Administration.—A wholly different set of educational problems relate to school organization and administration in the cities. These relate to the grading of schools, instruction of special classes, playgrounds and vacation schools, kindergartens and pre-school training, schools for delinquents, compulsory education, health work in the schools, vocational instruction and guidance, business organization, school plant, professional supervision and similar matters. Practically everywhere in cities the schools, while regarded as State schools in theory and under the provisions of the general State school law, are for control placed under the immediate oversight of a local school board, generally known as the board of education. Standard procedures have been established which are quite generally followed, namely: that the superintendent of city schools shall be the recognized executive officer of the board of education, responsible to it for the proper carrying on of the school business of the city; that the board shall legislate, and the superintendent and his staff shall execute; that the superintendent shall be in immediate charge of the educational department, but with supervisory oversight of all other department heads; and that the initiative in all such matters as the determination of the courses of study, the selection of text-books and teaching supplies, the nomination and placement of teachers, the supervision of the instruction, the progress of pupils in the schools, and the determination of records to be kept and reports to be made shall rest with the superintendent of schools.

A distinctive feature of city school systems, and one that has made them an interesting object of study to students of educational administration coming from other lands, is the wide diversity in educational facilities which they provide, with a resulting adaptability of the instruction to the needs of the many different classes in the population which attend. Unlike most European two-class school systems, the American public school has been compelled to organize its instruction about a one-track form of educational organization and provide an educational ladder nominally at least open to all. The adjustment to the needs of the different social and intellectual classes which attend has had to be made by providing a diversity of types of classes and instruction. This adaptability has been made possible only by reason of the unity of its administration and finance, and it could not have been provided except under a centralized large-scale form of educational organization.

In business administration and finance, the city school district has long enjoyed exceptional advantages. As a part of the State educational organization, the cities share in any apportionment of State school funds and taxes made. In the rate of taxation which must be levied locally or degree of support which must be provided, the State has set the limits rather than the local city governing authorities. In addition, due to the concentration of wealth which the city usually represents, and with local school levies made on the city school district as a whole by one administrative board, a pooling of costs is made possible which results in the provision of uniform educational advantages for all without undue burden to any portion of the whole.

In practice, city boards of education determine their own expenditures, within limits set by the State school law, in approximately three-fourths of the cities of the United States, and in the remaining cities they formulate their budget but are dependent on the city council for allotment of the amount they may have to spend, after the State minimum requirements have been met. In the United States as a whole, approximately 20% of all money expended comes from State sources, approximately 15% from county sources and the remaining 65% is levied locally, though with wide variations in these proportions in the different States. Approximately 25% of the total taxes levied for all purposes in cities is devoted to the maintenance of schools, with extremes as low as 10% and as high as 40%. For school administration in other countries *see* EDUCATION.

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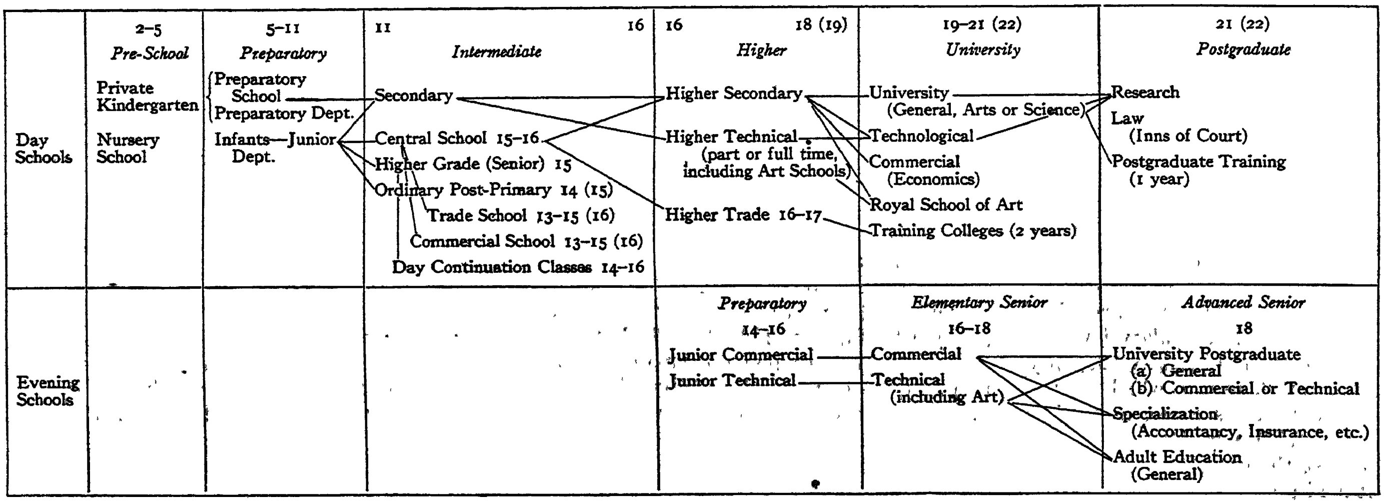
(E. P. Cu.)

SCHOOL AND CURRICULUM. A curriculum is a course of study laid down for the students of a university or school, or, in a wider sense, for schools of a certain standard, *e.g.*, secondary, elementary, etc. (Lat. *curriculum,* a course).

GREAT BRITAIN

Secondary School.—The beginnings of the present curriculum in English secondary schools are to be sought in that of the "Public Schools" which during the 18th and the early part of the 19th century was practically confined to Latin and Greek, even the grammar of both languages being taught through the medium of action. Classics in fact were held to provide the complete outfit for the education of the scholar and gentleman that it was the ideal of the school to produce. The girls' schools (*see* WOMEN, EDUCATION OF) as they grew and multiplied helped by their example to accelerate the introduction of more modern subjects. But each subject, whether science, history or the like, had so to

say, to fight its way in the curriculum as something that was *per se* desirable from the standpoint of general education. The rapid growth of the municipal and county secondary schools after 1902 gave a further impetus to the modern side of education already recognized in the public schools. None the less the idea of a scientific curriculum as a whole composed of carefully selected ingredients with a clear objective in view in place of a conglomeration of supposed indispensable subjects has been very slow in making its way in Great Britain. Almost equally tardy has been the recognition of the vital principle that the curriculum exists for the average pupil and not the average pupil for the curriculum, with its corollary that the inclusion of this or that subject is not to be decided by its supposed intrinsic value alone, but either by the duration of the educational life of the pupil or by the nature of his future vocation. Every complete type of education should have a sound basis of general culture with some degree of specialization at the top. How far this is being realized in England may be seen from the table given below:



Elementary Schools.—During the 19th century up to 1870 and even later, reading, writing and arithmetic, and cooking and needlework for girls were considered to be the end all and be all of elementary education. Later, science found its way into the higher departments not so much on its merits as from the financial advantages it offered to the school Boards of earning additional grants from the Science and Art department. Other subjects like history and geography being less remunerative came in much more slowly. The abolition of payment by results conferred a welcome elasticity on the curriculum, possibly in some cases an excessive one. But the introduction of definite curricula for the central schools has effected a steadying influence and with the gradual putting into effect of the Hadow report (*see* ELEMENTARY EDUCATION) involving a definite break in the education of boys at the age of 11, the growing ideal of education being for livelihood as well as life is bound to be reinforced, while any undue diffusion of effort that may have existed in the past by the attempt to embrace too many subjects is likely to disappear. At the same time the hitherto slow differentiation of the curriculum to suit different localities and their needs (*see* EDUCATION AND INDUSTRY) will receive a much needed momentum. This is especially a matter of great importance in rural districts (*see* RURAL EDUCATION), where the curriculum until recently has been moulded much too closely on that of the town schools. For a forecast of the future development of a differentiation of the curriculum on still broader lines (*see* B. Branford's *Janus and Vesta*, chap. x.), which deals among other things with the still excessive subdivision of the curriculum into subjects and their regrouping in larger units.

Broadly speaking, the teaching in all subjects during the last 30 years both in secondary and elementary schools has undergone a change at once vast and beneficial. Originally it was predominantly *intensive*, the idea being to study a little, but to study it well (*non multa sed multum*), a premium being placed on the cultivation of the memory. To-day it has become largely *extensive*, the aim being rather to cover as much ground as possible and cultivate the reason and imagination of the pupil. Possibly in some subjects the insufficient stress laid on the acquisition of technique has gone too far. Recent psychological research in America has been re-establishing the claims of habit-forming and memory. Already one may note in some subjects the harking back to some extent to older methods whether it be the memorizing of dates (history), or of place names (geography), or of grammatical forms (modern languages) or of accuracy and the mastery of numerical manipulations (arithmetic). In any case to English teachers whose teaching has also been based on experimenting by trial and error, the necessary adjustments should not prove difficult. (*See* EDUCATION.) (C. BR.)

The Mother-tongue.—There is nothing so paradoxical in the history of education in England as the insignificant part that till recently the teaching of the mother-tongue has occupied in the schools. There has been a remarkable conspiracy of circumstances to prevent it from taking its right place. The Norman conquest drove English for a considerable time underground.

But the mother-tongue had another more powerful rival. During the middle ages Latin was the international language, used by the theologian, the diplomatist, and the scholar. It was, however, Latin in a debased form, despised by the humanists of the Renaissance. They had noble ideals of culture and education based upon the recovered classical masterpieces, but the only pathway to these was through the grammars of the ancient tongues, especially Latin. A few voices like those of Mulcaster and Locke were raised on behalf of English in the schools.

But, in the main, the classical system in the degenerate form of "grammatic flats and shallows," kept its hold throughout the 18th and 19th centuries. This had important and besides, for the most part, unfortunate consequences for popular education in England, which began its systematic development after the Reform Bill (1832). It was inevitable that in any form of State-controlled education for the mass of the population, English should be the basis. But the statesmen and officials who organized the system, and who drew up the curricula of the training colleges for teachers had been, as a rule, educated on the prevalent and narrow type of humanism which substituted linguistic for literary study. They therefore encouraged the teaching of English in the elementary schools on the same formal lines as Greek and Latin were being taught in the higher stages. Thus English in the elementary school meant little more than grammar, and this, in its turn, meant chiefly analysis and parsing. Literature had scarcely any place in the curriculum.

From the opening of the present century a number of circumstances have combined to produce what may be called a new renaissance of English in the schools. The acts of 1902 and 1903 brought for the first time the different stages of English education into close relation. Among other results was the establishment of an extensive system of junior county scholarships which enabled a number of children from elementary schools to pass

annually to secondary schools. It was found that these scholars, coming from homes without a cultural background, needed above all some literary training through the mother-tongue. This led to reconsideration of the scope of English both in the secondary and elementary schools and the methods of teaching it. Important suggestions were made in the report of a conference on the teaching of English in London elementary schools (1909). Among the points on which stress was laid were the importance of oral work and the necessity for the ample provision of reading-books of good literary quality. As a result of the conference a circulating scheme was arranged by which 40,000 sets of books passed from one London elementary school to another. Oral work, with all that it involves—enunciation, pronunciation and expression—was dealt with more fully in the report of another London County Council conference on speech-training (1916). The emphasis on English as a *spoken* language is one of the chief notes of progress, to which the study of phonetics has contributed.

In the secondary schools, the growth of higher education for women has been favourable to the teaching of English. In girls' schools the mother-tongue had not to fight for its place against a traditional classical supremacy and advance was easier. For the majority of girls a liberal culture had to be chiefly based on modern, especially English, literature, and women began to specialize as teachers of the subject. But with the growth of "advanced courses" in modern studies, and other post-matriculation work in English, the necessity of specialists and of libraries for the use of themselves and their pupils became evident in both boys' and girls' schools.

Much stimulus to English work, especially in secondary education, has been given since 1907 by the English Association. Many of its pamphlets deal with aspects of English in the secondary school curriculum, and its conferences give opportunities for discussion.

It was partly due to a suggestion from this Association that Mr. Herbert Fisher, when president of the Board of Education, appointed in May, 1919, a departmental committee to report on the teaching of English in England. The committee, of which Sir Henry Newbolt was chairman, issued in 1921 a comprehensive report dealing with the teaching of English in all its stages from the elementary school to the university. It emphasized its position as the only possible basis for the humanistic training of the nation as a whole. The report was a survey and a statement of principles, and not a handbook of methods. But it has already had important practical results. The course in English for training college students has been remodelled; a London university diploma in dramatic art has recognized the part now played in the schools by dramatic work; and the number of scholarships and fellowships in English at the universities, though still inadequate, has increased. Without such support and recognition English cannot maintain its due academic position; and it is to the universities, with which the training colleges are being more closely associated, that the schools must look for a constant supply of fully qualified teachers of English, to consolidate the position that it has taken so long to win.

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(F. S. B.)

HISTORY

For many years the neglect of History teaching in British schools contrasted strangely with the practice of almost every other civilized country. In 1868, Matthew Arnold had (in a Training College Report) pleaded for "broad views over the history of our race . . . and its connection which universal history gives."

It was not till 1900 that the elementary code made history an obligatory subject. Every school in the country has now added history to its curriculum. The Board of Education's *Suggestions for Teachers* (1905–27) show how the attitude towards school history has been revolutionized. From being treated almost exclusively as a bare political outline, often read aloud by the class from dull unscholarly "readers" giving odd bits of dry information, it has been extended till it includes all aspects of history: for example—social, economic, civic; local and imperial; the great names and discoveries of science (the steam engine "as a symbol of one of the greatest changes in history"); and, especially since the World War, European and universal (including Ancient and Biblical) history.

Methods have been no less transformed. There is more study of books—of less narrowly-conceived text and other books—and closer contact with literature. The increasing use of "sources," of time-charts, of historical atlases and maps, involving co-ordination with geography; visits to museums and monuments; the use of illustrations (pictures, portraits, cartoons, models, facsimiles of historic documents) and of the rich treasures of the British Museum—all have gone to improve the technique of history teaching in every type of schools.

It was not till the organization of secondary schools by the State that history became established as an essential part of their curriculum. The Education Act of 1902, the Board of Education's Circular 599 (1908), the institution of approved examinations and the organization of advanced courses (1917) for secondary schools, mark an epoch. Concurrently, the movement has been fostered by the foundation of the Historical Association (1905), and especially by the establishment of university history faculties which resulted in a growing stream of trained students, thus making possible "specialist" teaching in secondary and other schools. The university local examinations which had dominated secondary schools unduly stressed the isolated "period" in preference to the "wide-outline" scheme; but recent official changes have caused the general adoption in the school syllabus of a complete survey of British history with the relevant European history treated concurrently. Modern history, especially the 19th century or some other "special topic," now receives more adequate attention and is studied, especially in the Advanced Courses (modern studies), with the corresponding literature.

The publication of Green's *Short History* represents a landmark in the revolution outlined above. And in the realm of examinations, the pioneer work of the Civil Service Commission calls for special mention. "The revelation of that vision of a higher entity to which we all belong" is (writes Sir Stanley Leathes) "the single greatest gift of history, comprehending all gifts of wisdom and beauty and inspiration which we are capable of receiving." Whither examinations lead, schools are prone to follow.

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MATHEMATICS

It is beyond doubt that in the present century a revolution in the teaching of school mathematics has taken place. In part it consists in breaking away from the teaching of geometry by means of Euclid's elements and in part that break is typical of the change that has also taken place in the other branches of school mathematics, algebra, trigonometry, Cartesian geometry, mechanics, and arithmetic.

Up to about the year 1900 school mathematics centred around "Euclid" as the subject of geometry was then universally called. The teaching was based on the belief that the subject had a sure foundation in the fundamental assumptions, that the superstructure was raised on the foundations by a process of irrefragable logic, and that the best training consisted in the reproduction of Euclid's reasoning. The impulse towards reform came

from the realization by the teachers that the teaching did not always furnish a training in reasoning to certain of their pupils, who committed the book to memory and reproduced it mechanically and without understanding.

Reformed Methods.—The reform was due to the Mathematical Association. The reformers set about the designing of a course suited to the average child. Text books were written from which the more subtle of Euclid's propositions were omitted and only those propositions retained that had a substantial meaning. To make it possible to carry out the reform it was necessary to secure the sympathy of examining bodies. The Civil Service Commission was the first to support the movement. The old examination paper consisted of propositions, the writing out of which might not indicate understanding, and of problems which certain pupils could not touch. The task of the examining bodies was to find questions on the subject matter that would test understanding and would at the same time be within reach of the average child.

On the old system each branch of mathematics was a separate subject fashioned as far as possible on Euclidian lines with a series of set propositions based upon definitions and axioms. The reform movement led to the disappearance of the lines of demarcation between the branches and their fusion into the single subject of mathematics. At the same time things of little practical value like the theory of numbers were dropped. The time saved by this fusion and pruning was utilized to carry the more important subjects farther and to introduce new subjects. The infinitesimal calculus thus entered the school curriculum and is now sometimes taught from the age of 14. Before the reform numerical work was almost confined to the teaching of arithmetic, being rare even in the supposedly practical subject of trigonometry. It has since played a great part in all varieties of mathematics.

Mechanics.—Mechanics gained greatly by the reform. The pupil now verifies the laws by laboratory experiments. Formerly much energy was expended in deducing the parallelogram of velocities and the parallelogram of forces from fundamental assumptions. The conception of "simultaneous velocities" which is the last remnant of the old system must soon disappear. The subject has been extended to include moments of inertia and simple motions of rigid bodies.

Geometry.—In geometry after the reform the methods of Euclid and Descartes enjoyed equal status and each problem was treated by the most appropriate method. The set propositions of conic sections disappeared. In the time saved geometry of three dimensions was taught, chiefly on the methods of Euclid and Descartes, but also to a small extent on the method of Monge, the graphical method by means of which every point and line of a three-dimensional figure can be represented on a two-dimensional sheet of paper. This method which has great educational value and is in constant use in the engineering world will no doubt be given its proper place in the school; geometry will then be treated by the three co-equal methods, the synthetic method of Euclid, the analytical method of Descartes and the graphical method of Monge.

Relativity.—Mathematical teaching will have to take account of the theory of relativity, and while the chief effect will be on the universities, the schools are concerned in one particular. On the relativity theory it is only in a restricted region that Euclidian conditions hold. The treatment of parallels by the study of their behaviour at infinity therefore becomes invalid. Other treatments that do not trespass beyond the restricted region are now to a small extent in use and must in time displace the Euclidian treatment. (D. B. MA.)

ARITHMETIC

In arithmetic the guiding idea of the reform was contact with reality. Except for mensuration which had to some extent preserved contact with reality, arithmetic before the reform was chiefly mechanical computation, the pupil being told which process he was to use. The reform substituted problems from every day life and left the pupil to decide on the process. The change is well illustrated by one of the early reform questions. The question being "Mr. Gladstone was born in 1809 and died in 1898; how many years did he live?", one candidate replied "I do not know whether this is multiplication or division," while another used multiplication and gave the answer as "3,433,482."

This laudable striving after making arithmetic entirely concrete and practical has led however in some instances to a form of pseudo-realism which though clothed ostensibly in a concrete form, postulates (say) the mowing of an impossible number of acres by a certain number of men in a fixed time, to cite only one instance, taken from a paper set in a recent public examination. Again the attempt to base the early teaching of arithmetic predominantly on logic is being challenged to-day, mainly in America, by psychologists. It is asserted that many children, especially young children, like to perform numerical manipulations without the conscious need to understand their rationale and that rote and even the recitation of the multiplication table are a pleasure to such minds, the reward in such cases coming from the sense of rhythm and of enhanced skill and dexterity, together with the immediate satisfaction of getting the sum right. There is probably a good deal to be said for such types of mind that are content with the "how" and ignore the "why," practical types of mind that instinctively prefer doing to thinking how a thing is done; their motto seems to be *Primo agere deinde philosophari* (first act, then analyse), if we may slightly alter Bergson's favourite phrase. Possibly between these two extreme views, one that builds on conscious logic, the other on the formation of accurate automatisms (sub-conscious logic), the real deciding factor is the "mental age" of the child. With very young children the automatic process should be at its maximum, as in the older ones the rational should be predominant, though neither should be absent at any period. Both elements, mastery of technique and mind-training are indispensable; the problem lies in the particular weight and importance to be attached to each at different stages of the course.

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SCIENCE

Until recent years science unfortunately was relegated to the specialists, but during the last two decades great strides have been made in the teaching of scientific subjects. That science for all is a national need was one of the outstanding lessons of the World War, and the publication of the report of the Government Committee in 1918, was a great stimulus to discussion and with its many useful suggestions provided a constructive basis for improvement. The method of teaching science having swung from the demonstration lesson to the strictly practical or *Heuristic* (experimental) type has found its level in a balance between practice and theory. There is also a constantly increasing tendency to make the regular school work less and less academic and to relate it more closely with actual life.

Secondary Schools.—In all grant-aided schools it is compulsory to make adequate provision for the teaching of science. The majority of the public schools provide full opportunities for boys wishing to take the subject, but they do not all sufficiently recognize the principle that science should form an important and necessary part of education. The introduction of advanced courses into the larger secondary schools has improved the organization of the subject while leading to the provision of better apparatus and more comprehensive reference libraries. The abolition of examinations of the Junior Local type and the improvements made in the first examinations have done much to encourage a wider conception of the subject. Nature study and elementary measurement are usual in the lower forms of all schools but in the majority of boys' schools the science in the upper classes is confined to chemistry and physics, in very few cases is biology added; in some of the larger girls' schools physics, in addition to both

botany and chemistry, is given to the university examination level, but in the smaller schools, botany alone remains, in others botany or chemistry, only in very few cases is physics carried to any high level. Zoology and hygiene are almost negligible subjects in all types of schools; but some hygiene is taught incidentally in certain girls' schools.

Elementary Schools.—In spite of much progress compared with the past, the teaching of science in these schools is still handicapped. This is due, in parts of the country, to the lack of adequately equipped laboratories in all but the larger boys' schools, partly to the large classes, and to the comparative lack of science specialists. In the girls' schools, a laboratory, if provided, is seldom equipped with water and gas and often has to be used as a classroom. The curriculum generally takes the form of nature study in the lower school which is followed by the teaching of everyday science. The time devoted to the subject varies from one hour to two and a half hours per week. In the girls' schools some of this time is given to hygiene and physiology. In central schools the conditions are better and the science taught varies very much with the district and as a whole is adapted to local environment.

Summary.—The teaching of science has much improved in all departments of education, but there is still (1928) room for further development. More laboratory accommodation and better equipment would solve the main difficulties in many secondary schools. As for the lack of biological teaching in boys' schools it is due to some extent to the scarcity of graduates qualified on the biological side and the demand will probably secure the supply in the future. Headmasters are now quite alive to its value.

For the elementary schools, with certain exceptions, the chief need is for better laboratory equipment. Other desiderata are the reduction of classes, the provision of science specialists on all staffs in the towns, and special classes for teachers in rural districts. With the increased interest in national health the teaching of hygiene on scientific lines should also be a part of the science curriculum in all schools both secondary and elementary.

See *Report* of the Committee on the Position of Natural Science in the Educational System of Great Britain (1918) and *Report* of an Enquiry into the conditions affecting the Teaching of Science in Secondary Schools for Boys in England (1927), both H.M.S. Office.

(M. J. Re.)

GEOGRAPHY

While under the capable leadership of Dr. H. R. Mill, the late Sir John Scott Keltie, the late Prof. Herbertson, the Rt. Hon. Sir Halford Mackinder and others, the study of geography in Great Britain has attained to a distinctness of aim, an individuality of method, and a coherence of content which have entitled the subject to be regarded as an important element in the education of future citizens. But it follows that geography has its full educational value only when it is so taught as to represent faithfully in the classroom the spirit and character of the corresponding movement in the wider intellectual world. This means that school geography is not, as it was 30 years ago, the mere learning of geographical data and results, but a training in the geographer's characteristic methods and principles of interpretation, and an assimiliation of his characteristic point of view.

It is now generally agreed that school geography is mainly concerned with the study of the adjustment of the life, the activities and the distribution of man to the conditions of his environment. In studying any particular area the paramount task at all stages of the teaching is to examine the present "adjustment" as carefully and accurately as possible, a difficult task whose importance is even now hardly realised. In the more advanced stages of teaching the interpretation of the present "adjustment" sends the student to other subjects—History, Geology, Climatology, etc.—whose results are taken and used by the teacher for his own special purposes. Nor can the geography of a region be understood unless its relations with other regions, both near and far away, are studied. Most of these geographical distributions and adjustments, as well as internal and external regional relationships, are capable of both graphic and verbal portraiture. The mapping of geographical material in the geographer's characteristic way, and the development of the art of verbal description are matters of great importance to the modern teacher.

Geography has an invaluable contribution to make to the equipment of the educated citizen of to-day, for its study brings to one focus, naturally and without forced correlation, the three elements found constantly recurring in home and world problems: the personality and potentialities of a district or region; the characteristics, needs and outlook of its inhabitants; and the nature, needs, and results of their work. These three elements will be recognized as the "place," "folk," "work" of Professor Patrick Geddes. Good geography teaching is constantly dealing with the relations and interactions of these three, and with their synthesis, and this inevitably develops in its students extremely valuable habits of mind.

Modern geographical teaching has been criticized on the ground that it deals too much with broad generalizations and too little with an accurate knowledge of particular examples. It is said that before the introduction of the new methods pupils did at least know the whereabouts of places on the map and that they amassed facts concerning the limited areas then studied in school. The world is a big place, it contains many countries, while the time devoted to geographical study in schools is short. Nevertheless, it should be the aim of the teacher to give that broad study of the world which modern conditions demand, and side by side with this, so to arrange the syllabus that at each stage some important areas or problems are studied as fully as possible within the limits of the time allowed and the stage of advancement of the pupils. Fortunately the general acceptance of the regional treatment of geography assists both objects. Extensive and intensive studies should proceed side by side.

See *Geography Teaching* (British Association Reprint); J. Fairgrieve, *Geography in School;* H. J. Mackinder and W. H. Barker, *Geography in Education and Citizenship; The Content of Philosophical Geography* (Proceedings of International Geographical Congress, 1928).

(L. Br.)

MUSIC

The teaching of music at the beginning of the present century was practically confined to class singing, but with the increasing recognition of the subject as an educational force, a demand for more scientific methods arose. All the newer ones worthy of serious consideration tend in the same direction; the understanding of music. While the method of singing classes has been retained, the work has been carefully graded. Certain apparatus is practically indispensable. (1) Song books containing a large selection of national or folk songs; graded sight singing books; small manuscript books. Copies should be available for every pupil. (2) Sheet music, modern and classical, from any of the now widely known series of school songs. (3) A good pianoforte in a spacious room, preferably on a raised platform. (4) Wall blackboards, with the lines of the stave at least 2 in. apart, and a modulator. A gramophone, or a pianola will be found very useful for certain kinds of teaching. Some schools also make use of the wireless. For quite young children a set of percussion instruments is often provided, and a percussion band is formed, with frequently excellent results.

Practically all teachers agree that the *sol fa* system of pitch names and key relationship, as shown on a modulator, should be retained; but the exact stage for the introduction of the staff notation is still debatable. The more modern method is to begin at once with the staff notation in the lowest class, and to disregard the *sol fa* notation as such, while applying the *sol fa* method to the staff notation. (*See* Musical Notation.) From the elementary training of the ear, and simple musical dictation, to the understanding of a movement of a symphony is now one connected chain of teaching. Two important links in the chain are the study and the writing of short melodies, and the study of simple binary and ternary forms. The term "musical appreciation" is often used in this connection. It means, of course, teaching children to *understand* music, inculcating in them, at least in some small degree, the faculty of discrimination. Aural culture has been well described as "educating future audiences."

The comparatively recent revival of folk song and folk dance has had a remarkable effect on the teaching of music. Folk music

has given teachers a new criterion. Simplicity, directness of expression, rhythmic freedom, unfettered melodic outline, and modal tendency are to be noted in these melodies. Before leaving school, a boy or girl should know a great number of these lovely songs and dance tunes.

The theories of Jacques Dalcroze have found wide acceptance in schools. Put briefly, his method is to teach music through movement and gesture. Much, however, depends upon the quality of the teaching, and a preliminary course of training is necessary. (*See* EURHYTHMICS.)

The old idea that a boy should drop singing when his voice breaks is now discredited by many enlightened teachers. If he is taught to use his newly-acquired "man's voice" with discretion, no harm will ensue. In any case it is not necessary for his general musical education to cease. The formation of a voluntary musical society or club in a school will be found to react favourably on the school music by interesting and inspiring its members.

A golden rule is to conduct as little as possible for simple songs. Many teachers have given up the use of a baton, conducting with the hand only.

The time table should be carefully planned. The time given is often a minimum, especially in the upper forms, owing to the requirements of examinations, though there are hopeful signs that singing will take a more prominent place in these forms than in the past. (*See* also MUSIC, TEACHING OF.) (G. SH.)

ART

When it was first introduced into the schools, whether elementary or secondary, the teaching of art was based on the old academic system, whose ultimate aim was technical attainment. The course started with exercises in the drawing of perpendicular, horizontal or oblique parallel lines, followed by similar graduated exercises in curves, leading up to the development of several *motifs,* with the Greek Anthemion or acanthus as their final objective. Geometry and perspective were then introduced and the knowledge thus acquired was brought to bear on model drawing, which was taught in the same methodical manner.

The formal system held sway for a generation. Then followed a period of experiment and revolt. Many systems, often competing ones, sprang into existence. Ambidexterity, brush work, mass drawing, pastel work—all had their vogue. But certain features have come to stay—imaginative and memory drawing, the careful delineation of natural objects, the practice of design with a specific object in view as against mere pattern making. A point on which there is less agreement is the extent to which the child's imagination should be allowed free rein at the possible expense of acquiring adequate technique. It is the old quarrel between the modernists and traditionalists and possibly the truth lies somewhere between the two. All good teachers however are unanimous in holding that the main idea should be to develop the pupil as far as possible on his own lines, and not as a mere replica of the teacher. In fact the general effect has undoubtedly been to make for greater freedom all round, and for this we have to thank the psychologists, one or two of whose works are quoted in the bibliography. The subject has also considerably gained in prestige in the schools. To-day in elementary and central schools it is taught throughout; and in the latter by a specialist teacher.

In the secondary schools a great step forward was taken when art, in 1924, was made a subject in the general school examination, while art can now be offered as a main subject in the advanced course. (*See* SECONDARY EDUCATION.) Further advance will be possible in the elementary schools by the appointment of a specialist to organize the subject. In the secondary schools the next reform in view is the recognition of art as a second subject in the arts and crafts group for non-linguistic or non-mathematical pupils in the general school examination (*see* EXAMINATIONS), while a growth in the number of advanced courses in art may also be confidently anticipated. Again in many schools of both types greater co-ordination between the other subjects, all forms of handicraft in particular, is also overdue.

Finally it should be pointed out that the schools do not aim at producing a small number of skilful executants—though, with efficient teachers, advanced courses and sufficient scholarships to higher places of art teaching, this should be increasingly possible. The chief objective is the aesthetic and mental development of the pupil through the arts as one of the main channels of culture, which is still too often interpreted in England in purely literary terms. All pupils cannot be expected to create works of art, but practically all may be taught to appreciate them. Hence the teaching of *appreciation,* both by direct and indirect means, forms today an essential feature of art education.

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(R. R. T.)

HANDICRAFT

The introduction of the crafts into elementary schools was authorized by the Education Code in 1890. Prior to that the School Board of London, aided by the City guilds, had already provided instruction in a limited number of schools. Since then the number of school workshops has steadily increased and now, in both elementary and secondary schools, the provision of handicraft is compulsory. The training in the crafts is strictly non-vocational, and the value of the cultural content predominates. Several of the school leaving examinations now include both woodwork and metalwork as subjects for presentation.

Types of Work.—The chief crafts for boys are:—Woodwork, metalwork, basketry, printing, bookbinding, leatherwork, the plastic arts (modelling in clay, wood and the softer metals), etc., whilst the most important crafts in girls' schools are:—Needlecraft, weaving (raffia, basketry, textiles), the plastic arts, leatherwork, printing and bookbinding. Some of these crafts require special accommodation and equipment, and very often one workshop serves several elementary schools. The children usually attend one or more sessions per week. Boys' central and secondary schools are practically all provided with workshops.

Woodwork.—Woodwork is the most popular subject for boys. The tool equipment need not be elaborate and, usually, timber is easily obtained and is capable of being worked by boys. The commoner metals also give good scope for training, particularly in conjunction with the woodwork. A few simple machines are necessary (lathe, drill, grinder, etc.), though much useful work may be accomplished with the ordinary hand tools (hammer, chisel, file, hack-saw, etc.). The bench-work is accompanied by working drawings made by the pupil, and good technique is insisted on throughout. After the preliminary exercises have been worked through, a fair amount of liberty is usually given in the choice of articles made. Various interests, belonging to both home and school, are catered for. This is in accordance with the recent tendency towards encouraging originality in the pupil. When the subject was first introduced technique was insisted on far too rigidly. In order to encourage the application of good design in the exercises, every well-equipped workshop has its small reference library of good craft books. There is a growing co-ordination between the teaching of art and of crafts, and the latter is occasionally combined with teaching of applied mathematics in the case of mechanics.

The majority of the other crafts may be taught in the ordinary classroom, especially if strong tables are used instead of the sloping desks. In most modern schools a room is set apart for practical work.

Teachers.—The City guilds of London Institute grant qualifying certificates to teachers in various crafts, and many of the training colleges now give craft instruction. The Shoreditch Training college provides a specialized course for men in both woodwork and metalwork.

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J. S. Hewitt-Bates, *Bookbinding for Schools* (1927); N. A. Poole, *Simple Crafts for Girls* (1928). (T. Rd.; N. A. P.)

DOMESTIC SCIENCE

The teaching of domestic subjects in public elementary schools is nearly as old as the school itself. Stimulated by Government grants, awarded on results, the numbers receiving some sort of instruction in domestic subjects rose from 844 in 1874 to 59,812 in 1882. In 1898 records show that cookery was taught to 181,973 girls, while in 1924–25 the number receiving instruction in domestic subjects was 488,584.

It is easier to obtain pupils than to create teachers, and as late as 1907 Board of Education reports contain adverse criticism of teachers, methods and results. The failure of early attempts to include cookery in the ordinary teachers' training course was a foregone conclusion. The last decade of the nineteenth century, however, saw the establishment of a number of important domestic science training colleges and the enlargement and improvement of others, both in London and the provinces. All those recognized by the Board of Education offer a minimum two year teachers' course which may be supplemented by additional specialization, and only students trained in such courses are eligible to teach domestic subjects in public elementary schools.

In the practice of the higher schools there is no sort of uniformity: most grant-aided secondary schools find room in their time-table for domestic subjects, others do not always do so. Of the 25 schools controlled by the Girls' Public Day School Trust, which between them provide for nearly 10,000 or about 7% of the total of secondary school girls, less than one-third make adequate provision for such teaching. But the tendency is all in the direction of providing it, if circumstances permit, and it is significant that the Headmistresses' Association, in pressing for the reform of the First School examination (*see* EXAMINATIONS), suggests that group IV. (music, art, housecraft or other crafts) should be allowed to rank equally with the languages and mathematics and science groups towards a pass in the examination, urging that if the subjects of group IV. as they now stand, are not held of equal value with those of other groups, this inferiority lies in the syllabus and is not inherent in the subjects.

The most noteworthy attempt to remove the stigma of inferiority from the teaching of housecraft was the foundation in 1908 of the Household and Social Science Department of King's College for Women. There seemed no doubt that the somewhat mechanical methods in vogue and the stress laid on manipulative skill apart from scientific principle, were responsible for the failure to attract girls of brains and ability. The new course, with a curriculum which included, besides physical and biological science, instruction in hygiene and economics, was recognised by the University of London, at first by the award of a diploma to successful candidates, and since 1920 by a B.Sc. degree. A course on similar lines has been recently instituted by the University of Bristol, in co-operation with the Gloucestershire Training College of Domestic Science. Another development which will bring the domestic science colleges into closer touch with the universities is the new scheme by which, from 1930, the Board of Education will discontinue and the universities will take up the conduct of examinations for teachers in training. (H. Re.)

RELIGION

Public interest in the problem of religious education in England centres largely on its position in the primary school. Up to 1870 such instruction was largely provided by the two great school societies, the National Society and the British and Foreign School Society, and these two bodies made further provision for securing such instruction by establishing residential training colleges. From 1870 to 1902 the newly established board or council schools included religious instruction upon an undenominational basis, under the Cowper-Temple clause. The Balfour Act of 1902 financially strengthened the dual system and included in the extended provision for secondary education similar arrangements for undenominational religious instruction. The development of central or modern schools, accelerated by the publication of the Hadow Report on the Adolescent, and the consequent decapitation of many country schools, has intensified the task of the Church authorities in saving their black-listed schools (and with them their denominational religious instruction) from extinction. Great efforts are at present being made both to consolidate and safeguard such schools. As regards the matter of religious instruction in the undenominational schools provided by local education authorities, important advances towards improved and agreed syllabuses have recently been made, of which perhaps the Cambridgeshire syllabus is the best known. Concurrent with these efforts to safeguard denominational religious instruction in non-provided schools and to improve the religious instruction in the provided schools have been attempts to make more general provision in training colleges for instruction in the matter and methods of religious education. The Board of Education does not make such provision in non-denominational training colleges and university training colleges obligatory, but the general atmosphere towards such provision, especially upon a voluntary basis, is very favourable.

Religious instruction in other than primary schools has received increasing attention in recent years. Problems arising out of its place and character in public schools have been the subject of many private conferences, while the work of the late Dr. Sophie Bryant was influential as showing what could be done in large modern high schools for girls. Many movements variously directed towards special problems of religious education have accordingly sprung up. The Student Christian Movement exercises a world-wide influence amongst students of all classes, creeds, and races and is especially active in publications and international conferences. It stands mainly for an undenominational but Christian position. The Church Tutorial Association, founded by Albert Mansbridge, is an effort to provide a high grade of religious education to adults by means of tutorial classes. Its success has been substantial but not spectacular. Such schools as those of the Woodard Corporation, founded with the express purpose of providing secondary and public school education upon a definitely Anglican (High Church) basis have more than held their own during the past half century, and have led to similar foundations by adherents of other types and denominations, *e.g.*, Sherborne School for Girls and the Kingswood school, Bath. The provision for theological education as the necessary complement to general religious instruction has been greatly extended of recent years. Faculties of theology have sprung up in many of the newer universities, and seminaries for prolonged and systematic theological training have been established by such bodies as the Community of the Resurrection (at Mirfield) and the Society of the Sacred Mission (at Kelham). The Sunday schools of the country are now largely run upon reformed lines and vacation schools for Bible study and training in the methods of religious instruction are frequent and successful. The larger problems, however, of confirming the religious education of the nation have led to the establishment by the archbishops of Canterbury and York of a strong committee of enquiry.

In the Dominions, where State provision for religious instruction in the schools normally follows undenominational lines, the denominational supplement largely depends upon the local churches and upon assistance from societies with their headquarters in England. In German schools, the position of denominational religious instruction has been somewhat shaken since the establishment of the republic. In France the opponents of secular civic instruction have pointed to the free Catholic schools as a bulwark for religion and morality alike. In Italy under the present régime religious instruction in the schools has been strengthened, but how far in a really liberal and free direction it is difficult to say. Everywhere, the more technical problems of the treatment of scriptures, of creeds, of competing world religions, are receiving increasing attention.

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reference to Sunday school work, 1903), *The Cambridgeshire Syllabus of Religious Teaching* (1924; 2nd ed., 1926), and syllabuses issued by the London County Council, Hants County Council and other educational bodies, and publications of the Student Christian Movement. (A. A. C.)

THE UNITED STATES

Since 1900 the outstanding problem in the curricula of the schools of the United States has been the selection of material. Prior to the opening of this century, the traditional curricula were accepted without serious question. During the colonial period they were dominated by British practices and traditions. Text-books used in the United States were printed in England, and British courses of study were only slightly modified for use in American schools. Even when, following the American Revolution, America began to print its own text-books, their content was not materially changed until the 20th century, and in some fields no important changes have yet occurred.

The principle of selection with which the schools of the United States are experimenting is that of usefulness. But to American thought the concept of usefulness is given a meaning sufficiently broad to include aesthetic, social, moral and intellectual, rather than merely vocational and financial uses. Utility was not always of major importance in curriculum construction. For centuries educators assumed that the organized fields of knowledge—grammar, history, botany, mathematics, and the like—were appropriate for instructional purposes. The practical value of these courses of study was based upon the doctrine of transfer of training, expounded by Locke in the 17th century. In 1902 Thorndike's studies on the transfer of training appeared, causing educators to question the adequacy of the text materials to train students in those abilities which are useful outside of school.

The exploration of the concept of usefulness has taken several directions in the United States. One approach is through activity analysis; another is by way of the long familiar organized fields of knowledge. The investigators interested in discovering the activities, needs, problems or interests of the persons to be educated are divided into two groups, one interested in exploring children's activities, and the other adult activities. The former group, which asserts that the "school *is* life rather than a preparation for life," to use Dewey's phrase, more or less consciously analyses child activities and interests to discover the most important of these; and upon them they base the curriculum. Numerous studies of children's spelling vocabularies, their errors in language, their use of mathematics, and so on, have been made and an educational cult, the so-called "progressive" education (*q.v.*), has arisen. A second group, which assumes that the school is an agency established by the State to teach the young the patterns of behaviour which a good citizen should follow, have analysed the activities, interests and problems of adults, and have based the selection of their curriculum on the results of such analyses, with adaptation of the material to children's interests and activities. Careful studies have been made by this group. Studies of adult vocabularies and errors, of the use of mathematics, geography, history and the like, have been published. The second group has been interested also in the analysis of vocations as a basis for the selection of materials for vocational curricula. Analyses of the activities of pharmacists, secretaries, machinists, and a wide variety of other occupations were made in constructing a curriculum for each.

Those investigators who still approach the curriculum through the organized fields of knowledge, have felt the influence of the concept of usefulness and have made adaptations of their courses accordingly. In the elementary school and junior high school, "general" courses have been organized. For instance, in the junior high schools are found courses in general science which are composed of synthesized materials drawn from zoology, botany, physics and chemistry. In colleges a similar synthesis is seen in orientation courses in which the student is given a general survey of related fields of knowledge. Orientation courses in the social sciences, in aesthetics and in the natural sciences are examples of this tendency. These courses are substituted for detailed introductory courses in the separate fields.

As the concept of usefulness is developed farther, theories of learning, introduced from psychology, have been utilized. With the acceptance of the theory that purposeful learning in solving problems felt to be valuable by pupils is superior to the learning of systematized information, the usefulness of which is not appreciated, the "project" has been evolved. The project curriculum is one in which significant problems, as nearly like life situations as may be, are selected as units of instruction, and such subject matter as is needed is drawn from the organized fields of knowledge in a form appropriate to the completion of the project. This subject matter the pupil is supposed to assimilate as he works through the project. This type of material is having a very wide use, both in the elementary and high schools, and in the vocational schools and colleges. In the college field, programmes which set up conditions for independent study by more mature students have led to the introduction of honour courses adapted from those of British universities and popularized by the Rhodes scholars. The concept of usefulness has also been applied to practice and has given impetus to courses in which the student develops skill in activities in addition to securing information about them. This point of view has been in existence for some time and is found in such forms as that of practice teaching, internship in hospitals, etc. In its newer forms, it is found in co-operative courses such as those developed by the University of Cincinnati and Antioch college, where a student alternates short periods of instruction in school with short periods of experience in business and industry.

The foregoing statement of trends is not intended to imply that the influence of any one will be found in all types of schools. The educational system of the United States is too large in extent and too complex in organization to allow any trend to become universal. Rather these tendencies may more accurately be described as influencing the constructive policies of substantial groups of educators.

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RELIGION

The early public schools in America, as well as private and parochial schools, gave full expression to the religious faith of their constituency. Especially in New England, where it was favoured by a sympathetic relation of church and State, the public schools avowed a religious aim and taught religious subjects. *The New England Primer,* for example, for 150 years widely used as a text-book, was largely composed of scriptural and doctrinal material. Catechisms were taught in the public schools and prayer was offered twice a day.

A relative secularization of education has taken place since about 1775. This is in part due to causes which are world-wide, such as the progress of invention and discovery, the expansion of the sciences and arts, and the practical materialism associated with the industrial revolution. It is due also to two principles and two sets of circumstances peculiarly characteristic of the United States. The principles are (1) the religious freedom guaranteed by the national Constitution; (2) the assumption by the States of responsibility for education. The circumstances are: (*a*) the heterogeneity of population which has resulted from immigration; (*b*) the multiplicity of religious denominations, together with the jealous, divisive sectarianism which has in general characterized their defence of their distinctive tenets and practices. The secularization of public education in the United States was not purposed, but incidental—a by-product of the working out of these two principles under the circumstances named. Whenever a minority, or even an individual, has chosen to object, on what are averred to be conscientious grounds, to some religious element in the programme or curriculum of the public schools, that element has forthwith been eliminated, and no other religious element has taken its place.

The movement has been wholly negative. Each religious group has been more concerned to see to it that the public schools should not contain anything out of line with its peculiar beliefs than it has been concerned to preserve in these schools the great principles of morality and religion upon which American citizens generally agree. The result has been to strip the public schools almost completely of religious teaching and religious worship. It is true that in some States and many communities each day's session is yet opened with the reading of a brief passage from the Bible and the recital in unison of the Lord's prayer. With this exception, the programme and curriculum of the schools give practically no place to religion and afford no conscious recognition of the part that religion has played and is playing in the life of humanity. Religious education, it is commonly said, is the business of the home and of the church, not of the school and the community.

In colonial days the churches generally, except in New England, maintained elementary schools, and later took the lead in founding academies and colleges. As the public school system became established throughout the country, most of the churches surrendered the idea of maintaining church-controlled elementary and secondary schools. The outstanding exceptions to this rule are certain German-speaking branches of the Lutheran Church and the Roman Catholic Church. The latter, particularly, dissents in principle from the current policy of public education. Education as a whole is a unitary process, it holds, which must include religion. But the State is not competent to teach religion. The State, may, therefore, levy and collect taxes for the support of schools, may set standards which it requires schools to maintain in certain subjects, and may even conduct schools for those who are without the Catholic faith, if they so desire; but it is the function of the church to carry on through its schools, the education of childhood and youth. Especially since the Third Plenary Council of Baltimore in 1884, this church has laboured strenuously to provide strong schools, organized into diocesan systems, for the education of its young.

In the Colonies religious education was chiefly by means of instruction in doctrinal catechisms. In the 19th century catechetical instruction declined in the Protestant churches; and they came to depend generally, except in the more liturgical communions, upon successive waves of emotional-spiritual revival for the conversion and enlistment even of the children of their own members. Most churches had no definite policy for the religious education of children; they cared little for the increasing secularization of the public schools and failed to realize the larger educational responsibility which was thus being thrown upon them. This failure was due, not so much to neglect, as to the idea that regeneration is quite independent of all natural laws and processes, hence unaffected by nurture and education—an idea which was fostered by the great revival movements. This idea and the practices associated with it were sharply challenged by Horace Bushnell in an arresting book, *Christian Nurture* (1st ed., 1846), in which he maintained, in opposition to the current reliance upon emotional experiences of conversion, that the life of the family in the home is of primary importance in the religious education of children, and that it is possible for a child to grow up as a Christian, and never think of himself as being otherwise.

The Sunday school movement took firm root in the United States early in the 19th century, and expanded rapidly with the organization of the American Sunday School Union in 1824 and the initiation of the International Uniform Sunday School Lesson system in 1872. In spite of ungraded curricula, untrained volunteer teachers and short instruction periods, the Sunday schools rendered indispensable service through the promotion of Bible study and evangelism.

In the 20th century American citizens began to awake to the dangers involved in the omission of religion by otherwise competent public schools and the throwing of the main burden of religious education upon educationally incompetent Sunday schools. The organization of the Religious Education Association in 1903 marks the getting under way of a new interest in the problems of religious education which has grown steadily. In 1920 the Protestant churches united to reorganize the old International Sunday School Association into the International Council of Religious Education. The movement has resulted in the grading of Sunday schools, the devising of better curricula, the training of teachers and the erection of church-school buildings designed and equipped for educational purposes. A new type of church school is being developed—a church school for the teaching of religion, maintained by a local church or a group of neighbouring churches, for children whose education in other respects is provided for in the public schools. These newer church schools are graded in the same way as the public schools; they provide for the religious education of children through activity as well as through instruction; and their schedule includes week-day as well as Sunday hours.

A movement to establish week-day schools of religion is spreading. In many communities, following the example of Gary, Ind., which began this policy in 1914, citizens of all creeds have united in petitioning the public school board to excuse pupils, at the request of their parents, for one or two hours a week of religious instruction. That such a practice is not illegal or contrary to public policy was affirmed by a decision of the Supreme Court of New York in the White Plains case (1927). Its desirability is urged on the ground that it constitutes a recognition by the public schools of the place of religion in human life and of the right of parents to secure the education of their children in the principles of religious faith. Week-day schools of religion are maintained in other communities without time being granted by the public schools. The Jewish congregations have long followed this policy. Throughout the country, there is a notable development of daily vacation schools for the teaching of religion, conducted for terms of two to four weeks. (L. A. WE.)

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SCHOOL AND THE HOME. Direct co-operation between home and school is far less developed in England than in the United States (*see* PARENTAL EDUCATION) or Germany. Nevertheless, English parents and schoolmasters are beginning to think alike, or at least to realize that they are all fighting in the same cause—the welfare of the rising generation. Schoolmasters, thanks to improvements in status and salaries, have largely shaken off the pedagogical dust that was once apt to envelope them. The average parent, on the other hand, is better educated than formerly, and better able to meet the schoolmaster on his own ground and to enter into reasonable discussion of the joint problems of home and school.

Open days, held in connection with civic and education weeks, enable local parents to visit the various schools and institutions which their children attend, and to see for themselves what is actually being done for the pupils. During an education week, the schools of an area usually combine to arrange an exhibition of school work, and to give concerts and demonstrations open to the public. Public meetings are held and addressed by local education officials and officers, as well as by outside educationists or representatives of the Board of Education. All this has an excellent effect in stimulating the interest of parents in schools of the town in which they live. An attractive handbook is usually published at the time setting forth the educational facilities of the area and indicating where further information can be obtained. The London County Council publishes especially valuable guides of various kinds to education and the choice of employment, describing the wealth of educational opportunity provided in London.

A few parents' councils exist in England in connection with public secondary day schools, but these do not compare in any sense with the powerful parent-teacher associations of America. The English parents' council, where it exists, has usually been formed on the initiative of the headmaster or headmistress; its function is to arrange parents' meetings, at which some well-known educationist or the headmaster or headmistress addresses the gathering on a subject of interest to parents. Discussion is invited, but it is rare for animated discussion to arise. An ex-

ception is the Parents' Association (56 Manchester street, London, W.), which is concerned with the interests of parents sending children to public, preparatory and private schools all over the country. The formation of this association was due to parental initiative, and schoolmasters and schoolmistresses, while welcomed as associate members and often invited as speakers, have no voice in its councils. The Parents' National Educational Union (26, Victoria street, London, S.W.) exists mainly for the purpose of furthering the ideals and methods of Miss Charlotte Mason, its late founder. This union, better known as the "P.N.E.U.," publishes *The Parents' Review* and conducts what is known as the "P.U.S." or Parents' Union school, a scheme by which children can work in home schoolrooms and be examined on a common syllabus.

While, no doubt, many of the members of governing bodies of English schools are parents, there has been no general movement towards appointing them as such on these bodies. In 1927 a parent of a boy in the school was elected to the council of a newly created public preparatory school, and the precedent is one that will no doubt be generally followed as parents combine to make their influence felt. Such an appointment, if judiciously made, should greatly help a school, while obviating carping and dissatisfaction. In the few cases where a woman takes an active part on the governing body of a boys' school, her experience is usually of great value in questions concerning diet, health, and the domestic economy and internal finances of the institution. In certain garden cities and satellite towns the elementary schools enjoy the patronage and support of local educational associations which include parents and other citizens. Where such an association exists, there is some likelihood that the children of all classes in the community may attend the public primary schools, as commonly occurs in the United States. A parents' representative is now obligatory (Decree Jan. 24, 1928) on governing bodies of French secondary schools (boys and girls), and such a representative must be chosen from the parents' association, or, in default of such, from the parents themselves.

See Radice, *Home and School* (1926). (S. Rad.)

SCHOOL ARCHITECTURE. Modern school buildings are very different in design from those of the 19th century. It is now recognized that the health and happiness of the children must be the first consideration if they are to take full advantage of the education provided. Consequently, in the latest designs, every effort is made to secure for the children a maximum amount of sunlight and a continuous supply of fresh air, combined with surroundings which are in themselves congenial.

GREAT BRITAIN

The building regulations issued by the Board of Education in 1914, required that the classrooms should not be arranged to open directly from a hall, and in some schools erected shortly after the war these requirements were met in a way that dispensed with an intervening corridor, the rooms not used for classroom purposes being placed next the hall.

On the resumption of building work after the war considerable difficulties in respect of labour and materials were experienced, and as a result one-storey schools of light construction were erected. They were more or less experimental in character but from these has been evolved the latest type which might be termed the open-air type of one-storey elementary school. In these, the classrooms have a southern aspect and thorough ventilation is provided so as to secure the maximum amount of sunlight and fresh air. Experiments have been made with a view to applying the same principles to the planning of buildings of two and three storeys.

The improvement in cross ventilation has made possible important reductions in the heights of rooms. In the Board of Education building regulations (1907) the minimum height of classrooms was laid down as 13 ft. This was reduced in the regulations of 1914 to 12 ft.

Elementary Schools.—The illustration shows the plan of a one-storey elementary school (boys', girls' and infants' departments) on a site sloping to the south. In this plan all the classrooms have a southern aspect. Those on the south side of the open courts are entered from an open verandah; those on the side exposed to the north, from a low corridor over which cross ventilation to the open air is obtained. The halls are central, isolated, and cross-ventilated. The staff room of the girls' department is placed over that of the boys' department. The height of the classrooms is 11 ft.

Secondary Schools.—The requirements of secondary schools are more complex than those of elementary schools; and secondary schools, therefore, present a rather different problem in planning and arrangement. School planning on the lines of the open-air type of elementary school has not yet reached such an advanced stage as regards secondary schools.

It will be seen by comparing the above plans with the plan of an elementary school, that in the secondary school a much larger proportion of the floor area is taken up by rooms for special subjects, *e.g.*, laboratories, art room, gymnasium and manual-training room. In a secondary school dining accommodation is generally provided but not always in a separate dining room. Sometimes the assembly hall and gymnasium are combined, but more usually the gymnasium is kept apart and used for its particular purpose whilst the hall is also used as a dining room. The latest tendency in the design of secondary schools is to approximate to that of elementary schools more particularly as regards the classrooms. (G. T. F.)

THE UNITED STATES

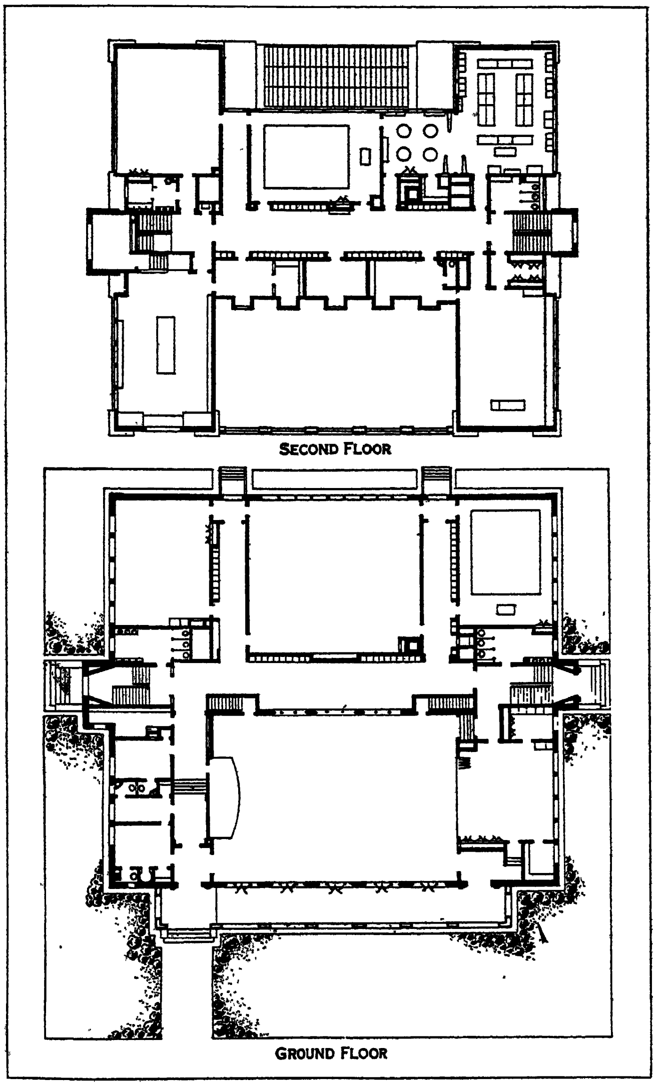
Types of School Buildings.—Originally the school building consisted of a single room or hall. As the schools developed there came into use that treatment of the building having a room in each of the four corners with a hallway through the centre, then came the two storey plan, duplicating the first storey, followed by the three storey building with the third storey containing an assembly hall. These buildings were usually surmounted by a cupola containing the school bell. As the number of pupils increased the need for more space resulted in the addition of more rooms and there followed diversity of arrangement in the general type of plan. These may be classified as the closed and the open types, the closed type being the solid rectangle, the hollow rectangle and the rectangle with interior auditorium and courts, the open type being in the form of one of the following letters: I, T, U, E or H. In determining the type of plan, consideration should be given to the following factors in the order named: (1) orientation; (2) natural light and natural ventilation of the classrooms; (3) expansiveness; (4) flexibility; (5) light corridors; (6) effective supervision; (7) reduction of vertical travel.

The World Fairs held in Chicago in 1893 and in Paris in 1900 (*see* Exhibition Architecture) brought together a brilliant exhibition of school plans which brought immediate results in the planning and designing of school buildings. At the same time the public began to show more liberality in their appropriations and to expect of the architect a higher grade of design and construction. The National Education Association in the United States appointed a committee of its foremost educators and architects to study the planning of school buildings. This committee's report, *Schoolhouse Planning* (1925), provided for a set of standards by which a school-house plan might be measured for right use of floor space, and contained chapters on the process of planning a school building, choice of plan, determining the schedule of rooms, illumination, etc. The National Fire Protection Association acting with the American Engineering Standards committee published a report, *Safety to Life in Schools* (1927), giving rules for planning corridors, stairways, exits and general construction. Previous to 1900 the usual secondary school was easily housed in the old form of school building. There was comparatively little architectural development except in ornamentation. Within the first quarter of the 20th century, however, there developed a movement in school administration brought about by the rising costs of school housing that made a marked impression on the school-house plan.

The idea that each pupil should have one central desk and additional stations elsewhere has been shown to be based on a false

conception of school needs. The superintendent of schools of Gary, Ind., adopting an educational idea that had been in use in Europe, evolved a programme of studies and time periods that made it financially possible for all school committees to give their pupils the benefits of a more enriched programme than was possible under the old plan of administration. The programme plans that every room, hall, shop, gymnasium and recreational centre shall be occupied and in use every school period.

Modern Tendencies.—The modern school-house has unilateral lighting with a glass surface equal to 20% of the floor space and its artificial lighting is laid out in accord with the code of the Illuminating Engineers' Association. Better construction means greater resistance to fire and few schools are now built without fire resisting corridors and stair wells. There are fire alarms and means for extinguishing fire. The building, also, is divided into sections by means of fire doors that automatically



FRANK IRVING COOPER CO., ARCHITECTS
JUNIOR HIGH SCHOOL, LONGMEADOW, MASS.

close when the electric latch holding them open is released by the current sounding the fire alarm. School toilet rooms are located on the various floors instead of being concentrated in the basement, and they have the same type of fixtures as are found in the home. The heating and ventilating plant of educational buildings has been developed; and while there are differences of opinion as to the best type of ventilation, it is agreed that ventilation is necessary and the amount of fresh air to be supplied is prescribed by law in nearly all the States. Physical training is now often required, and this has led to some school buildings being provided with gymnasiums, showers and swimming pools. There is a growing tendency to plan a building so that it may be altered to meet the demands of a changing school programme without undue cost. In general this means providing rooms that may be enlarged or reduced in size without destroying vital parts of the school-house structure. There is a small but insistent demand for rooms equipped so that the laboratory method of teaching may be employed. By this method the pupil may receive instruction based on his own free examination, inquiry and experiment. The modern school building in many communities is equipped for radio reception and also for the talking moving picture. The principal's office may have a microphone transmitter connected to loud speaking telephones in each class room; thus the principal is able to address the entire student body from his desk. In the auditorium the works of the master musicians providing the world's best music may be heard by the pupils by means of auditorium reproducers, actuated by record discs, microphones and amplifiers. Three secondary school buildings near Boston were so equipped in 1927–28,—the first installations of this kind for school buildings in the world. There is also a tendency for auditoriums to be reduced in size and to plan two or more of different sizes in the same building. Rooms for the school nurse, physicians and dentists are often added in administration suites to those for the principal, his clerks and assistants.

Examples.—The development of school architecture in America is nowhere more clearly shown than in New York city, where school buildings may be seen dating from the 17th century to the present year. Nearly all the secondary school buildings were designed while C. B. J. Snyder held the office of architect of the department of education, 1891–1923. His De Witt Clinton high school, 1910, was cited by the United States Bureau of Education as the finest high school building in America.

A small building for 300 pupils, a junior high school in Longmeadow, Mass., designed by Frank Irving Cooper, is of the simplest type. It has a combination assembly hall and gymnasium to accommodate all the pupils of the school; at one end is a stage shut off by folding doors, and when shut off the stage is used by classes in domestic arts. Small rooms are provided for packing away the seats of the assembly hall to make possible its daily use as a gymnasium. Showers and locker rooms are located in the basement. At the rear of the building is a room of large size used as a general shop, and on the second floor are rooms for domestic science. There is a room for the library with an open beam ceiling. There are the usual class-rooms, science rooms, administration suite and rooms for the school nurse and medical attendant. This building is of the U type and additional accommodations may be provided by an extension of the arms of the U.

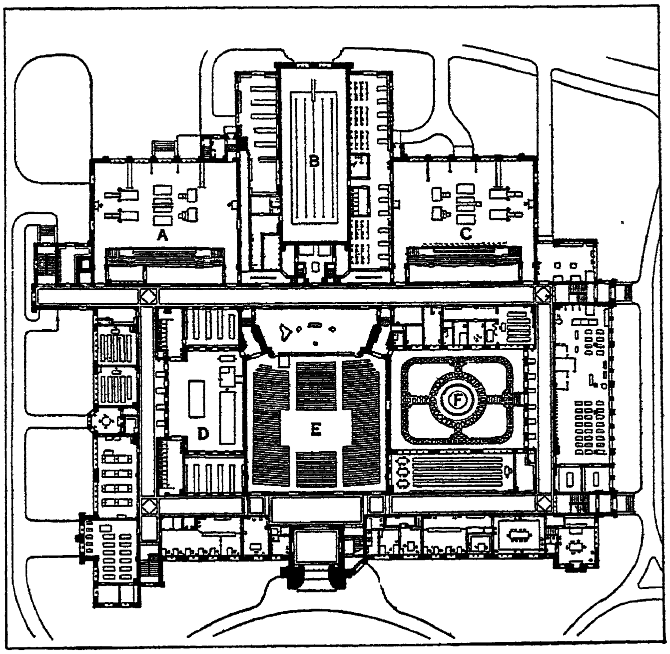
The Bulkeley high school building in Hartford, Conn., also designed by Cooper, shows how the simple type may be used to accommodate a school of nearly 2,000 pupils. This building is of the I plan with the central unit used for academic work. There is a gymnasium at one end and an auditorium at the opposite end of the building. Shops occupy a separate unit at the rear. Each of these units may be used by the school or community without disturbing occupants of the other units.

The Columbia high school, South Orange and Maplewood, N.J., designed by Guilbert and Betelle, is a building with a capacity of 1,600 pupils. There are standard class-rooms supplemented by rooms for special subjects. The auditorium seats 1,300 persons and on the large stage is a pipe organ. Full size gymnasiums are provided for both boys and girls, and between the gymnasiums is a swimming pool with spectators' gallery.

The Central Technical high school, Columbus, O., designed by William B. Ittner, is one of a group of buildings comprising a new civic centre. Its outstanding features are a music-lecture room facing two sunken gardens in the forecourt, the main entrance approach being across its roof, which brings the room into a location where it can be turned over for community uses without entrance to the school building proper; an auditorium, seating 1,500 persons, that combines a gymnasium and stage,—the stage, 20 ft. deep, being separated from the girls' gymnasium by a steel sound-proof curtain, and being adjoined by the boys' gymnasium

on the other side at the rear, thus making it possible to throw the entire health suite together for pageants, large choruses and the social features of the school; and an art group, comprising a room for drawing and a room for commercial art, printing, ceramics and art metal work, grouped on the top storey around an art gallery, the entire group being top or gallery-lighted. The pupil accommodation approximates 1,800.

The Eureka junior high school, Eureka, Calif., designed by John J. Donovan, exemplifies a group development often found



GUILBERT AND BETELLE, ARCHITECTS

COLUMBIA HIGH SCHOOL, SOUTH ORANGE, N.J.

in the Western United States. The 30 ac. of land include a huge gulch which has been converted into a stadium (*q.v.*) encircled by a quarter mile track. Between the shops and the bleachers is the proposed swimming pool, with dressing rooms on either side for boys, girls, men and women. To the south end of the stadium is the proposed open-air theatre stage with dressing rooms, which with the swimming pool pavilions will be built of rustic lumber or of logs.

The first floor plan of the junior high school shows the class-rooms around three sides of an interior court. The north side of the court is formed by the assembly hall, east of which are the boys' and girls' gymnasiums. There are class-rooms, a study hall, library with a stack room, two mechanical drawing rooms, two general science laboratories, administration suite, sewing room, cooking room, typing and book-keeping room, art rooms and an assembly room with a stage that has a seating capacity of 150 persons. The assembly room is used by members of the community as well as students; it has a capacity of 1,200 seats.

Bibliography.—The best sources of information on modern school buildings are the leading architectural magazines of the various countries (*see* bibliography under Architecture) and, in the United States, *The American Educational Digest, The American School Board Journal* and *The Platoon School.* (F. I. C.)

SCHOOLCRAFT, HENRY ROWE (1793–1864), American explorer, ethnologist and author, was born on March 28, 1793, in Albany county, N.Y., and died at Washington, D.C., on Dec. 10, 1864. After studying chemistry and mineralogy in Union college and applying them in a glass factory of which his father was manager, he collected mineralogical specimens in Missouri and Arkansas, and in 1819 published his *View of the Lead Mines of Missouri.* In 1820 he accompanied Gen. Lewis Cass as geologist in his expedition to the Upper Mississippi and Lake Superior copper region, and in 1822 was appointed Indian agent, with headquarters at Michilimackinac. He married Jane D. Johnston, the granddaughter of an Indian chief and the daughter of a wealthy and cultivated Indian trader, who aided him in acquiring information as to the institutions and beliefs of the natives. From 1828 to 1832 he was an active member of the Michigan legislature. In 1832, when on an embassy to some Indians, he ascertained the real source of the Mississippi to be Lake Itasca. Schoolcraft was the author of some stilted verse, of several books on exploration in the Middle West, and of numerous works on the Indians. The most important of these are *Information respecting the Indian Tribes of the United States* (6 vol., 1851–57), a lavishly illustrated compilation issued as the result of a commission by Congress, and *Algic Researches* (2 vols., 1839; 1856 ed., *The Myth of Hiawatha*). Save in the latter volume, Schoolcraft's style is pompous and cumbersome, but he was a pioneer in the work of preserving the aboriginal myths and lyrics. Inspired by his researches, Longfellow decided to weave the red men's "beautiful traditions into a whole," the result being *Hiawatha;* numerous other poets such as J. R. Lowell and T. B. Aldrich based shorter pieces upon his publications.

See his *Personal Memoirs of a Residence of Thirty Years with the Indian Tribes* (1851), which, although poorly digested, gives a fair notion of his work; also an article by F. B. Streeter in the *American Collector* (vol. v., Oct., 1927).

SCHOOL HYGIENE AND PHYSICAL EDUCATION form very important branches of public hygiene in the United States. The school, since practically all the children are collected there, furnishes the great opportunity for caring for the health of all the people. During recent years the importance of this has been recognized, and a great advance both in physical education and in the application of hygiene in the schools has been made. Although they are more or less interrelated, the two subjects may be best treated separately.

School Hygiene.—School hygiene may be divided into four main branches: (1) Sanitation of school-houses and school grounds. (2) The hygiene of the school child, including prevention of contagious and other diseases, health examinations both physical and mental, the prevention and treatment of defects and positive training for the development of habits of health. (3) The hygiene of school teachers. (4) The hygiene of school instruction together with mental hygiene.

The School-house.—This branch of school hygiene is concerned first of all with the best conditions of a workshop for growing children occupied in brain work. Architectural and artistic considerations, although usually considered important, are secondary. First of all should be considered the health of the workers. For example, the unit in a school-house is the schoolroom, and the size of the room should be determined by consideration of the average limits of normal sight and hearing, etc. Many scientific studies of the best forms of construction, and of methods of heating, ventilation, lighting, have been made; and from these and the experience in building millions of school-houses certain definite norms for construction have been established. Although many poor school-houses are still scattered throughout the country in defiance of the rules of hygiene, the best are models of sanitary excellence.

Hygiene of the School Child.—Child hygiene is based upon the character of the child's body and the laws of growth. It seeks to determine the needs and to avoid the dangers of each stage of development. Among its important contributions have been many scientific studies of development, the diseases and abnormalities of school children, the defects of the sense organs, the incidence of disease by years, seasons, months of the school year, the relation of defects to school progress and studies also in detecting and controlling contagious diseases. By the introduction of health inspection into the public schools, not only has the importance of school hygiene been emphasized, but valuable material for the study of child health has been collected.

Hygiene of Teachers.—A new branch of school hygiene relates to the health of teachers. The few studies made emphasize the great importance of the health of the great army of teachers. It appears that the members of the teaching profession are prone to respiratory diseases and to nervous disorders. Thus it is seen to be a matter of importance to make conditions healthful for the work and the life of the teachers as well as of the pupils.

Hygiene of Instruction.—This emphasizes the hygienic im-

portance of the mental habits formed by education, the secondary effects of instruction; and it studies every educational principle and method, the relations of teacher and pupil, the problems of the period of study, from the point of view of hygiene.

The importance of this newer field of school hygiene is seen when one considers the fact that an important means of cure for nervous and mental disorder is re-education, the development of healthy habits of mental activity,—wholesome interests, habits of attention, self-control and orderly association,—in fact, the very habits that are essential for hygienic school work. More and more scientific investigation and observation are showing the hygienic importance of mental hygiene both for pupil and teacher.

School Legislation.—The development of school hygiene is shown by the growth of medical inspection as well as by the training of teachers, the legislation in regard to the health of children and the sanitation of school buildings. While none of the laws in the different States are adequate, the legislation indicates fairly well the present interest and aims. According to J. F. Rogers of the Bureau of Education, 42 States make some provision for medical inspection. In 16 States it is mandatory; 19 command or imply a complete health examination of the school children; half the States have legislation in regard to ventilation of school buildings. About 60% of the cities require annual health examinations of the children. In recent years, with increased attention to physical defects as well as contagious disease, the health inspection has been placed largely under the direction and control of the educational authorities.

Physical Education.—As concerns the school this subject may be divided as follows: (1) General physical exercise including play and training in health habits; (2) systematic physical training, gymnastics (*q.v.*), callisthenics, and the like; (3) athletics (*q.v.*); (4) the higher aims of physical education.

Special treatment of gymnastics, athletics and mental hygiene is given under separate articles. Only general aspects of the subject are discussed here.

The importance of physical education in relation to health has been emphasized in recent years in a twofold way: first, because of its significance for the normal development of children and the maintenance of general physical health; second, because of its significance for mental health. The minimum amount of physical exercise for the maintenance and development of physical health has been suggested by Hetherington as follows: Four hours of muscular activity at the age of 5 years, five hours from the age of 7 to 9, six hours from 9 to 11, five hours from 11 to 13, four hours from 13 to 16, three hours from 16 to 18, and two hours daily from 18 to 20.

The slogan of physical education from the days of the Greeks until the present has been *mens sana in corpore sano,* the sound mind in the sound body, with the implication that the sound body is a condition of mental sanity. In modern times, under the influence of the great teachers of physical training in Europe, Guts, Muths, Jahn and others in Germany, Ling and the founders of Swedish gymnastics, the training has naturally centred much more upon physical education. While the mental factor in this twofold aim has often been neglected, in recent times the emphasis has been placed largely on the mental aspects of physical training. In a report of a special committee to the Society of Directors of Physical Education in Colleges made in 1921 the committee emphasized right mental attitudes, self-sacrifice, loyalty and co-operation, and mentioned some of the more generic of these mental attitudes as their first group of aims. Thus to-day there is growing the theory that physical education affords opportunity for important training in mental hygiene as well as for physical health. While we do not go as far as Plato and say that God gave men music and gymnastics for mental culture alone, we do now emphasize the development of healthy mental attitudes and interests as the culminating value of such training.

With the development of physical education in relation to somatic and mental health, it has become a subject for scientific research as well as a practical art, as indicated by recent literature. In the practice of hygiene the best schools to-day supplement instruction by actual training in health habits; and in the colleges the highest ideal is the acquisition of health intelligence as demonstrated by health habits. (*See* also PHYSICAL CULTURE, and for English legislation on the subject *see* EDUCATION.)

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SCHOOL LIBRARIES. The school library is a comparatively late development in British Elementary Education. (For the school library in the U.S., *see* LIBRARIES.) Under the old system of payment by results there was little opportunity of straying from the narrow path represented by the "three Rs." But teachers have gradually learnt that with teaching to read, the appetite for reading must come with the eating; the mere teaching of the principles of mastication is of little good. This appetite has undoubtedly been developed within the classroom itself by the system of circulating libraries of reading books, giving a far wider range and choice of interests than when each school had a limited set of readers of its own. But care must be taken to create first an appetite and then taste, though the more ambitious teachers have often begun with the latter. To-day a properly equipped school library contains books for enjoyment and books for information and the cultivation of taste. Books for enjoyment especially, should be attractively bound and if possible illustrated. Children's books should look as tempting as their games and toys, and indeed many school books are attractively got-up to-day, the line of demarcation between the ordinary book and the school book being often very thin. Children should be taught to take reasonable care of books, but they must not be made afraid of them. A set of well-thumbed books is a finer testimonial to a school than a set of immaculate volumes. To tempt the children on to more serious books is part of the teacher's task. Once they have caught the reading habit they may be diplomatically led on to something a little better. The longer works of Dickens and other standard authors may be tackled, provided the teacher knows how to put forward what is best, and how to pass over what is likely to be tedious or unintelligible. Valuable books of voyages, travel, biography should also be brought into their ken. Books for information will include books too difficult to read as a whole, but not too difficult to be used for reference or simpler research. Boys of 13 cannot be expected to read a whole history of English literature, but they ought to be able to consult one. Again, when reading a play of Shakespeare they should have at hand a life of Shakespeare, and a glossary of Shakespeare and other similar books. Among the books of reference Whitaker's Almanac should have an honoured place, especially in those schools where the daily paper is used to stimulate curiosity (by extracts on current events being placed on the notice-board).

Both for pleasure and for profit, a close touch should be established with the local free library wherever one exists. Many free libraries have a juvenile section including sometimes a junior reading room, and work in full co-operation with the elementary school. Private reading makes a full child, and should be one of the best antidotes to the elementary pupils' faults of thinness and discontinuity in reading. The large sale of such series as the Everyman Library, the Home University Library, etc., is clear evidence of the great advance in the standard of popular reading since the beginning of the century. The reference library for teachers must not be forgotten. It ought to be not merely for reference but for more extensive reading. The more advanced local authorities not only provide circulating libraries of books for children, often with the aid of the Carnegie Trust, but have also central libraries where teachers can borrow or consult books connected with any side of learning and culture.

A similar revolution has taken place in the English secondary schools. Books for individual reading are available in class

libraries or in the general section of the library. The most advanced schools draw up lists of story books, often in modern languages, suitable to the age and the class. Some teachers go still further and keep a register under each pupil's name of the books read, which enables them to see that each pupil takes out at least one book per term. Others devote part of the English lesson to description or discussion by the individual pupils of the books read. In spite of the bad name the holiday task has acquired in some instances, a good deal of voluntary reading is done in the holidays. An excellent system is to have a list of books for the pupils to buy and read in the holidays throughout their school life. In this way practically every child on leaving the school has voluntarily purchased and read a nucleus library of some 20–30 books.

Reference libraries have developed in the same fashion, being open alike to the teachers and the children, especially in cases where the Dalton plan has been adopted. Advanced courses have given them a further impetus, as a good reference library in all subjects is indispensable to the advanced student. Local authorities now often make yearly grants for libraries to their elementary and secondary schools. But in spite of much that has been done there still remains a great deal to do in the way of raising all schools to the level of the best and in making the reference library sufficiently comprehensive to meet the requirements of the curriculum and the needs of the teachers.

Similar developments have taken place in the Evening Institutes and Training Colleges and the introduction in the universities of Seminar Libraries in different subjects also marks a great advance. Mention should also be made here of the Central Library for students as well as that in connection with the Workers Education movement, while the Board of Education Library with its 60,000 books and pamphlets is of special interest to teachers and students of education. (G. SN.; C. BR.)

SCHOOL MEALS. The feeding of needy children of school age was first started in France by the institution of *cantines scolaires*. Pioneer work of a similar kind was established at Manchester, Bradford, London and other large towns in the later years of the 19th century. Meals thus provided were usually breakfasts.

The report of the Physical Deterioration Committee published in 1904, and that of the royal commission on physical training in Scotland, published in 1903, led to the appointment by Lord Londonderry of an inter-departmental committee which, in 1905, reported that feeding schemes were in operation in about one-third of the non-county boroughs and urban districts, but that little was being done in the county areas. By the Education (Provision of Meals) Act, 1906, local education authorities were empowered to spend money out of the rates and to recover from parents the whole or part of the cost of the meals supplied, except where the parent was unable to pay. These provisions were consolidated in the Education Act, 1921.

As the chief medical officer of the Board of Education wrote in his annual report (1927), "The problem is not the relief of poverty, but the prevention or amelioration of undernourishment." In that year 389,828 individual children were fed by 173 education authorities in England and Wales; the number of children fed was twice as many as in 1913, while the total number of meals provided was five times as many.

In the United States, school lunches were primarily intended for children suffering from malnutrition, but of recent years, educational authorities in the larger cities have realized that the provision of proper food during the noon intermission for all pupils is now a part of the general educational movement.

SCHOOLS, ANCIENT. This article deals with the history of Greek and Roman schools, from which modern schools are derived. For modern schools *see* SCHOOL AND CURRICULUM and for a general historical sketch *see* EDUCATION.

GREEK SCHOOLS

First Phase.—The term and the institution date, not from the great or what may be called the Hellenic age of Greece, but from the later Macedonian or Hellenistic period. The account given by K. I. Freeman in his *Schools of Hellas* (1907) may be summed up in the statement, "There were no schools in Hellas." That is, there were no schools in the modern sense, where, during boyhood and youth, boys spent their whole time in a continuous course of instruction. There were professional teachers of three kinds: (1) the *grammatistes*, who taught reading, with writing and perhaps arithmetic, in the *grammateion;* (2) the *citharistes*, who taught music, *i.e.*, playing and singing to the cithara; (3) the *paedotribes*, who taught gymnastic, wrestling, boxing, running, jumping, throwing the javelin, etc., in the *palaistra.* To these teachers the boys were taken by slaves, called boy-leaders (παιδαγωγοί, whence our pedagogues), as single pupils, and were not taught in classes.

Roughly, the age for the grammar-school and song-school was 7 to 14, for the gymnastic school 12 to 18. A certain amount of literature was imparted, and especially in the song-school, Homer and other early poets, the very Bibles of Hellas, were learnt by heart. In later days, under the Sophists, and Socrates, "the greatest of the Sophists," 450–400 B.C., something approaching secondary education was developed. But it was wholly unorganized. The itinerant orators or rhetoricians taught oratory, and the learning that was considered necessary to the political orator, a smattering of Greek history, constitutional law and elementary logic. The philosophers, such as Protagoras, discoursed vaguely on natural science, "things in the heavens above and the earth beneath," and divinity, "whether there are gods or not," mathematics and ethics, or any subject which attracted them, while the lawyers, in the same unsystematic way, taught what law was necessary in a State where the Constitution was at the mercy of chance majorities in a sovereign assembly of 30,000 people, and trials at law were settled by 600 jurymen-judges.

Second Phase.—In the next generation, the orators and the philosophers, by settling down in fixed places, began to establish something more like schools. Plato, though like his master Socrates he taught without asking fees, was the first to give a regular educational course extending over three or four years, and in a fixed place, the Academy. The gymnasium was originally a parade or practice ground for the militia or conscript army of the State, which derived its name from the exercises being in that climate performed naked (γυμνός). At the age of 15 or 16 the boys left the palaestra, or private gymnasium, for this public training school, maintained at the public expense, preparatory to their admission as youths (ἔφηβοι), to take the oath of citizenship and undergo two years' compulsory training in regiments on the frontier. After those two years were over, they still required continuous exercise to keep themselves in training; consequently men of all ages, from 16 to 60, were to be found in the gymnasium. Though the gymnasium was free, the teachers and trainers in gymnastics were paid, and as the poorer citizens had to earn their own living, the Athenian gymnasium, like the modern university, was for educational purposes chiefly frequented by the well-to-do. So the Academy became a fashionable lounge, and here developed the walking and talking clubs, which became the Platonic or Academic Schools. Logic and ethics, built on a foundation of geometry and mathematics, seem to have been the staple subjects. An inner circle met, and dined together in Plato's private house and garden, close to the Academy. Plato devised the house and garden to his successor Speusippus, who passed them on to Xenocrates. They thus became the first endowment of the first endowed college, which grew very rich and lasted till the disestablishment and disendowment of the old learning by Justinian in A.D. 529. Aristotle, a pupil of Plato for 20 years, set up a school of his own in the Lyceum, another public gymnasium, where he lectured twice a day, in the morning esoterically to the inner circle of regular attendants, in the afternoon to the public. From these two institutions three nations of Europe have derived three different terms for a school, the Germans their gymnasium, the French their lycée, and the Scotch their academy. Yet none of the originals was a school in any real sense of the word. In the days of their founders they were like discussion forums; at the most, courses of lectures. In later years, the gilded youth who flocked to Athens from the whole Graeco-Roman world were en-

rolled among the ephebi, and the so-called "university of Athens" was evolved.

Third Phase.—It is to the Alexandrines, either to Antiodorus or to Eratosthenes, *c.* 250 (J. E. Sandys, *Hist. of Classical Scholarship,* 7), that grammar, as a term and a science, which included literary criticism and scholarship, and the grammar school are due. The earliest extant treatise on grammar is by Dionysius of Thrace (born *c.* 146), a pupil of the Homeric critic, Aristarchus. It defines grammar as "the practical knowledge of the usage of writers of poetry and prose" and includes exegesis or explanation of the author in the widest sense as well as mere verbal or syntactical grammar. It was from the term thus understood that the grammar school (*scola grammaticalis*), the term which described the typical secondary school from that day to 1869, derived its denotation and its connotation. Throughout the 13 centuries which intervened between Dionysius Thrax and Dr. Kennedy, Dionysius's grammar was the standard work and the foundation, directly or indirectly, of all other grammars, while the grammar school has always meant, and, in the hands of the better class of teachers, has always been, not a gerund-grinding machine, but a place for the training and exercise of the mind by the study of literature. The word "school," as well as the word "grammar," seems to be due to Alexandria. The first known use of it in that sense seems to be in Dionysius Halicarnassus' Letter to Ammaeus, *c.* 30 B.C. But as Plautus (*c.* 210) uses the corresponding Latin term, *ludus literarius,* some two centuries earlier, we may safely infer that he used it as a translation of grammar school.

ROMAN SCHOOLS

First Stage.—At Rome schools began with intercourse with Greeks. According to Suetonius, the emperor Hadrian's secretary, who wrote *The School Masters* (*De grammaticis*) about A.D. 140, literary teaching and the science of grammar began with Livius Andronicus, a Greek from Magna Graecia in the south of Italy, who, being brought to Rome as a slave in 272 B.C., became a freedman, translated the *Odyssey* into Latin, and taught both Greek and Latin. Ennius, the first Latin poet, was also half-Greek, and came to Rome in 209 B.C., where he also taught both languages. According to Plutarch (*Quaest. Rom.* 59) the first grammar school (*grammatodidaskaleion*) was opened by Spurius Carvilius, a freedman of Carvilius, about 230 B.C. According to Suetonius, Crates, who about 169 B.C. came to Rome as ambassador from Attalus, king of Pergamum, a great centre of learning, and was kept there by a broken leg, occupied himself in giving lectures. His example was soon followed by Romans. Schools of grammar, in which, even as late as Cicero's time, the Laws of the Twelve Tables were the chief text-book and were learnt by heart, were kept by Greeks or freedmen. These seem to have been of the nature of elementary schools. But at Rome, as at Athens, the working-classes were for the most part slaves; and elementary schools were like English preparatory schools rather than public elementary schools. Schools of rhetoric, which were more like secondary schools, were also opened after the model of that of Isocrates at Athens. In 92 B.C. schools of Latin rhetoric were put down as an innovation. Yet among the treatises written by Cato, the praiser of the past at the expense of the present, was one on public speaking, the chief rule in which was "take care of the sense, and the sounds will take care of themselves." Neither the gymnasium or palaestra, nor the music school, flourished at Rome. As at Athens, so at Rome the boys were sent to school in charge of a slave, a *pedagogus, comes* or *custos.* But it would seem that at Rome the pedagogus, generally a Greek slave, often himself gave elementary instruction. In Varro's much-debated phrase, "Educat nutrix, instituit pedagogus, docet magister," "the nurse brings up, the pedagogue instils the elements, the master teaches." *Magister*, which in English became "maister" and then "master," remained the term for the teacher of the public school from that day to this, though attempts were made at the time of the Reformation to introduce the Greek word *didascalus* in its place.

The Roman school was very much like the modern school. All the methods of torture which have made the service of the Muses for most boys a veritable slavery were in full vogue. Instruction was now in a foreign language, and grammar became prominent. Early rising, loud speaking and hard flogging were in the ascendant. The staple of instruction in the Roman schools was the works of the poets, Greek and Latin, Homer and Virgil, Hesiod and Aesop, Menander and Terence. Horace says (*Ep.* i. 19. 40) "that he was not thought worthy of going the round of the schoolmasters' desks"; but it was a fate not long delayed, and the writings of the poets of the silver age, Lucan and Statius, became school-books in their own lifetimes.

Our knowledge of the Roman curricula is mainly due to Quintilian's *Institutio oratoria, c.* A.D. 91. Fabius Quintilianus, born on the banks of the Ebro, was not only the son of a man who kept a rhetoric school, but himself kept one, and is said by St. Jerome to have been the first who kept a public school, in the sense that he was the first who received a stipend from the emperor. In endeavouring to create the perfect orator, Quintilian discusses the whole of education from the cradle upwards.

Second Stage.—The first definitely endowed school we hear of is one founded by Pliny the younger, a pupil of Quintilian, at his native place Como. Later historians say that the emperor Antoninus Pius (138–161) assigned offices and salaries (*honores et salaria*) for rhetoricians throughout the provinces; and that Alexander Severus did the same, and also established exhibitions for poor boys, with the limitation, curiously repeated a thousand years later in the statutes of All Souls College and of Eton, *modo ingenuos, i.e.,* provided only that they should be free-born.

There were complaints that the masters were ill-paid. Quintilian made a fortune by his school, but Juvenal calls him in this respect a white crow.

Later Schools.—Grammar and rhetoric schools spread throughout the Roman world and continued substantially unchanged in method and subject to the days of Gregory the Great and Augustine the apostle of the English. The *Confessions* of St. Augustine of Hippo, a schoolmaster at Carthage, Rome and Milan, before his baptism in the year 387, and the poems of his contemporary Ausonius, educated in the grammar school at Toulouse, and himself a schoolmaster at Bordeaux before becoming prefect of Illyria and of Gaul, show that the schools were much the same in the 4th century as in the first. Ausonius celebrated in verse all the Bordeaux schoolmasters, some coming from schools at Athens, Constantinople, Syracuse and Corinth, one the son of a Druid at Bayeux, others schoolmasters from Poitou, Narbonne, Toulouse, who went to Lerida and other places in Spain. Ausonius had for his pupil the emperor Gratian, who in 376 established a legal tariff for schoolmasters' salaries. "In every town which is called a metropolis, a noble professor shall be elected." The rhetoric master (rhetor) was to have at least 24 annonae (an annona being a year's wages of a working man); while the grammar masters were to receive half that. But at Trier, then the capital of the Western empire, the rhetor was to have 30, the Latin grammarian 20, and the Greek grammarian, if one could be found, 12 annonae (*Cod. Theod.* xiii. 3. 11). The same century saw Priscian, a schoolmaster at Constantinople, compose the Latin grammar, which, itself for the most part a mere translation from Greek, reigned without a rival till the Reformation, and is represented by over 1,000 mss. Venantius Fortunatus, educated in the grammar school at Treviso, wrote in 570 a life of St. Martin of Tours in three books of hexameter verse, and lives of saints and bishops. His era was one of transition, and marks the passing of the schools from secular to ecclesiastical control. His contemporary Pope Gregory in a letter to Desiderius, "bishop of Gaul," at Vienne commends the monks whom Gregory was sending with Laurence the priest and Mellitus the abbot to Augustine of Canterbury, thus bringing the grammar-school-teaching bishop into direct connection with the conversion of the English, and the foundation of the first English school.

SCHOOLS, EVENING, schools open in the evening to enable those working during the day to continue their education. Evening schools in Great Britain are discussed under COMMERCIAL EDUCATION, CONTINUATION SCHOOLS and TECHNICAL EDUCATION. The following article describes the work in the United States.

Evening schools in the United States for apprentices and others were opened in New York (1833) and Louisville, Ky., (1834). Ohio (1839) enacted legislation requiring towns to provide evening schools for males over 12 years of age. Massachusetts (1847) permitted towns to appropriate money for instructing adults in reading, writing, English grammar, arithmetic and geography. By 1862 Cincinnati, San Francisco, St. Louis, Chicago, New Orleans and other cities to the number of at least 15 had conducted free public evening schools. Thirty-two cities reported such schools in 1881, and the report of the U.S. bureau of education for 1887–88 showed a total enrollment in cities of 8,000 or more of 135,654. The enrollment for 1925–26 was 937,-736 pupils, of whom slightly less than half were girls.

Classes are maintained in Americanization work, elementary, high school and vocational subjects. The objectives of Americanization work are to teach immigrants to speak, read and write English; to aid them to get an understanding of American institutions; and to prepare them to take out citizenship papers. Many employers co-operate helpfully in this work, and sometimes pay part or all of the expenses of these classes. Elementary classes are for those who wish to obtain further instruction in subjects usually covered in day grade schools. High school classes enroll pupils who wish to pursue work of high school grade in English, history, mathematics, science and classical or modern languages, and also offer courses in such fields as choral singing, dancing, art work and business law. Vocational courses range from work which appeals to an avocational interest in fancy work or manual arts to specific vocational training for office workers, housekeepers and apprentices and journeymen in industrial trades. A typical relative demand is shown in a registration of 200,000 different persons in one year in New York State schools. About $\frac{1}{5}$ were enrolled in Americanization classes, $\frac{1}{4}$ in academic high school subjects, $\frac{1}{5}$ in commercial subjects, $\frac{1}{10}$ in home economics, $\frac{1}{5}$ in industrial, and $\frac{1}{25}$ in elementary subjects.

Pupils usually attend evening school two hours per night for two or three evenings per week, from Oct. 1 to April 1. By increasing the time allotment, Cincinnati, Chicago, Boston, Philadelphia and other cities offer an evening school diploma equivalent to that of the day high school. Rural evening schools have developed an enrollment of more than 15,000. This work is essentially for adult men, and is strictly vocational. The growth of evening schools, more than seven-fold in 50 years, has been phenomenal.

The evening school in the United States, excepting Americanization classes, is chiefly for young working people. The pupils average about 19 years in age and are about equally divided as to sex. (O. D. E.)

SCHOOLS OF ART. As institutions, art schools are comparatively recent. The first signs of organization were perhaps in the Middle Ages when the arts and trades were controlled by guilds. Courses of instruction, promotions, competitions, and general advisory councils were in existence at that time in the more important art centers of England, France, Germany, and, especially, Italy. However, such organizations did not take the place of personal instruction by the masters of the arts, fine and applied. It was to the great artists that pupils looked for supervision, and the term "school" as applied to these masters (such as the school of Michelangelo) has no connection with organized institutions. The 19th and early 20th centuries have seen the birth and development of innumerable art schools, especially in countries where the government has made appropriations for such educational work, but this advancement has not meant the obliteration of personal instruction under pre-eminent artists and it is not uncommon to find students who have never attended an art school. This "personal supervision" system of study has its weaknesses, chief among which is the tendency toward imitation. The artist, in imparting the secrets of his craft, as well as certain generally established laws and traditions, stands pre-eminent, and it is often difficult for his pupils so to forget the tricks and mannerisms of their master as to become individualists themselves.

The modern school of art had its inception perhaps in the Royal Academy of Fine Arts, which was founded in Paris in 1648 and has been running ever since. Like this institution, most schools have their departments of painting, sculpture, architecture, engraving, etc., with the allied arts, in which such divisions as the history of art, theory and practice of design, perspective, etc., are taught in regular classes. Free-hand drawing, involving the co-ordination of hand and eye, is generally used as the foundation upon which most of the training is based. While considerable study is required in history, theory, and in the necessary rules for good design, the emphasis in most modern schools of art is placed upon the actual studio work. With the development of museums where design may be studied from the collections of art work more and more importance is given to observation classes. In many of the municipal museums, especially in the United States, an art school is conducted in connection with the museum (*see* MUSEUMS). For pupils interested in the industrial arts most schools have branches for detailed technical instruction in that field, such as pottery, basketry, carpet weaving, batik work, etc. However, this can be successfully taught only after the pupil has a working knowledge of the fundamentals of drawing and design. (*See* DRAWING.)

Public exhibitions, local and international, have perhaps been the greatest stimulus in the development of art schools in Europe and the United States. About the middle of the 19th century considerable competition in the industrial arts was started among the European countries, which meant decided progress in the manufacture and keener valuations in the design of the products of industry. This idea of competition, which later spread to the United States, has made itself manifest also in local exhibitions in the larger cities.

Of the many important schools of art only a few can be mentioned in the following list. (*See also* SOCIETIES OF ART; DESIGN; PAINTING; SCULPTURE; ARCHITECTURE; ART TEACHING.)

THE UNITED STATES

Special schools of art, many of which bear no relation to the public schools, have a powerful influence on art education in the United States. (*See* ART TEACHING.) While the state universities, larger high schools, and even the lower grades, often have an art department, where drawing and elementary design are taught, they do not provide courses for pupils specializing in one or more of the arts, but rather for those who take a regular course and are sufficiently interested in art to select it as one of many studies. Art schools are, therefore, established and controlled largely by art societies, boards of trustees, and private patronage, a very small number depending upon governmental aid. A few of the large cities maintain art schools, some connection with the museums, and charge only a small fee for admission.

The Departments of Fine Arts in the larger universities of the United States serve as important factors in maintaining the balance necessary for institutions that seek to give an insight to all the arts and sciences. Although most of these departments are closely allied with the College of Liberal Arts and Science, giving pupils who work toward a bachelor's degree the opportunity of choosing one or more of the arts as a "major" or "minor" study, there is a growing tendency to organize all the fine arts into a School of Fine Arts, which can then be divided into its various departments. The University of Pennsylvania is a good example, although it tends to specialize in architecture. In 1920 all of the various divisions of the university providing instruction in the fine arts were grouped together under the School of Fine Arts, viz: Department of Architecture, Department of Landscape Architecture, Department of Fine Arts, and Department of Music. In 1928 there were 31 instructors and 444 students in the school.

Of the other larger universities that have outstanding courses in the various arts, the following should be mentioned: (1) Yale University, School of Fine Arts, having four-year courses in architecture, drawing and painting, sculpture, and drama. The enrollment in 1927 was 705. (2) University of Michigan, College of Architecture, offering three programs, each requiring a minimum of four years. Two of these courses are in architecture, and one is a four-year course in decorative design which empha-

sizes interior decoration, with instruction in drawing, painting, and modeling as supplementary. (3) Carnegie Institute of Technology, College of Fine arts. The most important activity of this department, and the one which distinguishes it from others in the country, is the annual International Exhibition of Paintings. This exhibition has been held each year since 1896 with the exception of the years during the World War. The school intends to specialize in contemporary painting. Practically all of the paintings in the permanent collection date from 1896 or thereabout. (4) University of Illinois, Department of Architecture and Department of Art and Design. (5) University of Iowa, Department of Graphic and Plastic Arts. (6) University of Missouri, School of Fine Arts. (7) University of Nebraska, School of Fine Arts. (8) Columbia University, Department of Fine Arts (Teachers College). (9) New York University, Department of Fine Arts. (10) Syracuse University, College of Fine Arts. (11) Ohio State University, Department of Fine Arts. (12) University of Wisconsin, Department of Industrial Education and Applied Arts.

Of the art schools that are independent of State or municipal control, the better known ones are in the larger cities. In New York, the following list comprises the more important ones: (1) Art Students League of New York, which had an enrollment in 1927 of 2,850 pupils, 28 instructors, and a curriculum that included painting, drawing, illustration, sculpture, etching, lithography, composition, wood-block, sculptural wood-carving, stone cutting, and mural painting. As in most of the larger art schools, evening classes are offered for those who cannot attend during the day. (2) Beaux-Arts Institute of Design, with an enrollment in 1927 of about 2,000 students, and a course of instruction that covers largely architecture, mural painting and sculpture, and interior decoration. (3) Cooper Union, which is divided into a Night School of Art and a Woman's Art School with an enrollment in 1927–28 of 1,446 and 337, respectively. Tuition is free, and it holds a unique position in affording instruction to students who work during the day or whose means are limited. (4) Grand Central School of Art, founded in 1924, with the object of developing a note of individuality in every pupil. The fact that this institution is associated with the well known art galleries and in its first four years became one of the largest and best known of the country is particularly significant. It is self-supporting, and in 1927 had an enrollment of 875, with a faculty of 18 instructors. (5) Pratt Institute, Brooklyn, with 53 instructors and 1,498 pupils in 1927. This school is noted particularly for its work in the applied arts.

The School of the Art Institute of Chicago exerts great influence in the Middle West, and has perhaps the largest enrollment of any art school in the United States, having 4,662 for the school year of 1927–28. More than half of these attend the evening or the Saturday school. There were 69 instructors in 1927–28, serving the five specialized departments of Drawing, Painting and Illustration, Sculpture, Design, Teacher Training and Drama.

Other large and influential schools of art are: The Art Academy of Cincinnati; The Cleveland School of Art; Maryland School of Fine and Practical Arts; Art School of the Detroit Society of Arts and Crafts; St. Louis School of Fine Arts; School of Industrial Art of the Pennsylvania Museum.

Schools of industrial art, which center their interests on design as applied to industry, as well as to the decorative arts, are gaining ground in the United States. These schools must be distinguished from the schools of the fine arts, where painting, sculpture, and architecture predominate. Sometimes the industrial arts are taught in the same schools as the fine arts, but they are designated as different departments.

In the teaching of the arts, the growing tendency in America is toward the encouragement of individual expression as distinguished from the hard, tight, or academic style. The idea is that a thorough technical training may be secured without prejudicing the minds of the students in favor of any particular creed of art, leaving them free to express their own individuality without undue influence from their instructors, whose business it is to guide and develop rather than to encourage imitation.

(F. L. D.)

GREAT BRITAIN

The opening of an art school at Somerset House, London, in 1827 was a forerunner of the many provincial schools that followed. The Exhibition of 1851, at the Crystal Palace, was of untold influence not only in Great Britain but on the Continent. France had taken the lead in the industrial arts and the exhibition of her products in London caused an awakening as to the advantages in organized training for art trades. In 1889 the Technical Instruction Act was passed and in 1897 the Royal College of Art was inaugurated, the latter being perhaps the greatest factor in the movement toward national art education. The Education Act of 1902 meant that art became a definite subject in the curriculum of English elementary and secondary education. The Burnham scales of salaries for teachers and the Pension Act of 1925 have meant a higher standard of art teaching.

Some of the important schools of art in Great Britain and Ireland are: *London*: Royal College of Art, London County Council Central School of Arts and Crafts, St. John's Wood Art Schools, Glade School at University College, School of Art of the Royal Academy; *Bristol*: University of Bristol, Merchant Venturers' College; *Edinburgh:* College of Art; *Glasgow:* School of Art, Technical College; *Liverpool*: University of Liverpool; *Manchester*: Municipal School of Art; *Cheltenham*: School of Arts and Crafts; *Derby*: School of Arts and Crafts; *Dover*: School of Art; *Dublin:* Metropolitan School of Art, Hibernian Academy of Art; *Leeds:* School of Art, Hudders' Field, Technical College; *Newcastle:* Aermstrong College; *Nottingham:* Municipal School of Art and Design; *Reading:* University College.

THE CONTINENT

France.—*Paris*: The *École Nationale des Beaux-Arts,* with departments of architecture, sculpture, painting and engraving, is free to the French and admits a limited number of foreigners. The *École Nationale des Arts Décoratifs* gives a general training in the decorative arts, with special courses in decorative paintings, decorative sculpture, tapestry and glass. The *École du Louvre* is a graduate school of the history and theory of the arts, using the collections of the Louvre for illustration and research. The *École des Hautes Etudes Urbaines* specializes in city planning and decoration, and urban administration. It is a graduate school for men. The *École Centrale d'Architecture* is a private incorporated school recognized officially as an "institution d'utilite publique." There are also in Paris many private schools of drawing and painting, the most celebrated being the *Atelier Julien* and the *Atelier L'Hôte*. The *École d'Art Animalier* of M. Navalier, for sculptors of animal life, is of high repute. The New York School of Fine and Applied Arts, directed by Professor Parsons, maintains a branch at Paris for American students, especially those who cannot speak French.

Italy.—An *Istituto di Belle Arti,* a government-controlled art school, is found at Florence, Bologna, Lucca, Modena, Naples, Palermo, Parma, Venice and Siena (provincial). In Milan, Perugia, and Ravenna similar art schools are known as *Accademia di Belle Arti.* The *Istituto Superiore di Belle Arti* is at Rome.

Spain.—There are in most of the provinces elementary schools of Arts and Crafts or Fine Arts where design and modeling are taught. The various higher institutions of learning also have art classes. Among the important schools of art in Madrid are: *Escuela especial de Pintura, Escultura y Grabado,* in Calle de Alcalá. The *Escuela Superior de Bellos Oficios* is in Barcelona.

The Netherlands.—The following are the chief schools of art: *Amsterdam:* The State Academy of Fine Arts, The Central Institute for Decorative and Industrial Arts; *The Hague:* Academy of Fine Arts; *Rotterdam*: Academy of Fine Arts and Applied Sciences; *Haarlem*: School of Architecture, Decorative Arts and Trade Arts; *Utrecht*: Museum School of Industrial Arts.

Belgium.—As an art center, Brussels has one of the largest and most active art schools of the world, the *Academie Royale des Beaux-Arts et École des Arts Decoratifs.* This school had its inception when in 1711 the Magistracy of Brussels gave a room in

the *Hotel de Ville* to the Deans of Painters, Sculptors, and Decorators to practice their art there. From this beginning it has ever since, excepting periods of war, received substantial patronage; the great families of Brussels vied with one another in giving gifts of money and of models. (X.)

Outside of Paris.—The *École Nationale des Beaux-Arts de Lyon,* at Lyons, is modeled after the one of the same name in Paris. Other Beaux-Arts schools are at Dijon and Algiers, North Africa. "Regional" schools, supported by the State, provide free instruction in industrial and decorative arts at Amiens, Clermont-Ferrand, Montpellier, Nancy, Reims, Rouen, St. Étienne and Tours. There are many "Municipal" art schools, also maintained by the State, and a few independent schools of very high rank. Four *Écoles Nationales des Arts Décoratifs,* three *Écoles Nationales Speciales,* and two Regional Schools of Industrial Art are also of interest. Information concerning the various art schools may be secured from the American University Union, Paris.

Germany and Austria.—The leading art schools of Germany are the government-managed "Kunstakademien." Of the various institutions in the individual cities, including also some "Kunstgewerbeschulen" (schools for applied art) the following may be mentioned: Berlin: *Akademische Hochschule für die bildenden Künste, Akademisches Meisteraltelier für die bildendem Künste, Preussiche Akademie der Kunst, Unterrichtsanstalt des Kunstgewerbemuseums;* Breslau: *Akademie für Kunst und Kunstgewerbe;* Dresden: *Akademie der bildenden Künste, Staatliche Akademie für Kunstgewerbe;* Frankfort: *Städtische Künstgewerbeschule;* Hamburg: *Staatliche Kunstgewerbeschule;* Hanover: *Kunstgewerblicher Unterricht für Frauen und Mädchen;* Cologne: *Kunstgewerbe und Handwerkerschule der Stadt Köln;* Leipzig: *Staatliche Akademie für graphische Künste und Buchgewerbe;* Munich: *Bayerische Akademie der bildenden Künste, Staatliche Kunstgewerbeschule München,* and *Malschule der Stadtischen Kunstgewerbeschule.* Other important art schools are at Cassel, Karlsruhe, Konigsberg, Potsdam, Stuttgart and Weimar. In Austria the *Kunstgewerbe Schule* in Vienna is of outstanding importance as well as the *Akademie der Bildenden Künste.*

SCHOPENHAUER, ARTHUR (1788–1860), German philosopher, was born at Danzig on Feb. 22, 1788, the son of a wealthy merchant, who removed to Hamburg in 1793 when the free city, for which he had the strongest patriotic feeling, surrendered to Prussia. His mother, *née* Johanna von Trosiener, who was 20 years younger than her husband, became a novelist of repute. The marriage was an unhappy one, and the two children, Arthur and Adèle, suffered in their nerves. The elder Schopenhauer wanted his children to see the world, and they spent much time in Holland, France and England.

Education.—The son's education was intermittent. He spent two years (1797–99) at Havre, four years in an elementary school at Hamburg, six months in England, and then entered a merchant's office in Hamburg. He had been there for three months when his father, who had shown signs of mental malady, fell or threw himself into the canal.

His mother settled in Weimar, where she gathered round her a small salon. Arthur left his merchant's office, and spent two years in studying the classics. In 1809 (aged 21) his mother handed over to him the third part of the paternal estate, which gave him an income of £150, and in Oct. 1809 he entered the University of Göttingen, where he read especially Plato and Kant. Among his few acquaintances were Bunsen, the subsequent scholar-diplomatist, and Bunsen's pupil, W. B. Astor. Even then he found his trustiest mate in a poodle. After two years at Göttingen he took two years at Berlin, where he heard Fichte and Schleiermacher. Here he also dipped into various fields of learning, notably into the classics under Wolf. Between 1811 and 1813 the lectures of Fichte (later published by Schopenhauer from his notes in his *Nachgelassene Werke*) dealt with what he called the "facts of consciousness" and the "theory of science," and struggled to present his final conception of philosophy. Though Schopenhauer listened usually in opposition, his speculation was undoubtedly influenced by Fichte.

In Berlin Schopenhauer was lonely and unhappy. One of his interests was to visit the Hospital La Charité and study the evidence it afforded of the interdependence of the moral and the physical in man. In the early days of 1813 sympathy with the national enthusiasm against the French carried him so far as to buy a set of arms, but no farther. He hurried away to the quiet Thuringian town of Rudolstadt, where, in the inn "Zum Ritter," he wrote, helped by books from the Weimar library, his thesis for the degree of doctor in philosophy at Jena. His first book, *Über die vierfache Wurzel des Satzes vom zureichenden Grunde* (1813), appeared at Rudolstadt. In the winter of 1813 Schopenhauer spent a few months at Weimar with his mother. But the strain of daily association was too much for their antagonistic natures. His splenetic temper and her volatility culminated in an open rupture in May 1814. From that time till her death in 1838 Schopenhauer never saw his mother again. At Weimar he made some acquaintances who influenced the course of his thought. Conversations with the orientalist, F. Mayer, directed his studies to the philosophical speculations of ancient India, made available in Friedrich Schlegel's *Language and Wisdom of the Old Hindus,* and Anquetil Duperron's version of the *Upanishads.* Most important was his contact with Goethe, who interested him in his investigations on colours. Schopenhauer took up the subject in earnest, and wrote *Über das Sehen und die Farben* (1816). The essay was written at Dresden, where he settled after the rupture with his mother. It had been sent in ms. to Goethe in the autumn of 1815, who, finding in it a transformation of his own ideas, inclined to regard the author as an opponent.

"The World as Will and Idea."—The interest of his life at Dresden was the composition of a work which should give expression in all its aspects to the idea of man's nature and destiny which had been gradually taking shape in his mind. More and more he learned from Cabanis and Helvetius to see in the will and the passions the determinants of intellectual life, and in the character and the temper the source of theories and beliefs. The conviction was borne in upon him that scientific explanation could never do more than systematize and classify the mass of appearances which to our habit-blinded eyes seem to be the reality. To get at this reality and thus to reach a standpoint higher than that of aetiology was the problem of his as of all philosophy. It is only by such a tower of speculation that an escape is possible from the spectre of materialism, theoretical and practical; and so, says Schopenhauer, "the just and good must all have this creed: I believe in a metaphysic." The mere reasonings of theoretical science leave no room for art, and practical prudence usurps the place of morality. The higher life of aesthetic and ethical activity —the beautiful and the good—can only be based upon an intuition which penetrates the heart of reality. At the end of 1818 the book appeared (with the date 1819) as *Die Welt als Wille und Vorstellung* (*The World as Will and Idea*), in four books, with an appendix containing a criticism of the Kantian philosophy (Eng. trans. by R. B. Haldane and J. Kemp, 1883). Long before the work was published Schopenhauer had rushed off to Italy. He stayed for a time in Venice, where Byron was then living, but the two did not meet; he also visited Rome, Naples and Paestum. About this time the family fortunes of his mother and sister and himself were threatened by the failure of the firm in Danzig, and Schopenhauer showed considerable business ability in saving something from the wreck.

Life at Berlin.—After some stay at Dresden he began to lecture, without much success, in Berlin. He soon abandoned the attempt, attributing his failure to Hegelian intrigues. Thus, except for some attention to physiology, the first two years at Berlin were wasted. In May 1822 he set out by way of Switzerland for Italy. After spending the winter at Florence and Rome, he left in the spring of 1823 for Munich, where he stayed for nearly a year, the prey of illness and isolation. When, at the end of this wretched time, he left for Gastein, in May 1824, he had almost entirely lost the hearing of his right ear. Dresden, which he reached in August, no longer presented the same hospitable aspect as of old, and he was reluctantly drawn onwards to Berlin in May 1825. The next six years, in Berlin, were a dismal period in the life of Schopenhauer. Hegelianism reigned in the schools and in

literature and basked in the sunshine of authority. Schopenhauer fell into morbid meditations. The sexual passion had a strong attraction for him at all times, and, according to his biographers, the notes he set down in English, when he was turned 30, on marriage and kindred topics are unfit for publication.

Life in Frankfurt.—In 1833 he settled finally at Frankfurt, gloomily waiting for the recognition of his work, and terrified by fears of assassination and robbery. As the years passed he noted down every confirmation he found of his own opinion, already expressed in *Die Welt als Wille und Vorstellung,* in the writings of others, and every instance in which his views appeared to be illustrated by new researches. He gave each *aperçu* a place in his alphabetically arranged note-book. Everything he published in later life may be called a commentary, an excursus or a scholium to his main book. Meanwhile he grew more and more embittered by the neglect of his own work and the triumph of the Hegelians. His accumulated ill-humour found vent in the wild outcry against the philosophy of the professoriate, entitled *Über den Willen in der Natur* (1836; revised and enlarged, 1854; Eng. trans., 1889). In 1841 he published, under the title *Die beiden Grundprobleme der Ethik,* two essays which he had sent in 1838–39 in competition for prizes offered by Norwegian and Danish academies of science; he was awarded the Norwegian prize but the Danish academy denied it to him, although he was the only competitor.

Final Recognition.—In 1844 appeared the second edition of *Die Welt als Wille und Vorstellung* (2 vols.). The first volume was a slightly altered reprint of the earlier issue; the second consisted of a series of chapters forming a commentary parallel to those into which the original work was now first divided. The longest of these new chapters deal with the primacy of the will, with death and with the metaphysics of sexual love. But, though only a small edition was struck off (500 copies of vol. i. and 750 of vol. ii.), the report of sales which Brockhaus rendered in 1846 was unfavourable, and the price had afterwards to be reduced. Yet there were faint indications of coming fame, and Schopenhauer welcomed eagerly each new tribute from critic and admirer. His principal admirer was Frauenstädt, who made his personal acquaintance in 1846. It was Frauenstädt who succeeded in finding a publisher for the *Parerga und Paralipomena,* which appeared at Berlin in 1851 (2 vols., pp. 465, 531; selected trans. by J. B. Saunders, 1889; French by A. Dietrich, 1909). For this bulky collection of essays, philosophical and others, Schopenhauer received as honorarium only ten free copies of the work. Soon afterwards, Dr. E. O. Lindner, assistant editor of the *Vossische Zeitung,* began a series of Schopenhauerite articles. Amongst them may be reckoned a translation by Mrs. Lindner of an article by John Oxenford which appeared in the *Westminster Review* for April 1853, entitled "Iconoclasm in German Philosophy," being an outline of Schopenhauer's system. In 1854 Frauenstädt's *Letters on the Schopenhauerean Philosophy* showed that the new doctrines were becoming a subject of discussion, and the University of Leipzig offered a prize for the best exposition and examination of the principles of Schopenhauer's system. Between 1847 and 1860 new editions of his works were called for. In 1854 Richard Wagner sent him a copy of the *Ring of the Nibelung,* with some words of thanks for a theory of music which had fallen in with his own conceptions. Schopenhauer died at Frankfurt on Sept. 21, 1860.

His Philosophic System.—More than others the philosopher leads a second life in the spirit or intellect alongside of his life in the flesh—the life of knowledge beside the life of will. It is inevitable that he should be especially struck by the points in which the sensible and temporal life comes in conflict with the intellectual and eternal. It was thus that Schopenhauer by his own experience saw in the primacy of the will the fundamental fact of his philosophy; and found in the engrossing interests of the selfish ἔρως the perennial hindrances of the higher life. For his absolute individualism, which recognizes in the State, the Church, the family only so many superficial and incidental provisions of human craft, the means of relief was absorption in the intellectual and purely ideal aims which prepare the way for the cessation of temporal individuality altogether. But theory is one thing and practice another; and he will often lay most stress on the theory who is most conscious of defects in the practice. It need not, therefore, surprise us that the man who formulated the sum of virtue in justice and benevolence was unable to be just to his own kinsfolk and reserved his compassion largely for the brutes, and that the delineator of asceticism was more than moderately sensible of the comforts and enjoyments of life. The philosophy of Schopenhauer, like almost every system of the 19th century, can hardly be understood without reference to the ideas of Kant. But in various ways a reaction arose against this absorption of everything in reason. In Fichte the source of being is primeval activity, the groundless and incomprehensible deed-action (*That-Handlung*) of the absolute ego. The innermost character of that ego is an infinitude in act and effort. "The will is the living principle of reason," he says again. "In the last resort," says Schelling (1809), in his *Inquiries into the Nature of Human Freedom,* "there is no other being but will. *Wollen ist Ursein* (will is primal being); and to this alone apply the predicates fathomless, eternal, independent of time, self-affirming." Idealism was never without a protest that there is a heart of existence, life, will, action, which is presupposed by all knowledge and is not itself amenable to explanation. We may, if we like, call this element, which is assumed as the basis of all scientific method, irrational—will instead of reason, feeling rather than knowledge.

It is under the banner of this protest against rationalizing idealism that Schopenhauer advances. But what marks out his armament is its pronounced realism. He fights with the weapons of physical doctrine and on the basis of the material earth. He knows no reason but the human, no intelligence save what is exhibited by the animals. He knows that both animals and men have come into existence within assignable limits of time, and that there was an anterior age when no eye or ear gathered the life of the universe into perceptions. Knowledge, therefore, with its vehicle, the intellect, is dependent upon the existence of certain nerve-organs located in an animal system; and its function is originally only to present an image of the interconnections of the manifestations external to the individual organism, and so to give to the individual in a partial and reflected form that feeling with other things, or innate sympathy, which it loses as organization becomes more complex and characteristic. Knowledge or intellect, therefore, is only the surrogate of that more intimate unity of feeling or will which is the underlying reality—the principle of all existence, the essence of all manifestations, inorganic and organic. And the perfection of reason is attained when man has transcended those limits of individuation in which his knowledge at first presents him to himself, when by art he has risen from single objects to universal types, and by suffering and sacrifice has penetrated to that innermost sanctuary where the euthanasia of consciousness is reached—the blessedness of eternal repose.

Schopenhauer disputes the claims of reason to priority and seeks to demonstrate the relativity and limitations of science. Science, he says, is based on final inexplicabilities; and its attempts by theories of evolution to find an historical origin for humanity in rudimentary matter show a misconception of the problem. In the successions of material states there can nowhere be an absolute first. The true origin of man, as of all else, is to be sought in an action which is everlasting and which is ever present: *nec te quaesiveris extra.* There is a source of knowledge within us by which we know, and more intimately than we can ever know anything external, that we will and feel. That is the first and the highest knowledge, the only knowledge which can strictly be called immediate; and to ourselves we as the subject of will are truly the "immediate object." It is in this sense of will—of will without motives, but not without consciousness of some sort—that reality is revealed. Analogy and experience make us assume it to be omnipresent. It is a mistake to say will means for Schopenhauer only force. It means a great deal more; and it is his contention that what the scientist calls force is really will. In so doing he is only following the line predicted by Kant (*Kritik* trans. anal., bk. ii., appendix) and anticipated by Leibniz. If we wish, said Kant, to give a real existence to the thing in itself or the noumenon we can only do so by investing it with the attributes found in our

own internal sense, viz., with thinking or something analogous thereto.

It is thus that Fechner in his "day-view" of things sees in plants and planets the same fundamental "soul" as in us—that is, "one simple being which appears to none but itself, in us as elsewhere wherever it occurs self-luminous, dark for every other eye, at the least connecting sensations in itself, upon which, as the grade of soul mounts higher and higher, there is constructed the consciousness of higher and still higher relations" (*Über die Seelenfrage*, p. 9, 1861). It is thus that Lotze declares (*Mikrokosmus*, i., 408, 2nd. ed.) that "behind the tranquil surface of matter, behind its rigid and regular habits of behaviour, we are forced to seek the glow of a hidden spiritual activity." So Schopenhauer, but in a way all his own, finds the truth of things in a will which is indeed unaffected by conscious motives and yet cannot be separated from some faint analogue of non-intellectual consciousness.

Influence Upon the World.—In two ways Schopenhauer has influenced the world. He has shown with unusual lucidity of expression how feeble is the spontaneity of that intellect which is so highly lauded, and how overpowering the sway of original will in all our action. He thus reasserted realism, whose gospel reads, "In the beginning was appetite, passion, will," and has discredited the doctrinaire belief that ideas have original force of their own. This creed of naturalism is dangerous, and it may be true that the pessimism it implies often degenerates into cynicism and a cold-blooded denial that there is any virtue and any truth. But in the crash of established creeds and the spread of political indifferentism and social distintegration it is probably wise, if not always agreeable, to lay bare the wounds under which humanity suffers, though pride would prompt their concealment. But Schopenhauer's theory has another side. If it is daringly realistic, it is no less audacious in its idealism. The second aspect of his influence is the doctrine of redemption of the soul from its sensual bonds, first by the medium of art and second by the path of renunciation and ascetic life. It may be difficult in each case to draw the line between social duty and individual perfection. But Schopenhauer reminds us that the welfare of society is a temporal and subordinate aim, never to be allowed to dwarf the full realization of our ideal being. Man's duty is undoubtedly to join in the common service of sentient beings; but his final goal is to rise above the toils and comforts of the visible creature into the vast bosom of a peaceful Nirvana.

Bibliography.—Complete works edit. by J. Frauenstädt (6 vols., Leipzig, 1873–74); with notes and introduction, M. Brasch (3rd ed., Leipzig, 1891); E. Grisebach (6 vols., Leipzig, 1892). There are many translations of special works in all languages; among English translators are R. B. Haldane, T. B. Saunders, W. M. Thompson, A. B. Bullock. *Arthur Schopenhauers handschriftlicher Nachlass* was published by Grisebach in 4 vols. (1896), from mss. in the royal library at Berlin. On Schopenhauer's life *see* Gwinner, *Schopenhauers Leben* (1878); E. Grisebach, *Schopenhauer, Geschichte seines Lebens* (1897); J. Volkelt, *Schopenhauer* (1907). A list of works is given by Balan, *Schopenhauer-Literatur* (1880); *see* also G. F. Wagner, *Encyklopädisches Register zu Schopenhauers Werken* (1909), and W. L. Hertslet, *Schopenhauer-Register* (1890). Among earlier criticisms *see:* Frauenstädt and Lindner, *A. Schopenhauer; von ihm; über ihn* (1863); Helen Zimmern, *Schopenhauer and his Philosophy* (1877); O. Busch, *A. Schopenhauer* (1878); K. Peters, *Schopenhauer als Philosoph* (1883); Koeber, *Schopenhauers Erlösungslehre* (1881), and *Die Philos. A. Schopenhauers* (1888). More recent works are: T. Whittaker, *Schopenhauer* (1909); G. Simmel, *Schopenhauer und Nietzsche* (1907); F. Paulsen, *Schopenhauer. Hamlet. Mephistopheles* (1900), three studies in pessimism; T. Lorenz, *Zur Entwickelungsgeschichte der Metaphysik Schopenhauers* (1897); Mobius, *Schopenhauer* (1899); R. Lehmann, *Schopenhauer und die Entwickelung der monistischen Weltanschauung* (1892); and *Schopenhauer. Ein Beitrag zur Psychologie der Metaphysik* (1894); Th. Ribot, *La Philosophie de Schopenhauer* (9th ed., 1903); H. Bamberger, *Das Tier in der Philosophie Schopenhauers* (1897); Kuno Fischer, *Schopenhauer* (in the *Gesch. d. neuer. Philos.*, 1893); R. Böttger, *Das Grundproblem der Schopenhauerschen Philos.* (1898); W. Caldwell, *Schopenhauer's System* (1896); O. Damm, *Schopenhauers Ethik im Verhältnis zu seiner Erkenntnislehre* (1898) and *Schopenhauers Rechts- und Staatsphilosophie* (1901); W. Hauff, *Die Überwindung des Schopenhauerschen Pessimismus durch F. Nietzsche* (1904); M. Kelly, *Kant's Ethics and Schopenhauer's criticism* (1910). (W. Wal.; X.)

SCHORL, in mineralogy the name given to coarse black varieties of tourmaline (*q.v.*). Schorl was originally a mining term applied both to black tourmaline and to hornblende.

Schorl rocks are crystalline aggregates of quartz and tourmaline and occur almost always in association with tourmaline-bearing granites or pegmatites. They originate by the action of gases and vapours on granites, porphyries and other rocks. Sometimes direct pneumatolytic derivatives of the granite itself, they are also frequent as replacement products of the country rock into which the granite is intruded. The altered granite known as *luxullianite*, from its occurrence near Luxullian, a village in Cornwall, is a tourmalinized granite in which a progressive replacement of biotite and felspar by quartz and tourmaline can be traced. The rock still contains pink felspars in large porphyritic felspars set in a dark tourmaline matrix, giving polished specimens a handsome appearance. By impregnation with boron-bearing vapours, the slates and sandstones surrounding granites are locally converted into schorl rock, schorl schist, or tourmaline hornfels consisting almost wholly of quartz and tourmaline. Banding, lamination, or cleavage of the original slates, etc., is frequently preserved in these assemblages. (*See* also Pneumatolysis.) (C. E. T.)

SCHOULER, JAMES (1839–1920), American lawyer and historian, of Scotch descent, was born in West Cambridge (now Arlington), Mass., on March 20, 1839. He graduated at Harvard in 1859, taught a year at St. Paul's school in Concord (N.H.). studied law in Boston and was admitted to the bar in 1862. His legal practice was interrupted by service in the Union Army; and in 1869 he removed to Washington, where he opened a branch office and for three years published the *United States Jurist*. After his return to Boston, he devoted himself to office practice and to literary pursuits, lecturing also at Boston university, the National University law school, Washington (D.C.), and Johns Hopkins university. In 1896–97 he was president of the American Historical Association. He died at Intervale (N.H.), on April 16, 1920. His legal publications include treatises on domestic relations (1870), bailments (1880) and wills (1887). He is best known, however, as an historian, his most important work being a *History of the United States under the Constitution 1789–1871* (7 vols., 1880–1913). Among his other publications are *Historical Briefs* (1896), which contains his biography up to that period; *Constitutional Studies* (1897); lives of Thomas Jefferson (1893) and Alexander Hamilton (1901); *Americans of 1776* (1906); and *Ideals of the Republic* (1908).

SCHREINER, OLIVE (1862–1920), pen name of Mrs. Cronwright-Schreiner, was born in Basutoland, the daughter of a German missionary. In 1882 she brought to England the ms. of her first novel *The Story of an African Farm*, a vivid and penetrating study of the life she knew well, and submitted it to George Meredith, then reader for Chapman and Hall. It was published in 1883 by this firm over the pseudonym "Ralph Iron," and proved an immediate success, entirely surpassing any of her subsequent writings in literary merit. Her later work includes *Dreams* (1891); *Trooper Peter Halkett of Mashonaland* (1897), a much-criticized attack on the first settlers in Rhodesia; *An English South African's View of the Situation* (1899); and *Woman and Labour* (1911), a fragment of an earlier ms. which had been burnt during the South African War. She died at Cape Town on Dec. 12, 1920. She had married in 1894 S. C. Cronwright, a member of the Cape parliament, who afterwards took the name of S. C. Cronwright-Schreiner. He wrote *The Life of Olive Schreiner*, which appeared in 1923.

SCHREINER, WILLIAM PHILIP (1857–1919), was born in the district of Cape Colony. After studying law at Cape Town, and at Cambridge and London universities, he was called to the bar (Inner Temple) in 1882 and on returning to South Africa in the same year was admitted as an advocate of the Cape Supreme Court. He was for many years leader of the Cape bar; in 1887 he entered Cape politics as attorney-general in the second Rhodes Ministry. He was prime minister on the outbreak of the South African War (1899). In 1914 he was appointed high commissioner for the Union in London, and he died at Llandrindod Wells, Wales, on June 28, 1919.

SCHREYER, ADOLF (1828–1899), German painter, was born at Frankfurt-on-Main on May 9, 1828. He studied art first at the Staedel Institute in his native town, and then at Stuttgart, Munich, and Düsseldorf; but he formed his style in Paris, whilst he found his favourite subjects in his travels in the Near East. In 1862 he settled in Paris, but returned to Germany in 1870; and settled at Cronberg near Frankfurt, where he died in 1899. Schreyer was especially esteemed as a painter of horses, of peasant life in Wallachia and Moldavia, and of battle incidents. His work may be seen in the Schwerin Gallery, in the collection of Count Mensdorff-Pouilly, the Ravené gallery, Berlin, the Metropolitan Museum, New York, and in the Rockefeller, Vanderbilt, J. J. Astor, W. Astor, A. Belmont, and W. Walters collections.

SCHRODER, FRIEDRICH LUDWIG (1744–1816), German actor, manager and dramatist, was born in Schwerin on Nov. 3, 1744. In 1764 he appeared with the Ackermann company (K. E. Ackermann was his stepfather) in Hamburg, playing leading comedy parts; but his most famous performances were in the tragic rôles of Hamlet, Lear and Philip in Schiller's *Don Carlos*. After Ackermann's death in 1771 Schröder and his mother took over the management of the Hamburg theatre, and he began to write plays—largely adaptations from the English, making his first success with the comedy *Die Arglistige*. In 1780 he left Hamburg, and after a tour with his wife, Anna Christina Hart, accepted an engagement at the Court theatre in Vienna. In 1785 Schröder again took over his Hamburg management and conducted the theatre with marked ability until his retirement in 1798. In 1811 he returned to it for one year. He died on Sept. 3, 1816. As an actor Schröder abandoned the stilted style of former tragedians; as a manager he first brought Shakespeare before the German public. Schröder's *Dramatische Werke*, with an introduction by Tieck, were published in four volumes (1831).

See B. Litzmann, *Friedrich Ludwig Schröder* (Hamburg, 1890–94); R. Blum in the *Allgemeines Theater-Lexikon* (1842); and Brunier, *Friedrich Ludwig Schröder* (Leipzig, 1864).

SCHUBERT, FRANZ PETER (1797–1828), Austrian composer, was born on Jan. 31, 1797, in the Himmelpfortgrund, a small suburb of Vienna. His father, Franz, son of a Moravian peasant, was a parish schoolmaster; his mother, Elizabeth Fitz, had before her marriage been cook in a Viennese family. Of their 14 children nine died in infancy. The father, a man of worth and integrity, possessed some reputation as a teacher, and his school, in the Lichtenthal, was well attended. He was also a fair musician.

At the age of five Schubert began to receive regular instruction from his father. At seven he was placed under the charge of Michael Holzer, the Kapellmeister of the Lichtenthal Church. Holzer's lessons seem to have consisted mainly in expressions of admiration, and the boy gained more from a friendly joiner's apprentice, who used to take him to a neighbouring pianoforte warehouse and give him the opportunity of practising on a better instrument than the poor home could afford.

In Oct. 1808 he was received as a scholar at the Convict, which, under Salieri's direction, had become the chief music-school of Vienna, and which had the special office of training the choristers for the Court Chapel. Here he remained until nearly 17, profiting little by the direct instruction, which was almost as careless as that given to Haydn at St. Stephen's, but much by the practices of the school orchestra, and by association with congenial comrades. Many of the most devoted friends of his after life were among his schoolfellows: Spaun and Stadler and Holzapfel, and a score of others who helped him out of their slender pocket-money, bought him music-paper which he could not buy for himself, and gave him loyal support and encouragement.

EARLY COMPOSITIONS

Meanwhile his genius was already showing itself in composition. A pianoforte fantasia, 32 close-written pages, is dated April 8–May 1, 1810: then followed in 1811, three long vocal pieces written upon a plan which Zumsteeg had popularized, together with a "quintet-overture," a string quartet, a second pianoforte fantasia and a number of songs. His essay in chamber-music is noticeable, since we learn that at the time a regular quartet-party was established at his home "on Sundays and holidays," in which his two brothers played the violin, his father the violoncello and Franz himself the viola. It was the first germ of that amateur orchestra for which, in later years, many of his compositions were written. During the remainder of his stay at the Convict he wrote a good deal more chamber-music, several songs, some miscellaneous pieces for the pianoforte and, among his more ambitious efforts, a *Kyrie* and *Salve Regina*, an octet for wind instruments—said to commemorate the death of his mother, which took place in 1812—a cantata, words and music, for his father's name-day in 1813, and the closing work of his school-life, his first symphony.

At the end of 1813 he left the Convict, and, to avoid military service, entered his father's school as teacher of the lowest class. For over two years he endured the drudgery of the work, which, we are told, he performed with very indifferent success. There were, however, other interests to compensate. He took private lessons from Salieri, who annoyed him with accusations of plagiarism from Haydn and Mozart, but who did more for his training than any of his other teachers; he occupied every moment of leisure with rapid and voluminous composition. His first opera—*Des Teufels Lustschloss*—and his first Mass—in F major—were both written in 1814, and to the same year belong three string quartets, many smaller instrumental pieces, the first movement of the symphony in B flat and 17 songs, including such masterpieces as *Der Taucher* and *Gretchen am Spinnrade*. But even this activity is far outpaced by that of the *annus mirabilis* 1815. In this year, despite his school-work, his lessons with Salieri and the many distractions of Viennese life, he produced an amount of music the record of which is almost incredible. The symphony in B flat was finished, and a third, in D major, added soon afterwards. Of church music there appeared two Masses, in G and B flat, the former written in six days, a new *Dona nobis* for the Mass in F, a *Stabat Mater* and a *Salve Regina*. Opera was represented by no fewer than five works, of which three were completed—*Der Vierjährige Posten, Fernando* and *Claudine von Villabella*—and two, *Adrast* and *Die beiden Freunde von Salamanca*, apparently left unfinished. Besides these the list includes a string quartet in G minor, four sonatas and several smaller compositions for piano, and, by way of climax, 146 songs, some of which are of considerable length, and of which eight are dated Oct. 15, and seven Oct. 19.

In the winter of 1814–15 Schubert made acquaintance with the poet Mayrhofer: an acquaintance which, according to his usual habit, soon ripened into a warm and intimate friendship. They were singularly unlike in temperament: Schubert frank, open and sunny, with brief fits of depression, and sudden outbursts of boisterous high spirits; Mayrhofer grim and saturnine, a silent man who regarded life chiefly as a test of endurance.

As 1815 was the most prolific period of Schubert's life, so 1816 saw the first real change in his fortunes. Somewhere about the turn of the year Spaun surprised him in the composition of *Erlkönig*—Goethe's poem propped among a heap of exercise-books, and the boy at white-heat of inspiration "hurling" the notes on the music-paper. A few weeks later Von Schober, a law-student of good family and some means, who had heard some of Schubert's songs at Spaun's house, came to pay a visit to the composer and proposed to carry him off from school-life and give him freedom to practise his art in peace. The proposal was particularly opportune, for Schubert had just made an unsuccessful application for the post of Kapellmeister at Laibach, and was feeling more acutely than ever the slavery of the class-room. His father's consent was readily given, and before the end of the spring he was installed as a guest in Von Schober's lodgings. For a time he attempted to increase the household resources by giving music lessons, but they were soon abandoned and he devoted himself to composition. "I write all day," he said later to an inquiring visitor, "and when I have finished one piece I begin another."

The works of 1816 include three ceremonial cantatas and two new symphonies, No. 4 in C minor, called the *Tragic*, with a striking andante, No. 5 in B flat, as bright and fresh as a symphony of Mozart; some numbers of church music, fuller and more

mature than any of their predecessors, and over a hundred songs, among which are comprised some of his finest settings of Goethe and Schiller. There is also an opera, *Die Burgschaft,* spoiled by an illiterate book.

All this time his circle of friends was steadily widening. Mayrhofer introduced him to Vogl, the famous baritone, who did him good service by performing his songs in the salons of Vienna; Anselm Hüttenbrenner and his brother Joseph ranged themselves among his most devoted admirers; Gahy, an excellent pianist, played his sonatas and fantasias; the Sonnleithners, a rich burgher family whose eldest son had been at the Convict, gave him free access to their home, and organized in his honour musical parties which soon assumed the name of Schubertiaden. The material needs of life were supplied without much difficulty. No doubt Schubert was entirely penniless, for he had given up teaching, he could earn nothing by public performance, and, as yet, no publisher would take his music at a gift; but his friends came to his aid with true Bohemian generosity—one found him lodging, another found him appliances, they took their meals together and the man who had any money paid the score. Schubert was always the leader of the party and was known by half-a-dozen affectionate nicknames, of which the most characteristic is *"kann er 'was?"* his usual question when a new acquaintance was proposed.

The year 1818, though, like its predecessor, comparatively unfertile in composition, was in two respects a memorable year. It saw the first public performance of any work of Schubert's—an overture in the Italian style written as an avowed burlesque of Rossini, and played in all seriousness at a Jäll concert on March 1. It also saw the beginning of his only official appointment, the post of music-master to the family of Count Johann Esterhazy at Zelesz, where he spent the summer amid pleasant and congenial surroundings. On his return to Vienna in the autumn he found that Von Schober had no room for him, and took up his residence with Mayrhofer. He made his first public appearance as a songwriter on Feb. 28, 1819, when the *Schäfers Klagelied* was sung by Jäger at a Jäll concert. In the summer of the same year he took a holiday and travelled with Vogl through Upper Austria. At Steyr he wrote his brilliant piano quintet in A, and astonished his friends by transcribing the parts without a score. In the autumn he sent three of his songs to Goethe, but, so far as we know, received no acknowledgment.

MATURITY

The compositions of 1820 are remarkable, and show a great advance in development and maturity of style. The unfinished oratorio *Lazarus* was begun in Feb.; later followed, amid a number of smaller works, the 23rd Psalm, the *Gesang der Geister,* the quartettsatz in C minor and the great pianoforte fantasia on *Der Wanderer.* But of almost more biographical interest is the fact that in this year two of Schubert's operas appeared at the Kärnthnerthor theatre, *Die Zwillingsbrüder* on June 14, and *Die Zauberharfe* on Aug. 19. Still, however, publishers held obstinately aloof, and it was not until his friend Vogl had sung *Erlkönig* at a concert in the Kärnthnerthor (Feb. 8, 1821) that Diabelli hesitatingly agreed to print some of his works on commission. The first seven opus-numbers (all songs) appeared on these terms; then the commission ceased, and he began to receive the meagre pittances which were all that the great publishing houses ever accorded to him. Much has been written about the neglect from which he suffered during his lifetime. It was not the fault of his friends, it was only indirectly the fault of the Viennese public; the persons most to blame were the cautious intermediaries who stinted and hindered him from publication.

The production of his two dramatic pieces turned Schubert's attention more firmly than ever in the direction of the stage; and towards the end of 1821 he set himself on a course which for nearly three years brought him continuous mortification and disappointment. *Alfonso und Estrella* was refused, so was *Fierrabras; Die Verschworenen* was prohibited by the censor (apparently on the ground of its title); *Rosamunde* was withdrawn after two nights, owing to the badness of its libretto. Of these works the two former are written on a scale which would make their performances exceedingly difficult (*Fierrabras,* for instance, contains over 1,000 pages of manuscript score), but *Die Verschworenen* is a bright, attractive comedy, and *Rosamunde* contains some of the most charming music that Schubert ever composed. In 1822 he made the acquaintance both of Weber and of Beethoven, but little came of it in either case, though Beethoven cordially acknowledged his genius. Von Schober was away from Vienna; new friends appeared of a less desirable character; on the whole these were the darkest years of his life.

In the spring of 1824 he wrote the magnificent octet, "A Sketch for a Grand Symphony"; and in the summer went back to Zelesz, when he became attracted by Hungarian idiom, and wrote the *Divertissement à l'Hongroise* and the string quartet in A minor. Most of his biographers insert here a story of his hopeless passion for his pupil Countess Caroline Esterhazy; but whatever may be said as to the general likelihood of the romance, the details by which it is illustrated are apocryphal, and the song *l'Addio,* placed at its climax, is undoubtedly spurious. A more debatable problem is raised by the grand duo in C major (op. 140) which is dated from Zelesz in the summer of this year. It bears no relation to the style of Schubert's pianoforte music, it is wholly orchestral in character, and it may well be a transcript or sketch of the "grand symphony" for which the octet was a preparation. If so, it settles the question, raised by Sir George Grove, of a "symphony in C major" which is not to be found among Schubert's orchestral scores.

Despite his preoccupation with the stage and later with his official duties he found time during these years for a good deal of miscellaneous composition. The Mass in A flat was completed and the exquisite "Unfinished Symphony" begun in 1822. The *Müllerlieder,* and several other of his best songs, were written in 1825; to 1824, beside the works mentioned above, belong the variations on *Trockne Blumen* and the two string quartets in E and E flat. There is also a sonata for piano and arpeggione, an interesting attempt to encourage a cumbersome and now obsolete instrument.

The mishaps of the recent years were compensated by the prosperity and happiness of 1825. Publication had been moving more rapidly; the stress of poverty was for a time lightened; in the summer there was a pleasant holiday in Upper Austria, where Schubert was welcomed with enthusiasm. It was during this tour that he produced his "Songs from Sir Walter Scott," and his piano sonata in A minor (op. 42), the former of which he sold to Artaria for £20, the largest sum which he had yet received for any composition. Sir George Grove, on the authority of Randhartinger, attributes to this summer a lost "Gastein" symphony which is possibly the same work as that already mentioned under the record of the preceding year.

From 1826 to 1828 Schubert resided continuously in Vienna, except for a brief visit to Graz in 1827. The history of his life during these three years is little more than a record of his compositions. The only events worth notice are that in 1826 he applied for a conductorship at the opera, and lost it by refusing to alter one of his songs at rehearsal, and that in the spring of 1828 he gave, for the first and only time in his career, a public concert of his own works. But the compositions themselves are a sufficient biography. The string quartet in D minor, with the variations on the song *Der Tod und das Mädchen,* was written during the winter of 1825–26, and first played on Jan. 25. Later in the year came the string quartet in G major, the "Rondeau brilliant," for piano and violin, and the fine sonata in G which, by some pedantry of the publisher's, is printed without its proper title. To these should be added the three Shakespearian songs, of which *Hark! Hark! the Lark* and *Who is Sylvia?* were written on the same day, the former at a tavern where he broke his afternoon's walk, the latter on his return to his lodging in the evening. In 1827 he wrote the *Winterreise* songs, the fantasia for piano and violin, and the two piano trios; in 1828 the *Song of Miriam,* the C major symphony, the Mass in E flat, and the exceedingly beautiful *Tantum Ergo* in the same key, the string quintet, the second Benedictus to the Mass in C, the last three piano sonatas, and the collection of songs known as *Schwanengesang.* Six of these

are to words by Heine, whose *Buch der Lieder* had recently appeared. Everything pointed to the renewal of an activity which should equal that of his greatest abundance, when he was suddenly attacked by typhus fever, and after a fortnight's illness died on Nov. 19 at the house of his brother Ferdinand. He had not completed his 32nd year.

HIS ACHIEVEMENT

Some of his smaller pieces were printed shortly after his death, but the more valuable seem to have been regarded by the publishers as waste paper. In 1838 Schumann, on a visit to Vienna, found the dusty manuscript of the C major symphony and took it back to Leipzig, where it was performed by Mendelssohn and celebrated in the *Neue Zeitschrift*. The most important step towards the recovery of the neglected works was the journey to Vienna which Sir George Grove and Sir Arthur Sullivan made in the autumn of 1867. The travellers rescued from oblivion seven symphonies, the *Rosamunde* music, some of the Masses and operas, some of the chamber works, and a vast quantity of miscellaneous pieces and songs. Their success gave impetus to a widespread public interest and finally resulted in the definitive edition of Breitkopf and Härtel.

Schubert is best summed up in the well-known phrase of Liszt, that he was "le musicien le plus poète qui fut jamais." In clarity of style he was inferior to Mozart, in power of musical construction he was far inferior to Beethoven, but in poetic impulse and suggestion he is unsurpassed. He wrote always at headlong speed, he seldom blotted a line, and the greater part of his work bears, in consequence, the essential mark of improvisation: it is fresh, vivid, spontaneous, impatient of restraint, full of rich colour and of warm imaginative feeling. He was the greatest song-writer who ever lived, and almost everything in his hand turned to song. In his Masses, for instance, he seems to chafe at the contrapuntal numbers and pours out his whole soul on those which he found suitable for lyrical treatment. In his symphonies the lyric and elegiac passages are usually the best, and the most beautiful of them all is, throughout its two movements, lyric in character. The standpoint from which to judge him is that of a singer who ranged over the whole field of musical composition and everywhere carried with him the artistic form which he loved best.

Like Mozart, whose influence over him was always considerable, he wrote nearly all the finest of his compositions in the last ten years of his life. His early symphonies, his early quartets, even his early Masses, are too much affected by a traditional style to establish an enduring reputation. It is unfair to call them imitative, but at the time when he wrote them he was saturated with Mozart, and early Beethoven, and he spoke what was in his mind with a boy's frankness. The andante of the Tragic symphony (No. 4) strikes a more distinctive note, but the fifth is but a charming adaptation of a past idiom, and the sixth, on which Schubert himself placed little value, shows hardly any appreciable advance. It is a very different matter when we come to the later works. The piano quintet in A major (1819) may here be taken as the turning-point; then come the Unfinished symphony, which is pure Schubert in every bar; the three quartets in A minor, D minor and G major, full of romantic colour; the delightful piano trios; the great string quintet; and the C major symphony which, though diffuse, contains many passages of surpassing beauty.

His larger operas are marred both by their inordinate length and by their want of dramatic power. The slighter comedies are pretty and tuneful, but, except as curiosities, are not likely to be revived. We may, however, deplore the fate which has deprived the stage of the *Rosamunde* music. It is in Schubert's best vein; the *entr'actes*, the romance, and the ballets are alike excellent, and it is much to be hoped that a poet will some day arise and fit the music to a new play.

Of his pianoforte compositions, the sonatas, as might be expected, are the least enduring, though there is not one of them which does not contain some first-rate work. On the other hand his smaller pieces, in which the lyric character is more apparent, are throughout interesting to play and extremely pleasant to hear. A special word should be added on his fondness for piano duets, a form which before his time had been rarely attempted.

His concerted pieces for the voice are often extremely difficult, but they are of a rare beauty which would well repay the labour of rehearsal.

Of the songs it is impossible, within the present limits, to give even a sketch. They number over 600, excluding scenas and operatic pieces, and they contain masterpieces from the beginning of his career to the end. *Gretchen am Spinnrade* was written when he was 17, *Erlkönig* when he was 18; then there follows a continuous stream which never checks or runs dry, and which broadens as it flows to the *Müllerlieder*, the Scott songs, the Shakespearian songs, the *Winterreise*, and the *Schwanengesang*. He is said to have been undiscriminating in his choice of words. Schumann declared that "he could set a handbill to music," and there is no doubt that he was inspired by any lyric which contained, though even in imperfect expression, the germ of a poetic idea. But his finest songs are almost all to fine poems. He set over 70 of Goethe's, over 60 of Schiller's.

In his earlier songs he is more affected by the external and pictorial aspect of the poem; in the later ones he penetrates to the centre and seizes the poetic conception from within. But in both alike he shows a gift of absolute melody which, even apart from its meaning, would be inestimable. Neither Händel nor Mozart—his two great predecessors in lyric tune—have surpassed or even approached him in fertility and variety of resource. The songs in *Acis* are wonderful; so are those in *Zauberflöte*, but they are not so wonderful as *Litanei*, and *Who is Sylvia?* and the *Ständchen*. To Schubert we owe the introduction into music of a particular quality of romance, a particular "addition of strangeness to beauty"; and so long as the art remains his place among its supreme masters is undoubtedly assured.

Bibliography.—Kreissle von Hellborn, *Franz Schubert* (1865, Eng. tr. by A. D. Coleridge, 1869); Reissmann, *Franz Schubert* (1873); Niggli, *Schubert* (Leipzig, 1880); Otto Erich Deutsch, *Franz Schubert* (Munich, 1905–19); Walter Dahms, *Schubert* (1918); Gerold, *Schubert*, with bibl. (Paris, 1923); Grove's *Dictionary of Music*, 3rd ed., vol. iv. with bibl. (1928); H. Foss (Editor), *The Heritage of Music* (1928); Newman Flower, *Franz Schubert, the Man and His Circle* (1928). (W. H. H.)

SCHÜCKING, WALTER (1875–), German jurist, was born on Jan. 6, 1875, at Munster, Westphalia. He taught at the universities of Breslau and Marburg 1900–21, and in 1921 was appointed a professor at the Berlin commercial high school. In 1919 he was appointed a member of the National Assembly and chief German delegate to the Peace Conference at Versailles. In 1919 he became a member of the permanent court of arbitration at The Hague. In 1920 and again in 1924 he was elected to the Reichstag and became one of the leaders of the German Democratic party.

His works include: *Das Küstenmeer im internationalen Recht* (1897), "Die Verwendung von Minem im Seekrieg" (in Niemeyer's *Zeitschrift*, vol. 16), *Die Organisation der Welt* (2nd ed. 1909), *Der Staatenverband der Haager Conferenzen* (1912) (Eng. trans. 1918), *Neue Ziele der staatlichen Entwicklung* (3rd ed. 1913), *Internationale Rechtsgarantien* (Hamburg, 1918), *Die Satzung des Volkerbundes* (2nd ed. 1924), *Garantiepakt und Rüstungsbeschrankung* (1924), *Das Genfer Protokoll* (1924).

SCHULZE-DELITZSCH, FRANZ HERMANN (1808–1883), German economist, was born at Delitzsch, in Prussian Saxony, on Aug. 29, 1808. The suffix Delitzsch was added in 1848 to distinguish him from other Schulzes in the National Assembly. He studied law at Leipzig and Halle, became an assessor in the court of justice at Berlin in 1838, and three years later was appointed *patrimonialrichter* at Delitzsch. Entering the parliament of 1848, he joined the Left Centre, and, acting as president of the commission of inquiry into the condition of the labourers and artisans, became impressed with the necessity of co-operation to enable the smaller tradespeople to hold their own against the capitalists. He was a member of the Second Chamber in 1848–49; but a quarrel with the minister of justice led him to throw up his public appointments in October 1851, and withdraw to

Delitzsch. Here he devoted himself to the organization of co-operative societies, and of Vorschussvereine (people's banks). In 1859 he promoted the first *Genossenschaftstag,* or co-operative meeting, in Weimar, and founded a central bureau of co-operative societies. In 1861 he again entered the Prussian Chamber. The next few years were given to the formation of local centres, and the establishment of the Deutsche Genossenschafts-Bank, 1865.

The spread of these organizations led to legislation on the subject, and this too was chiefly the work of Schulze-Delitzsch. As a member of the Chamber in 1867 he was mainly instrumental in passing the Prussian law of association, which was extended to the North German Confederation in 1868, and later to the empire. Schulze-Delitzsch also contributed to uniformity of legislation throughout the states of Germany, in 1869, by the publication of *Die Gesetzgebung über die privatrechtliche Stellung der Erwerbs- und Wirthschaftsgenossenschaften,* etc. His remaining years were spent in consolidating his work. He died on April 29, 1883, at Potsdam.

His works include: *Kapitel zu einem deutschen Arbeiter-Katechismus* (1863); *Soziale Rechte und Pflichten* (1867); and *Die Entwicklung des Genossenschaftswesen in Deutschland* (1870). *See* also A. Bernstein, *Schulze-Delitzsch* (1879); B. Rampal, *Esquisse Biographique* (1874).

SCHUMANN, ROBERT ALEXANDER (1810–1856), German musical composer, was born on June 8, 1810, in Zwickau, Saxony, the son of a publisher. He tells us that he began to compose before his seventh year. At fourteen he wrote an essay on the aesthetics of music and also contributed to a volume edited by his father, entitled *Portraits of Famous Men.* While still at school in Zwickau he read, besides Schiller and Goethe, Byron (whose *Beppo* and *Childe Harold* had been translated by his father) and the Greek tragedians. But the most powerful and permanent of the literary influences exercised upon him, however, was that of Jean Paul Richter. This influence may clearly be seen in his youthful novels *Juniusabende* and *Selene,* of which the first only was completed (1826). In 1828 he left school, and after a tour, during which he met Heine at Munich, he went to Leipzig to study law. His interest in music had been stimulated when he was a child by hearing Moscheles play at Carlsbad, and in 1827 by the works of Schubert and Mendelssohn. But his father, who had encouraged the boy's musical aspirations, had died in 1826, and neither his mother nor his guardian approved of a musical career for him. Nevertheless, both at Leipzig and at Heidelberg, whither he went in 1829, he neglected the law for the philosophers, and began composing songs. At Easter 1830 he heard Paganini at Frankfurt. In December 1830 he returned to Leipzig, taking piano lessons with his old master, Friedrich Wieck. In his haste to acquire a perfect execution he permanently injured his right hand. His ambitions as a pianist being thus suddenly ruined, he began a course of theory under Heinrich Dorn, conductor of the Leipzig opera. About this time he contemplated an opera on the subject of *Hamlet.*

The fusion of the literary idea with its musical illustration, which may be said to have first taken shape in *Papillons* (op. 2), is foreshadowed in an essay on Chopin's variations on a theme from *Don Juan,* which appeared in the *Allgemeine musikalische Zeitung* in 1831. Here the work is discussed by the imaginary characters Florestan and Eusebius (the counterparts of Vult and Walt in Jean Paul's novel *Flegeljahre*), and Meister Raro (representing either the composer himself or Wieck) is called upon for his opinion. By the time, however, that Schumann had written *Papillons* (1831) he had gone a step farther. The scenes and characters of his favourite novelist had now passed definitely and consciously into the written music, and in a letter from Leipzig (April 1832) he bids his brothers "read the last scene in Jean Paul's *Flegeljahre* as soon as possible, because the *Papillons* are intended as a musical representation of that masquerade." In the winter of 1832 Schumann visited his relations at Zwickau and Schneeberg, when the first movement of his symphony in G minor was performed. In Zwickau the music was played at a concert given by Wieck's daughter Clara, then only thirteen. The death of his brother Julius and of his sister-in-law Rosalie in 1833 affected Schumann with profound melancholy. By the spring of 1834, however, he started *Die neue Zeitschrift für Musik,* the paper in which appeared the greater part of his critical writings. The journal effected a revolution in the taste of the time, when Mozart, Beethoven and Weber were neglected, and the genius of Chopin and of Berlioz unappreciated.

During the the summer of 1834, Schumann became engaged to Ernestine von Fricken, a girl of sixteen, the adopted daughter of a rich Bohemian, from whose variations on a theme in C♯ minor Schumann constructed his own *Études symphoniques.* The engagement was broken off by Schumann, for reasons which have always remained obscure. In the *Carnaval* (op. 9=1834), Schumann commenced nearly all the sections with the musical notes signified in German by the letters that spell Asch, the town in which Ernestine was born, which also are the musical letters in Schumann's own name. By the sub-title "Estrella" to one of the sections in the *Carnaval,* Ernestine is meant, and by the sub-title "Chiarina" Clara Wieck. In the *Carnaval* Schumann went farther than in *Papillons,* for in it he himself conceived the story of which it was the musical illustration. On Oct. 3, 1835, Schumann met Mendelssohn at Wieck's house in Leipzig, and his appreciation of his great contemporary was shown with the generous freedom that distinguished him in all his relations to other musicians.

In 1836 Schumann's acquaintance with Clara Wieck, already famous as a pianist, ripened into love, and a year later he asked her father's consent to their marriage, but was met with a refusal. The series of *Phantasiestücke* for the piano (op. 12) once more illustrates the fusion of literary and musical ideas as embodied conceptions in such pieces as "Warum" and "In der Nacht." In the *Kreisleriana,* written in 1838, the composer's realism is again carried a step farther. Kreisler, the romantic poet brought into contact with the real world, was a character drawn from life by the poet E. T. A. Hoffmann (*q.v.*), and Schumann used him as a mouthpiece for the recital in music of his own personal experiences. The *Phantasie* (op. 17), written in the summer of 1836, is a work of the highest quality of passion. With the *Faschingschwank aus Wien,* his most pictorial work for the piano, written in 1839, after a visit to Vienna, this period of his life comes to an end. As Wieck still withheld his consent to their marriage, Robert and Clara dispensed with it, and were married on Sept. 12 at Schönefeld, near Leipzig.

Until now Schumann had written almost solely for the pianoforte, but in 1840 he wrote about a hundred and fifty songs. Schumann's biographers represent him as caught in a tempest of song, the sweetness, the doubt and the despair of which are all to be attributed to varying emotions aroused by his love for Clara. Yet it would be idle to ascribe to this influence alone the lyrical perfection of "Frühlingsnacht," "Im wunderschönen Monat Mai" and "Schöne Wiege meiner Leiden." His chief song-cycles of this period were his settings of the *Liederkreis* of J. von Eichendorff (op. 39), the *Frauenliebe und Leben* of Chamisso (op. 42), the *Dichterliebe* of Heine (op. 48) and *Myrthen,* a collection of songs, including poems by Goethe, Rückert, Heine, Byron, Burns and Moore. The songs "Belsatzar" (op. 57) and "Die beiden Grenadiere" (op. 49), each to Heine's words, show Schumann at his best as a ballad writer, though the dramatic ballad is less congenial to him than the introspective lyric. As Grillparzer said, "He has made himself a new ideal world in which he moves almost as he wills." But in his lifetime the sole tokens of honour bestowed upon Schumann were the degree of Doctor by the University of Jena in 1840, and in 1843 a professorship in the Conservatorium of Leipzig. In 1841 he wrote two of his four symphonies. The year 1842 was devoted to the composition of chamber music, and includes the pianoforte quintet (op. 44). In 1843 he wrote *Paradise and the Peri,* his first essay at concerted vocal music. He had now mastered the separate forms, and from this time forward his compositions are not confined during any particular period to any one of them. In Schumann, above all musicians, the acquisition of technical knowledge was closely bound up with the growth of his own experience and the impulse to express it. The stage in his life when he was deeply engaged in

his music to Goethe's *Faust* (1844–1853) was a critical one for his health. The first half of the year 1844 had been spent with his wife in Russia. On returning to Germany he had abandoned his editorial work, and left Leipzig for Dresden, where he suffered from persistent nervous prostration. As soon as he began to work he was seized with fits of shivering, and an apprehension of death which was exhibited in an abhorrence for high places, for all metal instruments (even keys) and for drugs. He suffered perpetually also from imagining that he had the note A sounding in his ears. In 1846 he had recovered, and in the winter revisited Vienna, travelling to Prague and Berlin in the spring of 1847 and in the summer to Zwickau.

To 1848 belongs his only opera, *Genoveva.* It is interesting for its attempt to abolish the recitative, which Schumann regarded as an interruption to the musical flow. The music to Byron's *Manfred* is pre-eminent in a year (1849) in which he wrote more than in any other. The insurrection of Dresden caused Schumann to move to Kreischa, a village near the city. In August, on the occasion of the centenary of Goethe's birth, such scenes of Schumann's *Faust* as were already completed were performed in Dresden, Leipzig and Weimar, Liszt as always giving unwearied assistance and encouragement. The rest of the work was written in the latter part of the year, and the overture in 1853. From 1850 to 1854 the text of Schumann's works is extremely varied. In 1850 he succeeded Ferdinand Hiller as musical director at Düsseldorf; in 1851–1853 he visited Switzerland and Belgium as well as Leipzig. In January 1854 Schumann went to Hanover, where he heard a performance of his *Paradise and the Peri.* Soon after his return to Düsseldorf, a renewal of the symptoms that had threatened him before showed itself. Besides the single note he now imagined that voices sounded in his ear. One night he suddenly left his bed, saying that Schubert and Mendelssohn had sent him a theme which he must write down, and on this theme he wrote five variations for the pianoforte, his last work. On Feb. 27 he threw himself into the Rhine. He was rescued by some boatmen, and taken to a private asylum in Endenich near Bonn, where he remained until his death on July 29, 1856.

His wife, Clara Schumann (1819–1896), extended her own reputation as a pianist beyond the borders of Germany, and it was thanks to her efforts that Schumann's compositions became generally known in Europe. From 1865 onward she was a regular visitor in London. In 1878 she was appointed teacher of the piano at the Hoch Conservatorium at Frankfurt, a post which she held until 1892, and in which she contributed greatly to the modern improvement in technique. As an artist she is remembered, together with Joseph Joachim, as one of the first executants who really played like composers. She was herself the composer of a few songs and of some charming music, mainly for the piano, and the authoritative editor of her husband's works for Breitkopf and Härtel.

The following are the chief compositions of Robert Schumann.

Pianoforte Works.

Papillons (op. 2)	1829–31
Études symphoniques (op. 13)	1834
Carnaval (op. 9)	1834–35
Sonata in F sharp minor (op. 11)	1835
Sonata in G minor (op. 22)	1833–35
Kinderszenen (op. 15)	1836
Fantasia in C (op. 17)	1836
Fantasiestücke (op. 12)	1837
Kreisleriana (op. 16)	1838
Novelletten (op. 21)	1838
Faschingschwank aus Wien (op. 26)	1839

Songs and Choral Works

Songs:—"Liederkreis" (Heine), nine songs (op. 24)	
"Myrthen," twenty-six songs (4 books) (op. 25)	
"Liederkreis" (Eichendorff), twelve songs (op. 39)	
"Frauenliebe und Leben" (Chamisso), eight songs (op. 42)	1840
"Dichterliebe," sixteen songs from Heine's *Buch der Lieder* (op. 48)	
"Belsatzar," ballad (Heine) (op. 57)	
Song, "Tragödie" (Heine) from op. 64	1841
Ballad, "Der Handschuh" (Schiller)	probably 1851
Songs from Wilhelm Meister and Requiem for Mignon for chorus (op. 98)	1849
Spanische Liebeslieder (op. 138)	1849
Choral and Dramatic Works:—"Paradise and the Peri," for solos, chorus and orchestra (op. 50)	1843
Faust music	1844–1853
"Genoveva," opera	1848
Manfred music	1849
"Der Rose Pilgerfahrt" (Moritz Horn), for solos, chorus and orchestra (op. 112)	
"Der Königssohn" (Uhland), for solos, chorus and orchestra (op. 103)	1851
"Des Sängers Fluch" (Uhland) for solos, chorus and orchestra (op. 139)	
Mass for four part chorus and orchestra (op. 148)	1852
"Vom Pagen und der Königstochter," four ballads (Geibel) for solos, chorus and orchestra (op. 135)	
"Das Glück von Edenhall," ballad (Uhland), for solos, chorus and orchestra (op. 143)	
Festival overture on the *Rheinweinlied* for orchestra and chorus (op. 123)	1853

Chamber Music

Three quartets for strings in A minor, F and A (op. 41)	
Quintet for pianoforte and strings in E flat (op. 44)	
Quartet for pianoforte and strings in E flat (op. 47)	1842
Fantasiestücke for pianoforte, violin and violoncello (op. 88)	
Andante and variations for two pianofortes (op. 46)	1843
Trio for pianoforte and strings in D minor (op. 63)	1847
Trio for pianoforte and strings in F (op. 80)	
Fantasiestücke for clarinet and pianoforte (op. 73)	
Five "Stücke im Volkston" for piano and violoncello (op. 102)	1849
Three Romances for oboe and piano (op. 94)	
"Märchenbilder" for pianoforte and viola (op. 113)	
Sonata for pianoforte and violin in A minor (op. 105)	
Trio for pianoforte and strings in G minor (op. 110)	1851
Sonata for pianoforte and violin in D minor (op. 121)	
"Märchenerzählungen," four pieces for clarinet, viola and pianoforte, probably written in	1853

Orchestral Works

B flat Symphony (op. 38)	
Fourth Symphony in D minor (op. 120)	1841
Overture, Scherzo and Finale	
Second Symphony in C (op. 61)	1846
Third or "Rhenish" Symphony in E flat (op. 97)	1850

Concertos and Concert-Stücke

For Pianoforte in A minor (op. 54)	1841–1845
Concert-stück for four horns (op. 86)	
Introduction and Allegro-appassionato for Pianoforte (op. 92)	1849
Concerto for Violoncello (op. 126)	1852

Bibliography.—Wasielewski, *Robert Schumann* (1858; trans., 1878); A. Reissmann, *Robert Schumann, sein Leben und seine Werke* (1865; trans., 1886); J. A. Fuller Maitland, *Schumann* ("Great Musicians" series); *The Life of Robert Schumann told in his Letters* (with a preface by J. G. Jansen), translated from the German by May Herbert (1902); *Letters of R. Schumann,* edited by Karl Storck (Eng. trans. by Hannah Bryant, 1907); V. Joss, *Der Musikpädagoge Friedrich Wieck und seine Familie;* Litzmann, *Clara Schumann* (1902); Moser's *Joseph Joachim* (trans., 1901; new ed., 1908) and the first volume of Kalbeck's *Brahms* (4 vols., 1904–14) contain much that is important as to Schumann's later years. *See* also Grove's *Dictionary of Music and Musicians* (1928).

SCHUMANN-HEINK, ERNESTINE (1861–), contralto, was born at Leiben, near Prague, June 15, 1861. After making her début as Azucena, Oct. 13, 1878, at the Court theatre, Dresden, she was engaged at the Stadt theatre, Hamburg, where she remained until she went to the Royal theatre, Berlin. After appearing with success at Bayreuth, in 1896, she made her American début in *Lohengrin,* at Chicago in 1898. Her London début was at Covent Garden, in *Das Rheingold,* 1902.

See Mary Lawton, *Schumann-Heink* (1929).

SCHURMAN, JACOB GOULD (1854–), American educationalist and diplomat, was born at Freetown, Prince Edward island, on May 22, 1854, of Dutch descent, his loyalist ancestors having left New York in 1784. He secured his B.A. and M.A. degrees at the University of London (1877 and 1878) and studied for several years in Paris, Edinburgh and Germany, where he met Andrew D. White. He was professor of English literature, political

economy and psychology in Acadia college in 1880–82, of metaphysics and English literature at Dalhousie college, Halifax (N.S.), in 1882–86, and of philosophy at Cornell university in 1886–92, being dean of the Sage school of philosophy in 1891–92 and president of the university from 1892 until 1920. Like his predecessor, Andrew D. White, he united a diplomatic with an educational career. He was president of the first United States Philippine Commission in 1899, minister to Greece and Montenegro in 1912–13, and minister to China from 1921 until 1925, when he was appointed ambassador to Germany. In addition to editing the *Philosophical Review*, which he founded in 1892 with J. E. Creighton and James Seth, he wrote *Kantian Ethics and the Ethics of Evolution* (1881), *The Ethical Importance of Darwinism* (1888), *Belief in God* (1890), *Agnosticism and Religion* (1896), *The Balkan Wars, 1912–1913* (1914) and *Why America Is in the War* (1917).

SCHURZ, CARL (1829–1906), German-American statesman and reformer, was born in Liblar, near Cologne, on March 2, 1829, the son of a school-teacher. He studied in the Jesuit gymnasium of Cologne in 1840–46, and then entered the University of Bonn, where he became a revolutionary and assisted Gottfried Kinkel professor of literature and history in editing the *Bonner Zeitung*. On the outbreak of the revolution of 1848 he took the field, but when Rastatt surrendered he escaped to Zürich. In 1850 he returned secretly to Germany, rescued Kinkel from prison and helped him to escape to Scotland. Schurz went to Paris, but the police forced him to leave France on the eve of the *coup d'état*, and until Aug. 1852 he lived in London, making his living by teaching German. He married in July 1852 and removed to America, living for a time in Philadelphia.

In 1856 after a year in Europe he settled in Watertown, Wisconsin, and immediately became prominent in the Republican Party. In the Illinois campaign of the next year between Abraham Lincoln and Stephen A. Douglas he took part as a speaker; and later in 1858 he began to practise law in Milwaukee. In the State campaign of 1859 he made a speech attacking the Fugitive Slave Law and in the same year he delivered in Faneuil Hall, Boston, an oration on "true Americanism," which coming from an alien was intended to clear the Republican Party of the charge of "nativism." In the Republican national convention of 1860 Schurz was chairman of the delegation from Wisconsin. Lincoln sent him in 1861 as minister to Spain. He returned to America in Jan. 1862, was commissioned brigadier-general of volunteers in April, and in June took command of a division under Frémont, and then in Sigel's corps, with which he took part in the second battle of Bull Run. He was promoted major-general of volunteers on March 14, and was a division commander at Chancellorsville of the XI. Corps, under Gen. O. O. Howard. He was at Gettysburg and at Chattanooga and was then put in command of a corps of instruction at Nashville; he was with Sherman's army in North Carolina in the last months of the war and resigned immediately after the close of hostilities. In 1865 President Johnson sent him through the South to study conditions; but Schurz's valuable report, suggesting the readmission of the States with complete rights and the investigation of the need of further legislation by a Congressional committee, was not heeded by the president. In 1866–67 he was chief editor of the Detroit *Post* and then became editor and joint proprietor with Emil Praetorius (1827–1905) of the *Westliche Post* of St. Louis.

In 1869–75 he was U.S. senator from Missouri, and made a great reputation by his speeches on financial subjects. During this period he broke with the administration: he started the Liberal Republican movement in Missouri in 1870 and in 1872 he presided over the Liberal Republican convention. He opposed Grant's Santo Domingo policy, his Southern policy, and the Government's selling arms and making cartridges for the French army in the Franco-Prussian War. But in 1875 he campaigned for Hayes, as the representative of "sound money," in the Ohio gubernatorial campaign. In 1876 he supported Hayes in the contest for the presidency, and Hayes made him in 1877 his secretary of the interior. Upon his retirement in 1881 he removed to New York city, and from 1881 to 1883 was editor-in-chief and one of the proprietors of the New York *Evening Post*. In 1884 he was a leader in the Independent (or Mugwump) movement against the nomination of James G. Blaine for the presidency and for the election of Grover Cleveland. In 1892 he succeeded George William Curtis as president of the National Civil Service Reform League and held this office until 1901. He succeeded Curtis as editorial writer for *Harper's Weekly* in 1892–98, in which he did much for civil service reform and for Cleveland's nomination and election in 1892. He opposed W. J. Bryan for the presidency in 1896, speaking for sound money; in 1900 on the anti-imperialism issue he supported Bryan. He died in New York city on May 14, 1906.

Schurz published a volume of *Speeches* (1885); *Henry Clay* (1887) in the "American Statesmen" series; *Abraham Lincoln* (1889); and *Reminiscences* (1907–08), in the third volume of which is a sketch of his life and public services from 1869 to 1906 by Frederic Bancroft and William A. Dunning.

SCHUSTER, SIR ARTHUR (1851–), British physicist, was born in Frankfurt-on-Main on Sept. 12, 1851, the second son of F. J. Schuster, a native of Frankfurt, who became a merchant banker in London and a British subject. Arthur Schuster was educated at Owens college, Manchester, and at Heidelberg university, and studied astronomy and mathematical physics. He was chief of the "Eclipse" expedition to Siam in 1875, and from 1888 to 1907 was professor of physics in Manchester university, his main work being connected with advanced research in spectroscopy. He was one of the secretaries of the Royal Society from 1912 to 1920, foreign secretary from 1920 to 1924, and president of the British Association in 1915. He was also secretary of the International Research council, and during the World War he did invaluable work as a scientific adviser for the organization of research in various departments. He was knighted in 1920 and was appointed a member of the royal commission on the universities of Oxford and Cambridge.

His numerous publications include: *Theory of Optics* (2nd ed., 1909); *The Progress of Physics* (1911); *Britain's Heritage of Science* (with Sir A. E. Shipley, 1917); and many papers in philosophical journals.

SCHUSTER, SIR FELIX, Bart. (1854–), British financier, was born on April 21, 1854. He was the third son of F. J. Schuster, and brother of Sir Arthur Schuster (*q.v.*). Felix Schuster was educated at Owens college, Manchester, and studied abroad, afterwards making his career in London banking. From 1895 he was identified, as governor, with the Union Bank of London, afterwards the Union of London and Smiths Bank, and in 1918 amalgamated with the National Provincial Bank as the National Provincial and Union Bank of England. He was a member of the Council of India from 1906 to 1916, and became chairman of the Central Association of Bankers, and of the committee of London clearing banks. In these years he established for himself a leading position in financial and economic circles, and was made a member of several important Government committees and royal commissions. He was created a baronet in 1906.

SCHUYLER, PHILIP JOHN (1733–1804), American soldier, was born at Albany, N.Y., on Nov. 11, 1733. The Schuyler family was established in the New World by Philip Pieterse Schuyler (d. 1683), who migrated from Amsterdam in 1650, and whose son, Peter (1657–1724), was the first mayor of Albany. The family was one of the wealthiest and most influential in the colony and was closely related by marriage to the Van Rensselaers, Van Cortlandts and other representatives of the old Dutch aristocracy. Philip Schuyler served in the Provincial army during the Seven Years' War, first as captain and later as major, taking part in the battles of Lake George (1755), Oswego River (1756), Ticonderoga (1758) and Fort Frontenac (1758). From 1768 to 1775 he represented Albany in the New York assembly, and he was closely associated with the Livingston family in the leadership of the Presbyterian or Whig Party. He was a delegate to the second Continental Congress in May, 1775, and on June 19, was chosen one of the four major generals in the Continental service. Placed in command of the northern department of New York, he made preparations for an invasion of Canada. Soon after the expedition started he was prostrated by rheumatic gout, and the

actual command devolved upon Gen. Richard Montgomery. On the death of Montgomery and the failure to take Quebec the army retreated to Crown Point, and its commander, Gen. John Sullivan, was superseded by Gen. Horatio Gates. Gates claimed precedence over Schuyler and, on failing to secure recognition, intrigued to bring about Schuyler's dismissal. The necessary withdrawal of the army from Crown Point in 1776 and the evacuation of Ticonderoga in 1777 were magnified by Schuyler's enemies into a retrograde movement, and, on Aug. 19, 1777, he was superseded. A court martial appointed in 1778 acquitted him on every charge. He resigned from the army in April, 1779. In 1788 he joined his son-in-law Alexander Hamilton, John Jay and others in leading the movement for the ratification by New York of the Federal constitution. He served in the United States Senate as a Federalist in 1790–91 and was again elected in 1797. He was also active for many years as Indian commissioner and surveyor-general and helped to settle the New York boundary disputes with Massachusetts and Pennsylvania. In 1792–96 he carried to a successful conclusion a project for connecting the Hudson with Lake Ontario by way of the Mohawk, Oneida lake and the Onondaga river. He died on Nov. 18, 1804.

See Bayard Tuckerman, *Life of General Philip Schuyler* (1903).

SCHWAB, CHARLES MICHAEL (1862–), American steel manufacturer and financier, was born at Williamsburg, Pa., on Feb. 18, 1862. He was educated in the public schools and at St. Francis college, Loretto, Pennsylvania. From 1878 to 1880 he was a clerk in a store at Braddock, Pa., and then became a stake-driver in the engineering corps of the Edgar Thomson Steel Works of Carnegie Brothers and Company. His ability brought him rapid promotion and in 1881 he was made chief engineer and assistant manager, and in 1889 general superintendent. In 1892, after the formation of the Carnegie Steel Company, he became general superintendent of the Homestead works. In 1897 he was elected president of the Carnegie Steel Company, and when this was merged in 1901 in the United States Steel Corporation he was its president. In 1903 he resigned from the United States Steel Corporation and soon after obtained control of the Bethlehem Steel Corporation.

After the outbreak of the World War in 1914, and before the United States entered it, these companies filled orders for the Allies aggregating between $400,000,000 and $500,000,000. After America's entrance into the war, Schwab became, in April 1918, director-general of the Emergency Fleet Corporation. After the signing of the Armistice in Nov. 1918, he resigned and returned to his position as chairman of the board of directors of the Bethlehem Steel Corporation. He was president in 1927 of the American Society of Mechanical Engineers and also of the American Iron and Steel Institute.

SCHWABE, RANDOLPH (1885–), distinguished English draughtsman, was born in Manchester on May 19, 1885. He studied at the Slade school and under J. T. Laurens in Paris. During the World War he was official artist to the Ministry of Information. He is a member of the New English Art club and of the London group, and instructor of drawing at the Royal College of Art; examiner in art on the Board of Education. Though essentially modern in spirit, his art adheres to the sound and constructive traditions of the 15th century Renaissance. His illustrations for books are distinguished for clearness of form and delicacy and directness of line. (*See* his designs for the works of Edmund Blunden, Walter de la Mare, Arthur Symons, Elroy Fletcher and John Clare.) Schwabe is also a well known theatrical designer, and has published a valuable book on *Historic Costume* in collaboration with F. M. Kelly (1928). The Imperial War museum has some of his paintings and drawings, the British museum has his prints, etchings and lithographs; the Victoria and Albert museum his designs. He is also represented in the permanent collections at Bradford, Manchester and Oldham. A selection of his drawings appeared in *Contemporary Draughtsmen* (Benn, 1928).

SCHWANN, THEODOR (1810–1882), German physiologist, was born at Neuss in Rhenish Prussia on Dec. 7, 1810. After studying at Cologne, Bonn and Würzburg, he graduated in medicine at Berlin in 1834. There he assisted James Müller in his experimental work on physiology. Schwann in 1838 was called to the chair of anatomy at the Roman Catholic university of Louvain, and in 1847 went as professor to Liège, where he remained till his death on Jan. 11, 1882. While working with Müller, Schwann's attention was directed to the physico-chemical basis of life. In 1836 he demonstrated the influence of organisms and lower fungi in the production of fermentation and putrefaction, and thereby disproved spontaneous generation. In fact the whole germ theory of Pasteur, as well as its antiseptic applications by Lister, is traceable to his influence. About the same time he demonstrated the organic nature of yeast, and the necessity to digestion of the presence of a ferment called by him pepsin.

In 1837 he began to investigate the laws of muscular contraction, discovering the striped muscle in the upper part of the oesophagus, and, later, the envelope of the nerve-fibres which now bears his name. The publication of his famous *Microscopic Investigations on the Accordance in the Structure and Growth of Plants and Animals* in 1839 (trans. Sydenham Society, 1847) set forth his important discovery that both animal and vegetable tissues are to be traced back to cells and that the cells of each are identical in character. His cell theory was taken up by Virchow, who disproved his hypothesis of the discontinuity of cell formation.

SCHWANTHALER, LUDWIG MICHAEL (1802–1848), German sculptor, was born in Munich on Aug. 26, 1802. He studied in Munich and in Italy. After 1832 he found abundant work in Munich, among the new palaces, and museums built by Ludwig I. The palace at Munich is peopled with Schwanthaler's statues, among which are twelve imposing gilt bronze figures, 10 ft. high in the throne-room. He also furnished the old Pinakothek with 25 marbles, commemorative of painters, and supplied a composition for the pediment of the exhibition building facing the Glyptothek. His work in the Ruhmeshalle included ninety-two metopes, and the colossal but feeble figure of Bavaria, 60 ft. high. Outside Munich he executed groups within the north pediment of the Walhalla, Ratisbon, and also numerous portrait statues, including those of Mozart, Jean Paul Richter, Goethe and Shakespeare. Schwanthaler died at Munich in 1848, and left by will to the Munich academy all his models and studies, which now form the Schwanthaler Museum.

SCHWARTZE, TERESA (1852–), Dutch portrait painter, was born at Amsterdam, the daughter of Johan Georg Schwartze (1814–1874). Her portraits are remarkable for excellent character drawing, breadth and vigour of handling and rich quality of pigment. Some of her best pictures, notably a portrait of Piet J. Joubert, and "Three Inmates of the Orphanage at Amsterdam," are at the Ryks Museum, and one entitled "The Orphan" at the Boyman Museum in Rotterdam.

SCHWARZ, KARL (1812–1885), German Protestant theologian, was born at Wiek on the Isle of Rügen on Nov. 19, 1812. Karl Schwarz pursued the study of theology and philosophy at Halle, and afterwards at Bonn (1831) and Berlin (1832–1834). At Berlin he came under the influence of Schleiermacher and Hegel, whose influences are seen in his work *Das Wesen der Religion* (1847). In 1837 he was imprisoned for six months on account of his advanced political opinions. After his release he helped (from 1838) with the *Hallische Jahrbücher*. From 1843–1845 he lectured at Halle, and was then suspended by the government. In 1849, however, he was appointed professor extraordinarius, and later received a number of distinctions (in 1858 chief court preacher, etc.). Schwarz took an important part in the founding and directing of the German Protestantenverein, and became an eminent exponent of liberal theology. His work *Zur Geschichte der neuesten Theologie* (1856, 4th ed. 1869) is a valuable source for the history of theology in Germany. His other works include *Lessing als Theologe* (1854) and *Grundriss der christl. Lehre* (1873, 5th ed. 1876). He died on March 25, 1885.

See G. Rudlöff, *Karl Schwarz* (1887); F. Hummel, *Die Bedeutung der Schrift von Karl Schwarz: Über das Wesen der Religion* (1890).

SCHWARZENBERG, FELIX, Prince zu (1800–1852), Austrian statesman, was born on Oct. 2, 1800.

After six years' service in the Austrian army, Felix espoused a diplomatic career at the instance of Metternich, and underwent

a period of probation (1824–1848) at various European courts, which confirmed his aristocratic aversion to popular government. In 1848 he took an active part in the war against Piedmont and the insurgents in Vienna. On Nov. 21 of the same year he was appointed head of a reactionary ministry, at the instance of his brother-in-law, Prince Windischgrätz. Himself a soldier, he aimed at the ultimate restoration of the absolute monarchy by means of the army. He supervised the abdication of Ferdinand and proclamation of Francis Joseph as Emperor, and although at first he held out prospects of constitutional government, he dissolved the Kremsier Reichstag at the earliest opportunity (March 7, 1849) and late in November called in the Russians to end the war in Hungary. He then turned his attention to Germany. His refusal to incorporate only the German provinces of the monarchy in the proposed new German Empire had thrown the German parliament into the arms of Prussia. His object now was to restore the *status quo ante* of the Confederation, with the old predominance of Austria. His success in this respect was partly due to exterior circumstances, notably the mistimed exaggerations of the German revolutionists, but largely to his diplomatic skill, unscrupulousness and iron tenacity of purpose with which the weakness of Frederick William IV. and his ministers was unable to cope. His triumph came with the restoration of the old federal diet in May 1850 and the signature of the convention of Olmütz on Nov. 29 of the same year. (*See* GERMANY: *History.*) Schwarzenberg was also mainly responsible for Francis Joseph's suspension of the last remnants of the Constitution on Dec. 31, 1851. He died on April 5, 1852.

See Berger, *Felix, Fürst zu Schwarzenberg* (Leipzig, 1853); A. Beer, *Fürst Schwarzenberg's Deutsche Politik bis zu den Dresdener Konferenzen* (Historisches Taschenbuch, Leipzig, 1891).

SCHWARZENBERG, KARL PHILIPP, PRINCE ZU (1771–1820), Austrian field marshal, was born on April 15, 1771, at Vienna. He entered the imperial cavalry in 1788, fought in 1789 under Lacy and Loudon against the Turks, distinguished himself by his bravery, and became major in 1792. At Cateau Cambresis in 1794 his brilliant charge at the head of his regiment, vigorously supported by 12 British squadrons, earned him the cross of the Maria Theresa order. After taking part in the battles of Amberg and Würzburg in 1796 he was promoted major-general, and in 1799 lieutenant field marshal. At Hohenlinden in 1800 his promptitude and courage saved the right wing of the Austrian army from destruction, and he afterwards commanded the rearguard. In 1805 he commanded a division under Mack, and when Ulm was surrounded by Napoleon in October he was one of the brave band of cavalry, under the archduke Ferdinand, which cut its way through the hostile lines. In the same year he was made a commander of the order of Maria Theresa and in 1809 he received the Golden Fleece.

In 1808 he was sent on a mission to St. Petersburg (Leningrad) but returned in time to take part in the battle of Wagram, and was soon afterwards promoted general of cavalry. After the Peace of Vienna he was sent to Paris to negotiate the marriage between Napoleon and the archduchess Maria Louisa. The prince gave a ball in honour of the bride on July 1, 1810, which ended in the tragic death of many of the guests, including his own sister-in-law, in a fire. Napoleon held Schwarzenberg in great esteem, and it was at his request that the prince took command of the Austrian auxiliary corps in the Russian campaign of 1812. In 1813 Schwarzenberg, recently promoted field marshal, was appointed commander-in-chief of the allied Grand Army of Bohemia against France. As such he was the senior of the allied generals who conducted the campaign of 1813–14 to the final victory before Paris and the overthrow of Napoleon. He has been accused of timidity and over-caution but he was always hampered by political considerations: his victory, however achieved, was as complete as Austria desired. His many rewards included the position of president of the Hofkriegsrath, and, as a specially remarkable honour, the right to bear the arms of Austria as an escutcheon of pretence. In 1820, when revisiting the battle-field of Leipzig, he was attacked by a stroke, and died there on Oct. 15.

See Prokesch-Osten, *Denkwürdigkeiten aus dem Leben des Feldmarschall's Fürsten Schwarzenberg* (Vienna, 1823); Berger, *Das Fürstenhaus Schwarzenberg* (Vienna, 1866).

SCHWARZENBERG, a town of Germany, in the republic of Saxony, situated on the Schwarzwasser, 16 m. W. from Annaberg by rail. Pop. (1925) 11,465. It has an old palace. It manufactures paper, tin wares, machinery, worsted, and porcelain, and there are large iron-works in the vicinity.

SCHWECHAT, a small market town in Lower Austria, near the confluence of the River Schwechat with the Danube. Situated in a fertile loess land and only 5 m. from Vienna it is a prosperous town participating in the industrial life of the capital through its huge Dreher brewery, smelting and iron works, cotton-spinning and factories of electrical plant.

SCHWEIDNITZ, a town in the Prussian province of Silesia, situated on the left bank of the Weistritz, 28 m. S.W. of Breslau by rail. Pop. (1925) 30,626. Schweidnitz, dating from about the 11th century, received civic rights in 1250. About 1278 it became the capital of a principality, with an area of about 1,000 sq.m., which belonged to Bohemia from 1353 till 1741, when it passed into the possession of Prussia. The "Pölerei of Schweidnitz" is the name given to the riotous revolt of the town, in 1520–1522, against a royal edict depriving it of the right of coining its own money. The town contains several old churches, one of which was built in the 14th century, and an old town hall. The surrounding country is fertile and highly cultivated, and the large quantities of flax and hemp there raised encourage an active weaving industry in the town. Beetroot for sugar, grain and fruit are also grown. The manufacture of linens, hosiery, furniture, gloves, machinery, margarine, organs, carriages and other hardware goods is carried on. The beer of Schweidnitz has long been famous. Schweidnitz is the chief grain market of the district.

SCHWEINFURT, a town in the republic of Bavaria, on the Main, 27 m. N.E. of Würzburg by rail, and at the junction of lines to Kissingen, Bamberg and Gemünden. Pop. (1925) 36,336. Schweinfurt is mentioned in 790, and in the 10th century was the seat of a margrave. Receiving civic rights in the 13th century, it maintained its independence as a free imperial city with few interruptions until 1803, when it passed to Bavaria. In the Thirty Years' War it was occupied by Gustavus Adolphus, who erected fortifications, remains of which are extant. The Renaissance town hall dates from 1570. St. John's church is Gothic with a tower; St. Salvator's was built about 1720. The chief manufacture is paint, introduced in 1809; but beer, sugar, machinery, ball bearings, bicycles, brushes, soap and other drysalteries, basket work and vinegar are also produced. Schweinfurt is the seat of an important sheep and cattle market.

SCHWEINFURTH, GEORG AUGUST (1836–1925), German traveller in East Central Africa and ethnologist, was born at Riga on Dec. 29, 1836. He was educated at the universities of Heidelberg, Munich and Berlin (1856–62), where he particularly devoted himself to botany and palaeontology. Commissioned to arrange the collections brought from the Sudan by Freiherr von Barnim and Dr. Hartmann, his attention was directed to that region; and in 1863 he travelled round the shores of the Red Sea, repeatedly traversed the district between that sea and the Nile, passed on to Khartoum, and returned to Europe in 1866. In 1868 the Humboldt-Stiftung of Berlin sent him on a scientific mission to the interior of East Africa. Starting from Khartoum in Jan. 1869, he went up the White Nile to Bahr-el-Ghazal, and then, with a party of ivory dealers, through the regions inhabited by the Diur (Dyoor), Dinka, Bongo and Niam-Niam; crossing the Nile watershed he entered the country of the Mangbettu (Monbuttu) and discovered the river Welle (March 19, 1870) which by its westward flow he knew was independent of the Nile. Schweinfurth formed the conclusion that it belonged to the Chad system, and it was several years before its connection with the Congo was demonstrated.

The discovery of the Welle was Schweinfurth's greatest geographical achievement; he also elucidated the hydrography of the Bahr-el-Ghazal system. He described in detail the cannibalistic practices of the Mangbettu, and his discovery of the pygmy Akka settled conclusively the question as to the existence of dwarf

races in tropical Africa. Unfortunately nearly all his collections made up to that date were destroyed by a fire in his camp in Dec. 1870. He returned to Khartoum in July 1871 and published an account of the expedition, under the title of *Im Herzen von Afrika* (Leipzig, 1874, rev. ed. 1918; Eng. ed., *The Heart of Africa,* 1873, new ed. 1878). In 1873–74 he accompanied Gerhard Rohlfs in his expedition into the Libyan desert. Settling at Cairo in 1875, he devoted himself to African studies, historical and ethnographical. In 1876 he penetrated into the Arabian desert with Paul Güssfeldt, and continued his explorations therein at intervals until 1888, and during the same period made geological and botanical investigations in the Fayum, in the valley of the Nile, etc. In 1889 he removed to Berlin; but he visited the Italian colony of Eritrea in 1891, 1892 and 1894. Schweinfurth died in Berlin on Sept. 20, 1925. His botanical and geological collections were given to the Prussian State.

The accounts of all his travels and researches have appeared either in book or pamphlet form or in periodicals, such as *Petermanns Mitteilungen,* the *Zeitschrift für Erdkunde,* etc. Among his works may be mentioned *Artes Africanae; Illustrations and Descriptions of Productions of the Industrial Arts of Central African Tribes* (1875).

SCHWEITZER, JEAN BAPTISTA VON (1833–1875), German politician and dramatic poet, was born at Frankfort-on-the-Main on July 12, 1833, of an old aristocratic Catholic family. He was attracted by the Social Democratic labour movement, and after the death of Ferdinand Lassalle in 1864, he became president of the "General Working-men's Union of Germany," and in this capacity edited the *Sozialdemokrat,* which brought him into frequent trouble with the Prussian Government. In 1867 he was elected to the parliament of the North German Federation, and on his failure to secure election to the German Reichstag in 1871, he resigned the presidency of the labour union, and retired from political life. Schweitzer composed a number of dramas and comedies; also a political novel, *Lucinde oder Kapital und Arbeit* (Frankfort, 1864).

SCHWENKFELD, KASPAR (1490–1561), of Ossing, German theologian, entered the service of the duke of Liegnitz, over whom he had great influence. In 1522 he visited Wittenberg, where he made the acquaintance of Andreas Carlstadt and Thomas Münzer. On his return to Liegnitz he helped to spread the principles of the Reformation in the principality and in Silesia, while warning his colleagues against the abuse of the doctrine of justification by faith. The controversy on the Eucharist (1524) revealed his disagreement with Luther on that critical point. He sought to establish a *via media* between the doctrines of Luther and Zwingli, and vainly hoped to obtain for it Luther's acceptance. He as vainly sought to secure Luther's adoption of a strict rule of church discipline, after the manner of the Moravian Brethren. Meanwhile the Anabaptists obtained a footing in Silesia, and suspicions of Schwenkfeld's sympathy with them were aroused. Letters and writings of his own (1527–1528) proved him to hold strongly anti-Lutheran views, and both Catholics and Lutherans urged the duke of Liegnitz to dismiss him. He voluntarily left Liegnitz in 1529, and lived at Strasbourg for five years amongst the Reformed clergy there. In 1533, in an important synod, he defended against Martin Bucer the principles of religious freedom as well as his own doctrine and life. But the heads of the church carried the day, and Schwenkfeld left Strasbourg for a time. The publication (1539) of a book in proof of his most characteristic doctrine—the deification of the humanity of Christ—led to active persecution by the Lutherans and his expulsion from the city of Ulm. The next year (1540) he published a refutation of the attacks upon his doctrine with a more elaborate exposition of it, under the title *Grosse Confession.* The book emphasized the differences between the Lutherans and Zwinglians on the doctrine of the Eucharist at a moment when efforts were being made to reconcile them. An anathema was accordingly issued from Schmalkald against Schwenkfeld (together with Sebastian Franck); his books were placed on the Protestant "index"; and he himself was made a religious outlaw. Schwenkfeld went into hiding. He and his followers withdrew from the Lutheran Church, declined its sacraments, and formed small societies of kindred views. He died at Ulm, on Dec. 10. 1561.

Schwenkfeld left behind him a sect (who were called subsequently by others Schwenkfeldians, but who called themselves "Confessors of the Glory of Christ") and numerous writings to perpetuate his ideas. His writings were partially collected in four folio volumes, the first of which was published in the year 1564, containing his principal theological works. His adherents were to be found at his death scattered throughout Germany. In Silesia they formed a distinct sect, which persisted. In the 17th century they were associated with the followers of Jacob Böhme, and were undisturbed until 1708, when an inquiry was made as to their doctrines. In 1720 a commission of Jesuits was despatched to Silesia to convert them by force. Most of them fled from Silesia into Saxony, and thence to Holland, England and North America. Frederick the Great of Prussia, when he seized Silesia, extended his protection to those who remained in that province. Those who had fled to Philadelphia in Pennsylvania (1734) formed a small community under the name of Schwenkfelders; and Zinzendorf and Spangenberg, when they visited the United States, endeavoured, but with little success, to convert them to their views. This community still exists in Pennsylvania and their views appear to be substantially those of the Quakers.

Schwenkfeld distinguished between an outward word of God and an inward, the former being the Scriptures and perishable, the latter the divine spirit and eternal. In his Christology he departed from the Lutheran and Zwinglian doctrine of the two natures by insisting on what he called the *Vergötterung des Fleisches Christi,* the deification or the glorification of the flesh of Christ. His peculiar Christology was based upon profound theological and anthropological ideas, which contain the germs of some recent theological and Christological speculations.

See Arnoldt, *Kirchen- und Ketzer-Historie* (Frankfort, ed. 1700); Salig, *Historie der Augsburg. Confession;* W. H. Erbkam, *Gesch. der prot. Sekten* (1848); Dorner, *Gesch. d. prot. Theol.* (1867); also R. H. Grützmacher's article in Hauck-Herzog's *Realencyklopädie;* Robert Barclay's *Inner Life of the Religious Societies of the Commonwealth* (1876); C. Beard's *Hibbert Lectures* (1883); H. W. Kriebel, "The Schwenkfelders in Pennsylvania," *Pa.-German Soc. and Addresses,* vol. xiii. (1904); and S. K. Brecht, *The Geneological Record of the Schwenkfelder Families* (1923).

SCHWERIN, KURT CHRISTOPH, Count von (1684–1757), Prussian general field marshal, was born at Löwitz, Pomerania. He served in the Dutch army and then in the Mecklenburg-Schwerin armies during the War of the Spanish Succession. In 1713 he was with Charles XII. of Sweden in his captivity at Bender, and in 1718 was made major-general. In 1719 he opposed the Hanoverian army which invaded Mecklenburg (in the course of which he fought a brilliant action at Walsmühlen on March 6, 1719), and in 1720 entered the Prussian service. In 1730, as a major-general, he was a member of the court-martial which tried the crown prince of Prussia (afterwards Frederick the Great) for desertion, and in 1733, at the head of a Prussian army, conducted with great skill the delicate and difficult task of settling the Mecklenburg question. Frederick promoted Schwerin to the rank of general field marshal and made him a count. At the battle of Mollwitz (April 10, 1741) his brilliant leading converted a doubtful battle into a victory. In the Second Silesian War (1744–1745) Schwerin commanded the army which, marching from Glatz, met the king's army under the walls of Prague and contributed to the capture of that place. In the first campaign of the Seven Years' War (1756) he conducted the war on the Silesian side of Bohemia; and in 1757, following the same route as in 1744, again joined Frederick at Prague. On May 6, leading on a regiment of the left wing to the attack with its colour in his hand, the old field marshal was shot dead.

See Varnhagen von Ense, *Biographische Denkmale,* vol. vi. (3rd ed., Leipzig, 1873), and *Leben Schwerins* (Berlin, 1841).

SCHWERIN, a town of Germany, the capital of the republic of Mecklenburg-Schwerin, situated at the south-west corner of the lake of Schwerin 129 m. by rail N.W. of Berlin, and 20 m. S. of the Baltic. Pop. (1925) 46,905. Schwerin is mentioned as a Wendish stronghold in 1018, its name (*Zwarin* or *Swarin*) being a Slavonic word signifying "game-preserve." The town, founded

in 1161 by Henry the Lion in opposition to this pagan fortress, received civic rights in 1166. From 1170 to 1624 it gave name to a bishopric; and it was also the capital of the duchy of Schwerin, which formed the western part of the grand-duchy of Mecklenburg-Schwerin. Destructive fires, the hardships of the Thirty Years' War, and the removal of the court to Ludwigslust in 1756 seriously depressed the town.

The town is closely surrounded and hemmed in by a number of lakelets. Though Schwerin is the oldest town in Mecklenburg, its aspect is comparatively modern, a fact due to destructive fires, which have swept away most of the ancient houses. The most conspicuous of the many fine buildings is the former ducal palace built in 1844–57 in the French Renaissance style. It stands on a small round island between Castle lake and the lake of Schwerin, formerly the site of a Wendish fortress and of a later mediaeval castle. The older palace, the government buildings and the museum all stand in the "old garden," an open space at the end of the bridge leading to the new palace. Among the other secular buildings are the former palace of the heir-apparent, and the library. The cathedral was originally consecrated in 1248, though the present building—a brick structure in the Baltic Gothic style, with an unfinished tower—dates for the most part from the 15th century. The chief industry is the making of furniture, and there are also some manufactures of dyes, pianos, wool yarn, sugar, cement and soap.

SCHWERTE, a town in the Prussian province of Westphalia, 9 m. N. E. of Hagen by rail, at the junction of the lines Aix-la-Chapelle-Holzminden and Schwerte-Münster. Pop. (1925) 16,326. Schwerte received civic rights in the 12th century. It has a Romanesque church, with a carved altar of 1523, and stained glass of the 14th and 15th centuries; and there is a 16th century town hall. The industries are practically confined to the manufacture of iron and steel goods.

SCHWIEBUS, a town in the Prussian province of Brandenburg, 47 m. E. of Frankfort-on-Oder by the railway to Posen. Pop. (1925) 9,734. The territory of Schwiebus originally belonged to the principality of Glogau, and in the 16th and 17th centuries was a bone of contention between the electors of Brandenburg and the emperors. In 1686 the elector received the lordship of Schwiebus on renouncing his claims to certain other principalities. Frederick III., however, restored Schwiebus to the emperor Leopold I. in 1695, receiving £40,000 in exchange. By the peace of 1742, Frederick the Great regained Schwiebus with the rest of Silesia. The town is still in part surrounded by its mediaeval wall, and has an old market-place, a castle and many old houses. Cloth, machinery, and bricks are manufactured, and there are flour-mills, breweries, and lignite mines.

SCHWIND, MORITZ VON (1804–1871), German painter, was born in Vienna in 1804. His early art training was rudimentary and at 17 he entered the circle of artists who gathered around Schubert in the capital and became a devoted friend and admirer of the composer, dividing his enthusiasm between music, poetry and painting. In after life he frequently introduced Schubert's portrait or the subjects of his songs into his paintings and illustrations. In 1827 Schwind went to Munich, where he came under the influence of Schnorr and Cornelius, and in 1834 was commissioned to decorate Ludwig II.'s new palace with wall-paintings after Tieck. The revival of art in Germany was favourable to the development of his fanciful genius and he soon became popular through his illustrations of Goethe and other poets. From 1844 he lived in Frankfort, where he painted the "Singers' Contest in the Wartburg" (1846), made the designs for the Goethe celebrations and did numerous book illustrations. In 1847 he became professor at the Munich academy. He died at Munich in 1871.

Schwind also designed the wall-paintings for the castle of Hohen-Schwangau in the Bavarian Tirol and for the Wartburg. In 1857 he published a cycle of the *Seven Ravens* from Grimm. Many of his watercolours etc. of the early Vienna days are preserved in the City Museum, and the Schubert sketches, including the large portrait group, "Schubert-Abend bei Josef R. von Spaun," a sepia drawing completed about 1868, are in the Schubert Museum, Vienna. His "Symphony" (Neue Pinakotek, Munich) also contains portraits of Schubert and others of the circle.

See Karl Kobald, *Schubert und Schwind* (1928).

SCHWOB, MARCEL (1867–1905), French author. Many of his novels have an historical setting, but his art is extraordinarily versatile, and includes tales of imagination, of the future, legends, psychological essays, and many short stories. In the prefaces to *Coeur double, Roi au masque d'or* (1893) Schwob makes an attempt to analyse his art. In spite of his unusual historical, linguistic and scientific knowledge, and his crowded canvas, his style is simple and straightforward. His work includes translations of Shakespeare and Defoe. He had a wide and close knowledge of English literature. He was a friend of Oscar Wilde, who dedicated *Salome* to him. The *Vies Imaginaires* (1896, reprint 1922) is a series of sketches in which the *légendes* of various famous people are the basis, rather than their actual lives.

His works include *Spicilège* (1896); *La Croisade des Enfants* (1896); *La Lampe de Psyché* (1903); *La Guerre Commerciale* (2 vols. 1896 and 1904).

SCHWYZ, one of the ancient forest cantons of central Switzerland. Its total area (1923–24 determinations) is 350·5 sq.m., of which 78·7% are reckoned as "productive" (forests covering 72·4 sq.m. and vineyards about 30 ac.) while of the rest 18·1 sq.m. are occupied by the larger lakes (chiefly several square miles of Zürich and of Lucerne, together with a small area of Zug and the whole of Lowerz—1·2 sq.m. draining into Lucerne); about 0·5 sq.m. is covered by glaciers. Its loftiest point is the Böser Faulen (9,199 ft.), while the two highest summits of the Rigi (the Kulm, 5,742 ft., and the Scheidegg, 5,463 ft.) are within its borders, but, on the whole, the land is hilly rather than mountainous. Its title as the "core of Helvetia" is more appropriate in respect of its position, for though much below average size for a Swiss canton, no less than seven other cantons touch its borders. It has two main valleys, the Muota receiving the waters of Lake Lowerz and draining into Lucerne, and the Sihl, which receives the river Alp on which Einsiedeln stands; the reinforced stream, though formed near the head of the Lake of Zürich, flows for a long distance roughly parallel to it and enters the river Limmat below the lake. The canton has but few main line railways, the principal being a portion of the main St. Gothard line between Sisikon and Küssnacht. Arth-Goldau (memorable for the great landslide of 1806) is a railway junction of some importance, with a line to Zug and another past Biberbrücke (junction for Einsiedeln and the water falls) towards Wädenswil. A popular mountain-railway also terminates at Arth-Goldau for the ascent of the Rigi-Kulm, with a branch to Rigi-Scheidegg. Of other mountain lines in the canton the most important is the electric cogwheel railway from Brunnen to Axenstein.

In 1920 the population was 59,731, of whom 58,337 were German-speaking, 912 Italian-speaking and 279 French-speaking, showing during the 20th century a substantial increase of the German tongue and a reduction in the other elements. There were 56,669 Catholics, 2,924 Protestants and 25 Jews. Schwyz, until 1814 in the diocese of Constance, now forms part of the see of Choire. The largest town is Einsiedeln (pop. 8,228), a great pilgrimage centre noted for its black Virgin and its Benedictine monastery. Schwyz (pop. 8,139), is the political capital and is connected with Brunnen, its port on Lucerne. The canton is essentially a pastoral one, its local race of brown cattle being much esteemed, particularly in north Italy, but some industrial activity (textiles) also takes place near the Lake of Zürich and the home weaving of silk is still general. The 30 cantonal communes are grouped into six administrative districts. The Constitution, dating mainly from 1876, was revised in 1898. The legislature (*Kantonsrat*) is composed of 103 members elected in the proportion of one for every 600 residents, and the elections, since 1907, take place according to the principles of proportional representation. The executive (*Regierungsrat*) of seven members is elected by a popular vote and, as is the case with the larger

body, holds office for four years. The two members of the federal *Ständerat* and the three of the federal *Nationalrat* are also chosen by a popular vote. Since 1876 the "obligatory referendum" has prevailed in the case of all laws and financial resolutions approved by the legislature, while 2,000 electors may claim a popular vote as to any remaining decrees or resolutions. Any 2,000 electors have also the right of "initiative" as to the revision of the cantonal Constitution or as to legislative matters.

History.—The valley of Schwyz is first mentioned in 972 as "Suittes." Later, a community of freemen settled at the foot of the Mythen, subject only to the count of the Zurichgau, as representing the German king. In 1240 the community obtained from the emperor, Frederick II., the privilege of being subject immediately to the empire. Its territory then included only the district round the village of Schwyz and the valley of the Muota. But in 1269 it bought from Count Eberhard, of Habsburg-Laufenburg, Steinen and Rothenthurm. Schwyz took the lead in making the famous everlasting league of Aug. 1, 1291, with the neighbouring districts of Uri and of Unterwalden, its position and political independence specially fitting it for this prominence. An attack by Schwyz on Einsiedeln was the excuse for the Austrian invasion that was gloriously beaten back in the battle of Morgarten (Nov. 15, 1315). In the history of the league Schwyz was always to the front, so that its name in a dialectal form (Schweiz) was from the early 14th century onwards applied by foreigners to the league as a whole, though it formed part of its formal style only from 1803 onwards. After the victory of Sempach (1386) Schwyz greatly extended its borders. An "alliance" with Einsiedeln in 1397 ended in 1434 with the assumption of the position of "protector" of that great monastery; between 1386 and 1436 the whole of the "March" (the region near the upper lake of Zürich) was acquired; in 1402 Küssnacht was bought, and in 1440 the "Höfe," the parishes of Wollerau, Feusisberg, and Freienbach, situated on the main lake of Zürich. All these districts were governed by Schwyz as "subject lands," the supreme power resting with the *Landsgemeinde* (or assembly of all male citizens of full age). Schwyz joined the other forest cantons in opposing the Reformation, and took part in the battle of Kappel (1531), in which Zwingli fell. In 1798 Schwyz, including Gersau (free from 1390), formed part of the République Telliane (or Tellgau), set up by the French, which a week later gave way to the Helvetic republic. In 1803 the separate canton of Schwyz was again set up. Schwyz joined, in 1832, the league of Sarnen, and in 1845 the Sonderbund, which was put down by a short war in 1847. In 1832 the outer districts (Einsiedeln, the March, Küssnacht, and Pfäffikon) formed themselves into a separate canton, an act which brought about a federal occupation of the old canton in 1833, this ending in the dissolution of the new canton, the constituent parts of which were put on an equal political footing with the rest. In 1838 strife broke out in the older portion of the canton between the richer peasant proprietors (nicknamed the "Horns," as they owned so many cows) and the poorer men (dubbed the "Hoofs," as they possessed only goats and sheep) as to the use of the common pastures, which the "Horn" party utilized far more than the others. The "Horn" party finally carried the day at the Landsgemeinde held at Rothenthurm. The cantonal constitution of 1848 put an end to the ancient Landsgemeinde; it was revised in 1876 (when membership of one of the 29 communes became the political qualification), and in 1898.

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SCHWYZ, the capital of the Swiss canton of that name, a picturesque little town, admirably situated, amid fruit trees, on a mountain terrace (at a height of 1,706 ft.), at the north-west foot of the conical peak of the Gross Mythen (6,240 ft.). Including the neighbouring hamlets of Ibach, Rickenbach, etc., the parish had 8,139 inhabitants in 1920, practically all German-speaking and Roman Catholics. The town is about 3 m. from Brunnen, its port on the lake of Lucerne.

Besides a stately 18th century parish church and several convents, it contains a 16th century town hall (housing various precious mss.), as well as several curious old patrician houses.

SCIACCA (Arabic, *Sciaqqak*), a town and episcopal see of Sicily, on the south coast, in the province of Girgenti, 52 m. N.W. of Girgenti by rail, and about 30 m. direct. Pop. (1921) 20,052 (town); 25,630 (commune). It is surrounded by walls erected about 1550, and has two ruined castles, belonging to the Luna and Perollo families, whose hereditary feuds lasted from 1410 to 1529, some fine medieval and 18th century palaces, and several interesting churches. The convent of Sta. Maria delle Giummare, with its battlemented walls, occupies the former palace of the Saracen governors, and contains a painting of the foundation of the convent by Count Roger. The town has only an open roadstead. Three miles E. of the town is the Monte San Calogero (the ancient Mons Cronius) with sulphurous and saline springs and vapour baths, which are still used and were known in Roman times as Aquae Larodes or Thermae Selinuntiae (Sciacca is about 15 m. direct S.E. of Selinus). The town is the birthplace of Tommaso Fazello (1498–1570), the father of Sicilian history.

See I. Scaturro, *Storia della città di Sciacca* (1925–26).

SCIALOJA, VITTORIO (1856–), Italian jurist and statesman, son of the eminent Neapolitan scientist, patriot and statesman, Antonio Scialoja, was born at Turin, and after graduating in jurisprudence was appointed professor of civil law at the University of Camerino when only 23 years of age. In 1880 he was transferred to the University of Siena, and in 1884 to that of Rome, where he still teaches. Many of the most distinguished jurists and political men in Italy have been his pupils, and through his teachings and writings he has exercised a wide influence on juridical thought and practical legislation. In 1904 he was nominated senator, and since then he has played an active part in Italian political life. In 1909 he was appointed minister of justice, and during the World War he was minister (without portfolio) in the Boselli and Orlando cabinets. In the autumn of 1919, on the resignation of Senator Tittoni, Senator Scialoja became minister of foreign affairs in the Nitti cabinet, and in this capacity he attended various meetings of the Peace Conference, either as assistant Italian delegate under Sig. Nitti or as first delegate. He left office on the fall of the cabinet in June 1920, and in the autumn of that year became a member of the Italian delegation at the League of Nations Assembly. Since 1925 he has been president of the Italian delegation at the Assembly and Italian representative on the Council of the League, in whose activities he has played an important part since its birth, having indeed collaborated in the drafting of the Covenant.

He is the author of a large number of books, pamphlets and articles on legal subjects, of which the most important are the following: *Sopra il precarium nel diritto romano* (1878); *Degli atti di emulazione nell' esercizio dei diritti* (1878); *Del diritto positivo e dell' equità* (1880); *Responsabilità e volontà nei negozi giuridici* (1885); Italian translation, with an introduction, of Savigny's *System of Roman Law* (8 vols., 1886–98); *Sul diritto al nome e allo stemma* (1889); *Sulla teoria dell' interpretazione della legge* (1898); *Dizionario pratico del diritto privato* (1899, etc.); *Sulle condizioni impossibili nei testamenti* (1901); *Sulle funzioni della IV. Sezione del Consiglio di Stato* (1901).

SCIATICA, a form of neuralgia localized in the sciatic nerve, or its cords of origin; *see* Neuralgia: *Paralysis*.

SCIENCE, a word which, in its broadest sense, is synonymous with learning and knowledge. (Lat *scientia,* from *scire,* to learn, know.) Accordingly it can be used in connection with any qualifying adjective, which shows what branch of learning is meant. But in general usage a more restricted meaning has been adopted, which differentiates "science" from other branches of accurate knowledge. For our purpose, science may be defined as ordered knowledge of natural phenomena and of the relations between them; thus it is a short term for "natural science," and as such is used here in conformity with a general modern convention.

The Origin of Science.—The beginnings of physical science

are to be sought in the slow and unconscious observation by primitive races of men of natural occurrences, such as the apparent movements of the heavenly bodies, and in the gradually acquired mastery over the rude implements by the aid of which such men strove to increase the security and comfort of their lives. Biological science similarly must have begun with observation of the plants and animals useful to man, and with empirical medicine and surgery. Again, it is probable that magic, by which man tries to obtain direct control over nature, helped to lead both to primitive religion and also, directly or indirectly, to practical science. But it was only when considerable progress had been made with ordered knowledge that men began to seek natural causes for phenomena, and to discern the connections between them.

In the earliest stage of development it seems that an anthropomorphic or mythological explanation is always assigned to the phenomena of nature. With no clue to trace the regularity of sequence and connection between those phenomena, an untutored mind inevitably refers the apparently capricious events which succeed each other to the direct and immediate intervention of some unseen being of a nature essentially similar to his own. The sun is the flaming chariot of the sun-god, driven day by day across the heavens; the clouds are cows from which milk descends as nourishing rain on the fruitful earth. We may regard such myths as childlike fancies, but they were doubtless an advance on the lack of explanation which preceded them; they supplied hypotheses which, besides providing suggestive themes of beauty for poetry and art, played the first and chief part of a scientific hypothesis in pointing the way for further inquiry. Much useful knowledge was acquired and much skill gained in logical analysis before these primitive explanations were proved insufficient. A false theory which can be compared with facts may be more useful at a given stage of development than a true one which is beyond the comprehension of the time, and is incapable of examination by any known means of observation or experiment.

The phenomena of the heavens are at once the most striking, the most easily observed and the most regular of those which are impressed inevitably on the minds of thinking men. Thus it is to astronomy we must look for the first development of scientific ideas.

Early Astronomy.—The orientation of many prehistoric monuments shows that a certain amount of astronomical observation had been acquired at a very early age, and the Chaldeans seem to have gone so far as to recognize a law of periodicity even in eclipses. The earliest known systematic advance on the mythological view of nature is to be found in the writings of the Ionian philosophers of whom Thales of Miletus (580 B.C.) is regarded as the first. Anaximander recognized the rotation of the heavens round the pole star, and saw that the dome overhead was but the half of a complete sphere. The earth was thus deprived of the base stretching to unfathomed depths imagined by the mythologists, and was left free to float as a flattened cylinder at the centre of the celestial sphere.

Next came the Pythagoreans, who simplified these conceptions by the suggestion that instead of a rotation of the vast sphere of the heavens the earth itself might be a sphere and revolve about a central fixed point, like a stone at the end of a string. The uninhabited side of the earth always faced the fixed point, and its inhabited side faced successively the different parts of the heavens. At the central fixed point they placed a "universal fire," which, like the fire on an altar, served as a centre for the circling of the worshipping earth. Mythology was losing its hold of science, but mystical symbolism still held sway. When, however, in the 4th century B.C., the growth of geographical discovery failed to disclose any trace of this central fire, the idea of its existence faded away, and was replaced by the conception of the revolution of the earth on its own axis. At a later date, Aristarchus (280 B.C.), believing that the sun was larger than the earth, thought it unlikely that it should revolve round the earth, and developed a heliocentric theory. But the time was not ripe; no indisputable evidence could be adduced, no general conviction followed, and to mankind the earth remained the centre of creation for many centuries. Even to Lucretius, the visible universe consisted of the central earth with its attendant water, air and aether surrounded by the sphere of the heavens, which formed the flaming walls of the world—*flammantia moenia mundi.*

The Problem of Matter and the Theory of Atoms.—Simultaneously with the birth of astronomy, the problem of matter came into being. The old Ionian nature philosophers, observing the sequence of changes from earth and water into the structure of plants and the bodies of animals, and through them again into the original constituents, began to grasp the conception of the indestructibility of matter, and to put forward the idea that all forms of matter might ultimately consist of a single "element." But the conception of a single ultimate basis of matter was far in advance of the age. It has only lately become a fertile working hypothesis in the light of all the gigantic increase in knowledge gained during the intervening two thousand years. At the time when it was put forward, the conception was of little use, and the immediate path of advance was found in the idea of Empedocles (450 B.C.) that the primary elements were four: earth, water, air and fire—a solid, a liquid, a gas and the flame which seemed to the ancients a type of matter of still rarer structure. This hypothesis served to interpret the phenomena of nature for many centuries, till, in modern days, the growth of chemistry disclosed the ninety and more elements of our text-books. And now they too have served their turn as a conception of the ultimate nature of matter, while still maintaining their place as the proximate units of chemical action.

In the four elements of Empedocles we trace the germ of the ideas of the Atomists. Empedocles saw that, by combining his separate elements in different proportions, he could explain all the endless differences in matter as known to the senses. Leucippus and Democritus developed the conception and gave to the world the theory of atoms, described at a later date by the Roman poet Lucretius. As matter is subdivided does it keep its characteristic properties throughout? Is iron always iron, however finely we divide it; is water always water? Are the properties of any kind of matter ultimate facts of which no explanation—no description in simpler terms—is possible? To avoid answering this last question in the affirmative, and resigning all hope of an advance in knowledge, the atomic theory of the Greeks was framed.

To recognize the significance of the doctrines of the Greek Atomists, we must remove from our minds all sense of comparison with the atomic theory of to-day. The Greeks had none of the detailed physical and chemical knowledge on which that theory is founded, and which it was framed to explain. The object of Leucippus and Democritus was quite different from that of Dalton and Avogadro. To the latter, the conception of atoms and molecules served as a means of explaining certain definite and detailed facts of chemical combination and gaseous volume in a more definite and exact way than any other hypothesis available at the time. To the Greek philosophers, the atomic theory was an attempt to make the universe intelligible. The particular explanation offered was not of so much importance as the idea that an explanation of some kind was possible. When we see the beliefs that held sway before their day, we realize the advance their ideas produced. The qualities of substances were thought to be of their essence—the sweetness of sugar was as much a reality as sugar itself, the black colour of water must survive all changes in its form, so that, to one who knew this doctrine, snow could never look white again. It was such confusion as this—such denial of facts if they failed to support a theory—that Democritus assailed:—"According to convention there is a sweet and a bitter, a hot and a cold, and according to convention there is colour. In truth there are atoms and a void." Atoms were many in size and shape, but identical in substance. All qualitative differences in substances were to be assigned to differences in size, shape, situation and movement of particles of the same ultimate nature. No attempt was made to examine into the nature of this ultimate substance; but one set of phenomena was expressed in terms of something simpler, and that is the essence of "explanation."

But the great difference between the position of the Greeks and that of ourselves in regard to natural knowledge consists in the

small number of phenomena known to them contrasted with the enormous wealth of accumulated observation which is available for us, as the result of centuries of experiment with the aid of apparatus unknown to the ancients. When a new theory is put forward, it is now almost always possible to test its concordance with facts by the use of material already accumulated, or to suggest, in the light of such material, experiments which will serve to refute it, or to lend it greater probability. Thus a theory which survives the trials that follow its birth has nowadays a fairly long expectation of life—probably the theory will serve to interpret phenomena discovered either by its means or in other ways for some time to come. But in the ancient world this was not so. To test a new theory, other phenomena were very rarely available than those which suggested it, or to explain which it was put forward. Thus thought was much more speculative, and, as is still the case with metaphysics, no general consensus of opinion was reached. Each philosopher had a system of his own in science, just as he still has in metaphysics—a system which, beginning anew from first principles, raises on them a superstructure, which, even if it logically follows from them, can have no more validity than the premises on which it is based. Thus to the Greeks, natural knowledge was truly philosophy. Philosophy can formulate natural problems and suggest different possible answers: when the time has come, science takes over the subject and decides between them.

The history of the atomic theory of Leucippus and Democritus illustrates the difficulties of a position where speculation has outstripped observation. The theory was nearer what is now accepted as truth than any other of the ancient schemes of physics. Yet the grounds on which it was based were so insecure that Aristotle (*c.* 340 B.C.), who started with other preconceptions, was able to bring to bear such destructive criticism that the theory ceased to occupy the foremost place in Greek thought. Democritus, for instance, had held that all things would fall with equal speed in a vacuum, and that the fact that heavy bodies were observed to fall faster than very light ones was due to the resistance of the air. Democritus's belief was true, though he was of course quite unconscious of the grounds on which it can alone be explained—the universal acceleration of gravity, and the remarkable and curious experimental fact that the weights of bodies are proportional to their masses. Aristotle agrees that in a vacuum all bodies would fall at an equal rate, but the conclusion appears to him so inconceivable that he rejects the idea of the existence of any empty space at all, and with the "void" rejects the rest of the allied concepts of the atomic theory. If all bodies were composed of the same ultimate matter, he argues, they must all be heavy, and nothing would be light in itself and disposed to rise. A large mass of air or fire would then necessarily be heavier than a small mass of earth or water. This result he thinks impossible, for certain bodies always tend upwards and rise faster as their bulk increases. It will be seen that Aristotle has no idea of the conceptions we now call density and specific gravity, though clear views about the question why some things rise through water or air might have been obtained without the aid of physical apparatus. Aristotle's doctrine that bodies are essentially heavy or light in themselves persisted all through the middle ages, and did much to delay the attainment of more exact knowledge. It was not till Galileo Galilei (1564–1642) discovered by actual experiment that, in cases where the resistance of the air is negligible, heavy things fall at the same speed as light ones, that the Aristotelian dogma was overthrown.

Early Biology.—Turning to the biological sciences, we may trace a somewhat similar course of development. Owing to its practical importance, medicine has left many records by which its progress can be traced. Just as primitive man personified the sun and the moon, the wind and the sea, so he regarded disease as due to the action of some malignant demon or to the spells of some human enemy. Greek literature enables us to trace the gradual decrease in the importance assigned to charms and magic, and the growth of more rational ideas among Greek physicians. But here, as in the physical sciences, the philosophic range of the intellect of the Greeks led them astray. Assumptions as to the nature of man or the origin of organic life were too often made the starting point of a train of deductive reasoning, the consequences of which were not always compared with the results of observation and experiment, even where such comparison was possible.

Among the multitude of their guesses, a few somewhat resembled the views that are now again rising into prominence from the basis of definite and exact experiment. A good example of the strength and weakness of ancient speculation is found in the cosmogony of the atomists, both on its physical and on its biological side. Lucretius describes how the world was formed by the conjunction of streams of atoms, which condensed into the earth, with its attendant water, air and aether, to form a self-contained whole. Unconscious of the mighty gap between inorganic matter and living beings, he proceeds to tell how, in the chances of infinite time, all possible forms of life appeared, while only those fittest to survive persisted and reared offspring. Here, surrounded by unsupported statements and false conclusions, we see dimly the germs of the ideas of the nebular hypothesis and the theory of natural selection, though Lucretius had the profoundest ignorance of the difficulties of the problem, and the vast stretches of time necessary for cosmical and biological development.

In those branches of biological science in which less ambitious theorizing and more detailed observation were forced on the Greeks, considerable progress was made. Aristotle compiled a laborious account of the animals known in his day, with many accurate details of their anatomical structure. Beginning from an earlier date, steady advance was made with geographical discovery. Maps of the known world, developed from the local maps invented by the Egyptians for the purposes of land-surveying, gave definiteness to the knowledge thus acquired, and showed its bearing on wider problems.

Geometry.—One of the most striking successes of Greek thought is seen in the development of geometry, the best type of deductive reasoning. Geometry has a twofold importance, as being itself the study of the properties of the space known to our senses, and as teaching us methods and means of studying nature by unfolding the full logical consequences of any hypothesis. Based on axioms, the result of innate ideas according to one school or of simple experience according to another, it traces from the ideas of solids, surfaces, lines and points the properties of other figures defined in terms of those ideas. As an example to other sciences, the deductive geometry of Euclid (*c.* 300 B.C.) had, perhaps, an unfortunate influence in emphasizing the deductive method, and teaching men to neglect the need of verifying by experiment the theories put forward to explain the more complex phenomena of nature at the conclusion, and at each possible step, of the deduction. But, in itself, the science of Euclidian geometry was brought to such a state of perfection that no advance was made till modern times: no change even in form attempted till quite recently. Unlike some other branches of inquiry we have mentioned, Euclid's geometry carried universal conviction, and represented a permanent step in advance which never had to be retraced.

Besides studying individual sciences, the Greeks paid even more attention to the laws of thought, and to the examination of the essence of the methods by which knowledge in general is acquired. In opposition to Plato's theory that all knowledge is but the unfolding and development of forgotten memories of a previous state of existence, Aristotle taught that we learn to reach the generalizations, which alone the Greeks regarded as knowledge, by remembering, comparing and co-ordinating numerous particular acts or judgments of sense, which are thus used as a means of gaining knowledge by the action of the innate and infallible *nous* or intellect. Neither Plato nor Aristotle could be satisfied without finding infallibility somewhere. Aristotle, it is true, investigated the logical processes by which we pass from particular instances to general propositions, and laid stress on the importance of observing the facts before generalizing about them, but he had little appreciation of the conditions in which observation and the induction based on it must be conducted in practice in order to obtain results where the probability of error is a minimum. Aristotle regarded induction merely as a necessary preliminary

to true science of the deductive type best seen in geometry, and, in applying his principles, he never reached the "positive" stage, in which metaphysical problems are evaded, if not excluded, and a scheme of natural knowledge built up in a consistent manner, so that metaphysical ideas, though they may underlie the foundation of the ultimate conceptions, do not intrude between the parts of the building. Hence Aristotle's explanations often turn directly on metaphysical ideas such as form, cause, substance, terms which do not occur (in the Aristotelian sense) in modern scientific terminology.

The Origin of Mechanics.—A century later than the time of Aristotle, Archimedes of Syracuse (287 to 212 B.C.) formulated the fundamental conceptions of hydrostatics, and took what may be regarded as the first step in the exact science of mechanics. The use of the lever must have been discovered at a very early date, and Archimedes set to work to study its quantitative laws. He made use of axioms which seemed to him to be simpler, and applied thereto deductive principles learnt from the geometers. Nowadays we should treat the law of the lever of unequal arms as one that is verified by direct and familiar experiment, and use it, in its turn, as the starting point for further deduction. Nevertheless, Archimedes' proof is of use and interest, a true type of all scientific "explanations." It reduces an unfamiliar phenomenon to others already well known to our minds, which, being creatures of habit, regard the familiar cases as in no need of explanation.

The Dark Ages and Mediaeval Period.—Thus before the intellectual activity of Greece was absorbed by the utilitarianism of Rome, which, in its turn, was lost in the dark ages following the barbarian conquests, the seeds were sown which, germinating after the lapse of centuries, developed in the more fruitful soil of the age of experiment. The ancient knowledge only survived fragmentarily in compendiums written just before the dark ages. Thereafter, secular learning, based on those compendiums, settled down into the elementary "trivium," consisting of grammar, rhetoric and dialectic, and the more advanced "quadrivium," music, arithmetic, geometry and astronomy. Music included a half-mystical doctrine of numbers and the rules of plainsong; geometry consisted of a selection of the propositions of Euclid without the demonstrations; while arithmetic and astronomy were cultivated chiefly because they taught the means of finding Easter. Meanwhile, the early alchemists of Alexandria, by the aid of mystical analogies with the conceptions of astrology, were making primitive experiments on the transformations of various substances. It was probably from them that the "sacred science" passed to the Arabs, among whom the greatest was one Jabir, who (*c.* A.D. 750) discovered many new chemical reactions and compounds.

With the intellectual revival in the west which began in the 11th century, and the gradual recovery of some of the lost works of the ancient writers, we turn a new page. The controversy between Plato and Aristotle upon the doctrine of ideas fascinated the minds of the middle ages, saturated as they were with the logical subtleties of dialectic. This controversy originated the long debate on the reality of universals, which absorbed the intellectual energies of many generations of men. Did reality belong only to the idea or universal—to the class rather than to the individual—to the common humanity of mankind, for instance, rather than to each isolated being? Or were the individuals the reality, and the universals mere names or mental concepts? In this question, trivial as it seems at first sight, logical analysis disclosed to the mediaeval mind the whole theory of the universe. Either answer contained danger to theological orthodoxy as then understood; hence the fervour with which it was debated. But, as communication with the East was reopened early in the 13th century, Latin translations of Aristotle's works were recovered gradually; the whole of Aristotle's philosophy was reimported into the schools of Europe, and reconciled with and adapted to Christian theology chiefly by the work of Saint Thomas Aquinas. A complete rational synthesis of knowledge was thus put together, in which Religion, Philosophy and Science formed inter-connected parts of the whole. In virtue of this synthesis, for three hundred years Aristotle reigned supreme in European thought, and exponents of the scholastic philosophy, ignoring their master's teaching on the need of experiment, settled questions of fact as well as those of opinion by an appeal to his books. Nevertheless, the subtlety of the schoolmen kept alive intellectual interests in Europe, and thus prepared the way for science. Outside the newly founded universities, experiment was carried on by the labours of the alchemists, who, early in the 13th century, borrowed ideas from the Arabs, and began to search for an *elixir vitae* and for a means of transmuting baser metals into gold. But alchemy never quite squared its account with orthodox theology, and the "sacred science" of the Alexandrians became associated in the mediaeval mind with the "black art" of witchcraft. Even a man like Roger Bacon, who, with some astrological mysticism, had a more modern idea of experiment both in chemical and physical problems, did not escape condemnation.

The Renaissance.—We now reach the period in the history of the world known as the Renaissance, when increased material prosperity and improved political stability in the 15th and 16th centuries gave many converging streams of thought opportunity to unite. The Renaissance was not, as it is sometimes represented, a sudden break with mediaevalism and a birth of the modern world. A number of conditions favourable to rapid development happened to coincide, and, in the course of a century, men's outlook on themselves and on nature became profoundly modified. The recovery of the Greek language, the voyages of Columbus, the decay of the Western and the passing of the Eastern empire, the temporary diminution in power of the papacy, the invention of printing, all tended to produce new ideas and to prepare men's minds to accept the more human and naturalistic view of the universe which had been current among the Greeks, in place of the theological aspect which it wore to the mediaeval schoolmen and ecclesiastics. At first the tendency was to substitute the authority of the ancients for the authority of the schoolmen, but gradually more independence of thought was secured; men like *Leonardo da Vinci* (1452–1519) began to observe and to experiment; *Nicolaus Copernicus* (1473–1543) revived the heliocentric theory, and showed how the accumulated mass of astronomical observations could be interpreted by its means; and *Vesalius* (1514–1564) took up again the study of anatomy, which gradually made its way in the schools of medicine, in face of the prejudice against mutilating the human body.

Physics.—In physics the true method was first used freely by Galileo Galilei (1564–1642), who, turning the newly invented telescope to examine the stars and planets, increased enormously the evidence for the theory of Copernicus. But a greater achievement was the foundation of the science of dynamics. We have seen how the Aristotelians held the belief that every body sought its natural place, the place of heavy bodies being below and that of light ones above. Innate qualities of heaviness and lightness were thus invoked, and it was believed that heavy things always fell faster than light ones. Galileo, rightly rejecting the current point of view, set himself to examine not why, but how, things fell. First he showed that, save for a small error due to the resistance of the air, heavy and light bodies fall at the same rate. Next, by trying the consequences of one hypothesis after another till he found one that was both self-consistent and gave deductions in accordance with experiment, he proved that the space traversed by a falling body is proportional to the square of the time of fall. To verify this result experimentally, Galileo convinced himself that a body falling down an inclined plane acquired a speed which is the same as that it would have attained in falling through the same vertical height. He could therefore use a slow movement down a plane for his experiments instead of the unmanageably rapid course of a body falling freely. Nor was this all. From this stage of the investigation another consequence of his results was found to spring. A ball after running down an inclined plane of a certain height will run up another plane of the same height irrespective of its inclination—that is, if friction be small. The second plane may be made very long, but still, if its final height be not greater than that of the first, the ball will reach its end. Hence it is the height that matters; none of the speed of the ball is destroyed unless it rises. If the second plane be made horizontal, the

ball will thus run on for ever unless stopped by friction or some other applied force. This fundamental result, put into definite words by Newton, is known as the first law of motion, and is the foundation of the whole science of dynamics. In Galileo's day it was an entirely new conception. It had been assumed that every motion required some cause or force to maintain it. Hence arose the need of hypothetical vortices to maintain planetary movements, and similar complications in other branches of mechanics. But it now became evident that it was not the continuous motion of the planets which needed explanation, but the constant deflection of that motion from the straight path it would hold if no applied force were in action. The way was open for Newton.

Sir Isaac Newton (1642–1727) proved mathematically that the observed motion of the planets about the sun could be explained by the supposition that the sun exerted a force on each planet proportional inversely to the square of its distance from the planet. But the earth, at any rate, does seem to attract bodies on or near its surface, the phenomenon being the familiar but mysterious gravity. Is this force competent to account for the motion of the moon round the earth? On the assumption of the law of inverse squares, Newton calculated what the force of gravity would be at the distance of the moon and got a fair concordance with facts. But he put aside his calculations till, some years later, he proved mathematically that a sphere would attract other bodies as though all its mass were collected at its centre. He could then treat the problem accurately and thus found that the fall of a stone to the earth and the sweep of the moon in her orbit were due to the same cause. The mechanism by means of which the force is exerted remained unrevealed to Newton, and baffled all inquirers till Einstein showed that this problem was soluble by quite other means. But Newton's discovery that all the movements of the heavens could be described by one simple law was the first great physical synthesis, and perhaps represents the highest achievement in the history of science.

A position similar to that won for physics by Galileo and Newton was only reached in chemistry a century later. Then Lavoisier, by the test of the balance, showed that the total mass involved remained unchanged throughout a chemical reaction, and, by his re-discovery of oxygen, explained combustion as the combination of ordinary substances possessing mass and weight.

Newton brought the existing state of the solar system within the cognizance of known dynamical principles, and the logical extension of such principles to explain the origin of that system was made by the speculations of *Pierre Simon, marquis de Laplace* (1749–1827), and developed by those who followed him down to Sir James Jeans in our own day. They have imagined a primitive state of nebulosity from which, by the action of known dynamical processes, the stellar universe and our sun and planets would be evolved.

The discovery by Sir George G. Stokes (1819–1903), J. B. L. Foucault (1819–1868), R. W. Bunsen (1811–1898) and G. R. Kirchhoff (1824–1887), that the spectroscope gave a means of investigating the chemical composition of the sun and the stars, brought another set of phenomena within the range of experiment, while the differences observed in stellar spectra suggested once more the idea of cosmical development, familiar from the nebular hypothesis of Laplace.

Geology.—Similar principles were during the 19th century applied to the history of the earth. The earlier conceptions of the origin of the rocks imagined catastrophes of fire or water, processes alien to those of everyday experience. But the "uniformitarian" school, founded by James Hutton (1726–1797) and expounded by Sir Charles Lyell (1797–1875), produced evidence to show that much, at any rate, of the structure of the surface of the globe was produced by processes still going on under our eyes. The deposition of material by the action of seas, rivers and volcanoes, was seen to need only time enough to produce beds of rock like those which make up our mountains. Comparison of the fossil remains of plants and animals found in different strata then enabled geologists to classify the rocks, and place them in a chronological sequence. Moreover, it became evident that a series of animal and plant types was associated with the gradual formation of the rocks, and that the age both of the earth itself and of the organic life found on it was much greater than had been suspected. The few thousand years of received cosmogonies stretched out into untold millions, during which the same familiar laws described the phenomena of development. The remains and traces of man, found, it is true, only in the later sedimentary deposits of the earth, were enough to prove his existence through ages beside which the dawn of history was but as yesterday. As Newton had extended known principles throughout the gigantic spaces of the heavens, so the later astronomers and geologists pushed them back over enormous epochs of time.

Physiology and Biology.—Turning back to the 17th century, we find William Harvey starting physiology on its true course by his discovery of the circulation of the blood. By experiments on living animals, Harvey (1578–1657), von Haller (1708–1777), Bernard (1813–1878) and many others, investigated the mechanism of circulation, respiration, digestion and the other functions of the body, and thus made modern medicine and surgery possible. Moreover, they showed that physical and chemical principles are applicable in physiology, and gave new support to the idea of "man as a machine," which, whether or no it be a complete explanation, is an almost necessary assumption for physiological research.

The part played by micro-organisms in disease, made clear by Pasteur (1822–1895) and his disciples, the multitudinous life of tropic lands observed during voyages of scientific exploration, the revelations of geology—all combined with the new knowledge of physiology to prepare the way for the biological work of Charles Darwin (1809–1882). The origin of living beings from a few ancestral types was an old conception, but Darwin first found an adequate intelligible cause in the slow action of sexual selection, in conjunction with the pressure of the struggle for life, which allowed only those individuals most suited to the environment by favourable variation to survive and rear their offspring. The advantage thus given to beings with useful variations may develop into permanent modifications in the course of ages, and, when the parent types have disappeared, their common posterity may exhibit the marked differences characteristic of the separate and distinct species now existent. From the point of view of the history of science, the significance of Darwin's theory lies in the new and vast extension it gives to the field in which causes intelligible to the human mind can be sought as explanations of phenomena. Thus evolution is co-ordinated in the history of thought with the Newtonian theory of gravitation, with physical and chemical theories of physiology and with the uniformitarian theory of geology.

Both before and after the appearance of Darwin's work, biologists devoted their attention to the study of how useful variations arise. Three views have been held. (1) Jean Baptiste, chevalier de Lamarck (1744–1829), regarded variation as due to the accumulated and inherited effect of use. Thus the giraffe acquires his long neck by the successive efforts of countless generations to browse on leaves just beyond their reach. (2) Darwin, while accepting changes in accordance with Lamarck's ideas as exceptional aids to variation, revolutionized biology by showing the primary importance of the struggle for life, when extended over long periods of time, in selecting useful variations which arise accidentally or in other ways. (3) Darwin also recognized the possible occasional effect of discontinuous variations or "sports," when a plant or an animal diverges from its parents in a marked manner. But of late years the rediscovery of the forgotten work of G. J. Mendel, Abbot of Brünn (1822–1884), and further study by Hugo de Vries, William Bateson and others, of discontinuous variations which arise spontaneously, have pointed to the conclusion that in nature such sudden leaps are the normal cause of development. If a "sport" has advantages over the parental type, it tends to survive, while, if it is not as fitted for its life struggle, it is destroyed by natural selection and never establishes itself. Such a theory does something to avoid the difficulty of pure "Darwinism," that organs useful, when fully developed, to an animal or plant are of no advantage in incipient stages.

Closely connected with such problems is the question of

inheritance. Lamarck's theory required the inheritance of characteristics acquired during the life of a parent. But difficulties, such as that of seeing how such a change could affect the simple germ cells, have led some more recent biologists to deny the possibility of any acquired characteristic being transmitted to offspring. This question, like that of the sufficiency of Darwinism and Mendelism to explain the facts of evolution, is still the subject of controversy. (*See* HEREDITY.)

Modern Physics.—Simultaneously with the growth of geology, and the birth of the Darwinian hypothesis, a new development took place in physical science—the development of the conception of energy as a quantity invariable in amount throughout a series of physical changes. The genesis of the idea in its modern form may be traced in the work of Newton and C. Huygens (1629–1695), who applied it to the problems of pure dynamics. But, in the middle of the 19th century, by the work of James Prescott Joule (1818–1889), Lord Kelvin (1824–1907), H. L. F. von Helmholtz (1821–1894), J. Willard Gibbs (1839–1903), R. J. E. Clausius (1822–1888) and others, it was extended to physical processes. The amount of heat produced by friction was found to bear a constant proportion to the work expended, and this experimental result led to the conception of an invariable quantity of something, to which the name of energy was given, manifesting itself in various forms such as heat or mechanical work. Energy thus took its place beside mass as a real quantity, conserved throughout a series of physical changes. Of late years, as we shall see below, evidence has appeared to show that mass is not constant, but may depend on the velocity when the velocity approaches that of light, while still more recent work suggests that mass and energy are mutually convertible. Since the only essential quality of matter is its mass, these results seem to strike at the root of the metaphysical conception of matter as a real, invariable quantity.

In ordinary physical conditions, the amount of energy in an isolated system remains invariable, but, if changes are going on in the system, the energy tends continually to become less and less available for the performance of useful work. All heat engines require a difference of temperature—a boiler and refrigerator, or their equivalents. We cannot continue to transform heat into mechanical work if all available objects are at a uniform temperature. But, if temperature differences exist, they tend to equalize themselves by irreversible processes of thermal conduction, and it becomes increasingly difficult to get useful work out of the supplies of heat. In an isolated system, then, equilibrium will be reached when this process of "dissipation of energy" is complete, and, from this single principle, the whole theory of the equilibrium of physical and chemical systems was worked out by Kelvin, Helmholtz and Willard Gibbs. Such a method avoids altogether the use of atomic and molecular conceptions.

But the other great line of advance in recent physics has been traced by a method which uses atomic and molecular conceptions in an extreme form. The passage of electricity through liquids had been explained by Michael Faraday (1791–1867), Kohlrausch and others as a transference of a succession of electric charges carried by moving particles of matter or ions. At the end of the 19th century these ideas were extended, chiefly by the labours of J. J. Thomson, to elucidate also the conduction of electricity through gases. In 1897 Thomson discovered that, in certain cases, the moving particles which carried the electric current were of much smaller mass than the smallest chemical atom, that of hydrogen, and that these minute particles, to which he gave the name of corpuscles, were identical from whatever substance they were obtained. They enter into the structure of all matter, and form a common constituent of all chemical atoms. The only known properties of these corpuscles are their mass and their electric charge. Now, a charged body when set in motion spreads electromagnetic energy into the surrounding medium. Thus, more force is needed to produce a given acceleration than if the body were uncharged. The body acts as though its mass were greater than when it is uncharged. Indeed there is reason to believe that the whole apparent mass of the minute corpuscles to which we have referred is an effect of their electric charge. The idea of a material particle thus disappears with that of material mass, and the corpuscle becomes an isolated unit of electricity—an electron, while electricity, mass and energy become different manifestations of the same underlying condition.

Another train of reasoning, starting from a different point, reinforces this result. The phenomena of the interference of beams of light in certain circumstances to produce darkness or colour, indicate that light is some form of wave motion, and, to carry these waves, a hypothetical luminiferous aether was invented. The theoretical work of J. Clerk Maxwell (1831–1879) and the experiments of H. R. Hertz (1857–1894) showed that the properties and velocity of propagation of light and of electromagnetic waves were identical and that their other properties differed only in degree. Thus light became an electromagnetic phenomenon. But light is started by some form of atomic vibration, and to start an electromagnetic wave requires a moving electric charge. Electric charges must exist within the atom, and we are led again to the theory of electrons by the road opened up by H. A. Lorentz and Joseph Larmor. Such a theory suggests the occasional instability of the atom, and the phenomena of radioactivity, shown in a remarkable form by the substance radium, discovered by M. and Mme. Curie, have been explained satisfactorily by the theory of Rutherford and Soddy, who regard the energy liberated as due to the disintegration of the atom. The evolutionary view of nature, established in the biological and sociological sciences, is thus extended to physical science, not only in the development of planets and suns, but even in the chemical atoms, hitherto believed indestructible and eternal. Many complex radioactive changes have been investigated in detail by Sir Ernest Rutherford and his pupils, and several new elements have been discovered.

Relations between the atomic weights of the elements and their properties were traced by Mendeléeff (1834–1907) and others, but in 1913 and 1914 a new light was thrown on the problem by H. G. J. Moseley. As diffraction gratings, surfaces ruled with multitudes of parallel scratches, give spectra with ordinary light, so the much finer atomic layers of crystals produce spectra when the even more minute waves of X rays are reflected from them. The structure of crystals has been investigated thus by Sir William and W. L. Bragg. Bombarding an element with cathode rays and using a crystal as grating, Moseley obtained X ray spectra, and discovered that the square roots of the frequencies of vibration of the characteristic X rays increase by equal steps as we ascend the list of elements in order of increasing atomic weight. Each element can thus be given an atomic number, ranging from 1 for hydrogen to 92 for uranium, and save for three gaps, elements corresponding to all intervening integral numbers are known. These numbers have an important physical meaning in the modern theory of the atom.

Meanwhile the atomic weights were shown to be whole numbers by the researches of Aston, who, by deflecting positive electric rays in strong magnetic and electric fields, measured accurately the mass of flying atoms. The chief exception is hydrogen, with an atomic weight of 1·008. Helium consists of four hydrogen nuclei, but its atomic weight is exactly 4. Thus, when an atom of helium is built up from hydrogen, there is a destruction of mass and an equivalent liberation of energy.

It proved to be an impossibility to explain either sharp line spectra or the localization of energy in continuous spectra by the vibration of electrons in orbits in accordance with Newton's dynamics. To overcome these difficulties, Planck devised a Quantum Theory, according to which energy is emitted in definite units or quanta. Led chiefly by the facts of radio-activity, Rutherford had come to view an atom as essentially a positive nucleus with negative electrons round it, and this view was adapted to the quantum theory by Bohr. Hydrogen has a nucleus of one positive unit or proton, with one electron circling round it, according to Bohr in one of four definite orbits. By supposing that radiation is emitted only when the electron leaps instantaneously from one stable orbit to another, Bohr explained many of the phenomena of the hydrogen spectrum. More complex atoms are imagined to be made of two or more positive protons bound together by a smaller number of negative electrons in a nucleus, the rest of the

electrons outside the nucleus being more loosely connected. Moseley's atomic number gives the number of these outer electrons.

In 1925 it became apparent that Bohr's theory of electronic orbits failed to explain the finer structure of spectra, and a new "wave mechanics," due chiefly to Heisenberg, de Broglie and Schrödinger, took its place. The electron then took on the likeness of both a particle and a wavelet, with either its position or its velocity mathematically indeterminate. We seem to be getting down to fundamental concepts, which cannot be represented to the mind in the guise of physical models, but must be left in terms of mathematical equations.

To explain the propagation of light, it had been necessary to imagine the existence of an aether to carry the waves. Yet the measured velocity of light proved to be the same in all directions, and therefore independent of the relative motion of the aether. The first comprehensive explanation of this difficulty was given by A. Einstein in 1905. Einstein pointed out that absolute space and time are metaphysical figments of the imagination. Time and space as known to us are determined by an observer, himself moving in certain ways, and may be different if measured by another observer. Thus time and space are relative and not absolute. Moreover they must be so connected that the velocity of light is always constant however measured—the first constant of the new physics. While space and time individually are relative, yet, as pointed out by Minkowski, a certain combination of them is absolute—the same for all observers—one second being equivalent to 180,000 miles, the distance described by light in that time. According to Einstein, in this space-time continuum, bodies move in natural paths, straight in empty space but curved near matter owing to something analogous to curvature in space-time. Thus Newton's idea of gravitational force may be unnecessary. (*See* SPACE-TIME.)

Mathematical investigation showed that this theory of relativity leads to consequences approximately the same as Newton's theory—so nearly the same, indeed, that it has needed all our experimental resources to decide in favour of Einstein. The most famous of the crucial experiments is based on the very minute deflection of a ray of light as it passes near the sun. This is twice as great on Einstein's theory as on Newton's.

The principle of relativity also involves the equivalence of mass and energy already suggested by other lines of research. In recent years the possible conversion of mass into energy has been used by astronomers to explain the old problem of the continued output of radiant heat from the sun and other stars. That output is now believed to be due to subatomic changes at the enormous temperature of many million degrees which must exist inside dense stars radiating heat and light. Some of it may be supplied by the conversion of one element into another, but a far greater store of energy would be liberated by the mutual cancellation of protons and electrons, whereby mass, passing completely into radiation, would be annihilated.

Thus in two directions—the quantum theory and relativity—recent science seems to be breaking away from the fundamental conceptions by which it has been guided since the days of Galileo and Newton. It is too soon as yet to look for a complete and consistent scheme of physics based on these new ideas. They are at present in that fascinating early stage of new knowledge when consistency is hardly a virtue, when indeed it is more useful to follow bravely each fresh line of development than to make premature attempts to co-ordinate the whole.

This historical sketch may help to make clear the method of science, and to throw some light on its value and meaning. Modern science began with the Renaissance. Mediaeval Scholasticism was a complete synthesis of knowledge, deduced rationally from premises regarded as certain—firstly, the doctrines of the Christian Faith as set forth by the Fathers and safeguarded by the Roman Church; secondly, human knowledge as found chiefly in Aristotle and applied by Christian Doctors, especially St. Thomas Aquinas. There was still room for interpretation and exposition, but no need for change, no idea of development. Thus the new experimental method brought about a revolution. The idea of a complete synthesis of knowledge was dropped. The new science was empirical and not rational; it observed and experimented on some quite limited problem; accepted the results whether or no they were in accordance with preconceived ideas; started again on another problem, and sometimes found that the two solutions agreed. It did not deduce knowledge *a priori*, but put it together slowly and laboriously like fitting the pieces into a puzzle.

Scholasticism, based on Revelation and Aristotle, assumed that it was dealing with reality, that the world in essence was what it seemed to be. Modern science, on the other hand, soon learnt that many of the superficial appearances of things—colour, taste or sound—are to it but the effect on the senses of matter in motion. Thus men came to regard matter and motion as real, and only later understood that they too were but useful concepts of the mind—that science itself was dealing with appearance and not necessarily with reality.

The Methods and Meaning of Science.—The philosophy of the new experimental methods was first studied by *Francis Bacon* (1561–1626). Warned by the failure of the scholastic methods to give a true knowledge of nature, Bacon laid exclusive stress on the value of experiment. As a corrective applied to the mediaeval philosophy Bacon's work was of the greatest value in the history of thought, and, from this point of view, it is perhaps but a small drawback that scientific discovery is seldom or never made by the pure Baconian method. The multitude of phenomena are too great for any subject which aims at explanation and not only at description to be attacked with success without the aid of hypothesis framed by the use of the scientific imagination. Facts are collected to prove or disprove the consequences deduced from the hypothesis, and thus the number of facts to be examined becomes manageable. If agreement is found, the hypothesis is, so far, confirmed, and gains in authority with every fresh concordance discovered. If the deductions from the hypothesis do not agree with the accepted interpretation of facts, the hypothesis may need modification, it may have to be abandoned altogether, or the want of concordance may point to some error or inconsistency in the fundamental concepts on which the hypothesis is based—the whole framework of that branch of science may need revision.

Even while Bacon was philosophizing, the true method was being practised by Galileo, who, with a combination of observation, hypothesis, mathematical deduction and confirmatory experiment, founded the science of dynamics. When Kepler had collected astronomical phenomena under a few general laws and Newton had given a mathematical theory which co-ordinated them all, the first great scientific synthesis was accomplished, the first separate pieces of the puzzle put together into a limited but consistent pattern.

The Classification of the Sciences.—In early times, when the knowledge of nature was small, little attempt was made to divide science into parts, and men of science did not specialize. Aristotle was a master of all science known in his day, and wrote treatises alike on physics and on animals. But as it became impossible for any one man to grasp all scientific subjects, lines of division were drawn for convenience of study and of teaching. Besides the broad distinction into physical and biological science, minute subdivisions arose, and, at a certain stage of development, much attention was given to methods of classification, and much emphasis laid on the results, which were thought to have a significance beyond that of the mere convenience of mankind.

But we have reached the stage when the different streams of knowledge, followed by the different sciences, are coalescing, and the artificial barriers raised by calling those sciences by different names are breaking down. Geology uses the methods and data of physics, chemistry and biology; no one can say whether the science of radioactivity is to be classed as chemistry or physics, or whether sociology is properly grouped with biology or economics. Indeed, it is often just where this coalescence of two subjects occurs, when some connecting channel between them is opened suddenly, that the most striking advances in knowledge take place. The accumulated experience of one department of science, and the special methods which have been developed to deal with its prob-

lems, become suddenly available in the domain of another, and many questions insoluble before may find answers in the new light cast upon them. Such considerations show us that science is in truth one, though we may agree to look on it now from one side and now from another as we approach it from the standpoint of physics, physiology or psychology.

The Philosophical Basis of Science.—Having traced the development of the most important of the fundamental conceptions of science, let us now examine the meaning of the knowledge thus acquired, and its relation to other branches of learning.

By the slow and laborious methods of observation, hypothesis, deduction and experimental verification, a scheme has been constructed which for the most part is consistent with itself, and bears the test of the comparison of one part with another. As a chart is drawn by the explorer of unknown seas to represent his discoveries in a conventional manner, so the scientific investigator constructs a mental model of the phenomena he observes, and tests its consistency with itself and its concordance with the results of further experiment. The chart does not give a lifelike picture of the coast as does a painting, but it represents one aspect of it conventionally in a manner best adapted for the immediate purpose. So the conceptions of one branch of science—mechanics, let us say—represent the phenomena of nature in the conventional aspect best suited for one particular line of inquiry. It does not follow necessarily that "nature" in reality resembles the particular mental chart which mechanical science enables us to construct. It does not even follow that there is any "reality" underlying phenomena and corresponding with any of our conceptions. The whole problem which mankind has to face undoubtedly includes an inquiry into the ultimate nature of reality. But that inquiry lies in the province of metaphysics, and is not necessarily involved in the pursuit of natural science. Metaphysics uses the results of natural science, as of all other branches of learning, as evidence bearing on her own deeper and more difficult questions. But it does not follow that natural science must solve metaphysical problems before being of use to man and enlarging the sphere of his knowledge. We need not ask whether the reality is represented accurately by our conventional model before using that model to introduce order into what would otherwise be mental confusion, and to enable us to make systematic and progressive use of natural resources. It is true that the possibility of constructing consistent schemes of scientific concepts is an argument in favour of the existence of a definite reality underlying phenomena resembling in some respects the pictures of it we draw. But metaphysicians are not agreed that it is a conclusive argument.

The difficulty of making a scientific picture of the ultimate nature of reality may be illustrated by an example. Our first conception of a wooden stick involves the ideas of a certain long-shaped form, of smoothness, of hardness, of weight, of a certain brown colour, perhaps of some amount of elasticity. A microscope reveals a structure much more detailed than we imagined, and our mental model of the stick ceases to be smooth. It becomes co-ordinated with those of a number of other bodies which we know to be parts of trees, the growth and structure of which we study by the help of botany. From the results of observation and experiment, physics teaches us that the properties of the stick can only be represented satisfactorily by imagining that the substance of it is not infinitely divisible, that it consists of discontinuous particles or molecules. Again, chemistry assures us that the molecules of the stick are made up of still smaller parts or atoms, which separate from each other when, for instance, the stick is burned, and afterwards can arrange themselves into new molecules. When we pursue our inquiries into the nature of these atoms, we find that they can be resolved, partly at any rate, into much smaller particles or corpuscles in continual motion within the atom. These corpuscles themselves have been identified with isolated units of negative electricity or electrons, the vibrations of which within the atom sort out the electromagnetic radiation which falls on them and allow to reach our eyes those waves only which give us the sensation of brown colour.

At present pioneers are attempting to look beyond the electron into still more intimate details of structure. But we have travelled far from our original conception of the nature of the stick, and, should the problem last stated be solved, we should only find ourselves faced by the next one, the nature of the units at which, for the time being, we have arrived. But what constitutes reality? Where, in the endless chain of explanations discovered or to be discovered, can we stop and say: "Here is the true picture of what the stick *is*"? But this impossibility does not prevent us from getting the full use of each conception in turn when used for its particular purpose. To the schoolboy, the effective and deterrent conception of the stick is that of a hard, elastic, long-shaped solid. The botanist regards it as built up by the action of vegetable cells, which he refers to a particular kind of tree. To the chemist the stick is made up of atoms of carbon, hydrogen and oxygen, each with definite properties and arranged in certain combinations. The physicist sees these atoms composed of whirling electrons, each an ultimate electric unit not yet capable of further explanation. Each idea is useful in turn. Since science is analytic it tends to regard the physical concepts, such as space, time, mass, atom, electron, as the most fundamental. They may or may not correspond with something in ultimate reality: with that science is not concerned. But accepting as convenient these and other less fundamental concepts, science examines experimentally the relations between them, and it is these relations which are the Laws of Nature about which so much has been said. We may not know what realities, if any, underlie the concepts of mass, length or time, of electric current or electro-motive force. But Ohm found that whatever they really be, current is proportional to electro-motive force, and Newton showed that, to a very high order of accuracy, two masses produce a mutual acceleration proportional directly to the product of the masses and inversely to the square of the distance between them. Nowadays we believe that mass, time and space are not what Newton thought, and the exact point of accuracy at which his law fails has been discovered by Einstein. But the law remains as a permanent achievement, all the more useful because its limits of accuracy are known. The gradual piecing together of such natural laws constitutes science, and the ultimate test of its validity can only be the final consistency with each other of the parts of the whole structure.

Such considerations show us the meaning of the subdivisions into which science has been arranged for convenience of study and research. They represent different aspects of nature, different sections, as it were, cut through the solid model which stands for the sum of all our scientific knowledge of the universe. The idea that a mechanical explanation of any known phenomenon is fundamental and complete may be traced to the familiarity of mechanical conceptions in our every day experience. The popular ideas of matter and force are not scientific definitions, but they lead to a false idea that the exact scientific concepts with the same names are understood. Matter is defined scientifically in terms of its mass or inertia, and is commonly known to us by our sense of touch, by its resistance to force. But the fact that we have a muscular sense, which gives us the impression of a force and so of mass and matter, is an accident of our bodies and minds. The electric fish or torpedo may have an electric sense, and a fish-philosopher might argue that it is more intelligible and satisfactory to explain mass in terms of electricity than electricity in terms of mass. Even to us, there seems now no reason to regard mechanics as philosophically the most fundamental science. It is merely one aspect from which we may regard any definite problem.

A nerve-impulse may be regarded from a psychological aspect when we deal with the thought which accompanied it; from a physiological aspect when we examine its relation to other changes in the body. But modern methods have co-ordinated it also with definite chemical and electrical changes, and are said sometimes to have "explained" the nerve-impulse in physical terms. But, as always, an "explanation" proves to be simply a restatement of a phenomenon in terms of ideas which are already familiar to the mind, and therefore appear to be better understood. Nevertheless, from our present point of view, no one of these possible aspects of the phenomenon—of the nerve-impulse—is essentially more fundamental than any other. To the psychologist the nerve-impulse is expressed in terms of thought, to the physicist by physi-

cal changes. The fact that a thought is accompanied by movement of matter or electricity does not make it less fundamental. The two manifestations appear together; there is "psychophysical parallelism." But the question of the connection between them cannot, at present at any rate, be answered by science. Now, and perhaps always, it is a problem for metaphysical speculation.

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SCIENTIFIC MANAGEMENT. The science of industrial management began in a machine-shop and was there developed by careful and systematic experiment and observation and guided, controlled and directed by an able, patient and persistent student, Frederick Winslow Taylor (*q.v.*). Writing in 1911, after he had retired from practice, Taylor said "at least 50,000 workmen in the United States are now employed under this (the Taylor) system of scientific management, and they are receiving from 30% to 100% higher wages daily than are paid to men of similar calibre with whom they are surrounded; while the companies employing them are more prosperous than ever before. In these companies the output per man and per machine has, on the average, been doubled. During all these years there has never been a strike among the men working under this system. In place of the suspicious watchfulness, and more or less open warfare which characterize the ordinary types of management there is now free cooperation between the management and the men."

No doubt, most of us when we first hear of such a thing as the science of shovelling by hand, are apt to be amused; shovelling is labour which anybody is supposed to be fitted for if he is sufficiently strong and phlegmatic. So far as is known, no one ever made a systematic study of shovelling, until Taylor, whose personal experience in manual work had been only as a machinist and pattern-maker, undertook to develop the science of shovelling in a large steel plant where many kinds of material were being handled, the heaviest being iron ore, the lightest, small size anthracite coal. Taylor selected a few of the better shovellers whom he placed under the instruction of trained observers; these men worked on various materials, using several sizes of shovels under differing conditions. Careful records were kept of every phase of the work; the effect of rest periods of different lengths and frequency was noted. It was finally determined that the best results were obtained when the shovel load was kept as close as possible to 21 lb., which was much less than the usual load for the heavier materials and much more than for the lighter ones, in other words, shovels had been regularly over-loaded for the heavy iron ore and much under-loaded for the lighter coal. Special shovels were then secured, each designed to hold 21 lbs. of the material for which it was to be used. Teaching and supervision were maintained, and when the new plan was in full operation, the average wages of the shovellers were 63% higher, though the cost of handling had decreased 54%. During the first year the total savings to the works in the cost of shovelling, including all increased overhead, amounted to $36,417.69.

Scientific management has sometimes been confused with the division and specialization of labour, and with mass production—both of which are fundamentally different. Adam Smith (1723–1790) described in his *Wealth of Nations* the division of labour and also mass production (*q.v.*) in the making of pins by hand. This same principle now made use of in the abattoir processes, and in the manufacture of automobiles, is sometimes erroneously called *scientific management*, though it frequently is combined with highly scientific management methods.

Machine Shop Tests.—In 1879, in a department of the Midvale Steel works, Philadelphia, a group of men were operating lathes on heavy work, mostly steel forgings. Taylor, who had been placed in charge of that department, soon became convinced that the men knowingly were not and did not intend doing the work they could easily accomplish. For certain reasons—not all traceable to the men—Taylor could not secure their co-operation in experiments designed to show how much work could be done. Finally, a 66 in. boring- and turning-mill was set aside to be used only for Taylor's experiments. During a period of six months many steel tires for locomotive driving-wheels were reduced to chips at various cutting speeds and feeds, using many different shapes of cutting tools; and, though it was then clear that only a beginning had been made in the development of the science of metal cutting, enough had been learned to more than pay for this pioneer work. Through a period of years many thousands of controlled experiments were made, and more than 800,000 lbs. of steel were cut up. The chemical and physical characteristics of each piece of metal were known, and it was thus revealed that for each variety of material there is, for each lathe, an optimum combination of cutting speed, etc.

During these experiments and tests, conditions were standardized; and this led to a progressive development of the lathe itself and to many investigations which, though only incidental to the main purpose of the work, turned out to be highly important in themselves.

Leather Belting.—One of the by-product investigations is given in Taylor's classic paper on leather belting (*Trans. A.S. of M.E.*) which first gave engineers concrete, comprehensive and definite information as to just what a leather belt may be depended upon to do in power transmission. As a direct outcome of these experiments, lathes were largely re-designed. Cutting tools were given new shapes and standardized; a new tool grinding machine was designed and, finally high-speed steel was invented by Taylor and Maunsel White. The first public exhibition of this new steel attracted much attention by turning forged steel at speeds sufficient to heat the chips to a deep blue. This one result of Taylor's studies has very greatly increased the output per man in most machine shops.

Operations Standardized.—For many kinds of work, however, the cutting speed is not the only important element. The operations of placing and fastening the work in position, and adjusting the cutting tools properly are of equal importance. All such work and many varieties of purely manual operations were studied; and, by separating these operations into their elements and timing each element by means of stop watches, the best combinations were determined and so combined as to make the most efficient complete operation, which was usually not only faster but more easily performed because it was done with the minimum of muscular effort and nervous strain.

Use of Stop Watches.—In determining the best manner of performing a piece of work, many studies were made by men with stop-watches, which must never be used secretly but only with the full co-operation of the worker. The workers are not, however, to be driven to accomplish the operations, but each is carefully and patiently instructed; being assured that, upon attaining a given degree of proficiency, he will be paid a premium, or bonus, the amount of which varies with the character of the work, but is always sufficient to be attractive. Besides higher wages and contented workers, the results are lower labour costs and lower total costs of production, notwithstanding a possible higher ratio or proportion of what is variously called "overhead expense," "operating expense" or "operating cost."

The New Plan of Management.—It became increasingly clear that maximum production could not be obtained until a system of management based upon a new conception of its functions had been devised. Things which had been left to the workers or to overburdened foremen should be attended to by others, preferably trained specialists. Tools and machines must be known to be ready for use when needed and in the best possible condition. Materials must always be on hand in the proper quantities; the successive operations and their proper sequence must be care-

fully planned by experts. Accompanying each shop order there should be full directions for executing it in accordance with the plan and within the predetermined time. A central planning department, in which all work is carefully laid out, is essential—usually expert workmen being trained for this work. Men with proper equipment move materials from one station to the next in accordance with directions; and thus the stream of materials is changed from a large, slow-moving one to a much smaller stream moving steadily and rapidly. Work spaces are much less congested, and often very great savings are made in inventories of raw stock, and of parts "in process," thus freeing capital for some useful purpose. No expenditure need be made upon any job until the way is cleared for it to go through the works without delay, and without interference with or by any other work.

Functional Foremen.—It was early perceived that the workmen could not be expected to go on doing work correctly if left to themselves or to the direction of a too-busy foreman, and so functional foremen were trained who issue directions for the execution of each component part of the work. It is made sure that these directions do reach the workers, that they understand them and that they are given all needed help in doing the work properly. For doing this, the worker receives, as a premium, an increase of pay which makes it worth his while to co-operate and follow instructions faithfully. In some cases the foremen may also receive a premium which is in proportion to the number of workers who attain the stipulated mark. The foremen cannot bring this about by mere driving, but only by giving genuine help and instruction. But the foreman must always recognize when teaching workers that he is dealing not with angels, nor yet with devils, but with human beings who have been previously trained at some expense and who should be presumed to wish to succeed and are nearly always willing to try if properly handled.

Manufacturing operations have been classified as unsystematized, systematized and scientific. Work may be systematized when it is relatively very simple and with little or no variation, each worker doing the same thing continuously, and using little or no machinery, so that the flow of work is automatic. Cigar-making by hand is an example of such an industry. Also complicated work may be carried through in such large volume as to make possible minute subdivision of it, each worker performing a simple operation upon a single part as it reaches him on a moving conveyor. This last is mass production, and is systematized as an incident to or as a necessary consequence of the volume of the work. But it will be apparent that scientific management differs radically from all of these, not only because it is applicable in some degree to practically every kind of work, but also because, like every true science it is based not upon notions or traditions, but upon facts developed by careful study with a definite object.

Forms and Reports.—Among the blank forms used in scientific management is the work-ticket, on which an assignment of work to be done, and its accomplishment, are recorded, and which, when the specified work has been finished, forms the basis of the pay-roll and of the cost accounting; the *balance of stores* cards, which are the basis of the perpetual inventory and show at all times, not only the stock on hand but when the *order point* for additional material has been reached, and render unnecessary an annual inventory. The use of these and other forms is not, however, scientific management, but only a part of its mechanism. But there must go with these mechanisms that state of mind or that attitude which inspires mutual confidence and a feeling of partnership in an enterprise in which success comes to those who achieve actual results and not through favouritism.

Cost of Idleness.—Though Gantt was not, perhaps, the first to note the great importance of the idleness of equipment, he was the first who called attention to its importance and made manufacturers realize that a machine-tool standing idle is a burden of cost; and to point out that the cost of this idleness should be known to the management, though it should not be included in the cost of the work actually done. All possible effort should be made to reduce the idleness of equipment and, when estimating the cost of work in prospect or determining the cost of what has been done, only charges for the equipment actually used should be made. Entering this cost in the profits and loss account, where it belongs, does not, of course, lessen the actual loss; but it eliminates the chance of self-deception, and brings into view actual facts that are otherwise concealed and often seriously misleading—particularly when preparing cost estimates in competitive business, or in making financial statements.

Influence of Gantt.—Both Taylor and Gantt declined to work with owners who were not willing to share the benefits of improved production with their workers. But with all of Taylor's intellectual keenness and in spite of his excellent intentions he was not a good psychologist. He had difficulty in perceiving why a proposition made by him, and which he believed to be entirely fair and even advantageous to the workers, should not be readily accepted by them, and their co-operation secured forthwith. Gantt, who worked with Taylor for a number of years, was well and broadly educated, but had had no industrial experience. Some time after he had been in practice on his own account, he became consultant to a group of factories in which the so-called *human element* had received much attention. His task was to unify the varying management systems and gradually supplant them with the Taylor system modified somewhat by his personal experience. It soon became apparent that, in order to make satisfactory progress, Gantt had to be relieved of all responsibility for bringing minor executives and employees "into line." Taylor's unmodified system showed weaknesses where it came into contact with foremen who had been in the habit of thinking, making suggestions and having them met with at least appreciative attention. These men lost interest at first and had to be taken in hand by some one whom they knew, and in whom they had confidence. After his work was completed, Gantt declared that this, the largest and most important installation made by him, was also the easiest, and the most successful, because he had the interested co-operation of everyone. Gantt had learned a great truth—that it is better to enlist, at the beginning, the interest of the workers and foremen by giving them recognition and a part to perform. The entry of the United States into the World War forced Gantt into what may be called a new and much better method of approach; one which is in accord with the demonstrated fact that, at least in America, most of the losses called *industrial wastes* are attributable to faults for which management and not the workers, is responsible.

The Gantt Chart is probably the most important contribution to the science of management made by Gantt. The fundamental principle of this chart will be understood from fig. 1, wherein it is assumed that 450 pieces of work are to be machined within a week of 45 working hours. This would mean an average of ten pieces per hour, so that, on this illustrative chart each horizontal space within a full day is taken as representing two hours of working time, also 20 pieces of work to be done. On Monday only 60 pieces were made, and the light horizontal line is accordingly drawn through three spaces to show the work done that day. Also a heavier horizontal, or totalizer, line is drawn below to the same length, or to the point (*a*). Tuesday 70 pieces were finished, and the light line in the Tuesday space is drawn through $3\frac{1}{2}$ horizontal

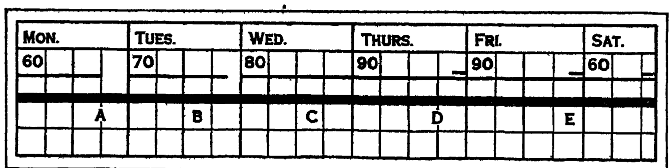

FIG. 1.—ILLUSTRATING THE PRINCIPLE OF THE GANTT CHART

spaces. At the same time the totalizer line is extended $3\frac{1}{2}$ spaces from (*a*) to (*b*) so that it then shows the completion of 130 pieces, or 50 pieces behind the schedule. Wednesday 80 pieces were done; the light line is drawn through the entire space for that day, and the heavy line still shows a shortage of 50 pieces, having been also extended through four spaces to (*c*). For each of the remaining days of the week the production was sufficiently above the schedule to complete the assigned task for the week. Whenever the production runs above the schedule for the day the light line is drawn to the left the proper distance to show the

excess, thus keeping it within its proper time space. In this manner, by means of very simple and easily drawn straight lines, there is available a daily picture of progress and accomplishment with relation to time; and, at any time during the period, the total is clearly indicated.

Fig. 2 is a chart such as is actually used to keep a record of the hours that machines are operated and, when they fall short of the full working period, the reason for it. On this chart there is no

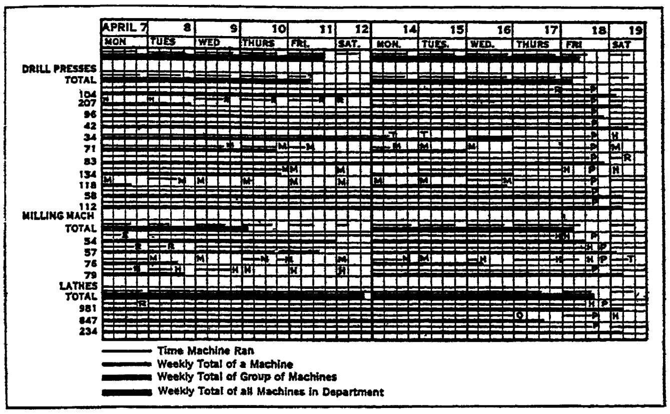

FIG. 2.—GANTT MACHINE RECORD CHART

record of the amount of work done, but only how much of the time the machines are actually operating, how much of it they are idle, and for what reason. Thus drill press 207 is shown to have had no one to operate it on Monday and Tuesday of the first week; Wednesday, Thursday and Friday, it operated only five hours each day, because it needed repairs, as indicated by R. On Saturday it was shut down and thoroughly repaired, so that during the following week it operated full time until Friday, when, as shown by the line of P's, there was trouble with the power which, of course, affected all the machines. Milling-machine 76 suffered mostly from lack of material and 79, from lack of help. Lathe 847 ran out of orders the second Thursday, and had no operator on Saturday. It is obvious that a chart may be ruled for all the working days of a month, or for all the months of a year, and be used to keep constantly within the vision all important facts. The charts are small; 11 x 17 in. (279 x 432 mm.) is a good size.

Man Record Charts.—Records of employees both in comparison with established standards, and with each other, called *man record* charts; records of departments, each by itself, and grouped upon a single chart for comparison; records of expenditures combined with the budget are readily reduced to a convenient size and style, and the general manager of a factory can get, almost instantly, a complete picture of how the work is going.

The Load Chart.—The principle of the Gantt chart can be applied to almost any collective activity. One of its most useful forms is called the *load* chart which shows at a glance the date to which each machine or work space has been loaded with work by the planning department. This is most important when the question of taking on more work arises, making promises of delivery, or deciding whether or not to install additional equipment. Very gratifying results have come from the application of the Gantt chart to purely managerial functions. Not only have such partial installations resulted in important reductions of inventories, but the allotted time between placing an order and its completion has been reduced in some cases to about one-fourth of what it had been. The work of Taylor, and his associates and followers, Gantt, Barth, Cooke and Hathaway has been supplemented by many others, mainly in the way of properly related and harmonious additions, and they have extended the work outside purely industrial operations and into the fields of budgeting, accountancy, sales and marketing and even financing. It is particularly to be noted that the object of scientific management is not to establish a paternal or an eleemosynary relation, but that it is a purely business arrangement, and like all other freely-made business arrangements must be advantageous to both parties. Taylor believed that its benefits would continue to go to employers and workers as long as it was used. That is for the future to decide; but it has proved in application in many cases greatly to the advantage of both worker and employer and does much to keep the peace in industrial fields, pending further advances in our knowledge of how best to get from the earth's resources and equitably distribute the things needed for the support, comfort, progress and happiness of the human family.

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SCIENTIFIC MANAGEMENT IN EUROPE

The development of scientific management in Europe may be regarded from two angles. The writings of F. W. Taylor have been translated into most of the European languages. The actual methods and systems which he employed have received attention from a number of leading industrialists in most European countries. Examples are to be found which, allowing for national differences, represent an attempt to apply completely in individual enterprises the management structure outlined in his books. Of greater importance, however, has been the tendency to accept the underlying philosophy which he applied to industrial control. Broadly speaking, that philosophy contemplated the full acceptance of the standards and methods of scientific investigation for the solution of every variety of problem presented by industrial life. It included the whole-hearted application to the tasks of management not only of discoveries in the exact sciences such as physics and chemistry, but of the outlook and work of experimental psychology, physiology, statistics and sociology.

Before the World War.—Prior to 1914 the progress of scientific management in this broader sense was slight. Mention may be made of Hans Renold Ltd. in Great Britain, who had begun to apply Taylor conceptions to their operations. In France Henri le Chatelier, de Frémenville and others introduced Taylor's ideas to their countrymen. On somewhat different lines Henri Fayol started as early as 1900 to publish the results of his long experience as director of the Société de Commentry-Fourchambault. But it was not till 1916 that the appearance of his *Administration industrielle et générale* directed popular attention to his doctrine of administration. This doctrine insisted on the importance of the administrative function, which he analysed into the activities of planning, organizing, directing, co-ordinating and controlling. It has many similarities to Taylor's work.

The period of the World War with its accompanying demand for unprecedented outputs of munitions and other products called into prominence any and every method which might help the nations of Europe in the industrial aspects of the struggle. At the same time considerations of national emergency did much to break down the trade union opposition to changes of method. Following on the strong attack against the Taylor system initiated by the American Federation of Labour, opposition had already assumed considerable dimensions in Europe. Throughout the war years, however, and during the period of reconstruction and boom conditions which followed the Armistice, Governments and industrialists co-operated in the study and application of scientific management. In France a number of professional soldiers placed in charge of munition factories contributed much constructive thought to the application of Taylor's principles, reinforced by their experience of the military services. In Great Britain the report of the Committee on the Health of Munition Workers (1916) and the foundation of the welfare department of the Ministry of Munitions (1917) emphasized the importance of the

scientific approach in dealing with the personnel of industry. There followed the foundation of the Industrial Fatigue Research Board and the National Institute of Industrial Psychology and Physiology. Applications of the exact sciences were covered by the Department of Scientific and Industrial Research, which organized research associations in various industries. The British Engineering Standards Association expanded its well-established activities in the direction of simplification and standardization. One of the pamphlets of the short-lived Ministry of Reconstruction officially recommended the adoption of scientific methods of industrial management. The trade union opposition was, however, still very strong and was reinforced by the demand for the restoration of pre-war union conditions.

In Germany also the period was marked by an increased interest in psycho-technology, and much research was undertaken on fatigue, selection of workers and allied subjects.

After the War.—The severe depression and the period of uncertainty in national finances which followed, delayed developments in the older countries. But in Eastern Europe the new countries which had been established by the Treaty of Versailles made a determined effort to build up their national economy on the most modern lines. The lead was taken by Czechoslovakia. The foundation of the National Academy of Labour at Prague was strongly supported by the Government. It was devoted to the study of scientific management in every aspect. On the initiative of Czechoslovakia a congress was called in 1924, with the active help of Mr. Hoover and the American Engineering council. The greater proportion of the time of this first congress was taken up with a general account of the state of the scientific management movement in the United States. It was therefore more in the nature of a lesson for Europeans than of an international exchange of views. It was attended by representatives from Italy, Czechoslovakia, Poland, Bulgaria, Yugoslavia and Russia. As a result of this congress an International Committee for Scientific Management was established. A further congress took place at Brussels in 1926 in which Belgium, Spain and France also co-operated.

Meanwhile most important developments had been taking place in Germany. An institution was set up under the title of *Reichskuratorium für Wirtschaftlichkeit* (National Council for Scientific Management) which was subsidized by the central Government. It was entrusted with the task of co-ordinating and exercising a general control over a number of national bodies of a technical and scientific character engaged in the study of various applications of science to industry. In this capacity it was given complete authority to distribute all grants for this purpose whether emanating from the Government or from large industrial organizations, grants which amounted in 1926 to more than a million marks. In addition it acts as a propagandist body throughout the whole country, calling attention to the results of scientific investigation by means of the press, special publications, congresses and exhibitions.

Parallel with this movement, the great German industrialists, faced with difficulties following on the stabilization of the mark, were compelled to give close attention to the more logical organization of the whole of their national industry. Their desire to eliminate inefficient plants and to escape from the worst effects of unregulated competition issued in a strong movement in favour of a deliberate attack on their problem by means of amalgamations on a national and international scale. This movement has been given the general title of "rationalization," a term which is at present used alternatively in a wider and a narrower sense. By a great many persons it is taken to imply merely the general tendency to a larger grouping of industrial units in cartels, trusts or combines which has been such a marked feature of industrial life in all European countries since the War. To others, among whom must be included the members of the World Economic Conference, the word connotes the whole of the changed attitude towards economics which looks to a deliberate and scientific control of the processes of production and distribution, whether in the individual works, within a national industry or on an international scale.

During this period encouragement of scientific management on a national scale took place in many other European countries. In Russia the *Central Council for Scientific Management* was established in Moscow and linked up with a wide range of local institutions established throughout the Union of Socialist Soviet Republics. In Italy the *Ente Nazionale Italiano per l'Organizzazione Scientifica del Lavoro* (Italian National Union for Scientific Management) greatly extended its activities with the full support of the Government. It thus became one of the most important instruments of the Fascist Administration in carrying through its programme of national reconstruction. Similar organizations were started in Austria, Belgium, France and Poland.

With the greater stability in national finances and the general improvement in European economic conditions of 1927 the stage was thus set for a forward step. The initiative was provided by a group of internationally-minded Americans who saw, in the theories of industrial management which had proved so valuable to many of their own enterprises, a strong impetus towards European economic recovery. Mr. E. A. Filene and Mr. H. S. Dennison, on behalf of the Twentieth Century Fund, approached the International Labour Office. A careful report on the position of the scientific management movement in Europe was prepared by P. Devinat, an official of the I.L.O. selected for this purpose. As a result of this report the International Management Institute was established at Geneva in the early months of the year, under the joint administration of the International Committee for Scientific Management, the Twentieth Century Fund and the I.L.O. A permanent establishment was thus provided for the comparative study of methods of industrial management on an international scale, and to promote a wider knowledge of scientific management practices.

Two immediate consequences followed. In the first place the documentation prepared for the Industrial Committee of the International Economic Conference on the whole question of rationalization was thorough, comprehensive and authoritative. The resolutions of the conference on the subject constituted a whole-hearted recommendation to traders, industries and Governments all over the world to study and apply the underlying philosophy developed by F. W. Taylor, not only to individual factories but to whole industries, both nationally and internationally, and to every phase of economic life including commerce, agriculture and the home. Thus the full weight of the greatest body of experts in the economic field which has ever been brought together was thrown definitely into the scales in favour of the ideas which Taylor had initiated. European countries which had viewed his practices with doubt and distrust suddenly found that they had received the official sanction and endorsement of the representatives of capital, labour and economic thought, specially convened to discover methods by which European trade might recover from its post-war difficulties.

The effect of these resolutions was very great. The third International Scientific Management Congress, convened at Rome in Sept. 1927 gave evidence of the widespread effort and interest which had been aroused. Over 150 papers were contributed to the proceedings, covering the application of scientific management methods not only to industrial production, but to agriculture, public administration, selling, office management and domestic work. Many of the papers were devoted to the special problems involved in introducing these methods into established organizations. The congress was attended by over 1,400 delegates representing 45 different countries.

The adaptation of scientific management technique to European conditions presents many difficulties. In countries where the standard of living is lower and the opportunities of economic expansion at a rapid rate are less favourable than in the United States, the immediate displacement of workers owing to improved efficiency requires special methods of approach. The psychology both of industrialists and of their employees differs widely from the American model. The consumers as a body are less ready to accept the results of standardized mass production. But on the whole it seems clear that the movement started by Taylor is fairly established in the great majority of industrialized coun-

tries. His ideas are being pursued with a vigour and enthusiasm almost unparalleled in any other department of thought. There is ground for belief that in Europe as in America the claim of his immediate followers will be substantiated. He will come to be regarded as the founder of a second industrial revolution.

(L. U.)

INDUSTRIAL COST ACCOUNTING

Industrial cost accounting is a definite division of accountancy which embodies the analysis, compilation and interpretation of such financial outlays as are necessary for the manufacturing of an article or the carrying on of a specific productive process. By use of this division of accountancy industrial executives are enabled to distinguish profitable units of production from unprofitable ones, to locate wasteful methods of production, to measure deviations from standard performance, to calculate the best methods of material handling and to establish selling prices upon the sound basis of costs of production. All financial outlays expended in the production of an article or a process readily classify into the three distinct cost elements. First are the outlays made for the material that goes into production: such as lumber for the making of desks, pig iron in the smelting of steel, and twine in the producing of nets. Secondly there are the outlays made for the labour that goes into production; such as the wages of varnishers of the desks, the wages of loaders of the open hearth steel furnaces, and the wages of the weavers of the nets. These two elements of material and labour can be directly applied to the specific article or process. The third element of cost, however, embraces all those outlays which by their nature can not be directly identified with any specific article or process. Insurance premiums spent to protect the plant, the dwindling away of the investment by the depreciation of building and equipment, the use of tools, the consumption of lubricants, and the services of supervisory labour—all are indicative of costs that cannot be allied directly with specific units or processes. This third type of outlay is designated as overhead costs.

Distribution of Overhead Costs.—Inasmuch as overhead costs are impossible of direct application, many methods have been developed of indirectly applying them to units and processes. In recent practice the entire plant is divided into small areas each one comprising a specific occupation or plant function. Such divisions have been termed production centres. Each production centre has its definite overhead rate per hour. Thus the time consumed in passing through a specific production centre determines the amount of overhead costs that the article or process must carry. Production centres may be made up of one large machine, such as a large turret lathe; again it may represent a battery of machines such as many drill presses or threaders; or perhaps a production centre may constitute a group of men working with small hand tools at a bench wherein no large machine tools whatsoever are involved. The proportionate amount of overhead costs that a given production centre must carry is based upon many different factors. For instance, floor area may be used for distributing fire insurance costs, heating costs and the like. Metered power consumption of a given production centre may be used in determining what portion of the total costs of operating the power plant should be carried by that production centre. Likewise, by quite similar methods, all overhead costs are distributed to specific production centres. Divide these costs so apportioned by the anticipated productive hours for a given period, say a month, and the hourly rate of the production centre is ascertained.

Types of Cost Systems.—Two systems are found in industry, one known as a job-order system, whereby costs are determined for the special articles or services purchased by a specific customer. The building of a bridge or the construction of a special piece of apparatus represents the type of manufacturing calling for a job-order cost system.

In point of contrast the process cost system is used in industries where a standard article is produced and where the articles are made for stock and sale, regardless of any particular purchaser. Automobiles (except custom-built) or electric bulbs are types of commodities calling for a process cost system. With the rise in standardization, the shift to process costs is becoming very pronounced, and with the shift comes a new use of industrial cost accounting. When uniformity in units made is once established, then standards are developed for each kind of work performed. These standards constitute quotas that are to be approximated by the different operating divisions. From this development it is but one step further in setting up standard costs prior to production taking place. Following the production, actual cost experience is compared with the pre-determined cost standards. The costs of selling the articles produced, also the costs of the general administration of an enterprise, are not as yet distributed to specific articles in most industrial establishments. Great strides, however, are being made by the more progressive firms in having both selling and administration costs allocated to specific articles or processes. Cost data to be of value in plant control must be presented in such a shape as will meet the specific needs of the different plant managers who need cost compilations. A general manager, for instance, will require an entirely different presentation from that required by a minor foreman or a research chemist.

(C. Re.)

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SCIENTIFIC METHOD is a collective term denoting the various processes by the aid of which the sciences are built up. In a wide sense, any mode of investigation by which scientific or other impartial and systematic knowledge is acquired is called a scientific method. Such methods are of two principal types—technical and logical. A *technical* or technological *method* is a method of manipulating the phenomena under investigation, measuring them with precision, and determining the conditions under which they occur, so as to be able to observe them in a favourable and fruitful manner. A *logical method* is a method of reasoning about the phenomena investigated, a method of drawing inferences from the conditions under which they occur, so as to interpret them as accurately as possible. The term "scientific method" in the first instance probably suggests to most minds the technical methods of manipulation and measurement. These technical methods are very numerous and they are different in the different sciences. Few men ever master the technical methods of more than one science, or one group of closely connected sciences. An account of the most important technical methods is usually given in connection with the several sciences. It would be impossible, even if it were desirable, to give a useful survey of all, or even of the most important, technical methods of science. It is different with the logical methods of science. These methods of reasoning from the available evidence are not really numerous, and are essentially the same in all the sciences. It is both possible and desirable to survey them in outline. Moreover, these logical methods of science are in a very real sense the soul of the technical methods.

In pure science the technical methods are not regarded as an end in themselves, but merely as a means to the discovery of the nature of the phenomena under investigation. This is done by drawing conclusions from the observations and experiments which the technical methods render possible. Sometimes the technical methods make it possible for the expert investigator to observe and measure certain phenomena, which otherwise could either not be observed and measured at all, or not so accurately. Sometimes they enable him so to determine the conditions of their occurrence

that he can draw reliable conclusions about them, instead of having to be content with unverified conjectures. The highly speculative, mainly conjectural character of early science was no doubt due entirely to the lack of suitable technical methods and scientific instruments. In a sense, therefore, it may be said that the technical methods of science are auxiliary to the logical methods, or methods of reasoning. And it is these methods that are to be considered in the present article. The technical methods of science, as ought to be clear from the preceding remarks, are of first rate importance, and we have not the remotest desire to underrate them; but it would be futile to attempt to survey them here.

Some Mental Activities Common to All Methods.—There are certain mental activities which are so absolutely indispensable to science that they are practically always employed in scientific investigations, however much these may vary in other respects. In a wide sense these mental activities might consequently be called methods of science, and they are frequently so called. But this practice is objectionable, because it leads to cross division and confusion. What is common to all methods should not itself be called a method, for it only encourages the effacing of important differences; and when there are many such factors common to all the methods, or most of them, confusion is inevitable. When the mental activities involved are more or less common to the methods, these must be differentiated by reference to other, variable factors—such as the different types of data from which the inferences are drawn, and the different types of order sought or discovered in the different kinds of phenomena investigated—the two sets of differences being, of course, intimately connected. The mental activities referred to are the following: Observation (including experiment), analysis and synthesis, imagination, supposition and idealization, inference (inductive and deductive), and comparison (including analogy). A few words must be said about each of these; but no significance should be attached to the order in which they are dealt with.

Observation and Experiment.—Observation is the act of apprehending things and events, their attributes and their concrete relationships. From the point of view of scientific interest two types of observation may be distinguished, namely: (1) The *bare observation* of phenomena under conditions which are beyond the control of the investigator, and (2) *experiment,* that is, the observation of phenomena under conditions controlled by the investigator. What distinguishes experiment from bare observation is *control* over what is observed, not the use of scientific apparatus, nor the amount of trouble taken. The mere use of telescopes or microscopes, etc., even the selection of specially suitable times and places of observation, does not constitute an experiment, if there is no control over the phenomenon observed. On the other hand, where there is such control, there is experiment, even if next to no apparatus be used, and the amount of trouble involved be negligible. The making of experiments usually demands the employment of technical methods, but the main interest centres in the observations made possible thereby. The great advantage of experiment over bare observation is that it renders possible a more reliable analysis of complex phenomena, and more reliable inferences about their connections, by the variation of circumstances which it effects. Its importance is so great that people commonly speak of "experimental method." The objection to this is that experiment may be, and is, used in connection with various methods, which are differentiated on other, and more legitimate, grounds. To speak of a method of observation is even less permissible, seeing that no method can be employed without it.

Analysis and Synthesis.—The phenomena of nature are very complex and, to all appearances, very confused. The discovery of any kind of order in them is only rendered possible by processes of analysis and synthesis. These are as essential to all scientific investigation as is observation itself. The process of analysis is helped by the comparison of two or more objects or events that are similar in some respects and different in others. But while comparison is a necessary instrument of analysis, analysis, in its turn, renders possible more exact comparison. After analysing some complex whole into its parts or aspects, we may tentatively connect one of these with another in order to discover a law of connection, or we may, in imagination, combine again some of them and so form an idea of what may be common to many objects or events, or to whole classes of them. Some combinations so obtained may not correspond to anything that has ever been observed. In this way analysis and synthesis, even though they are merely mental in the first instance, prepare the way for experiment, for discovery and invention.

Imagination, Supposition and Idealization.—Such order as may be inherent in the phenomena of nature is not obvious on the face of them. It has to be sought out by an active interrogation of nature. The interrogation takes the form of making tentative suppositions, with the aid of imagination, as to what kind of order might prevail in the phenomena under investigation. Such suppositions are usually known as hypotheses, and the formation of fruitful hypotheses requires imagination and originality, as well as familiarity with the facts investigated. Without the guidance of such hypotheses observation itself would be barren in science, for we should not know what to look for. Mere staring at facts is not yet scientific observation of them. Hence for science any hypothesis, provided it can be put to the test of observation or experiment, is better than none. For observation not guided by ideas is blind, just as ideas not tested by observations are empty. Hypotheses that can be put to the test, even if they should turn out to be false, are called "fruitful"; those that cannot be so tested, even if they should eventually be found to be true, are for the time being called "barren." Intimately connected with the processes of imagination and supposition is the process of idealization, that is, the process of conceiving the ideal form or ideal limit of something which may be observable but always falls short, in its observed forms, of the ideal. The use of limiting cases in mathematics, and of conceptions like those of an "economic man" in science are examples of such idealization.

Inference.—This is the process of forming judgments or opinions on the ground of other judgments or on the evidence of observation. The evidence may be merely supposed for the sake of argument, or with a view to the further consideration of the consequences which follow from it. It is not always easy to draw the line between direct observation and inference. People, even trained people, do not always realize, *e.g.,* when they pass from the observation of a number of facts to a generalization which, at best, can only be regarded as an inference from them. But the difficulty need not be exaggerated. There are two principal types of inference, namely deductive and inductive. *Inductive inference* is the process of inferring some kind of order among phenomena from observations made. *Deductive inference* is the process of applying general truths or concepts to suitable instances. In science inductive inference plays the most important role, and the methods of sciences are mainly instruments of induction or auxiliaries thereto. But deductive inference is also necessary to science, and is, in fact, a part of nearly all complete inductive investigations. Still, marked inductive ability is very rare. There are thousands who can more or less correctly apply a discovery for one who can make it.

Comparison and Analogy.—Reference has already been made to the importance of the process of comparison in the mental analysis of observed phenomena. The observation of similarities and differences, aided by the processes of analysis and synthesis, is one of the first steps to knowledge of every kind, and continues to be indispensable to the pursuit of science throughout its progress. But there are degrees of similarity. Things may be so alike that they are at once treated as instances of the same kind or class. And the formulation and application of generalizations of all kinds are based upon this possibility of apprehending such class resemblances. On the other hand, there is a likeness which stops short of such close class likeness. Such similarity is usually called analogy. The term is applied to similarity of structure or of function or of relationship, in fact, to similarity of almost every kind except that which characterizes members of the same class, in the strict sense of the term. And analogy plays a very important part in the work of science, especially in suggesting those suppositions or hypotheses which, as already explained,

are so essential to scientific research and discovery. As the subject is discussed in the article ANALOGY, no more need be said about it here.

After this brief survey of various mental activities which are more or less involved in the pursuit of every kind of knowledge, and consequently form no suitable bases for the differentiation of the various methods of science, we may now proceed to the consideration of the several scientific methods properly so called.

Classification.—This may be described as the oldest and simplest of scientific methods. The observation of similarities between certain things, and classing them together, marks the earliest attempt to discover some kind of order in the apparently chaotic jumble of things that confront the human mind. Language bears witness to the vast number of classifications made spontaneously by pre-scientific man. For every common noun expresses the recognition of a class; and language is much older than science. The first classifications subserved strictly practical purposes, and had reference mainly to the uses which man could make of the things classified. They were frequently also based on superficial resemblances which veiled deeper differences, or were influenced by superficial differences which diverted attention from deeper similarities. But with the growth of the scientific spirit classifications became more objective or more natural, attention being paid to the objective nature of the things themselves rather than to their human uses. Even now scientific classification rarely begins at the beginning, but sets out from current classifications embodied in language. It has frequent occasion to correct popular classifications. At the same time it has difficulties of its own, and more than one science has been held up for centuries for want of a really satisfactory scheme of classification of the phenomena constituting its field of investigation. To recognize a class is to recognize the unity of essential attributes in a multiplicity of instances; it is a recognition of the one in the many. To that extent it is a discovery of order in things. And although it is the simplest method of science, and can be applied before any other method, it is also the fundamental method, inasmuch as its results are usually assumed when the other methods are applied. For science is not, as a rule, concerned with individuals as such, but with kinds or classes. This means that the investigator usually assumes the accuracy of the classification of the phenomena which he is studying. Of course, this does not always turn out to be the case. And the final outcome of the application of other methods of science to certain kinds of phenomena may be a new classification of them.

The Evolutionary or Genetic Method.—When classifying things according to their present similarities and differences it sometimes happens that one is impressed by certain resemblances between things, although these cannot be regarded as belonging to the same class. In such cases the suggestion sometimes forces itself upon the mind of the investigator that these similar yet different classes of things may be descendants of a common ancestry. And, if he inclines to the general feasibility of the idea of evolution in some sense or other, he will feel confronted with a new problem, namely, that of tracing the stages in the descent or evolution of the kindred classes. This applies especially to the study of living things and their creations, including human customs, institutions, discoveries and inventions. This method of investigation is commonly known as the genetic or evolutionary method. Wherever it is applied with success it affords a deeper insight into the unity and continuity of certain kinds of facts than is afforded by the above-mentioned method of classification. Sometimes, indeed, the real significance of the resemblances on which ordinary classification is based is brought to light first by the genetic method, which shows the similar classes to be different stages or phases of a system of continuous or intimately connected differentiations.

The application of the genetic method is directed to the discovery of two things, namely: (1) the main stages through which the evolution of the facts under investigation has probably passed, and (2) the causes which produced the various changes constituting the several phases in the suggested course of evolution. In dealing with the first of these problems, namely the discovery of the main stages or gradations of an evolutionary series, the correct procedure, according to Darwin, is to seek them, in the first instance, among kindred classes of objects. But it is rarely possible to secure sufficient evidence from a study of the nearest kindred only. The investigator is, consequently, often compelled to seek farther afield for missing links in the probable chain of evolution. Thus, *e.g.*, Darwin himself, when investigating the evolution of the honeycomb of the hive-bee, kept closely to kindred species; but when he traced the evolution of the eye of vertebrates he went far afield, and invoked the help of facetted eyes, eyes without a lens, and eyes that are mere aggregates of pigment cells. Similarly, the comparative psychologist, when tracing the evolution of the human mind, does not confine his attention to the higher apes (the primates), but seeks light also from the lower animals, going even to the ant to learn of its ways. The second of the aforementioned tasks of the genetic method, namely, the determination of the causes which may have produced the various changes constituting the series of evolutionary stages, is mostly very difficult. A purely mechanistic explanation seems out of the question. In opposition to it there has been put forward the view of emergence (*q.v.*) or of *creative evolution* (*q.v.*). These views may be a healthy reaction against mechanistic pretensions; but they run the risk of confusing the christening of a problem with the solution of it.

The term "comparative method" is sometimes used as the equivalent of the evolutionary or genetic method just explained; but sometimes, perhaps more frequently, it is used in the rather ambiguous and indiscriminate sense of "the method of the comparative sciences," such as comparative philology, comparative anatomy, sociology, etc. These sciences, however, employ a variety of methods sometimes including the evolutionary method, and sometimes not. All they seem to have in common is a process of comparison. But, as already explained, comparison is no distinctive method, but rather an activity common to every method and want of method.

Methods for Discovering Causal Connections.—The method of classification and the evolutionary method satisfy to some extent the human quest for order, which is prompted mainly by the need of anticipation as a means to adaptation. Successful classification means a knowledge of the more or less uniform coexistence of certain attributes in the things concerned, so that it is possible to infer the presence of certain unobserved class-characteristics from certain others which are more accessible to observation—say the possession of a ruminant stomach in a quadruped having hoofs and frontal horns. The successful application of the genetic method means the possibility of inferring later stages from the present stage of an evolutionary series. But such uniformities are not the most reliable or most important for science or for life. Another and more important kind of uniform connection, perhaps the most important kind of uniform connection discoverable, is the causal connection between things or events. The general characters of causal connection is discussed in the article CAUSALITY, and an idea of it will be assumed here. To discover causal connection is to discover uniform connections between certain physical antecedents and certain consequents. Now, natural events do not disclose their causal connections to mere inspection. These connections can only be inferred or guessed from the observation of certain kinds of sequences or concurrences. The general character of the kind of observations which suggest causal connections, or confirm such suggestions, have been formulated in certain canons of induction, which are commonly known as the five simpler inductive methods. But there are also certain other methods of tracing causal connections, notably the statistical method, and certain combinations of the simpler inductive methods and deductive reasoning which may be called collectively the deductive-inductive method. We shall now proceed to deal with these methods in turn.

THE FIVE SIMPLER INDUCTIVE METHODS

These are based on our assumption that things and events are not a mere matter of chance, but are, in the main at least, the results determined by certain operative conditions, and occur only when these conditions operate. If, then, while other things remain

essentially the same, a certain factor or circumstance cannot be omitted, or changed in quantity, without affecting the phenomenon under investigation, it may be concluded that the factor or circumstance in question is an indispensable condition of that phenomenon, that is to say, is causally connected with it. On the other hand, any circumstance the absence, or quantitative variation, of which appears to make no difference to the phenomenon under investigation may be regarded as having no causal connection with it. It is necessary, therefore, to observe instances of the phenomenon concerned under circumstances as varied as possible, in order to find out from such observations what can and what cannot be removed or altered without affecting it. The procedure may assume one of two principal forms—a direct and an indirect form. In the direct form it is shown by observation or experiment: (1) that the elimination of a certain factor or antecedent is followed by the non-appearance of the phenomenon concerned, or (2) that a quantitative change in a certain factor or antecedent is followed by a quantitative change in that phenomenon, although, in either case, all other relevant factors remained the same. The first of these direct forms (1) is known as the Method of Difference, the second (2) is known as the Method of Concomitant Variations. The indirect form of this procedure consists in showing that so long as a certain antecedent or factor is present, a certain result seems to follow, and is not materially affected by changes in any of the other factors or circumstances that might appear to be relevant; and from this it is concluded that the phenomenon is not causally connected with the variable antecedents, but, since it must be causally connected with something, that it is so connected with the factor or antecedent that was present in all the observations made. This indirect method is known as the Method of Agreement. Of the two other methods belonging to this group, one, known as the Method of Residues, is only a modification of the Method of Difference, and the other known as the Joint Method of Agreement and Difference, is really the Method of Agreement supplemented by the study of certain negative instances so as to approximate to some extent to the Method of Difference.

The several methods have different degrees of cogency. The Methods of Difference and of Concomitant Variations are the most satisfactory; that of Agreement is least satisfactory. But the choice of method is not left entirely to the discretion of the investigator. Each method can only be applied to certain kinds of instances. And when the kind of instances required for the application of the most cogent method cannot be found, or produced, the investigator must perforce resort to the next best method, and so on. Sometimes, indeed, he may even find it necessary to apply rather loosely several of these methods to the same problem, and even then perhaps he may seek confirmation in deductive reasoning from the nature of the case in the light of accepted truths. We shall now formulate and explain each of the five methods separately.

The Method of Difference.—If two sets of circumstances are alike in all relevant respects, except that in one of them (the positive instance) a certain antecedent is present and a certain consequent follows, whereas in the other (the negative instance) both are absent, then that antecedent and that consequent are causally connected, that is to say, the consequent may always be expected to follow that antecedent in the absence of counteracting conditions. Using (here and throughout) the early letters of the alphabet to represent antecedents, the later letters to represent consequents, dots to represent the presence of irrelevant circumstances, and an arrow (→) to mean "is followed by," or "is causally connected with," the Method of Difference may be symbolized as follows: $a\ b\ c\ d. . . \rightarrow w\ x\ y\ z. . .$; $a\ b\ c. . . \rightarrow w\ x\ y$; $\therefore d \rightarrow z$. The instances compared may be two separate instances; or they may only be successive states of the same group of circumstances from which something is removed in order to obtain the negative instance, or to which something is added in order to obtain the positive instance; or, lastly, each instance may consist of a group of things. But in all cases the two instances must be as like as possible in all essentials, except in regard to the difference under investigation. The significance of a certain *difference* between instances can only be determined when the instances are *as like as possible in other respects*. The neglect of this precaution (known as the fallacy *non ceteris paribus*) easily leads to the attribution of an effect to the wrong antecedent (the fallacy of *post hoc ergo propter hoc*).

The Method of Concomitant Variations.—If a quantitative change in a certain antecedent is followed by a quantitative change in a certain consequent, although no other relevant circumstance has changed, then the antecedent and the consequent are causally connected. Symbolically, $a\ b\ c\ d_1 . . . \rightarrow w\ x\ y\ z_1 . . .$; $a\ b\ c\ d_2 . . . \rightarrow w\ x\ y\ z_2 . . .$; $a\ b\ c\ d_3 . . . \rightarrow w\ x\ y\ z_3 . . .$ [or briefly, z is a function of $d_1 z=f(d)$]; $\therefore d \rightarrow z$. This method may easily be expressed in a form that will show its kinship with the method of difference, the mere presence of a certain quantitative difference in the antecedent (d_1-d_2) being followed by a quantitative difference in the consequent (z_1-z_2). But, of course, the method of concomitant variations has no absolute negative instance such as the method of difference has. The tendency of modern science to become increasingly quantitative has given special importance to the method of concomitant variations as the instrument of *quantitative induction*, that is, for the establishment of precise quantitative correlations between phenomena, even when they are already known to be causally connected, or even when no interest attaches to the question of their causal connection. The concomitant variation may, of course, be either direct or inverse, that is, the consequent may increase with an increase in the antecedent, and diminish when it diminishes, or the consequent may diminish as the antecedent increases, and increase when it diminishes. And the proportion, in either case, may be quite simple or extremely complicated.

The Method of Agreement.—If several instances of a phenomenon have one relevant antecedent in common, then the common antecedent is causally connected with that phenomenon. Symbolically, $a\ b\ c\ d . . . \rightarrow w\ x\ y\ z . . .$; $b\ d\ f\ g . . . \rightarrow x\ z\ s\ t . . .$; $d\ f\ k\ l . . . \rightarrow z\ s\ p\ r . . .$; $\therefore d \rightarrow z$. It should be noted carefully that the instances required for the application of this method are instances that are as different from each other as possible except in regard to the common factor or antecedent which is under investigation. Just as the difference between instances is only significant when the instances are very similar in other respects, so the agreement or similarity between instances is significant only when the instances are as different as possible in other respects. A thousand instances which agree in everything would be no better, no more instructive, than one of them. The main precautions to be borne in mind when applying the method of agreement are the following: (1) To make sure that no relevant circumstance is overlooked; (2) Not to regard different consequents as similar, and assign them all to a common antecedent, merely because they may all serve more or less the same practical purpose; (3) To remember that the antecedent and consequent may have no direct causal connection, but may both be the consequents of some other antecedents.

The Method of Residues.—If part of a complex effect can be accounted for by reference to certain antecedents which are known to be, or to have been, present, and the consequents of which are already known from previous investigations, then the residue of the complex effect must be causally connected with the rest of the antecedents. Symbolically, $a\ b\ c\ d . . . \rightarrow w\ x\ y\ z . . .$; $(a\ b\ c \rightarrow w\ x\ y)$; $\therefore d \rightarrow z$. Sometimes these other antecedents are known to be present, but their precise effect has not yet been determined. At other times their presence is not suspected until the residual phenomenon compels the investigator to search for them. These latter cases are, perhaps, the most important, as they often lead to important discoveries. It was, *e.g.*, the residual weight or density of atmospheric nitrogen (as compared with nitrogen obtained from nitrous oxide, etc.), that led to the discovery of argon, and it was the residual deviation in the orbit of Uranus that led to the discovery of Neptune.

The Joint Method of Agreement and Difference.—If a group of instances in which a certain phenomenon occurs have only one relevant antecedent in common, while another group of otherwise similar instances in which the phenomenon does not

occur have nothing relevant in common except the absence of the common antecedent of the first group, then that antecedent is causally connected with that phenomenon. Symbolically, positive group: $a\ b\ c\ d \ldots \rightarrow w\ x\ y\ z \ldots$; $b\ d\ f\ g \ldots \rightarrow x\ z\ s\ t \ldots$; $d\ f\ k\ l \ldots \rightarrow z\ s\ p\ v \ldots$; negative group: $b\ c\ f \ldots \rightarrow x\ y\ s \ldots$; $b\ g\ k \ldots \rightarrow x\ t\ p \ldots$; $c\ l\ a \ldots \rightarrow y\ v\ w \ldots$; therefore $d \rightarrow z$. The positive group consists of instances such as are required for the method of agreement. The negative group, it should be noted carefully, does not contain any instance that, in conjunction with one of the positive instances, would enable one to apply the method of difference. But still the observation of such negative instances does strengthen the conclusion suggested by the positive instances, namely, by eliminating the possibility of plurality of causes in the positive instances (that is to say, the possibility that in each of the positive instances the common effect was produced by a different antecedent, not by the common antecedent). By treating each whole group as if it were one instance, we get here an approximation to the group form of the method of difference.

Note on "Relevance."—It may have been noticed that in the formulation of each of the simpler inductive methods reference was made to "relevant" factors or antecedents. The qualification is very important. Every event or change occurs in an infinitely complex setting, and it is only in so far as the vast majority of antecedents and accompaniments of any phenomenon can be safely ignored that it is possible to apply these and other methods at all. Of course, mistakes are sometimes made, and some thing that is dismissed or ignored as irrelevant may turn out to be most relevant. A warning to this effect had to be especially emphasized in connection with the Method of Agreement, for instance. The question therefore arises as to how it can be known whether an antecedent or circumstance is relevant or not. No general, fool-proof test can be suggested. In every inductive investigation, common sense, accumulated experience and knowledge, some originality, and a spirit of adventure are indispensable. Nothing, not even a study of scientific method, can serve as a substitute for these things. One can only indicate briefly how investigators are commonly guided in discriminating between what is likely to be relevant and what is likely to be irrelevant. The most important clue is that afforded by previous knowledge. Antecedents and circumstances the effects of which are already known, and are known to be different from the phenomenon under investigation, are generally dismissed as irrelevant, unless there is some *prima facie* ground for suspecting that they may be influencing it to some extent by way of modification or resistance. In this way the knowledge of what is relevant, like every other part of human knowledge, can only be improved or confirmed by more knowledge. Another clue is almost too vague for precise description, yet its influence is very real. It just consists of a vague feeling, or intuition, that certain things are relevant and others are not. This "feeling in our marrow" is probably an outcome of previous experience that has not yet emerged into articulate thought. Its very vagueness shields it from critical scrutiny. No wonder that it sometimes misleads. However, there it is, and a wise man makes the best of things, keeping an open and alert mind, and wasting no tears over the absence of sure signs and fool-proof criteria.

The Statistical Method.—The simpler inductive methods already described, and the Deductive-Inductive Method, which will be dealt with presently, can only be applied to phenomena that can be adequately analysed, and examined under sufficiently varied conditions or circumstances. But these requirements are not always satisfied. Many phenomena—meteorological, biological, medical, social, economic—are too complicated for adequate analysis, and are not observable under sufficiently varied or controlled conditions for the reliable application of these methods. In such cases, popular thought, impelled sometimes by practical needs and sometimes by sheer inability to suspend judgment, usually resorts to the so-called *Method of Simple Enumeration*. That is to say, it assumes a causal connection between any things or events between which a concurrence or sequence has been observed on a number of occasions. No attempt is made to discover exceptions or to study the phenomena under sufficiently varied circumstances. It is a loose habit of thought, or of thoughtlessness, rather than a scientific method. Most popular fallacies and superstitions are its offspring. Now, the Statistical Method is an attempt to deal with such complex and exceptionally difficult, phenomena in a scientific manner. It has several distinguishable functions. Its first and main business is to tidy up vast masses of varied data or material, so as to make them suitable for practical, or for scientific use. In this way it embraces such interests as the practical requirements of insurance companies, etc., and is a useful auxiliary to the methods of classification (which it furnishes with concise quantitative descriptions of classes of variable phenomena) and to other scientific methods. But here we are concerned with it mainly as an independent method of science for ascertaining connections between such phenomena as cannot be studied adequately by the other methods of science. The details of statistical technique are explained in the article STATISTICS. Here it is only proposed to sketch in outline the general character of statistical method as one of the methods of science.

Like other scientific methods statistical method aims at the discovery of connections between natural phenomena. And it does so by a close study of their concurrences or sequences. Unlike the so-called method of simple enumeration, it notes and records carefully not only actual concurrences and sequences, but also exceptions; it makes observations over as large and varied a field as possible; and cautiously draws conclusions that will fit *all* the observed facts. The observation of only a few cases of concurrence, or sequence, or concomitant variation, among certain phenomena, especially when the conditions are not under control and the full circumstances are not known, makes it impossible to distinguish a causal connection between the phenomena from a casual coincidence between them. But the observation of a large number of cases over a wide and varied range of circumstances, an exact record of positive and negative cases, and of variations between series of instances, may justify a highly probable conclusion about a causal connection between the phenomena concerned. The assumption on which the statistical method proceeds is this: If two phenomena, say A and B are not really connected, then their concurrence (or sequence, or concomitant variation) is a mere coincidence. In that case, the concurrence, etc., of B with other things than A should, as a matter of probability, be about as frequent as with A. But if the concurrence, etc., of B with A is appreciably greater than with things other than A, then the two are probably connected. Such greater concurrence of B with A than with *non-A* is called their correlation or association (according as the reference is to "variables," that is, things that can be present in various measurable magnitudes, or "attributes," that is, what can only be present or absent, what can be counted but not measured). And the main line of enquiry by means of statistical method, as an independent method of science, is into correlations and associations as clues to causal connections. The degree of such correlation or association may vary considerably, and is expressed by certain "co-efficients." When it is complete we get a general law of the ordinary type (*If A, then B*); if partial we get what is more especially called a statistical law stating that B occurs in such and such a percentage of cases of A, or $A = c\ (B)$, where c stands for some ascertained constant.

In view of the tendency to exaggerate the importance of statistical method as an independent method of science, it may, perhaps, be well to point out that it is only one of the methods of science, and really only a substitute for more cogent methods when these are inapplicable, for reasons already indicated. This seems obvious from the fact that as soon as the law of certain phenomena is discovered (by the other methods mainly) there is no further use for the statistical method in that field of enquiry. There was a time, for instance, when statistical records were kept of solar and lunar eclipses, just as they are still kept of meteorological phenomena. These records were useful and valuable, for they enabled the ancients already to note certain empirical cycles on which they could base fairly accurate anticipations of

eclipses, although they did not understand them. But since the laws of the occurrence of eclipses have been discovered there is no further need of statistical records of them—they can be foretold with accuracy and confidence. This, of course, does not affect the great value of statistical method as one of the methods of science, and as an auxiliary to the others. The important thing to bear in mind is that no amount of statistical technique can serve as an adequate substitute for a direct knowledge of, and familiarity with, the phenomena under investigation.

The Deductive-inductive Method.—Just as money makes money, so knowledge already acquired facilitates the acquisition of more knowledge. This fact has already been illustrated above in connection with the method of residues, etc. It is equally evident in the case of the method which will now engage our attention. The progress of science, and of knowledge generally, is frequently facilitated by supplementing the simpler inductive methods by deductive reasoning from knowledge already acquired. Such a combination of deduction with induction, J. S. Mill called the "Deductive Method," by which he really meant the "Deductive Method of Induction." To avoid the confusion of the "Deductive Method" with mere deduction, which is only one part of the whole method, it is better to describe it as the "Deductive-Inductive Method" or the "Inductive-Deductive Method." Mill distinguished two principal forms of this method as applied to the study of natural phenomena, namely, (1) that form of it in which deduction precedes induction, and (2) that in which induction precedes deduction. The first of these (1) he called the "Physical Method"; the second (2) he called the "Historical Method."

These names are rather misleading, inasmuch as both forms of the method are frequently employed in physics, where sometimes, say in the study of light, mathematical (*i.e.*, deductive) calculations precede and suggest physical experiments (*i.e.*, induction), and sometimes the inductive results of observation or experiment provide the occasion or stimulus for mathematical deductions. In any case, the differences in order of sequence are of no great importance, and hardly deserve separate names. What is of importance is to note the principal kinds of occasion which call for the use of this combined method. They are mainly three in number: (1) When an hypothesis cannot be verified (*i.e.*, tested) directly, but only indirectly; (2) when it is possible to systematize a number of already established inductions, or laws, under more comprehensive laws or theories; (3) when, owing to the difficulties of certain problems, or on account of the lack of sufficient and suitable instances of the phenomena under investigation, it is considered desirable either to confirm an inductive result by independent deductive reasoning from the nature of the case in the light of previous knowledge, or to confirm a deductive conclusion by independent inductive investigation.

An example of each of these types may help to make them clear. (1) When Galileo was investigating the law of the velocity of falling bodies he eventually formed the hypothesis that a body starting from rest falls with a uniform acceleration, and that its velocity varies with the time of its fall. But he could not devise any method for the direct verification of this hypothesis. By mathematical deduction, however, he arrived at the conclusion that a body falling according to his hypothetical law would fall through a distance proportionate to the time of its fall. This consequence could be tested by comparing the distances and the time of falling bodies, which thus served as an indirect verification of his hypothesis. (2) By inductions from numerous astronomical observations made by Tycho Brahe and himself, Kepler discovered the three familiar laws called by his name, namely, (*a*) that the planets move in elliptic orbits which have the sun for one of their foci; (*b*) that the velocity of a planet is such that the radius vector (*i.e.*, an imaginary line joining the moving planet to the sun) sweeps out equal areas in equal periods of time; and (*c*) that the squares of the periodic times of any two planets (that is, the times which they take to complete their revolutions round the sun) are proportional to the cubes of their mean distances from the sun. These three laws appeared to be quite independent of each other. But Newton systematized them all in the more comprehensive induction, or theory, of celestial gravitation. He showed that they could all be deduced from the one law that the planets tend to move towards each other with a force varying directly with the product of their masses, and inversely with the square of the distances between them. (3) H. Spencer, by comparing a number of predominantly industrial States and also, of predominantly military States, ancient and modern, inferred inductively that the former type of State is democratic and gives rise to free institutions, whereas the latter type is undemocratic and tends to oppression. As the sparse evidence hardly permitted of a rigorous application of any of the inductive methods, Spencer tried to confirm his conclusion by deductive reasoning from the nature of the case in the light of what is known about the human mind. He pointed out that in a type of society which is predominantly industrial the trading relations between individuals are the predominant relations, and these train them to humour and consider others. The result is a democratic attitude in all. In a State which is predominantly military, the relations which are most common among its members are those of authority, on the one part, and of subordination on the other. The result is the reverse of a democratic atmosphere.

Inductive Methods and Their Postulates.—All the methods of science start from observed facts, and usually end in some kind of generalization relating to a whole class of facts or events, or a large group of them. The number of instances actually observed is never more than a very small percentage of the whole class or group to which the generalization is extended. The question therefore arises as to the justification of such generalization from a limited number of observations. Even if we assume that there is law and order among natural phenomena this does not yet answer our question. It is probably impossible to offer a complete justification of scientific induction in this respect. As a matter of fact, certain assumptions are usually made, wittingly or unwittingly, both in science and in practical life. And all one can do is to state these assumptions or postulates explicitly, and hope that, to some extent at least, they are the result of a long process of adaptation of human thought to the nature of things. The first of these assumptions is that it is possible with reasonable care to select as samples from a group, or a class, that will fairly represent the whole group or class. This assumption is known as the *Principle of Fair Samples*. In order to obtain a fair sample, the selection must be made in a way that is calculated to avoid onesidedness or bias. In that sense such a sample is often described as a *random* sample; but the selection of such a sample usually calls for much knowledge and insight as to the best way of avoiding bias. The reliability of a sample can never be more than probable, and the degree of this probability varies with the size and variety of the sample—the actual number being less important than the variety, whenever there is reason to suspect variation in the whole that is to be judged by the sample. Much depends on our experience of the phenomena in question. In some cases a single instance (observed, say, under conditions of the method of difference) may be deemed to be a fair sample, in other cases even a large sample may fail to inspire confidence. This brings us to the second assumption. In cases of strict generalizations or uniformities (as distinguished from partial statistical laws), inferred inductively by means of one of the more reliable inductive methods, what happens is really this: The conditions under which the observations are made are such as to show that *in the particular cases observed* certain antecedents are causally connected with certain consequents. The generalization that all antecedents of that kind are causally connected with consequents of that kind is made so spontaneously that most people hardly realize that they have made it. But, strictly speaking, the generalization is an additional inference over and above the inference concerning the connection in the particular cases observed. And here again one cannot strictly justify it, but only state explicitly the assumption on which it rests. The assumption is that what is found to be a sufficient reason in one instance must be a reason in all instances of that kind. This assumption I have called the *Principle of the Uniformity of Reasons.*

Scientific Method and Scientific Explanation.—All the methods of science are essentially methods of discovering order in natural phenomena. For it is the ultimate aim of science to discover order in nature. To discover order in any class or group of phenomena is to explain them; that is, to make them clearer, more intelligible. Conversely, to explain anything is to indicate its place in some orderly system. In a broad sense it may be said that explanation generally takes the form of tracing the one in the many, or identity amid differences (*see* the article EXPLANATION). Still, there are different types of explanation, and their differences are worth noting. As might have been expected, there is a general correspondence between the several kinds of scientific method and the several types of explanation, as will appear from what follows. The main types of explanation may be summarily indicated under a few heads. (1) *Reference to a Class.* Sometimes an object is explained when it is allocated to its class, especially if the class is already known. If, *e.g.*, one is in doubt about the character of a plant, it is explained by finding out to what species or variety, etc., it belongs, or if one is puzzled by a certain flash of light it may be explained as lightning, etc. (2) *Reference to an Evolutionary Series.* Sometimes an object (or class of objects) is explained by assigning to it a place in a possible evolutionary series. Thus, *e.g.*, the rival explanations of the South African skull of an alleged ape-man assigned to it different places in the chain of biological evolution. (3) *Reference to Mediating Conditions.* Sometimes the problem is, how certain apparently remote or different facts or events come to be connected nevertheless. In such cases the explanation takes the form of indicating certain intermediate facts or events which bridge the gulf. Thus, *e.g.*, the perception of sound, light, etc., is explained by the mediation of air-waves or ether-waves, etc., between the source of stimulation and the percipient or receiver. (4) *Reference to Laws.* The commonest type of explanation consists in referring events to certain relevant laws. Thus, *e.g.*, the bent appearance of a stick partly immersed in water is explained by reference to Snell's law of refraction. The position of a planet may be explained by reference to Kepler's laws. And Kepler's laws themselves may be explained by reference to Newton's law of gravitation. (5) *Reference to Purpose.* In the study of human conduct, and of certain other biological phenomena, it seems impossible to dispense with all reference to purpose, even when other kinds of explanation are made use of at the same time. The most familiar way of explaining human actions is by referring them to some purpose that is pursued either consciously or unconsciously. Such explanations are suggested by our own felt experiences on similar occasions, and have always been found so satisfying to many people that they have been applied also to most other phenomena at one time or another. Hence the animism, fetishism, and anthropomorphism characteristic of the early history of human thought. This kind of extravagance was a serious obstacle to the progress of science during many centuries—to say nothing about the evil influences of theological anthropomorphism. Hence the reaction in modern science, which has not unnaturally displayed a strong hostility to all such teleological explanations, that is, explanations by reference to purposes. But the just revolt against one extreme does not justify another extreme. Such teleological explanations, too, have their proper place in certain limited fields of research. And it seems difficult to conceive how even the most violent opponent of teleological explanation could regard his own researches, writings and other higher activities as aimless and purposeless.

What has just been said may help to account for the tendency of modern science to disclaim all attempts to *explain* things, and to confine itself to the more modest task of *describing* them. The contrast is usually expressed by the statement that science only tries to answer *how* things happen, not *why*. But to say *how* things happen is also to explain them. Indeed, what is called scientific description often includes much that cannot be considered to be anything but explanation, right or wrong. The opposition to the question: *Why?* and the identification of all explanation with answers to such questions, betrays what is really at the back of the mind of the opponents of explanation as a legitimate aim of science. They really object to teleological explanation being applied indiscriminately to all kinds of natural phenomena. This is quite right. But it is a very short-sighted policy to give this extremely narrow meaning to the term "explanation," and so to deprive science of its legitimate and honourable claim to explain things, even if it does not explain everything, nor any one thing completely. The unsophisticated man of science who is not addicted to shibboleths certainly thinks not only that science explains things, but explains them most correctly. (*See* articles INDUCTION, LOGIC, EXPLANATION, PROBABILITY, LOGIC, HISTORY OF.)

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SCILLITAN MARTYRS, a company of early North African Christians who suffered under Marcus Aurelius in A.D. 180, and whose *Acta* are at once the earliest documents of the Church of Africa and the earliest specimen of Christian Latin. The martyrs take their name from Scilla (or Scillium), a town in Numidia. Their trial and execution took place in Carthage under the Proconsul Vigellius Saturninus, whom Tertullian declares to have been the first persecutor of the Christians in Africa. The date of their martyrdom is the 17th of July A.D. 180. We have in this martyrdom an excellent example of "Acts of Martyrs" properly so called. The document is in brief legal form, beginning with the date and the names of the accused, and giving the actual dialogue between them and their judge. It closes with the sentence, based on "obstinate" persistency in an illicit cult, and with the proclamation by the herald of the names of the offenders and the penalty. All this may quite well be a transcript of the *Acta,* or official report of the proceedings.

The Scillitan sufferers were twelve in all—seven men and five women. Two of these bear Punic names, but the rest Latin names. Six had already been tried: of the remainder, to whom these *Acta* primarily relate, Speratus is the principal spokesman. He claims for himself and his companions that they have lived a quiet and moral life, paying their dues and doing no wrong to their neighbours. But when called upon to swear by the genius of the emperor, he replies: "I recognize not the empire of this world; but rather do I serve that God whom no man hath seen, nor with these eyes can see."

BIBLIOGRAPHY.—The historical questions connected with these martyrs are treated by Lightfoot, *Ignatius* (1889, 2nd ed.), i. 524 ff. The Latin text, together with later recensions and a Greek version, is published in *Texts and Studies,* i. 2 (Passion of Perpetua, 1890); *see* also *Analecta Bollandiana* (1889), viii. 5; H. M. Gwatkin, *Selections from Early Christian Writers,* where, as in *Ante-Nicene Fathers,* ix. 285, there is an English translation.

SCILLY ISLES, group of small islands, off Cornwall, England, 25 m. W. by S. of Land's End. They form an outlying member of the series of granite masses of Cornwall and contain a few metalliferous veins. The origin of their name has never been authoritatively settled. The islands are wild and picturesque, with sheer cliffs and many large caves hollowed out by the Atlantic. Owing to the reefs and shoals by which these shores are surrounded, navigation becomes perilous in rough weather. In 1707 Sir Cloudesley Shovel perished here and a local proverb tells that for every man who dies a natural death on the islands the sea takes nine. On an outlying rock to the south-west is Bishop Light (49° 52′ 30″ N., 6° 27′ W.), constructed with infinite difficulty in 1858, and rebuilt 30 years later, and other lighthouses are on Round island and Penninis head (St. Mary's).

The islands are composed of granite, most of which is coarse and porphyritic, but the centre of the mass is finer and non-porphyritic. The finer granite occurs on the north-west side of St. Mary's, the southern part of Tresco, Bryher and Samson and the north-west side of Annet. Elvans (dykes) of quartz-porphyry are found in the granite. On the north-east end of White island a fragment of the altered killas (shale), which once covered the whole area, is still visible. A gravel deposit with chalk flints and Greensand cherts which caps some of the higher ground

on St. Mary's may possibly be of Eocene age. Raised beach, blown sand, fragmental granitic waste and an iron-cemented glacial deposit are found resting upon the granite.

The climate of the islands is unusually mild, snow being rarely seen, and the range of temperature being from 46° to 58° F. Fuchsias, geraniums and myrtles attain an immense size, and aloes, cactus and prickly pear flourish in the open. The gardens of the governor on Tresco island are quite subtropical in character, and, therefore, unique in the British isles. Great flocks of sea-birds haunt the remoter parts, and on some of the islands there are deer. Some of the rarer land-birds occasionally visit the islands, such as the golden oriole.

The islands are served by steamers from Penzance, and telephone and telegraph communication is established with the mainland. The raising of early asparagus, spring vegetables and flowers is the principal industry. There is also a small coasting trade; and fishing is carried on, lobsters being sent to London.

The true islands number about 40, with total area of 4,041 ac.; but only five islands are inhabited—St. Mary's, Tresco, St. Martin's, St. Agnes and Bryher. The total population in 1931 was 1,732. Hugh Town in St. Mary's is the capital, occupying a sandy peninsula crowned by the height known as the Garrison, with Star castle, dating from the days of Elizabeth. The town possesses a harbour, and a roadstead where large vessels can lie at anchor. Governed by a county council, they are part of the St. Ives parliamentary division, Cornwall.

On Tresco there are ruins of an abbey, and of two fortifications called Oliver Cromwell's tower and King Charles's tower. The church of St. Nicholas was built in 1882. Numerous rude pillars and circles of stones are to be noticed; and barrows are common, the most remarkable of these prehistoric remains being a barrow on the Isle of Samson, 58 ft. in girth, and containing a very perfect "kistvaen," or sepulchral chamber of stone.

It is not until the reign of Henry I. that we have written evidence concerning these isles. The king gave all the churches of Scilly and the land to the abbot and church of Tavistock. In 1180 the bishop of Exeter confirmed a grant by Richard de Wicha. Secular priests were temporally substituted for regulars by the abbot of Tavistock in 1345. The family of Blanchminster (de Albo Monasterio), at the beginning of the 14th century, held of the earldom of Cornwall lands in Scilly at a yearly service of 6s. 8d. or 600 puffins. The Blanchminsters resisted and imprisoned the coroner of Cornwall and in 1319 were granted a coroner of their own. In 1345 they are found petitioning the king against an invasion of the king's Welsh troops, who, being becalmed at Scilly, had carried away everything. In 1547 Silvester Danvers, as representing the Blanchminsters, sold his moiety of Scilly to Sir Thomas Seymour, by whose attainder in 1549 this and probably the other moiety fell to the Crown. The suppression of the religious houses had already placed church land and revenues at the king's disposal. During the Civil Wars, Hugh Town in 1645 gave shelter to Prince Charles, until his escape to Jersey. In 1649 the islands were occupied by a royalist, Sir Richard Grenville, who swept the surrounding seas for two years, before Admiral Blake and Sir John Ayscue forced him to surrender. In ancient times a haunt of pirates, the islands were afterwards notorious for smuggling. In 1687 the whole of Scilly was granted to Sidney Godolphin for 89 years from the expiration of the lease for 50 years granted to Francis Godolphin in 1636 by Charles I. In 1831 Augustus Smith succeeded the Godolphins as lessee.

SCIPIO ("staff"; the first *i* is long—Scīpio), the name of a patrician branch of the Cornelian gens whose historical representatives are separately noticed.

SCIPIO, PUBLIUS CORNELIUS, father of the elder Africanus. He was consul in 218 B.C., the first year of the Second Punic War, and sailed with an army from Pisa to Massilia, with the view of arresting Hannibal's advance on Italy. Failing to meet him, he returned by sea to Cisalpine Gaul, having sent back his army to Spain under the command of his brother Gnaeus, with instructions to hold the Carthaginian forces there in check. On his return to Italy he at once advanced to meet Hannibal. In a cavalry engagement in the upper valley of the Po, on the Ticinus, he was defeated and severely wounded. Again, in December of the same year, he witnessed the complete defeat of the Roman army on the Trebia, his colleague, T. Sempronius Longus, having insisted on fighting contrary to his advice. His term of command was extended, and we find him with his brother in Spain in the following year, winning victories over the Carthaginians and strengthening Rome's hold on that country, till 212 (or 211). The details of these campaigns are not accurately known, but it would seem that the ultimate defeat and death of the Scipios were due to the desertion of the Celtiberi, bribed by Hasdrubal, Hannibal's brother.

See Polybius iii. 40; Livy xxi.–xxv.; Appian, *Hannib.* 5–8, *Hisp.* 14–16.

SCIPIO AEMILIANUS AFRICANUS, PUBLIUS CORNELIUS, the younger (185–129 B.C.), was the younger son of L. Aemilius Paullus, the conqueror of Macedonia. He fought when a youth of 17 by his father's side at the battle of Pydna (168), which decided the fate of Macedonia and made northern Greece subject to Rome. He was adopted by P. Cornelius Scipio, the eldest son of Scipio Africanus the elder, and from him took the name Scipio. In 151, a time of defeat and disaster for the Romans in Spain, he voluntarily offered his services in that country and obtained an influence over the native tribes similar to that which the elder Scipio, his grandfather by adoption, had acquired nearly 60 years before. In the next year an appeal was made to him by the Carthaginians to act as arbiter between them and the Numidian prince Massinissa, who, backed up by a party at Rome, was incessantly encroaching on Carthaginian territory. In 149 war was declared by Rome, and a force sent to besiege Carthage.

In the early operations of the war, which went altogether against the Romans, Scipio, though a subordinate officer, distinguished himself repeatedly, and in 147 he was elected consul, while yet under the legal age, in order that he might hold the supreme command. After a year of desperate fighting and splendid heroism on the part of the defenders he carried the fortress, and at the senate's bidding levelled it to the ground. On his return to Rome he celebrated a splendid triumph, having established a personal claim to the surname of Africanus. In 142, during his censorship, he endeavoured to check the growing luxury and immorality of the period. In 139 he was unsuccessfully accused of high treason by Tiberius Claudius Asellus, whom he had degraded when censor. The speeches delivered by him on that occasion (now lost) were considered brilliant. In 134 he was again consul, with the province of Spain, where a demoralized Roman army was vainly attempting the conquest of Numantia on the Durius (Douro). After devoting several months to restoring the discipline of his troops, he reduced the city by blockade. The fall of Numantia in 133 established the Roman dominion in the province of Hither Spain. For his services Scipio received the additional surname of Numantinus.

Scipio himself, though not in sympathy with the extreme conservative party, was decidedly opposed to the schemes of the Gracchi (whose sister Sempronia was his wife). When he heard of the death of Tiberius Gracchus, he is said to have quoted the line from the *Odyssey* (i. 47), "So perish all who do the like again"; on his return to Rome he wrecked the working of the Gracchan agrarian legislation by getting the commissioners' judicial powers removed. This made him the chief enemy of the popular party for the time, and he died mysteriously in 129, the night before he was to have spoken on the agrarian laws. The mystery of his death was never cleared up, and there were political reasons for letting the matter drop, but there is little doubt that he was assassinated by one of the supporters of the Gracchi, probably Carbo.

He was a man of culture and refinement; he gathered round him such men as the Greek historian Polybius, the philosopher Panaetius, and the poets Lucilius and Terence. At the same time he had all the virtues of an old-fashioned Roman, according to Polybius and Cicero, the latter of whom gives an appreciation of him in his *De republica*, in which Scipio is the chief speaker. As a speaker he seems to have been no less distinguished than as a soldier. Though politically opposed to the Gracchi, he cannot be said to have been a foe to the interests of the people, but their revolutionary methods drove him into the arms of the Senatorial party, who

were not much more to his taste themselves. He was, in fact, a moderate man, in favour of conciliation, and as such inevitably unpopular, though respected, in an age of political violence.

See Polybius xxxv. 4, xxxix.; Vell. Pat. i. 12; Florus ii. 15, 17, 18; Appian, *Punica*, 72, 98, 113–131, *Hisp.* 48–95, *Bell. Civ.* i. 19; Plutarch, *Aemilius Paullus*, 22, *Tib. Gracchus*, 21, *C. Gracchus*, 10; Gellius iv. 20, v. 19; Cicero, *De orat.* ii. 40; exhaustive life by E. Person (Paris, 1877); monograph by Lincke (Dresden, 1898).

SCIPIO AFRICANUS, PUBLIUS CORNELIUS, the elder (237–183 B.C.), son of P. Cornelius Scipio; was present at the disastrous battles of the Ticinus (where, according to one tradition, he saved his father's life), the Trebia and Cannae. Even after the last he resolutely protested against several Roman nobles who advocated leaving Italy. The year after his father's death, he was elected to the command of the new army which the Romans resolved to send to Spain. All Spain south of the Ebro in the year of his arrival (210 or 209) was under Carthaginian control, but fortunately for him the three Carthaginian generals, Hasdrubal and Mago (Hannibal's brothers), and Hasdrubal the son of Gisgo, were not disposed to act in concert and were preoccupied with revolts in Africa. Scipio, on landing at the mouth of the Ebro, was thus enabled to surprise and capture New Carthage, the headquarters of the Carthaginian power in Spain. He thus obtained a rich booty of war stores and supplies, and an excellent harbour. His kindly treatment of the Spanish hostages and prisoners brought many over to his side. In 209 he drove back Hasdrubal, from his position at Baecula, on the upper Guadalquivir, but was unable to hinder his march to Italy. After winning over a number of Spanish chiefs he achieved in 206 a decisive victory at Ilipa (near Corduba), which resulted in the evacuation of Spain by the Punic commanders. With the idea of striking a blow at Carthage in Africa, he paid a short visit to the Numidian princes, Syphax and Massinissa, but at the court of Syphax he was foiled by the presence of Hasdrubal, the son of Gisgo, whose daughter Sophonisba was married to the Numidian chief. On his return to Spain Scipio had to quell a mutiny among his troops. Hannibal's brother Mago had meanwhile sailed for Italy, and in 206 Scipio himself, having secured the Roman occupation of Spain by the capture of Gades, gave up his command and returned to Rome. In the following year he was elected consul, the province of Sicily being assigned to him. Hannibal was by now penned in the south-west of Italy, and Scipio was strongly in favour of carrying the war into Africa. Here he was strongly opposed by the old Roman nobility, with whom he was unpopular. After a commission of enquiry had visited Sicily, he sailed in 204 and landed near Utica. Carthage meanwhile had secured the friendship of the Numidian Syphax, whose advance compelled Scipio to raise the siege of Utica and to entrench himself on the shore between that place and Carthage. Next year he destroyed two combined armies of the Carthaginians and Numidians. After the failure of peace negotiations in which Scipio displayed great moderation, he defeated Hannibal in a decisive battle near Zama (Oct. 19, 202; *see* PUNIC WARS). In the subsequent settlement with Carthage he upheld with success his comparatively lenient terms against the immoderate demands of many Roman aristocrats.

Scipio was welcomed back to Rome with the surname of Africanus, and had the good sense to refuse the many honours which the people would have thrust upon him. For some years he lived quietly and took no part in politics. In 193 he was one of the commissioners sent to Africa to settle a dispute between Massinissa and the Carthaginians. In 190, when the Romans declared war against Antiochus III. of Syria, Publius was attached as legate to his brother Lucius, to whom the chief command had been entrusted. The two brothers brought the war to a conclusion by a decisive victory at Magnesia in the same year. Meanwhile Scipio's political enemies had gained ground, and on their return to Rome a prosecution was started (187) by two tribunes against Lucius on the ground of misappropriation of moneys received from Antiochus. As Lucius was in the act of producing his account-books his brother wrested them from his hands, tore them in pieces, and flung them on the floor of the senate-house. This created a bad impression; Lucius was brought to trial, condemned and heavily fined. Africanus himself was subsequently (185) accused of having been bribed by Antiochus, but by reminding the people that it was the anniversary of his victory at Zama he caused an outburst of enthusiasm in his favour. The people crowded round him and followed him to the Capitol to offer thanks to the gods and beg them to give Rome more citizens like himself. He then retired to his native country seat at Liternum on the coast of Campania, where he died. By his wife Aemilia, daughter of the Aemilius Paullus who fell at Cannae, he had a daughter Cornelia, who became the mother of the two famous Gracchi.

Scipio was one of Rome's greatest generals. Skilful alike in strategy and in tactics, he had also the faculty of inspiring his soldiers with confidence. According to the story, Hannibal, who regarded Alexander as the first and Pyrrhus as the second among military commanders, confessed that had he beaten Scipio he should have put himself before either of them. He was a man of great intellectual culture and could speak and write Greek perfectly. He wrote his own memoirs in Greek. He also enjoyed the reputation of being a graceful orator. There was a belief that he was a special favourite of heaven and held actual communication with the gods. It is quite possible that he himself honestly shared this belief; to his political opponents he was often harsh and arrogant, but towards others singularly gracious and sympathetic. According to Gellius, his life was written by Oppius and Hyginus, and also, it was said, by Plutarch.

See Livy xxi.–xxxviii. and Polybius; Aulus Gellius iv. 18; Val. Max. iii. 7; biography by F. D. Gerlach (1868); E. Berwick (1817), with notes and illustrations; B. H. Liddell Hart, *A Greater than Napoleon —Scipio Africanus* (1926); also PUNIC WARS.

SCIRE FACIAS, in English and American law, a judicial writ founded upon some record directing the sheriff to make it known (scire facias) to the party against whom it is brought, and requiring the latter to show cause why the party bringing the writ should not have the advantage of such record. Proceedings in *scire facias* are regarded as an action, and the defendant may plead his defence as in an action. The writ in England is now of little practical importance. In America the writ has been abolished in the code States and an ordinary action is maintainable in its stead; in other States *scire facias* retains much of its original importance.

SCISSORS: *see* CUTLERY.

SCOLECITE, a mineral of the Zeolite group (*q.v.*). It is a hydrated silicate of lime and alumina, crystallizing in the monoclinic system, with angles very near those of the cube. It commonly occurs as bundles of radiating fibres, and when heated sometimes curls up like a worm, whence the name (Gr. σκώληξ, a worm). It is usually colourless or white and more or less transparent. Scolecite occurs frequently with other zeolites in the western isles of Scotland, Iceland, and in the Deccan Trap area in India, among many other localities.

SCOLOPACIDAE: *see* SNIPE; WOODCOCK; SANDPIPER.

SCONE, a parish of Perthshire, Scotland, containing Old Scone, the site of an historic abbey and palace, and New Scone, a modern village, 2 m. N. of Perth, near the left bank of the Tay. Pop. of parish (1931) 2,559. It became the capital of Pictavia, the kingdom of northern Picts, in succession to Forteviot. The Moot Hill, where the first national council of which we possess records was held (906), was known also as the Hill of Belief from the fact that here the Pictish king promulgated the edict regulating the Christian church. The abbey was founded in 1115 by Alexander I., but long before this date Scone had been a centre of ecclesiastical activity and the seat of a monastery. Kenneth is alleged to have brought the Stone of Destiny, on which the Celtic kings were crowned, from Dunstaffnage castle on Loch Etive, and to have deposited it in Scone, whence it was conveyed to Westminster abbey (where it lies beneath the coronation chair) by Edward I. in 1296. Most of the Scottish kings were crowned at Scone, the last function being held on Jan. 1, 1651, when Charles II. received the crown. The abbey and the house of Scone were burned down by the Reformers in 1559, and next year the estates were granted to the Ruthvens. On the attainder of the family after the Gowrie conspiracy in 1600, the land passed to Sir David Murray of the Tullibardine line, who became 1st vis-

count Stormont (1621) and was the ancestor of the earl of Mansfield, to whom the existing house belongs. Sir David completed in 1606 the palace which the earl of Gowrie had begun. The present palace, which dates from 1803 and stands in a beautiful park, contains several historic relics.

SCOPAS, probably of Parian origin, the son of Aristander, a great Greek sculptor of the 4th century B.C. Although classed as an Athenian, and similar in tendency to Praxiteles, he was really a cosmopolitan artist, working largely in Asia and Peloponnesus. The extant works with which he is associated are the Mausoleum of Halicarnassus (finished 349) and the temple of Athena Alea at Tegea (some time after 395). In the case of the Mausoleum, though no doubt the sculpture generally belongs to his school, we are unable to single out any special part of it as his own. A recent suggestion attributes the small "chariot-race" frieze to Scopas. But we have good reason to think that the pedimental figures from Tegea are Scopas' own early work. The subjects of the pedimental compositions were the hunting of the Calydonian boar and the battle between Achilles and Telephus. Four heads remain, that of Hercules, that of Atalanta and two of warriors: also part of the body of Atalanta and the head of the boar. Unfortunately all these are in very poor preservation; but it is allowed that they are our best evidence for the style of Scopas.

Ancient writers give us a good deal of information as to works of Scopas. He made for the people of Elis a bronze Aphrodite, riding on a goat (copied on the coins of Elis); a Maenad at Athens, running with head thrown back, and a torn kid in her hands was ascribed to him; of this Dr. Treu has published a probable copy in the Albertinum at Dresden (*Mélanges Perrot,* p. 317). Another type of his was Apollo as leader of the Muses, singing to the lyre. The most elaborate of his works was a great group representing Poseidon, Thetis and Achilles, accompanied by Nereids, Tritons and other sea-beings. On the basis of his known work, many extant statues can be confidently attributed to his influence and some may be direct copies.

Jointly with his contemporaries Praxiteles and Lysippus, Scopas may be considered as having completely changed the character of Greek sculpture. It was they who initiated the lines of development which culminated in the schools of Pergamum, Rhodes and other great cities of later Greece. In most of the modern museums of ancient art their influence may be seen in three-fourths of the works exhibited. At the Renaissance it was especially their influence which dominated Italian painting and through it modern art.

See B. Gräf in *Röm. Mittheit.* (1889), 199; Urlichs, *Scopas* (Greifswald, 1863).

SCOPIDAE: *see* HAMMERHEAD.

SCOPOLAMINE. Scopolamine or hyoscine is a complex alkaloid closely related to atropine and having the chemical formula $C_{17}H_{21}NO_4$. It is laevorotary to polarised light but in its commercial form may be mixed with its dextrorotary isomer. Scopolamine occurs in varying proportions and is extracted from deadly nightshade, henbane, thornapple and a few other less-known plants. Hyoscine hydrobromide, the official preparation of the British Pharmacopoeia, consists of transparent colourless bitter crystals, which are soluble in water and have the formula $C_{17}H_{21}NO_4HBr_3H_2O$. The therapeutic dose is $\frac{1}{200}$ to $\frac{1}{100}$ grain.

The chief action of scopolamine is hypnotic, a condition very similar to natural sleep being induced. This usually lasts for about six hours and the patient wakes up with an unclouded mind but may complain of thirst and dryness of the mouth and throat. In some cases a stage of excitement, giddiness and incoherent speech may precede that of sleep, and it is this uncertainty of action which renders the drug somewhat unreliable. Some tolerance is produced after prolonged exhibition of scopolamine so that the dose has to be increased to have the same effect.

Administration.—Scopolamine by itself does not relieve pain, so that for anaesthetic purposes it is usually combined with morphia. Some such mixture as:—Morphine gr. $\frac{1}{6}$, Scopolamine gr. $\frac{1}{100}$, is injected hypodermically, the scopolamine being repeated as necessary in doses of gr. $\frac{1}{400}$. This "twilight sleep" method does not produce surgical anaesthesia, but has the double action of dulling pain and producing loss of memory. It is thus useful in labour, especially when the process is likely to be prolonged, as in primiparae. In these cases the initial dose should be given when the first stage is well established. The patient should then fall into a somnolent condition from which she is partially roused when each pain occurs. To obtain the best effect, the patient's ears should be plugged with cotton wool, her eyes bandaged, and the room kept perfectly quiet. The chief disadvantage in the "twilight sleep" method in labour is that the child may be born in an apnoeic condition and a considerable time may elapse before regular respiration is established. If skilled attention is available, however, it is rare for the baby to suffer any ill effects. The action of the drug upon the foetal heart appears to be negligible. If forceps have to be applied or any other form of instrumental delivery is necessary, an inhalation anaesthesia will have to be administered in addition.

"Twilight sleep" can also be used as a preliminary to the various types of regional analgesia. For instance, a severe operation can be performed under preliminary morphine-scopolamine injection and subsequent spinal analgesia without the patient being aware that he has been moved out of bed.

Some anaesthetists also use the drugs as a preliminary to general anaesthesia, such as nitrous oxide-oxygen. This method undoubtedly lessens the apprehension of a nervous patient and has the advantage that less general anaesthetic is necessary, but it tends to depress respiration so that cyanosis and a difficult administration may ensue. The breathing may become so shallow that the requisite depth of anaesthesia is impossible to attain. The blood pressure also tends to fall, while the eye and other reflex signs which are useful in estimating the depth of anaesthesia can no longer be trusted.

Scopolamine-morphine is definitely contra-indicated in children, in severe abdominal operations and in cases of intestinal obstruction, as the drugs may increase the paralysis of the gut. Furthermore, it should not be given to patients who are known to have an idiosyncrasy for either of its constituents. For these reasons, scopolamine-morphine should not be used as a routine preliminary injection but should be reserved for selected cases.

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SCORDISCI, a Celtic tribe inhabiting the southern part of lower Pannonia between the Savus, Dravus and Danuvius. As early as 175 B.C. they came into collision with the Romans by assisting Perseus, King of Macedonia; and after Macedonia became a Roman province they were for many years engaged in hostilities with them. In 135 B.C. they were defeated by M. Cosconius in Thrace; in 118 B.C. Sextus Pompeius, the grandfather of the triumvir, was slain fighting against them near Stobi. In 114 B.C. they surprised and destroyed the army of Gaius Porcius Cato, but were defeated by Q. Minucius Rufus in 107. They still from time to time gave trouble to the Roman governors of Macedonia; they even advanced as far as Delphi and plundered the temple; but Lucius Cornelius Scipio Asiaticus finally overcame them in 88 B.C. and drove them across the Danube. In Strabo's time they had been expelled from the valley of the Danube by the Dacians (Strabo vii. pp. 293, 313).

SCORESBY, WILLIAM (1789–1857), English Arctic explorer, scientist and divine, was born near Whitby, Yorkshire, on Oct. 5, 1789. He made his first voyage with his father when he was eleven years of age, but on his return he was sent back to school till 1803. After this he was his father's constant companion, and was with him on May 25, 1806, on the whaler "Resolution," when he reached 81° 30′ N. lat. (19° E. long.). In 1811 his father resigned to him the command of the "Resolution." In his voyage of 1813 he established the fact that the temperature of the polar ocean is warmer at great depths than at the surface. In 1819 he was elected a fellow of the Royal Society of Edinburgh. In his voyage of 1822 to Greenland he surveyed and charted 400 m. of the east coast, between 69° 30′ and 72° 30′. This, however, was the last of his Arctic voyages. On his return

his wife had died, and he entered the church. After two years at Cambridge he took his degree (1825) and was appointed to the curacy of Bassingby, Yorkshire, later to preferments at Liverpool, at Exeter and Bradford. In 1824 he was elected F.R.S., and he received other honours. From the first he was an active member and official of the British Association, and he contributed especially to the knowledge of terrestrial magnetism. In order to obtain additional data for his theories on magnetism he made a voyage to Australia in 1856, the results of which were published in a posthumous work—*Journal of a Voyage to Australia for Magnetical Research,* edited by Archibald Smith (1859). He visited America in 1844 and 1848. He died at Torquay on March 21, 1857.

He wrote: *An Account of the Arctic Regions and Northern Whale Fishery* (1820) and *Journal of a Voyage to the Northern Whale Fishery, including Researches and Discoveries on the Eastern Coast of Greenland* (1823).

See also the *Life* by his nephew, R. E. Scoresby-Jackson (1861).

SCORIA, in geology, a name applied to lava when moderately vesicular and having a structure like that of a clinker (Lat. *scoria,* slag). Ejected masses of scoriaceous lava are often called "cinders," a term conveniently used for all lumps of vesicular lava. (*See* VOLCANO.)

SCORPIO or **SCORPIUS** ("The Scorpion"), in astronomy, the 8th sign of the zodiac (*q.v.*), denoted by the symbol ♏. The Greeks fabled that Orion having boasted to Diana and Latona that he would kill every animal on the earth, these goddesses sent a poisonous reptile—a scorpion—which stung him so that he died. Jupiter raised the scorpion to Heaven, and afterwards, at Diana's request, did the same for Orion. Not much of the constellation can be seen from the latitude of Britain, but in the southern hemisphere it is a particularly fine constellation, the resemblance to a scorpion being well-marked. The brightest star is Antares, of a noticeably red colour.

SCORPION, the name for the order Scorpiones of the Arachnida (*q.v.*), distinguished by having the last five segments of the body modified to form a flexible tail, armed with a sting consisting of a vesicle holding a pair of poison glands, and of a sharp spine behind the tip of which the ducts of the glands open. In addition, they have four pairs of walking legs; the second pair form powerful pincers, and those of the first pair smaller nippers. They feed principally upon insects although the larger kinds may kill small lizards and mice. The large pincers are studded with tactile hairs, and the moment an insect touches these he is seized by the pincers, the scorpion's tail brought over his back and the sting thrust into the prey. Scorpions vary in size from about 1 in. to 8 in. The poison is more virulent in some of the smaller than in the larger species. Upon mankind the effects of the poison are seldom fatal.

The belief that scorpions commit suicide by stinging themselves to death when tortured by fire is quite without foundation; the venom has no effect upon the individual itself, nor upon other members of the same species. Scorpions, however, succumb rapidly when exposed to the warmth of a fire or of the tropical sun. They are easily rendered innocuous by scraping off the sharp point of the sting; and it has been shown that immunity to the ill effects can be acquired by being repeatedly stung.

Many scorpions exhibit a conspicuous warning coloration of jet-black or black and yellow; and many have stridulating organs. These, like the rattle of rattlesnakes, advertise their presence and help to prevent their being attacked or trodden on. In habits they are nocturnal, spending the daytime concealed under stones or fallen tree trunks or in burrows. Amongst the burrowing kinds are the large African species of the genera *Pandinus* and *Opisthophthalmus* and the eastern genus *Palamnaeus.*

Scorpions are viviparous. The brood, which consists of a dozen or more young, is carried about on its mother's back until they are able to shift for themselves. The young resemble their parents and undergo no metamorphosis. Moulting occurs by means of a split just below the edge of the carapace as in king-crabs and spiders.

Scorpions were already in existence in the Carboniferous Period and there is no essential structural difference between these fossils and existing forms. These Carboniferous scorpions, however, were preceded by others, in Silurian deposits, which lived in the sea and exhibit differences marking them off as a distinct group and attesting affinity with the earlier marine Arachnida, known as Gigantostraca. Their legs were short, thick, and ended in a single claw, adapted for maintaining a hold upon rocks or seaweed against the wash of waves. These Silurian scorpions, of which the best-known genus is *Palaeophonus,* were only 1 or 2 in. in length.

At the present time scorpions are almost universal south of the 40th or 45th parallels of north latitude; and their geographical distribution shows a close correspondence with that of the mammalia, their absence from New Zealand being an interesting point of agreement. Scorpions are adapted to diverse conditions, some thriving in tropical forests, others on open plains, others in sandy deserts, and a few at high altitudes with abundant snow in winter. In the tropics they aestivate at times of drought; and in temperate latitudes they pass the cold months in hibernation.

SCORPION-FLY, the name given to insects of the family *Panorpidae* of the order Mecoptera. Their name is derived from the fact that the males carry the extremity of the body upwardly curved after the manner of a scorpion. These insects are recognizable by the beak-like prolongation of the front of the head and the two pairs of usually conspicuously marbled wings. The chief genus is *Panorpa,* which is widely distributed, three species occurring in the British Isles. Both the larvae and perfect insects are carnivorous: the former are caterpillar-like; they live in the earth and are provided with eight pairs of abdominal feet in addition to three pairs of short thoracic legs. The pupa is found in an earthen cavity below ground and the perfect insects occur among rank herbage in shaded situations.

SCORZONERA (*Scorzonera hispanica*), a hardy perennial, native to central and southern Europe, and cultivated in gardens as a vegetable for its fleshy cylindrical roots, which resemble those of salsify except in being black outside. They should be treated in every respect like salsify. The genus is a member of the family Compositae, and nearly allied to *Tragopogon,* to which salsify belongs.

SCOT, MICHAEL (? 1175–*c.* 1232), Scottish translator, mathematician and astrologer. He studied at Oxford and Paris, and after being ordained, held various benefices in Italy, but refused the appointment of archbishop of Cashel in Ireland. Having acquired a knowledge of Arabic at Toledo, he became one of the scholars of the court of Frederick II., and at the instigation of the emperor superintended (along with Hermannus Alemannus) a fresh translation of Aristotle and the Arabian commentaries from Arabic into Latin. The chief of these were the *De Animalibus,* the *De anima,* the *De coelo,* and probably the *Physics* and the *Metaphysics,* and also the *De Sphaera* of Al Bitrogi. Scot's own books, dealing almost exclusively with astrology, alchemy and the occult sciences generally, are mainly responsible for the development of the Michael Scot legend. Chief among these are *Super auctorem spherae* (pr. Bologna 1495, Venice 1631); *De sole et luna* (pr. Strassburg 1622), the *De chiromantia,* an opuscule often published in the 15th century; *De physiognomia et de hominis procreatione* (18 editions between 1477 and 1660).

Around his own death many legends gathered. He was supposed to have foretold that he would end by a blow from a stone of not more than two ounces in weight, and that to protect himself he wore an iron helmet, and that, raising this in church at the elevation of the host, the fatal stone fell on him from the roof. Italian tradition says he died in Italy; other accounts place his death in his native country, and his burial at Holme Cultram in Cumberland or in Melrose Abbey. In the notes to Scott's *Lay of the Last Minstrel,* of which the opening of the wizard's tomb forms the most striking episode, Scott recounts the exploits attributed by popular belief to the magician. "In the south of Scotland any work of great labour and antiquity is ascribed either to the agency of Auld Michael, of Sir William Wallace or the devil." He used to feast his friends with dishes brought by spirits from the royal kitchens of France and Spain and other lands. On an embassy to France he brought the French monarch to his knees by the stamp-

ing of his horse's hoof, the first ringing the bells of Notre Dame and the second causing the towers of the palace to fall. Other powers and exploits are narrated in Folengo's Macaronic poem of *Merlin Coccaius* (1595). Michael's reputation as a magician was early established. He appears in the *Inferno* of Dante (canto xx. 115–117) among the magicians and soothsayers. He is represented in the same character by Boccaccio.

See J. Wood Brown, *Life and Legend of Michael Scot* (1897); P. Duhem, *Le Système du Monde* t. III. (1917); C. Haskens, "Michael Scot and Frederick II." in *Isis* (1921) and *Studies in the Hist. of Mediaeval Science* (Cambridge, 1924); L. Thorndike, *Hist. of Magic and Experimental Science* (vol. 2, 1924).

SCOT AND LOT, a phrase common in the records of English mediaeval boroughs, applied to those householders who were assessed to any payment (such as tallage, aid, etc.) made by the borough for local or national purposes. They were usually members of a gild merchant. Previous to the Reform Act 1832 those who paid scot and bore lot were entitled to the franchise in virtue of this payment.

SCOTER (*Oidemia nigra*), a diving duck, also known as the "black duck" from the male being, save for a stripe of orange down the bill, wholly of that colour. Of all ducks the scoter has the most marine habits, keeping to the sea in all weathers, and coming to land only to breed. A second species, the velvet scoter, *O. fusca,* of larger size, with a white spot under each eye and a white bar on each wing, is less abundant. It has its American counterpart, *O. americana,* and a third, the surf-duck, *O. perspicillata,* with a white patch on the crown and another on the nape, and a curiously parti-coloured bill, is not uncommon in North American waters. All the species have their true home in arctic or sub-arctic countries, but the scoter itself breeds occasionally in Scotland. The nest is on the ground and contains five to eight creamy eggs. The females are soot-coloured above and brownish white beneath. The flesh of all these birds has an exceedingly strong taste, and ranked as fish in ecclesiastical dietary.

SCOTIA, a residential village of Schenectady county, New York, U.S.A., on the north bank of the Mohawk river, opposite Schenectady; served by the Boston and Maine railroad. Pop. 1930, 7,437. It was incorporated in 1904.

SCOTLAND, that portion of Great Britain which lies north of the English boundary; it also comprises the Outer and Inner Hebrides and other islands off the west coast, and the Orkney and Shetland islands off the north coast. With England lying to the south, it is bounded on the north and west by the Atlantic ocean and on the east by the North sea. It is separated from England by the Solway firth, the Sark, Scotsdyke (an old embankment connecting the Sark with the Esk), the Esk (for one mile), the Liddel, the Kershope, the Cheviot hills, the Tweed and a small area known as the "liberties" of Berwick. The greatest length from Cape Wrath in Sutherland to the Mull of Galloway is 274 m., and the greatest breadth from Buchan Ness to Applecross in the shire of Ross and Cromarty 154 m., but from Bonar Bridge at the head of Dornoch firth to the head of Loch Broom it is only 26 m. wide, and 30 m. from Grangemouth on the Forth to Bowling on the Clyde. The coast-line is estimated at 2,300 m., the arms of the sea being so numerous and in several cases penetrating so far inland that few places are beyond 40 m. from salt water. The total area is 19,069,500 ac. or 29,796 sq.m., exclusive of inland waters (about 608 sq.m.), the foreshore (about 498 sq.m.) and tidal water (about 608 sq. miles).

The name Scotland (the ancient *Caledonia*—a name still poetically used) originated in the 11th century, when (from the tribe of Scots) part of it was called Scotia (a name previously applied to what is now Ireland); and the name of Scotland became established in the 12th and 13th centuries.

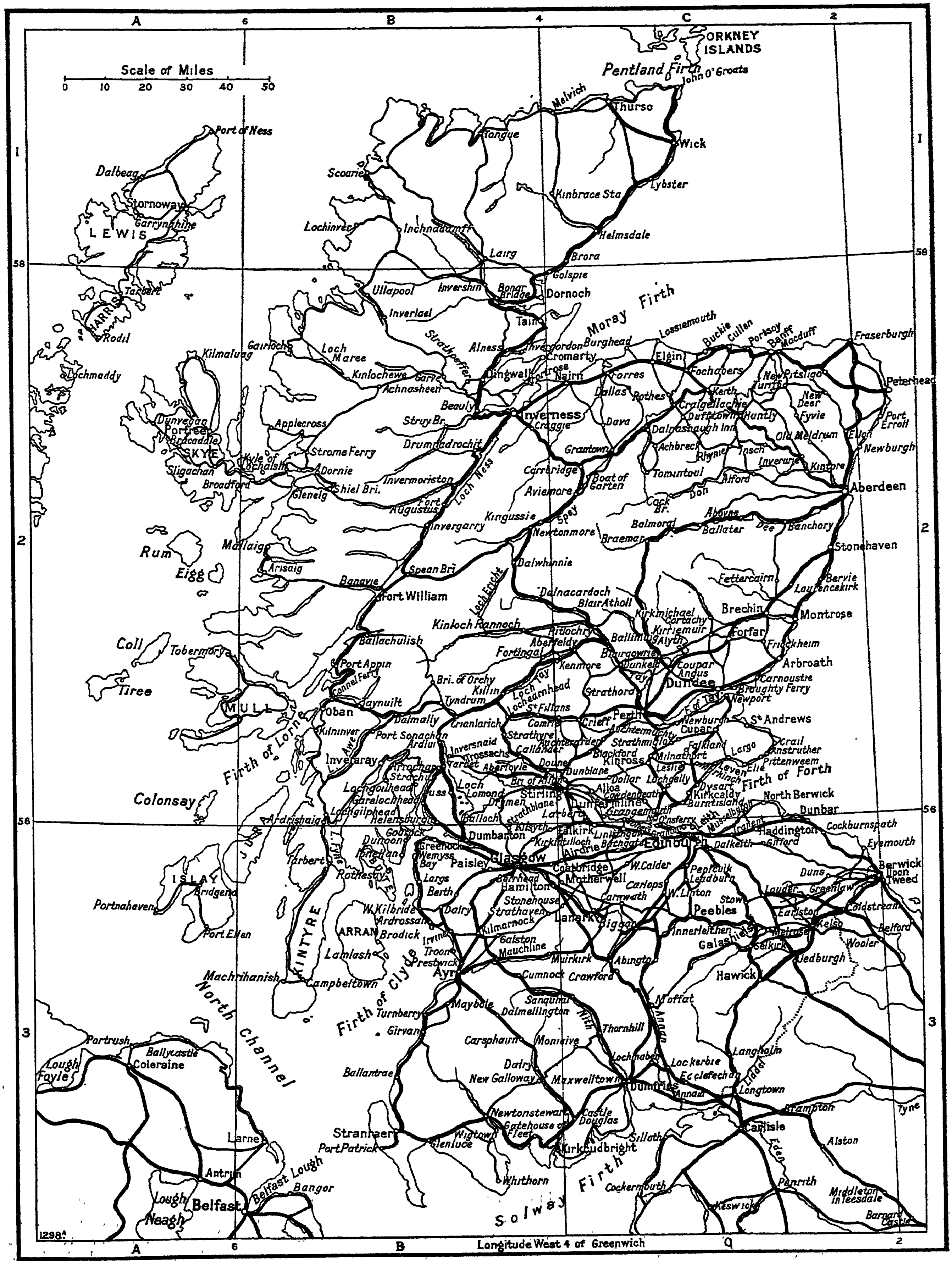
PHYSICAL GEOGRAPHY

Physically, Scotland is divided into three structural regions—the Highlands (subdivided by Glen More into the north-western and south-eastern Highlands); the central Lowlands (a tract of south-westerly to north-easterly trend, between a line drawn roughly from Girvan to Dunbar and a line drawn from Dumbarton to Stonehaven); and the southern Uplands. To these, geographers add a fourth division, to be regarded as at least a sub-region of the Highlands, viz., the lower eastern slopes of that region bordering the North sea, from Stonehaven and Aberdeen in the south to the high plain of Caithness in the north. It may be termed the north-eastern region.

The Highlands.—Nearly all this region is high ground, deeply trenched with valleys and sea lochs. The Highland hills stand in a succession of more or less parallel confluent ridges, having in the main a trend from north-east to south-west. These ridges are separated by longitudinal and furrowed by transverse valleys. The longitudinal valleys, which run in the same general direction as the ridges, have had their trend defined by geological structure, such as a line of dislocation (the Great Glen), or the plications of the rocks (Lochs Ericht, Tay and Awe, and most of the sea lochs of Argyllshire). The transverse valleys run north-west or south-east and are for the most part independent of geological structure. The valley of the Garry and Tay crosses the strike of all the Highland rocks, traverses the great fault on the Highland border, and finally breaks through the chain of the Sidlaw hills at Perth. River-gorges are characteristic features in many of the valleys. In the Old Red Sandstone they are particularly prominent where that formation has lain in the way of the streams sweeping down from the Highlands. In the basin of the Moray firth some fine examples may be seen on the Nairn and Findhorn, while on the west side of the Cromarty firth some of the small streams descending from the high grounds of the east of the shire of Ross and Cromarty have cut out defiles in the conglomerates, remarkable for their depth and narrowness. Towards the south margin of the Highlands instances of true canyons in the Old Red sandstone are to be seen where the Isla and North Esk enter that formation.

While many of the Highland mountains, viewed from near at hand, tower above the surrounding country, and are often of noble form, from a distance they are seen not to vary much from a general uniformity of height. A few exceptions occur along the western seaboard of Sutherland, in Skye, and elsewhere, but their structure explains the reason of their prominence. Regarded broadly, the Highland mountains are monuments of erosion, the relics of an old plateau, the surface and former slopes of which are shown approximately by the summits of the existing masses and the directions of the chief waterflows. The surface is rugged. The rocks project in bosses and crags, which roughen the sides and crests of the ridges. The shape and colour of these roughnesses depend on the nature of the underlying rock. Where it is hard and jointed, weathering into large quadrangular blocks, the hills are distinguished for the gnarled bossy character of their declivities, as may be seen in Ben Ledi and the heights to the north-east of it. Where, on the other hand, the rock decays into smaller debris, the hills assume smoother contours, as in the slate hills running from the Kyles of Bute to Loch Lomond.

The process by which the ancient plateau has been trenched into valleys and confluent ridges is best displayed among the higher mountains, where erosion proceeds at an accelerated pace. The long screes or talus-slopes at the foot of every crag and cliff bear witness to the continual waste. The headwaters of a river cut into the slopes of the parent hill. Each valley is consequently lengthened at the expense of the mountain from which it descends. Where a number of small torrents converge in a steep mountain recess, they cut out a crescent-shaped hollow or half-cauldron, which in the Scottish Highlands is known as a *corrie*. Usually the upper part of a corrie is formed by a crescent of naked rock, from which long trails of debris descend to the bottom of the hollow. Every distinct variety of rock has its own type of corrie, the peculiarities being marked both in the details of the upper cliffs and crags, and in the amount, form and colour of the screes. The Scottish corries have been occupied by glaciers. Hence their bottoms are generally ice-worn or strewn over with moraine stuff. Often a small tarn fills up the bottom, ponded back by a moraine. It is in such localities that we can best observe the evidences of the glaciers that once overspread the country. Among these high grounds also the gradual narrowing of ridges into sharp, narrow, knife-edged crests and the lowering of these into *cols* or passes



MAP OF THE MAIN ROADS OF SCOTLAND

can be well seen. The stages in this demolition are clearest where the underlying rock is of granite or similarly tough material, which at the same time is apt to be split and splintered by means of its numerous transverse joints. The granite mountains of Arran furnish excellent illustrations.

Where a rock yields to weather with considerable uniformity in all directions it is likely to assume conical forms in the progress of denudation. Sometimes this uniformity is attained by a general disintegration of the rock into fine debris, which rolls down the slopes in long screes. In other cases it is secured by the intersection of joints, whereby a rock, in itself hard and durable, is divided into small angular blocks, which are separated by weathering and slide down the declivities. In many instances the beginning of the formation of a cone may be detected on ridges which have been deeply trenched by valleys. The mountain Schiehallion (3,547 ft.) is an instance of a cone not yet freed from its parent ridge. A further stage in denudation results in isolated groups of cones completely separated from the rest of the rocks among which they once lay buried. Such groups may be carved out of a continuous band of rock extending into the regions beyond. The Paps of Jura, for instance, rise out of a long belt of quartzite which stretches through the islands of Islay, Jura and Scarba. In many cases, however, the groups point to the existence of some boss of rock of greater durability than those in the immediate neighbourhood, as in the Coolins (Cuchullins), and Red hills of Skye and the group of granite cones of Ben Loyal, Sutherland. The most impressive form of solitary cone is that wherein, after vast denudation, a thick overlying formation has been reduced to a single outlier, such as Morven in Caithness, the two Bens Griam in Sutherland, and the pyramids of red sandstone on the western margin of the shires of Sutherland and Ross and Cromarty. While, in Scotland, the dislocation of rocks has generally prevented the formation of continuous escarpments, there are instances of these in the wide basalt plateaux of the inner Hebrides, where lava has been poured out in nearly horizontal sheets, with occasional layers of tuff or other softer rock between them.

Erosion.—Platforms of erosion, successively established by the wearing down of the land to sea-level, occur both in the Highlands and among the southern Uplands. Allusion has been made to the flat-topped moorlands which, in the eastern Grampians, reach heights of 3,000 to 4,000ft. above the sea. The summits of Lochnagar and Ben Macdhui may be taken as examples. These mountains lie within granite areas; but not less striking examples may be found among the schists. That these high plateaux are planes of erosion is shown by their independence of geological structure, the upturned edges of the vertical and contorted schists having been shorn off and the granite wasted and levelled along its exposed surface. An example of the similar destruction of a much younger platform is to be found in the terraced plateaux of Skye, Eigg, Canna, Muck, Mull and Morven, which are portions of what was probably originally a continuous plain of basalt. Though dating back only to older Tertiary time, this plain has been so deeply trenched by denudation that it has been reduced to scattered fragments.

The Highlands are separated into two disconnected and in some respects contrasted divisions by the depression of the Great glen, extending from Loch Linnhe to Inverness. In the northwestern section the highest ground is found along the Atlantic coast, mounting steeply from the sea to an average height of 2,000 to 3,000 feet. The watershed consequently keeps close to the western seaboard, in some places not above 1½ m. from it. From these hills, which catch the first downpour of the rains from the ocean, the ground falls eastward. Numerous eminences, however, prolong the mountainous features to the North sea and south-eastward to Glen More. The difference of the general level on the two sides of the waterparting is reflected in the length of their streams. On the west the drainage empties itself into the Atlantic after flowing only a very few miles, on the east it has to run 30 or 40 miles. At the head of Loch Nevis the western stream is but 3m. long, while the eastern has a course of some 18m. to the Great glen. Throughout the north-western region uniformity of features characterizes the scenery, betokening, even at a distance, the general monotony of structure. But the sameness is relieved along the western coast of the shires of Sutherland and Ross and Cromarty by groups of cones and stacks, and farther south by the terraced plateaux and abrupt conical hills of Skye, Rum and Mull.

The south-eastern region of the Highlands, having a more diversified geological structure, offers greater variety of scenery. Most of the valleys, lakes and sea lochs run in a south-westerly and north-easterly direction, a feature strikingly exhibited in west Argyllshire. But there are also several important transverse valleys, that of the Garry and Tay, already noticed, being the most conspicuous example. The watershed, too, is somewhat different. It first strikes eastwards round the head of Loch Laggan and then swings southwards, pursuing a sinuous course till it leaves the Highlands on the east side of Loch Lomond. The streams flowing westward, however, are still short, while those running to the north-east, east and south-east have long courses and drain wide areas. There is a marked contrast between the configuration of the north-eastern district, and the other parts of this region. In that area the Grampians rise to level or gently rounded summits, often more than 3,000, and in a few places exceeding 4,000ft. in height, and bounded by steep declivities and sometimes by precipices. Farther south-west, in the shires of Perth, Inverness and Argyll, they give place to the more typical hummocky crested ridges of Highland scenery which, in Ben Nevis and Aonach Beg, reach heights of over 4,000 ft. Geological structure alone does not account for this contrast, and one reason may lie in the heavier rainfall, and consequently stronger erosion, to which the western mountains, facing the Atlantic ocean, have been exposed. Long narrow strips of flat land occur in the more important valleys. Most of the straths and glens have a floor of detritus which, spread out between the bases of the boundary hills, has been levelled into meadow land by the rivers and provides almost the sole arable ground in each district. It is appropriate here to notice certain terms common throughout Scottish topography in application to types of valleys and low-lying land, for examples of most of them are found in the Highlands or on their borders.

Straths are broad expanses of low ground between hills, usually traversed by one main stream and its tributaries—*e.g.*, Strath Tay, Strath Spey, Strath Conon. This name, however, has also been applied to wide tracts of lowland which embrace portions of several valleys, but are defined by lines of heights on each side; the best example is afforded by Strathmore—the "Great Strath" —between the southern margin of the Highlands and the line of the Sidlaw hills. This long wide depression, though it looks like one great valley, includes portions of the valleys of the Tay, Isla, North Esk and South Esk, all of which cross it. Elsewhere in central Scotland such a wide depression is known as a *howe*, as in the Howe of Fife between the Ochil and Lomond hills. A *glen* is a narrower and steeper-sided valley than a strath, though the names have not always been applied with discrimination. Most of the Highland valleys are true glens, Glencoe being the best known example. The hills rise steeply on each side, sometimes in grassy slopes, sometimes in rocky bosses and precipitous cliffs, while the bottom is occupied by a lake. In the south of Scotland the larger streams flow in wide open valleys called *dales*, as in Clydesdale, Tweeddale, Teviotdale, Liddesdale, Eskdale, Nithsdale. The strips of alluvial land bordering a river are known as *haughs*, and where, along estuaries, they expand into wide plains they are termed *carses*. The carses of the Forth extend seawards as far as Bo'ness and consist chiefly of raised beaches. The Carse of Gowrie is the strip of low ground intervening between the Firth of Tay and the Sidlaw hills. *Brae* signifies the steep bank of a river, and so any slope or hill-side.

Scottish lochs (or lakes) are sometimes classified into four groups—glen lochs, rock-tarns, moraine-tarns, and lochs of the Lowlands, of which the first and most important are practically confined to the Highlands and the second and third are far more numerous there than elsewhere. The small rock-tarns, lying in rock-basins on the flanks of mountains, or the summit of ridges, or rocky plateaux, are by far the commonest, and especially so in the north-west. They almost invariably lie in strongly

ice-worn platforms, and are held to occupy hollows produced by the gouging action of the ice-sheets in glacial times. Moraine-tarns—small sheets of water dammed back by moraines left by retreating glaciers—are also numerous in the Highlands, nestling in the bottoms of corries. In the south-west, where the glaciers continued longest to reach sea-level, lakes retained by moraine-barriers are found very little above the sea. More important, if less numerous than either of these categories, are the larger glen-lochs, which are associated with the finest inland scenery in the Highlands. These occupy depressions in the glens, not due to local heaping up of detritus, but true rock-basins, often of great depth. It is commonly but not invariably held that these depressions were formed by the erosive action of ice, since glaciers occupied the glens where they occur and wore down the rocks along the sides and bottom; but it is a point of difficulty in this theory whether ice could have eroded the deepest of the hollows. In any circumstances the lochs must be of recent geological date. Any such basins belonging to the time of the folding of the crystalline schists would have been filled up and effaced long ago, so rapid is the infilling by the torrents which sweep down detritus from the surrounding heights. Glen lakes are almost wholly confined to the western half of the Highlands. Hardly any lakes are to be seen east of a line drawn from Inverness to Perth. West of that line, however, they abound in both the longitudinal and the transverse valleys.

The western Highland coast is intersected throughout by long narrow sea-lochs or fiords. The mainland slopes steeply into the sea and is fronted by chains and groups of islands. These fiords are submerged land-valleys, for the whole western coast has subsided to a considerable depth beneath its former level. The Scottish sea lochs must be considered in connection with those of western Ireland and Norway. The whole of this north-western coast-line of Europe bears witness to recent submergence. On this view the Outer and Inner Hebrides were formerly one with themselves and the mainland, and the western isles therefore are truly grouped with the Highland province of Scotland. Nearly the whole coast-line is rocky. On the west the coast is mostly either steep rocky declivity or a sea-wall, though strips of lower ground are found in the bays. The cliffs vary in character according to the nature of the rock. At Cape Wrath, precipices 300ft. high have been cut out of the Archean gneiss. The varying texture of this rock, its irregular foliation and jointing, and its ramifying veins of pegmatite give it very unequal powers of resistance. Here it projects in irregular bastions and buttresses, there retires into deep recesses and tunnels, but shows everywhere a characteristic ruggedness. In striking contrast to these precipices are those of the Cambrian red sandstone a few miles to the east. Vast vertical walls of rock rise to a height of 600ft., cut by their perpendicular joints into quadrangular piers and projections, some of which stand out alone as islets in front of the main cliff. The sombre colouring is relieved by vegetation along the edges of the nearly flat beds which project like great cornices and serve as nesting-places for sea-fowl. Along the western sea-lochs raised sea-beaches sometimes afford the only arable soil, their flat green surfaces presenting a strong contrast to the brown moors above.

The population of the Highlands is naturally scattered, since great tracts of mountain and moorland are uninhabitable. The few small towns and larger villages are for the most part such as have grown in modern times as touring centres and places of summer residence along the west coast and the railways, in particular the line between Perth and Inverness. Settlements remote from these influences are commonly small, and some on the western seaboard share with Norwegian fjord-side settlements the characteristic of having their chief lines of access by water. The Highlands are not rich in minerals; only a few workings, such as that of the iron ore of Raasay, near Skye, are encountered; and only the modern development of hydro-electric power gives promise of any considerable industrial activity. This use of the water-power resources of the west, however, has already resulted in the establishment of aluminium works at Foyers and at Kinlochleven—the power itself being the sole attraction, for neither raw material, nor an easy line of commercial communication, nor even a potential industrial population, were available at these places. Further schemes are developing in Lochaber and the district near Mallaig. Otherwise, homestead industry, such as the manufacture of Harris tweed in the outer Hebrides, can maintain itself (apart from local consumption) only by the special excellence of its products. It thus follows that the Highland population is principally agricultural, and concentrated upon the limited cultivable areas, the resources of which it tends easily to outgrow, so that the Highlands have sent and still send abroad many emigrants. Only a few alluvial basins—up to an elevation of 1,200ft. in Banffshire, but usually much lower—the levels of raised beaches, and narrow isolated coastal strips offer fair agricultural land, and a more or less complete subsistence to the crofters, of whom those on the coast lands may add to their means of livelihood by fishing, while others may take service as gamekeepers on the large sporting estates which occupy a high proportion of the total area.

The North-eastern Region.—This division embraces the considerable low-lying areas in eastern Aberdeenshire and the northern parts of Banff, Elgin, and Nairn, together with the level strip of land bordering both sides of Moray firth. Farther north, the Highlands of Sutherland sink close to the coast, but the narrow coastal belt there broadens northward again in Caithness, which does not strictly belong to the Highlands. In the south-eastern part of the region (east and south-east of Moray firth) the principal rivers—Spey and Dee, and, within the angle formed by these, the Don, Ythan, Deveron, and others—drain long valleys separated by extended spurs of the Highland mountains. The hills sink to a fairly wide foreland, here sloping gently to the sea, there broken off in low cliffs. On this part of the coast there are neither islands nor deep inlets, though plenty of small bays offer shelter for shipping, especially fishing vessels. Northward, the coast is deeply indented by the Firths of Moray, Cromarty and Dornoch, and a further series of fine rivers, hardly less famous among salmon and trout fishermen than those just mentioned, enter the sea from the mountains to the west. The chief of these rivers are the Findhorn, Beauly, Conon, Shin, and Helmsdale. The peninsulas between the firths reach no great elevation—an extreme height of 800ft. is found in the Black Isle south of Cromarty firth. The coastal Lowland of Sutherland, as already indicated, is very narrow, but Caithness is a wide moor, terminating almost everywhere seaward in a range of precipices of Old Red sandstone.

The population of this region is, on the whole, closer on the coastal lands than in the interior; the largest towns, such as Aberdeen, Peterhead, Fraserburgh, Banff, Inverness, Wick, are seaports. In Sutherland population is almost confined to the raised beaches of the narrow coastal belt. On the other hand a fairly dense rural population covers most of the area between the lower Dee and the Deveron, and extends far up the valley of the Spey. The region is not devoid of very fertile lands, although their preparation for tilling has, in the past, necessitated in some parts immense labour in clearing the glacial boulders with which they were bestrewn. A high standard of farming is reached in the lower parts of the Dee and Don basins, the Laigh of Moray, and other localities. Oats and turnips, with some barley, are main crops, and the lower lands of the eastern division are famous for cattle. On the higher grounds sheep are more prominent. Granite is quarried at several points in the same division, and granite-polishing is a characteristic industry at Aberdeen. Pure water, favourable for malting, has helped in the establishment of the distilling industry. The fisheries centre mainly on Aberdeen, which is also the principal port for the export of herrings; the pelagic fisheries are carried on mostly from more northerly ports—Peterhead, Fraserburgh and Wick (as well as the Orkney and Shetland Islands).

The Central Lowlands.—These constitute a broad depression with south-westerly to north-easterly trend lying between the Highland line that runs from the head of the Firth of Clyde to Stonehaven and the pastoral uplands that stretch from Girvan to Dunbar. They may be regarded as a long trough of younger rocks let down by parallel dislocations between the older masses

to the south and north. The depression as such, however, is of great geological antiquity. Long dislocations have sharply defined its northern and southern margins. By other fractures and unequal movements of upheaval or depression portions of the older rocks have been brought up within the bounds of the younger, and areas of the younger have been enclosed by the older. On the whole, these disturbances have followed the prevalent north-easterly trend, and hence a tendency may be observed among the main ridges and valleys to run in that direction. The chains of the Ochil, Sidlaw, Pentland, Renfrew, Campsie and Fintry hills, and the valleys of the Strathmore, Firth of Tay, and the basin of Midlothian are examples. But the dominant cause in the determination of the topographical prominences and depressions of the district has been the relative hardness and softness of the rocks. Almost all the eminences in the Lowlands consist of hard igneous rocks, forming not only chains of hills such as those just mentioned and others in Ayrshire and Lanarkshire, but isolated crags and hills like those on which stand the castles of Edinburgh and Stirling, and others conspicuous in Fife and the Lothians.

Of the three chief valleys in the central Lowlands, two, those of the Tay and the Forth, descend from the Highlands, and one, that of the Clyde, from the southern Uplands. Though on the whole transverse, these depressions furnish another notable example of that independence of geological structure already referred to. The gorge in which the famous Falls of Clyde are situated is the best example of a river-gorge in the Lowlands. Lochs are not many. Occasional rock-tarns are found in the hills. The larger lochs of the Lowlands lie in hollows of the glacial detritus, which is strewn thickly over the lower grounds. As these hollows were caused by original irregular deposition rather than by erosion, they have no intimate relation to the present drainage-lines. The lakes vary in size from pools to sheets of water several square miles in area. As a rule they are shallow in proportion to their extent and surface. They were once more numerous than they are now, for some have disappeared through natural causes and others have been drained. The largest sheets of fresh water in the Lowlands are lakes of the plains, as Loch Leven and the Lake of Menteith.

The fact that two-thirds of the population of Scotland live in the central Lowlands on one-tenth of the total area of the country, is evidence of the pre-eminent industrial position of this region. Among the geographical reasons for that pre-eminence we find, first, ease of communication, both internal and external. The Firth of Clyde on the west, the Firths of Forth and Tay on the east, deeply indent the coasts and offer access for shipping directly or very near to the chief industrial centres. Secondly, the Carboniferous rocks of the Lowlands carry important coal-fields, the richest that of Lanarkshire, others in Ayrshire, about the head of the Firth of Forth, in the Lothians and in Fife. Iron is allied with coal, notably in the Ayrshire and Lanarkshire fields. Oil-shale is worked in Midlothian and Linlithgowshire, but its importance has declined; lead is worked in Lanarkshire. Upon the Lanarkshire coal-field, the city of Glasgow, and its neighbouring industrial towns, there centre a variety of great manufacturing industries—shipbuilding and engineering, cotton, woollen and linen manufactures, brewing and distilling, chemical, pottery and glass manufactures, and many others. Elsewhere certain great industries are definitely localized, such as the jute manufacture and jam and marmalade making at Dundee; the woollen industry in Stirlingshire and Clackmannanshire, linen manufacture at and about Dunfermline, Arbroath and Montrose, that of linoleum and oilcloth at Kirkcaldy, that of paper in places neighbouring to Edinburgh, and the dyeing industry at Perth. All depend now upon the coal supplies; the woollen manufactures were based originally upon the neighbourhood of wide hill-pastures for sheep, the jam-making of Dundee upon the fertile fruit-lands in the adjacent Carse of Gowrie and Strathmore; and all the textile industries, the paper mills, and the distilleries owe their establishment in part to ample supplies of pure water. Rich agricultural lands, albeit restricted in area, lie close to the manufacturing districts, especially in the east, in Perthshire, Forfarshire, Fife and the Lothians; barley, a high yield of wheat on a small acreage, and potatoes are crops especially noted.

The Southern Uplands.—These extend from the north channel in the south-west to St. Abb's head in the north-east, and form a well-defined belt of hilly ground, and though much less elevated (their highest point is 2,764ft. above the sea) than the Highlands, rise with scarcely less abruptness above the lower tracts that bound them. Their north-western margin for the most part springs boldly above the fields and moorlands of the central plain, and its boundary for long distances continues remarkably straight. On the south and south-east their limits in general are less prominently defined but are better seen west and south-west of the Nith, from which they extend to the sea and Loch Ryan, terminating in the extreme south-west in a plateau of which the loftiest point is little over 1,000ft. above the sea. The Cheviots do not properly belong to the Uplands, from which they are separated by Liddesdale and other hollows, and on which they abut abruptly. But though geologically the one set of mountains must be separated from the other, geographically it is convenient to include within the southern Uplands the whole area between the central plain and the Border. A survey of the Uplands, therefore, presents in succession from south-west to north-east the Kirkcudbrightshire and Ayrshire mountain moors, the Lowthers, the Moffat hills, the Moorfoots and the Lammermuirs. Distinguished by the smoothness of their surface, they may be regarded as a rolling moorland, traversed by many valleys conducting the drainage to the sea. This character is well observed from the heights of Tweedsmuir. Wide, mossy moors, 2,000ft. or more above the sea, and sometimes level as a racecourse, spread out on all sides. Their continuity, however, is interrupted by numerous valleys separating them into detached flat-topped hills, seldom marked by precipices of naked rock. Where the rock projects it more usually appears in low crags and knolls, from which long trails of grey or purple debris descend till they are lost among the grass. These smooth green hills form excellent pasture-land, while the alluvial flats in the valleys, and even some of the lower slopes, are fitted for grain and green crops. Only in the higher tracts are there rugged features recalling the character of Highland scenery. In the heights of Hartfell (2,651ft.) and Whitecoomb (2,695 ft.), whence the Clyde, Tweed, Annan and Moffat Water descend, the high moorlands have been scarped into gloomy corries, with crags and talus-slopes, which form a series of landscapes all the more striking from the contrast with everything around them. In Galloway, also, the highest portions of the Uplands have acquired a ruggedness and wildness more like those of the Highlands than any other district in the south of Scotland. In that region the Silurian rocks have been invaded by large bosses of granite, and have undergone a variable amount of metamorphism which has, in some places, altered them into hard crystalline schists. These various rocky masses have yielded unequally to disintegration; the harder portions project in rocky knolls, crags and cliffs, while the softer parts have been worn down into more flowing outlines. The highest summit in the south of Scotland—Merrick (2,764ft.)—consists of Silurian strata much altered by proximity to the granite, while the rest of the more prominent heights (all in Kirkcudbrightshire)—Rinns of Kells (2,668ft.), Cairnsmuir of Carsphairn (2,612ft.), and Cairnsmore of Fleet (2,331ft.)—are formed of granite.

The watershed of the southern Uplands runs from the mouth of Loch Ryan in a sinuous north-easterly direction, keeping near the northern limit of the region till it reaches the basin of the Nith, where it quits the Uplands, descends into the lowlands of Ayrshire, and, after circling round the headwaters of the Nith, strikes south-eastwards across half the breadth of the Uplands, then sweeps north and eastwards between the basins of the Clyde, Tweed and Annan, and then through the moors that surround the sources of the Ettrick, Teviot and Jed, into the Cheviot hills. Here, again, the longest slope is on the east side, where the Tweed bears the whole drainage of that side into the sea. Although the rocks throughout the southern Uplands have a persistent north-easterly and south-westerly strike, and though this trend is apparent in the bands of more rugged hills that mark the outcrop of hard grits and greywackes, nevertheless geological

structure has been much less effective in determining the lines of ridge and valley than in the Highlands. On the southern side of the watershed, in Dumfriesshire and Galloway, the valleys run generally transversely from north-west to south-east. But in the eastern half of the Uplands the valleys do not appear to have any relation to the geological structure of the ground underneath.

In the southern Uplands, owing to the greater softness and uniformity of texture of the rocks, as compared with those of the Highlands, rock-tarns are comparatively infrequent, except in Galloway, where the protrusion of granite and its associated metamorphism have reproduced Highland conditions of rock-structure. The best known and one of the most picturesque of moraine-dammed lochs is the wild and lonely Loch Skene, lying in a recess of Whitecoombe at the head of Moffat water. Others are sprinkled over the higher parts of the valleys in Galloway.

On the east the southern uplands plunge abruptly into the sea near St. Abb's head in a noble range of precipices 300 to 500 ft. in height, and on the west terminate in a long broken line of sea-wall, which begins at the mouth of Loch Ryan, extends to the Mull of Galloway and reappears again in the southern headlands of Wigtown and Kirkcudbright. Southward they sink to the narrow Lowland bordering Solway firth.

On the grassy hills of the Uplands, from end to end, sheep farming is naturally an outstanding occupation, and with it is associated the woollen industry centred in the chief inland towns of the Tweed basin. In the west (Galloway, Ayrshire) dairy farming is highly developed for the supply of the neighbouring populous centres in the Lowlands. Into the western dales, too, some of the industries of the Lowlands extend, with some coal-mining in Nithsdale, quarrying of freestone, etc., while the granite of Creetown and the neighbourhood is famous. But, as a whole, the human, like the physical, geography of the southern Uplands, is clearly differentiated from that of the Highlands and the Lowlands; it approaches more nearly in character to that of our north-eastern region. (O. J. R. H.)

GEOLOGY

Scotland lies in the course of a pre-Devonian mountain chain that stretches from Scandinavia to Ireland. This chain, called Caledonian by Suess, dominates the early geological history of the country. The general course of its structures is north-east-south-west. Its foreland is in the Outer Hebrides, its front in the north-west Highlands. Its latest manifestation is the corrugation of the Silurian of the Southern Uplands—where Lapworth demonstrated the true worth of graptolites.

Pre-Devonian of the North-west Highlands and Islands.—The oldest rocks are grouped as Lewisian Complex. They make the greater part of Lewis, with its companion Outer Hebrides, and much of the coast of the adjacent mainland. Apparently, their earliest members consist of metamorphic sediments, including magnesian marbles and graphitic schists. Into these are intruded igneous gneisses (intermediate, basic, etc.). Locally, late dykes of the complex have escaped metamorphism. The Lewisian abounds in records of pre-Torridonian movements executed under diverse conditions. Two phenomena have attracted particular attention: transformation of dolerite into hornblende-schist, and production by frictional fusion of so-called "flinty" crush-rock. A great development of "flinty" crush-rock follows an east-south-eastwardly inclined thrust-plane along the Outer Hebrides.

Torridonian succeeds Lewisian with complete unconformity. From Islay northward to Skye, the Lower Torridonian basal conglomerates, epidotic grits, grey sandstones, flags and grey and black shales reach a collective thickness of 7,000 feet. Farther north, Middle Torridonian arkose (6,000–8,000 ft.), with local breccias, rests among and covers over "fossil hills" of Lewisian gneiss which are sometimes more than 2,000 ft. in individual height. Upper Torridonian sandstones, flags and shales attain 4,500 feet.

The Durness Quartzite-limestone.—This succession begins at or below the Lower Cambrian and, according to American palaeontologists, extends into the Lower Ordovician (Durness lithology and fauna are of American facies). The base passes smoothly and unconformably across Torridonian east-south-eastwards on to Lewisian exposed in a pre-Cambrian anticline. The stratigraphy is persistent for 100 miles along the strike: basal quartzite, 320 ft.; quartzite with vertical worm "pipes," 270 ft.; dolomitic shales, mudstones and dolomites, with *Olenellus*, etc., 50 ft.; grit, with *Salterella* and also *Olenellus*, 30 ft.; limestones and dolomites in seven stages, some fossiliferous, 1,500 feet. Plutonic (possibly early Devonian) intrusions of alkali-syenite, borolanite, etc., accompanied by sills, cut the Durness sediments. Contact effects include dedolomitisation.

The Durness fossiliferous succession with its intrusions passes east-south-eastwards in disturbed fashion under the Moine Thrust overlain by crystalline schists. This thrust has been traced from Durness to Skye, and may continue through Islay. Near Durness, a thrust-outlier (Klippe) of the Moine Thrust-mass (nappe) has been preserved by down-faulting 10 miles in advance of the main outcrop. In Assynt and Glencoul, there are particularly good exposures of the disturbed belt with subsidiary thrusts bringing 1,500 ft. slices of Lewisian for miles over Cambrian. Recumbent folding occurs in and near Skye. Isoclinal packing, *schuppen Struktur*, crushing (mylonisation), slaty cleavage, etc., are diagrammatically exposed at many localities.

Pre-Devonian of the Highlands South-east of Moine Thrust.—Sedimentary quartzo-felspathic schist or gneiss, with sufficient mica to give a flaggy structure, is prevalent north-west of the Caledonian canal. Micaceous gneiss representing shales is also common. Such rocks are grouped together as Moine Schists. A limestone with particular associates occurs a little above the Moine Thrust in Eireboll. Several minor outcrops of Lewisian igneous and sedimentary types are generally interpreted as Lewisian inliers interfolded with unconformable Moines. The Inchbae porphyritic granite, now largely augen-gneiss, was intruded into the Moines before these had suffered regional metamorphism. Much of the resultant indurated hornfels, escaping subsequent deformation, retains minutiae of sedimentary structure, such as grains, ripple-marks and sun-cracks. The Moine Schists seem to decrease in metamorphism, near the Moine Thrust, but evidence is blurred by crush-phenomena. In Skye there is a thrust-mass under the Moine Thrust, the rocks of which are variously interpreted as Moines or Torridonian. Some think all Moines are metamorphosed Torridonian; most regard the Moine Metamorphism as pre-Torridonian.

Moine-like rocks cross the Caledonian canal fault, but half of this south-eastern district consists of a varied assemblage of undated sedimentary schists known as Dalradian. Quartzites, limestones and graphitic schists are characteristic members; the Schichallion conglomerate may be glacial; pillow lavas occur at Loch Awe; basic intrusions are wide-spread; granites, that have shared to some extent in the movements, are common in the east. The Dalradians overlie Moine-like rocks, pitching off them towards Loch Awe and Banffshire. Large-scale recumbent folds with fold-faults (slides), the whole refolded, are typically shown at Ballachulish and elsewhere.

Zonal mapping of regional metamorphism was first carried out in the Dalradian belt. The grade, varying from sillimanite-gneiss to roofing slate, is low at Loch Awe, in Banffshire and along the south-eastern Highland border.

Probable Upper Cambrian pillow lavas, radiolarian cherts and fossiliferous shales outcrop discontinuously along the Highland border fault. In Arran they overlie Dalradians. Farther north-east they are associated with a grit and conglomerate group (Margie Beds) and appear overthrust by Dalradians. At Stonehaven they are unconformably overlain by uppermost Silurian (Downtonian) sandstones with mudstones, tuffs and conglomerates (2,760 ft.), that yield fish and *Dictyocaris*.

Silurian of Lesmahagow and Pentland Anticlines in the Central Valley.—Lesmahagow exposures of Silurian show: Wenlock greywacke and shale (base not seen), 1,300 ft.; Ludlow mudstone, greywacke and shale 1,480 ft.; Downtonian yellow, red and chocolate sandstone with two conglomerates and some

mudstone, 2,700 feet. The Wenlock-Ludlow rocks have yielded many brachiopods and molluscs, especially in the Pentlands, also scorpion, phyllocarids, eurypterids and fish. The three last appear again in the Downtonian, accompanying a transition from marine to Old Red Sandstone conditions.

Ordovician and Silurian of the Southern Uplands.—Closely packed isoclinal folding (seldom accompanied by cleavage) and rapid cross-strike change of facies are characteristic. Nothing older than Arenig has been recognised. The succession is marine and ends with Wenlock near Girvan and with Ludlow on the English Borders.

The Ordovician commences with Arenig pillow lavas capped by Arenig-Llandeilo radiolarian cherts (70 ft.). Near Girvan 1,500 ft. of Arenig volcanic rocks are cut by serpentine, gabbro and granite which erosion bared before deposition of conglomeratic Upper Llandeilo (830 ft., including 60 ft. interbedded fossiliferous Stinchar limestone). South-east of Stinchar Valley, Upper Llandeilo suddenly becomes conformable to the radiolarian cherts and consists of mudstones and grits (500 ft.) and conglomerate (500 ft.). Farther south-east it passes to grit and greywacke (1,000 ft.) and then near Moffat to 20 ft. of graptolite shale (Glenkiln). The Caradoc (including Ashgillian) at Girvan is mostly mudstones, grits, flags and shales (2,800 ft.) with interbedded shelly and graptolitic faunas. Near Moffat this reduces to 100 ft. of graptolite shale and barren mudstone (Hartfell). Acid lavas occur at Wrae.

A general palaeontological break introduces the Silurian, although there was no upheaval at Moffat. The Llandovery at Girvan consists of conglomerates, grits, flags, shales and thin limestones (1,050 ft.) with interbedded shelly and graptolitic faunas. Near Moffat there are only 100 ft. of graptolite shale (Birkhill). The Tarannon, both at Girvan and Moffat, consists of grits, flags and shales with occasional graptolitic intercalations. This series is thinner and finer-grained at Girvan (2,100 ft.) than at Moffat (3,000 to 4,000 ft.). Wenlock is doubtfully represented near Girvan by conglomerates, grits, flags and shales, (500 ft. preserved) with minor graptolitic and shelly layers. Near the English Borders Wenlock conglomerates, grits, greywackes, shales and mudstones (1,000 to 1,500 ft.) contain several graptolitic bands with occasional eurypterids. Shelly layers also occur. In the same district Ludlow mudstones with limestone-nodules and grits (500–750 ft.) yield shells.

The Llandeilo unconformity at Girvan is probably a partial continuation of the post-Cambrian pre-Downtonian unconformity at Stonehaven. Upper Llandeilo and subsequent Ordovician and Silurian rocks of the southern Uplands tell of derivation of sediment from the north-west. Much of their material can be referred to denudation of Cambro-Arenig lavas, cherts and plutonics. Quartzite appears as pebbles in the Caradoc, and mica-schist in the Llandovery.

Undated post-Silurian mineral veins occur at Lead Hills.

Devonian.—The Scottish Devonian is wholly continental Old Red Sandstone. Three divisions are recognised with distinct faunas and floras. Fish have furnished most of the determinable fossils. The Lower Old Red Sandstone or Caledonian is most fully preserved in the Central Valley (19,000 ft., including lavas, Kincardineshire). A widespread type is dull purplish brown sandstone. Upper members in Strathmore are red sandstones and marls. Conglomerates attain great prominence towards the Highlands and southern Uplands. North-westwards there is conformity with Downtonian (Lesmahagow and Stonehaven) and violent unconformity with schists (within Highlands). South-eastwards there is violent unconformity with Downtonian, etc. (Pentlands, Girvan, Cheviot). A basal conglomerate of Silurian greywacke extends north-westward to Lesmahagow. Volcanic rocks (basalts, andesites, rhyolites) occupy a roughly central position in the Lower Old Red sequence (6,500 ft. in Ochils, well exposed also Pentlands to Ayrshire). In the Highlands (Oban, Glen Coe, Ben Nevis) and also at Cheviot, lavas greatly exceed sediment. Glen Coe and Ben Nevis are famous for cauldron-subsidences. At both localities granites (or granodiorites) with north-eastern dyke-swarms are later than the lavas. Granites cutting Lower Old Red Sandstone also occur at Distinkhorn (Ayrshire) and Cheviot. Others cut folded Silurian (southern Uplands). Many undated Highland granites are probably of Lower Old Red age, but granite pebbles are well known in Lower Old Red Sandstone conglomerates (Glen Coe, Stonehaven).

Middle Old Red Sandstone or Orcadian is widely developed in north-east Scotland (18,000 ft. in Caithness). It largely consists of flags, often bituminous, calcareous, ripple-marked and sun-cracked. The earlier part of the Orcadian is restricted to Caithness, but later divisions extend into Orkney and round the Moray Firth. The Rhynie Chert with wonderfully preserved plants is generally referred to the Orcadian. The Upper Old Red Sandstone (some thousands of feet thick) is found in the Central Valley and north-east Scotland. The Lower Old Red Sandstone was locally much faulted, folded and eroded before the deposition of the Upper. The Upper is also unconformable to the Middle, except perhaps in Shetland. Red sandstones with some wind-rounded grains are common in the earlier parts of the Upper Old Red Sandstone; while paler sandstones with cornstones occur towards the conformable base of the Carboniferous.

Carboniferous.—The Scottish Carboniferous, a marine, estuarine and terrestrial accumulation, is typically developed in the Central Valley and along the English Borders. The two areas of deposition were always connected across the east end of the southern Uplands. Farther west (Sanquhar) Upper Carboniferous rests on Silurian. In the Highlands, Carboniferous is scarcely known (Campbeltown, Bridge of Awe, Morven). In the Central Valley and on the Borders, it follows Upper Old Red Sandstone conformably, though with a palaeontological break. Measurements of sub-divisions in Edinburgh district are: Calciferous Sandstone Series, including Cementstone Group (1,000 ft.) and Oil Shale Group (3,000 ft.); Scottish Carboniferous Limestone Series, including Lower Limestone Group (700 ft.), Limestone (or Edge) Coal Group (1,050 ft.), and Upper Limestone Group (1,050 ft.); Millstone Grit (800 ft.); Productive Coal Measures (1,500 ft.); Barren Red Coal Measures (in Ayrshire, 1,500 ft.). Palaeontologically, the sequence is important for its abundant Lower Carboniferous land plants and estuarine fishes. These are completely replaced by English Upper Carboniferous forms one-third way up the Millstone Grit.

Economically, the oil shale and the two widely separated coal-bearing groups (with ironstones) are very valuable. Marine limestones are scarcely represented except in the Lower and Upper Limestone Groups (near Edinburgh, 8 beds reach the quite exceptional total of 230 ft.). A well-known 40-ft. fresh-water limestone (Burdiehouse) occurs in the Oil Shale Group. Rapid variations of group-thicknesses are characteristic. Near Patna in Ayrshire, the Lower Limestone Group reduces from 70 ft. to 30 ft., the Limestone Coal Group from 260 ft. to 100 ft., the Upper Limestone Group from 700 ft. to 40 ft., and the Millstone Grit from 390 ft. to 120 ft. in a distance of 2 miles. The floor of deposition evidently subsided in independently moving blocks. Change of facies is exemplified by the restriction of workable oil shale to West Lothian and its borders. Vulcanicity is common till the close of the Millstone Grit. Special activity reigned about the end of the Cementstone Group (Clyde Plateau, Arthur's Seat, Calton Hill). Products include essexitic basalts, mugearites, trachytes and phonolites. Contemporaneous weathering of Millstone Grit basalts has given valuable bauxitic clay (Ayrshire).

New Red Sandstone.—The Scottish deposits are of continental facies. A train of outcrops reaches intermittently across the southern Uplands and Central Valley from the Solway to Arran. In Ayrshire, lavas and tuffs (basalt and nepheline-basalt, 500 ft.) underlie brick-red desert sandstone (1,500 ft.). The volcanic period was one of faulting and was further marked by ash-necks and doleritic intrusions, some (essexitic) carrying nepheline, others quartz. It may correspond roughly with the Permo-Carboniferous intrusion period of many quartz-dolerite sills and east to west dykes between Stirling and Northumberland. In Arran brick-red desert-sandstone (2,000 ft.) underlies breccia, sandstone, and interbedded sandstone and marl with occasional nodular limestone. The top division, probably Keuper, is over-

lain, in a fallen mass within a Tertiary volcanic neck, by *Pteria contorta* shales (Rhaetic).

The base of the Mesozoics from Mull northwards consists of Trias conglomerates and sandstones with concretionary cornstones. Red colouration is often subordinate. In Western Mull 200 ft. of these rocks underlie 40 ft. Rhaetic with *Pteria contorta*. Elsewhere Rhaetic is only doubtfully distinguishable.

In Elgin two outliers of New Red Sandstone have yielded remarkable reptilian faunas. One of these outliers is of marked desert character and perhaps of Permian age, the other outlier is certainly Trias.

Jurassic.—Low-lying outcrops of Jurassic, conformable to Trias, are preserved on the west and east coasts of the Highlands. On the west, where a cover of Tertiary lavas has furnished additional protection, the type area is Skye and Raasay: Lower Lias (Broadford Beds, mostly limestone, 240 ft.; Pabba Shales, 600 ft.); Middle Lias (Scalpa Sandstone, 240 ft.); Upper Lias (shales, 70 ft.; Raasay Ironstone, 8 ft.); Inferior Oolite (shales, 70 ft.; sandstone, 600 ft.); Great Estuarine Series (sandstone, bituminous shale and limestone, 400 ft.); Cornbrash (limestone with comminuted fossils, only in Raasay, 20 ft.); Callovian (sandstone remnant in Skye); Upper Oxfordian (grits, Skye, 80 ft.) followed by Upper Oxfordian and Corallian (shales, Skye, 220 ft.). The sequence also reaches Corallian in Eigg, but in Ardnamurchan and Mull ends with Inferior Oolite. The Hebridean marine faunas are as rich as any in Britain. The Great Estuarine Series, agreeing in age with the Yorkshire Upper Estuarine Series, contains *Cyrena, Viviparus, Ostrea,* etc.

At Brora on the east coast are remarked: Lower Lias (shales, 80 ft.); Great Estuarine Series (over 80 ft. shale, sandstone, etc., with 3 ft. Brora Coal at top); Callovian (limestone, 5 ft.); Lower Oxfordian (shales, 275 ft.); Upper Oxfordian and Corallian (sandstone, 200 ft.); Kimmeridgian (sandstone and bituminous shale, 100 ft.; boulder-beds and shales, 500 ft.). The boulders of the boulder-beds consist of Old Red Sandstone. Many are big; one measures 150×90×30 ft. They have fallen from a moving submarine fault-scarp and are mixed with corals and shells. The throw of the fault exceeds 2,000 ft. In Skye another 2,000 ft. post-Corallian fault can be shown to have been planed down by erosion before Upper Cretaceous times.

Cretaceous.—Scotland is embraced within the scope of the great Upper Cretaceous marine transgression. The Upper Cretaceous rests indifferently on Lower Lias and later Jurassic rocks. It is known *in situ* (Skye, Scalpa, Raasay, Eigg, Mull, Morven), as block remanié in a Tertiary vent (Arran), and as remanié flints (Aberdeenshire). The Morven succession is: Cenomanian Greensand (45 ft.); White Sandstone (35 ft.); Silicified Chalk with *Belemnitella mucronata* (5 ft.). This condensation of the succession is typical of the Hebrides. The White Sandstone consists of desert sand blown on to the Scottish shore of the Franco-Britto-Russian Chalk sea. In Morven, Cretaceous is still preserved 1,600 ft. above sea-level.

Tertiary.—The Cretaceous Chalk was upraised, weathered and silicified and its crannies filled with desert sand (Mull). Subsequent conglomerate and lateritically weathered ash bespeak a change to moist climate and volcanic eruptions. Subaerial basalt lavas characterise Skye, Eigg, Mull and Morven. Leaf-beds intercalated near their base suggest early Eocene (Ardtun). Exceptionally these lavas are columnar (Staffa). The basalt succession in Mull is: olivine-rich, 3,000 ft.; olivine-poor, 3,000 ft. The Sgur of Eigg pitchstone seems to be an acid lava that flowed down a valley, the sides of which, consisting of basalt, have since been eroded away. Great plutonic centres occur at St. Kilda, Skye, Rum, Mull, Ardnamurchan and Arran. Some think that most of the lavas, still preserved, were fed from these centres. A Kilauean sink, repeatedly renewed in central Mull, was often occupied by a crater-lake, and lavas flowing into it developed pillow-structure. Vent-agglomerates are abundant in Skye, Mull, Ardnamurchan and Arran. In the last named island, the latest surface-rock *in situ* is Keuper, but masses of Rhaetic, Lias and Chalk have tumbled into a Tertiary vent and thus escaped erosion.

The Skye plutonic centre is well known for its gabbro to granophyre succession; Rum for its peridotites; Mull and Ardnamurchan for their ring-dykes—in Mull the plutonic succession is very complex and begins with granophyre, in Ardnamurchan it is essentially gabbroidal; Arran is specially noteworthy for the doming of its granite's roof—peripheral folding is a related feature in Mull. Cone-sheet complexes are extensively developed in Skye, Mull and Ardnamurchan. The Skye, Rum, Mull and Arran centres have crowded dyke-swarms. The general dyke-direction is north-westerly, but this is combined with a radial tendency in Rum. Some believe that most of the Hebridean lavas were fed from dykes (fissure eruptions). It is certain, however, that the great centres were established before the dyke-swarms, since they locate the latter. It is also certain that most of the dykes are later than any lavas spared by erosion.

West Highland scenery has been shaped entirely since the early Tertiary eruptions. The magnificent mountain and valley forms of Skye are cut in Tertiary plutonics.

Possible Pliocene gravel occurs near Turriff, Fyvie and in Central Buchan, all in Aberdeenshire.

Pleistocene and Recent.—During the Glacial Period, Scotland functioned as a complex centre of dispersal within the great North European ice-sheet. Scandinavian currents were almost excluded except in Shetland, whilst Scottish currents freely invaded England. Some districts were crossed by ice that traversed the sea-bed bringing in shells and, in Caithness, Mesozoic erratics. Glacial erosion is often pronounced. Crag and tail is developed to perfection in Edinburgh and elsewhere. Rock basins are numerous in the Highlands, with Loch Coruisk as a diagrammatic example. Characteristic deposits are: West Highlands, hummocky moraines; East Highlands, fluvio-glacial gravel; Lowlands, boulder clay, either flat or in drumlins, and gravel kames. In Glen Roy glacially dammed lakes are recorded by conspicuous strand-lines, and throughout most of eastern Scotland glacially diverted rivers can be traced by channels now left dry.

Raised beaches up to about 100 ft. occur round Scotland, but not in the Outer Hebrides, Orkneys and Shetlands. The higher beaches are late Glacial and are locally interfered with by glacial readvance (Loch Lomond and Mull). The best marked beach, often about 30 ft., has a temperate fauna. It rests in places on a peat or forest bed that continues below sea-level. Traces of early man are found in this raised beach. (E. B. B.)

FLORA AND FAUNA

Vegetation.—Geographical usage places Scotland within the cool-temperate forest division of the Northern Hemisphere, but in doing so implies no more than that Scotland lies between those latitudes within which neither arctic nor sub-tropical vegetation is characteristic, and that the conditions are those of a land under maritime, not interior-continental, climatic influence. Actually forests—extensive tree-covered areas, as distinct from the treeless "deer forests" of Scottish phrase—are practically absent in Scotland; wooded tracts are of no great extent and are scattered, save in so far as they appear mainly upon the eastern and southern borders of the Highlands. They consist mostly of conifers and oaks. Native species are few. Apart from destruction by man (which has in some measure been offset by planting) it is clear that Scotland, separated from Europe relatively soon after the final glacial epoch, was poorly colonized by north-European species of trees. A damp climate, imperfect drainage and wet soil, and unfavourable exposure to prevalent winds over wide areas, are further reasons adduced for the poverty of the growth. The upper limit of trees lies about 2,000ft. above sea-level in the southern Uplands, and somewhat below that height (1,700–1,900ft.) in the central Highlands; farther north, it falls to 1,200–1,400ft. in central Sutherland, and lower still in the extreme north. Types of vegetation in the Highlands may in a measure be localized. Thus, peat moors of wide extent occur in definite areas—in Sutherland and Caithness most notably; also, in the south, on the moor of Rannoch and about Lochs Awe and Etive, between the heads of Lochs Fyne and Lomond, and to the east of Callander, and on the long eastern flanks of the region. Marshy grass lands have

a wider extent in the west than in the east, in sympathy with the higher rainfall of the west; they are interspersed with drier mountain and pasture lands, usually at higher levels, with better drainage on the steeper slopes; while a definitely drier type of moorland occurs at lower levels in the north-west and on the outer islands, where the surface is much broken. Heath moors, as distinct from grass moors, occur widely both in the Highlands and on the southern Upland, but they are by far the more characteristic on the east side of the Highlands generally than on the west, and especially on the Grampian heights. The wide expanse of grassy hill-pasture on the southern uplands has already been mentioned, and indications have been given of the distribution of agricultural lands in the respective regional divisions. But the main localization of agricultural lands may be indicated briefly as occurring in an eastern belt following the curves of the coast between the Firths of Dornoch and Forth, with some extension north of the first and south of the second; for the rest, such lands, except in the non-industrial parts of the central Lowlands and in the dales and on the western slopes of the southern Uplands, are strictly limited in area. At certain points on all the coasts, but most notably the east, extensive sand-dunes, with their characteristic vegetation, are found. Finally, reference is due to the alpine and arctic types of plants, such as saxifrages and mountain willow, which are common on Highland summits above some 2,000ft. of elevation, though Ben Lawers (3,982ft.), above Loch Tay, is usually cited as offering examples of particular interest.

Fauna.—Deer-forests cover over 2¼ million acres. The red deer in Scotland is confined to the Highlands, but the roe-deer, living in woods, is found also in the southern Uplands in some parts where tree plantation has been carried out. Other kinds of the larger mammals, once abundant, are now extinct; the last wolf is said to have been killed in 1680. The wild cat survives in the Highlands; as also the otter, polecat, ermine and pine marten. Rabbits and hares are abundant, including both the common and the mountain hare, of which the last assumes a white coat in winter. Grouse moors occupy an extensive area; ptarmigan and blackcock, among other game birds, are found in many districts, and the capercailzie has been reintroduced. The golden eagle and the white-tailed eagle haunt only the remoter mountainous districts; other large birds of prey, such as the osprey and kite, are also becoming scarce. The islands and sea-cliffs, and some of the inland lochs, are frequented by a great variety of water-fowl. The Scottish lochs are noted in particular for salmon and trout; of this family there are several varieties, one of which, the Loch Leven trout, is peculiar to the loch of that name. Some arctic crustacea occur among the loch fauna; and a marine crustacean (*mysis*) appears to have migrated from the coastal waters to certain freshwater lochs not far from sea-level.

POPULATION

At the end of the 15th century it is conservatively estimated that the population of Scotland did not exceed 500,000—Edinburgh having about 20,000 inhabitants, Perth about 9,000, and Aberdeen, Dundee and St. Andrews about 4,000 each. By the Union with England (1707) the population is supposed to have grown to 1,000,000. In 1755, according to the returns furnished by the clergy to the Rev. Dr. Alexander Webster (1707–1784), minister of the Tron kirk, Edinburgh—who had been commissioned by Lord President Dundas to prepare a census for Government—it was 1,265,380.

At the first Government census (1801) it had reached 1,608,420. The increase at succeeding decades has been continuous though fluctuating in amount. After 1841, however, the population in several Highland shires—in which the clearance of crofters to make way for deer was one of the most strongly-felt grievances among the Celtic part of the people—in the islands, and in some of the southern counties, diminished. In 1931 the population amounted to 4,842,554 (females 2,516,687) showing a decrease of 0·8% on the 1921 figures, the first decrease to be recorded.

In 1921 there were 162 persons to each square mile, and 3·9 acres (excluding inland waters, tidal rivers and foreshore) to each person. The distribution of population is illustrated in the above table, in which is given the names and areas of the counties.

Area and Population of Civil Counties in 1931

Civil counties	Area in acres	Population	Increase or decrease % since 1921	Pop. per square mile
1. Northern:				
1. Shetland .	352,319	21,410	−16·1	38
2. Orkney .	240,847	22,075	− 8·4	58
3. Caithness .	438,833	25,656	− 9·3	37
4. Sutherland .	1,297,914	16,100	− 9·6	8
2. North-western:				
5. Ross and Cromarty.	1,977,248	62,802	−11·3	20
6. Inverness .	2,695,094	82,082	− 0·5	19
3. North-eastern:				
7. Nairn . .	104,252	8,294	− 5·6	50
8. Moray . .	304,931	40,805	− 1·8	86
9. Banff . .	403,053	54,835	− 4·3	87
10. Aberdeen .	1,261,521	300,430	− 0·2	152
11. Kincardine .	244,482	39,864	− 4·6	104
4. East Midland:				
12. Forfar . .	559,037	270,190	− 0·3	309
13. Perth . .	1,595,805	120,772	− 3·8	40
14. Fife . .	323,012	276,261	− 5·7	551
15. Kinross. .	52,392	7,454	− 6·4	92
16. Clackmannan	34,927	31,947	− 1·8	591
5. West Midland:				
17. Stirling. .	288,842	166,447	+ 2·9	369
18. Dumbarton .	156,927	147,751	− 1·9	602
19. Argyll . .	1,990,472	63,014	−18·0	20
20. Bute . .	139,658	18,822	−44·2	86
6. South-western:				
21. Renfrew .	151,431	288,575	+ 0·7	1222
22. Ayr. . .	724,251	285,182	− 4·7	252
23. Lanark. .	564,567	1,585,968	+ 2·2	1801
7. South-eastern:				
24. W. Lothian .	76,861	81,426	− 3·0	678
25. Midlothian .	234,325	526,277	+ 3·9	1437
26. E. Lothian .	170,971	47,369	− 0·2	177
27. Berwick .	292,535	26,601	− 5·8	58
28. Peebles. .	222,240	15,050	− 1·8	43
29. Selkirk . .	170,793	22,608	−....	85
8. Southern				
30. Roxburgh .	426,028	45,787	+ 1·8	68
31. Dumfries .	686,302	81,060	− 0·5	75
32. Kirkcudbright	575,832	30,341	− 2·3	33
33. Wigtown .	311,984	29,299	− 4·8	60

In the northern, north-western, north-eastern and southern divisions the population declined during the decade, 18 counties being thus affected. It will thus be seen that the far north and far south alike decreased in population, the decline being largely due to physical conditions, though it need not be supposed that the limit of population was reached in either area. The most sparsely inhabited county was Sutherland, the most densely Lanark. The counties in which there was the largest increase in the decennial period—Ayr, Fife, East Lothian, Argyll and 11 others—belonged largely to the central plain, or Lowlands, in which, broadly stated, industries and manufactures, trade, commerce and agriculture, and educational facilities have attained their highest development. Actually by far the largest increase (35%) was in Bute, but this was only an apparent and not a real increase, because of the number of summer visitors at the time the census was taken.

In every county the population increased between 1801 and 1841. The urban population (*i.e.*, that of burghs and special lighting and scavenging districts with populations of 1,000 and over) was 77·3% in 1921, as compared with 75·4% in 1911. Urbanization is highest in the lowland industrial areas, Lanark, Midlothian and Renfrew having an urban population of over 90%. The highest proportion of rural population is found in Ross and Cromarty (83·7), Orkney (77·8), Berwick (76·4), and Shetland (74·8). The population of the 176 inhabited islands is 154,624.

The burghs in which the largest proportion of Scottish-born persons lived (over 93%) in 1921 were Kirkcaldy, Aberdeen, Dundee, Perth, and Kilmarnock. The largest proportion of English-born were found in Dunfermline and Edinburgh, and Irish-born, in Port Glasgow, Greenock and Coatbridge. There were 20,223 foreigners. In 1926 there were 102,449 births and 63,780 deaths. The birth-rate, which was 29·5 per thousand of the population in 1901, has fallen every year since, with the exception of 1920 and 1921, when it rose to 28 and 25 per thousand. In 1926 it was 20·9. The death-rate also fell from 1901, when it was 17·8 per thousand, until in 1918 it was 16 and in 1926 13·00, the latter being the lowest figure on record, with the exception of that for 1923 (12·9). The marriage rate has remained roughly stationary at 6 or 7 per thousand, except in 1919 and 1920, when it rose to 9. The mortality of infants under one year of age had fallen to 83 per thousand births by 1926. Illegitimate births were 6·8 per hundred. These figures may be compared with those of 1855, when the birth-rate was 31 per thousand of the population, the death-rate 20·8, the marriage-rate 6·6, illegitimacy 7·8, and infant mortality 125 (per thousand births).

Of the total population of Scotland, 91·4% were Scottish in 1921, a figure which had been almost stationary for a considerable period before that date. English people represented 3·8%, Irish 3·2, Welsh 0·1, British Colonials 0·4, British born abroad 0·1, and aliens 0·4. The Irish (159,000 in 1921) and English (who increased by 17·2% between 1911 and 1921) are found mostly in the cities of the south and in the central industrial area; there are very few in the northern counties. In 1921 nearly 170,000 men were employed respectively in agriculture and transport, over 150,000 in mining and quarrying, and 280,000 in metal working. Professional occupations engaged 42,000. Among the women nearly 170,000 were engaged in personal service, and 146,000 in the manufacture of textiles, textile goods and clothes.

In 1931, of the total population 7,069 persons spoke Gaelic only, and 130,080 persons spoke both Gaelic and English. The highest percentages of Gaelic-speaking inhabitants were found in Ross and Cromarty (55), Sutherland (42·2), Inverness (42·1), and Argyll (33·7). In 21 counties under 1% spoke Gaelic, and over 50% of all those speaking the language were found in Ross and Cromarty and Inverness. Of the 73,602 inhabitants of the insular portions of Inverness, Ross and Cromarty and Argyll, 8,797 in 1921 spoke Gaelic only, as compared with 15,746 in 1911; the majority are children under nine or people over 50, Gaelic being still largely the language of the homes.

In recent years, large numbers of Scottish people have emigrated, owing to difficult economic conditions in the rural and isolated areas (from which a large proportion of the emigrants are drawn) and to the prevalence of unemployment in the industrial centres. In 1924 and 1925 Scottish emigrants numbered between one-third and one-half of the number emigrating from England and Wales, although the total population of Scotland is only about one-eighth of that of England and Wales. The population of Canada was 13% Scottish in 1921. This coincides with a large immigration of Irish labourers, which has caused some alarm to certain Scotch writers, as threatening the national traditions of Scotland.

Religion.—The Church of Scotland (Presbyterian) is the most influential and powerful religious body in Scotland, and its membership has increased during the last 50 years at a greater rate than that of the population in general. Nearly half the total marriages of Scotland are performed by Church of Scotland ministers, and there were some 760,000 communicants in 1927. The next most important body is the United Free Church, formed in 1900 by the union of the Free Presbyterian Churches of Scotland. The Church of Scotland Act (1921) was passed in order to facilitate union among the various Presbyterian bodies in Scotland, and the Church of Scotland bill of 1925 vested all the property and endowments of the Church in its general trustees. The Episcopal Church in Scotland had some 145,000 members (60,000 communicants) in 1925, with seven bishops and 352 clergy. There are also smaller bodies of Baptists, Congregationalists, Wesleyan Methodists and Unitarians.

There has always remained a small but steady native Roman Catholic population in Scotland, mostly centred in Inverness and Dumfries, but in recent times the infiltration of Irish labourers has resulted in a large increase in the Roman Catholic population, which was estimated at as high a figure as 606,650 in 1927. There are two Roman Catholic archbishops, four bishops, and one bishop auxiliary, and 13·6% of Scottish marriages are celebrated in Roman Catholic churches. There were over 500 Roman Catholic priests and monks in Scotland in 1921.

(O. J. R. H.)

GOVERNMENT

Parliamentary Representation.—By the Act of Union in 1707 the Scottish parliament was assimilated to that of England. Scottish representation in the parliament of Great Britain was fixed at 16 peers (to the 108 who formed the English House of Lords), to be elected for the duration of each parliament by the peers of Scotland, and 45 members (to the 513 English) in the House of Commons, of whom the Scottish counties returned 30 and the burghs 15. The power of the sovereign to create new Scottish peerages lapsed at the Union. The representation in the Lords has remained unchanged, but the Representation of the People (Scotland) Act of 1832 raised the number of members in the Commons to 53, the counties under a slightly altered arrangement returning 30 as before, and the burghs reinforced by the creation of certain new "parliamentary burghs," 23. The Act of 1867 added 7 members, the universities obtaining representation by two members, while two additional members were assigned to the counties and three to the burghs, and in 1885 the Redistribution of Seats Act gave an additional 7 members to the counties and 5 to the burghs. Under the Act of 1918 the total representation was raised to 74—38 members for the counties, 33 for the burghs and 3 for the universities of St. Andrews, Glasgow, Aberdeen and Edinburgh. Among the counties, Angus,[1] Argyll, Banff, Dunbarton, Dumfries and West Lothian return one member each; Fife and Renfrew, two members each; Lanarkshire 7 members (in the divisions of Bothwell, Coatbridge, Hamilton, Lanark, Motherwell, Northern and Rutherglen). The combined counties of Berwick and East Lothian, Caithness and Sutherland, Moray and Nairn, Orkney and Zetland, Roxburgh and Selkirk, and Galloway (the shire of Wigton and stewartry of Kircudbright combine to form the parliamentary county and sheriffdom of Galloway) return one member for each two counties; Midlothian and Peebles, Perth and Kinross, Stirling and Clackmannan, two for each two counties; Aberdeen and Kincardine, Ayr and Bute (including the division of Kilmarnock), Inverness with Ross and Cromarty (including the Western Isles division), three members for each two counties. While a majority of the burghs are included for parliamentary purposes in the counties in which they are situated,[2] the following form independent constituencies, namely, Greenock, Leith, Paisley, one member each; Aberdeen and Dundee, two members each; Edinburgh, 5; Glasgow, 15 (in the divisions of Bridgeton, Camlachie, Cathcart, Central, Gorbals, Govan, Hillhead, Kelvingrove, Maryhill, Partick, Pollok, St. Rollox, Shettleston, Springburn and Tradeston). Six groups or "districts of burghs," named after the leading burgh in each group, also return one member each, namely, Ayr, Dumbarton, Dunfermline, Kirkcaldy, Montrose, and Stirling and Falkirk districts of burghs.

The Central Authority.—The minister for Scottish affairs is the secretary of State for Scotland. This office came into existence at the Union but was abolished in 1746. From 1782 to 1885 Scottish business was entrusted to the Home Department (afterwards the Home Office) advised by the lord advocate, the

[1] By a resolution of the county council in May 1928 the county reverted to its older historic name of Angus in place of Forfarshire. Other instances of shire names derived from the county town giving place to the older name are the three Lothians, East, West and Midlothian, for Haddingtonshire, Linlithgowshire and Edinburghshire, and Moray for Elginshire. Dunbarton and Zetland are the Scottish forms for Dumbartonshire and Shetland.

[2] Twenty-three counties include all burghs within their area for parliamentary purposes.

chief Scottish law officer. The office of secretary for Scotland was restored in 1885, and in 1894 the Local Government Board for Scotland was established; in 1926 the secretaryship for Scotland was raised to a principal secretaryship of State with a seat in the cabinet. The department for Scottish affairs is the Scottish Office. The secretary for Scotland is the responsible head of the other departments by which Scottish business is administered, and he is assisted by the lord advocate and the solicitor general for Scotland, both of whom are members of the Government though not in the cabinet, and by the parliamentary and permanent under-secretaries. Official publication of Scottish business is made in the *Edinburgh Gazette*. The other Scottish departments, each with its permanent secretary and offices in Edinburgh, are the Scottish Board of Health, which succeeded in 1919 to the former Local Government Board for Scotland; the General Board of Control (Scotland), which was constituted as a Board of Lunacy in 1857; the Scottish Education Department; the Board of Agriculture for Scotland; and the Fishery Board for Scotland. There is also a Scottish Valuation Office in Edinburgh under the administration of the Board of Inland Revenue for the United Kingdom. The Scottish Board of Health is the department concerned with local government. There are, however, no Scottish departments to answer for the functions and policy exercised by the Home Office, the Board of Trade and the Ministries of Transport, Labour and Pensions (*see* GOVERNMENT DEPARTMENTS) in respect to mines, emigration, electricity supply, roads and canals, unemployment, etc. The Scottish Office and the Scottish Education Department have offices in London, and the last named being a committee of the privy council, the lord president of the council signs the annual report as *ex officio* head of the department. The Scottish departments are also assisted by advisory committees or councils, such as the Highlands and Islands Consultative Council for the 7 northern counties constituted under the Scottish Board of Health Act of 1919. By the Reorganization of Offices (Scotland) Act 1928, the Scottish Boards of Health and Agriculture and the prison commissioners for Scotland become departments as from Jan. 1929; the main effect of this is that they are under a single advisor instead of a group or board. Other Scottish officers are the keeper of the registers and records and the registrar-general.

LOCAL GOVERNMENT

Local government administration in Scotland follows the same general principles as in England. (*See* LOCAL GOVERNMENT.) But there are no urban or rural district councils in Scotland, poor relief is administered throughout by the parish councils, and education is entrusted to an *ad hoc* education authority for the county in place of the town, county and urban district councils in England. Public general Acts are sometimes modified, or their terms may be expressly excepted, with reference to their application in Scotland; local authorities are held to have more independent powers for raising loans and a simpler legal procedure for private bill legislation. On the whole, it is said, "independent powers have been more freely entrusted to small municipalities in Scotland than in England." Other differences are the levying of rates on both owner and occupier in Scotland; the election by town councils of their own magistrates or bailies for the burgh, as well as the closer relations to local bodies and wider administrative and judicial functions of the sheriffs.

Local Government Units.—The principal divisions of local government administration are the county, burgh and parish councils, with the education authorities already named. In addition, the following statutory bodies, mainly appointed by the county councils, may be named: the county district committees are the executive body of the council in each of the electoral divisions in which they are elected; the standing joint committee of the county is responsible for police administration and has control over all loans and capital expenditure; the county road board is the authority for road and bridge construction (maintenance and administration lie with the district committees); and district boards of control for counties and combined counties (with representatives of parish councils and royal and parliamentary burghs) deal with lunacy under the General Board for the country. The total number of these authorities is thus: the 33 county councils with their respective standing joint committees, county road boards and education authorities (Edinburgh, Glasgow, Dundee and Aberdeen are separate education authorities), and 27 district boards of control and 98 district committees; 201 burgh or town councils and 869 parish councils. There are 61 police districts, consisting of the 33 county and 28 burghal police districts. In addition, there are a number of statutory committees for particular purposes, such as finance, pensions, distress (unemployment), school management, health insurance, etc., committees, as well as joint committees of local bodies for purposes in which they are jointly interested, and special district committees for water supply, light, scavenging and drainage. About three-fourths of the population is "burghal," the remainder "landward": terms used in Scotland to denote urban and rural. Twenty-two burghs have a population of over 20,000; 8 counties have less than 10,000 population and 5 have a smaller population than in 1801. Of the parishes, 653 are landward; 210 are partly landward, partly burghal.

County, burgh and parish councils are directly elected bodies, and until recently were the three principal authorities for rating and borrowing. By the Rating (Scotland) Act 1926 parish councils ceased to be a rating authority. The chairmen of town and county councils are *ex officio* justices of the peace; the chairman of a town council is called the provost, or in some cases the lord provost; other chairmen in Scotland are called conveners.

Police and Other Powers.—Under the Local Government (Scotland) Act which set up the new county councils in 1889, royal and parliamentary burghs were excluded from the administrative county area. But a limiting condition as to population frequently applies in respect of certain duties and powers. Since 1892 a population of 20,000 is required for any new burgh wishing to maintain a separate police force, and for all burghs appointing a quota to the county insurance committee under the National Health Insurance Act. Any burgh may, however, consolidate its police establishment with that of the county and with royal and parliamentary burghs that do not maintain their own police are represented on the county council by a member or members of the town council, but voting only in respect of such delegated or excepted powers. Police burghs, though self-governing units for public health purposes, and in some cases including highways and police administration, are included in the county area for general county purposes.

Valuation and Assessment.—The word assessment is used in Scotland for rate in England, and the word valuation for what in England would be called assessment. Valuation rolls in Scotland are made up annually. By the Rating (Scotland) Act 1926, which came into force on May 16, 1927, parish councils ceased to be rating authorities, and there is thus only one rating authority for all rates leviable in any rating area, namely, either the town or county council. The amounts to be provided for each of the purposes administered by parish councils are certified by them to the rating authority, who fixes the rate or "assessment" per £.

County and parish rates are levied equally on owners and occupiers; in burghs about two-thirds of the aggregate sum raised by rates fall on occupiers and one-third on owners. Education authorities, district committees and district boards of control requisition for the sums they require by precept on the rating authority. Inequalities in the basis of rating, especially in respect of land held out of use and, on the vast scale which is peculiar to Scotland, for sporting purposes (*see* Report of the Scottish Land Enquiry Committee), have led to the promotion of a number of bills aiming at the reform of local taxation. Thus in 1904 the Land Values Taxation (Scotland) Bill, known as the "Glasgow Bill," gave effect to the principle of rating based on the site or capital selling value of the land, apart from improvements, and led in 1907–08 to a Government Land Values (Scotland) Bill, which however dealt with valuation and not with rating, and like other subsequent private members' bills failed to become law. (*See* TAXATION, LOCAL.)

The Common Good.—A feature of burgh accounts which is

peculiar to Scotland is the property known as the Common Good which is held by certain burghs for the benefit of the community. Originating in grants of land or the accumulated surpluses of feu duties, markets or other assets, the proceeds of the Common Good may be expended for any object directly beneficial to the community without the statutory restrictions that apply to the ordinary grant and rate income. Thus, the small town of Tain (pop. 1,551) with a rateable value of £10,479 in 1927 had a Common Good producing over £800 a year and Kirkcudbright one of £1,500 a year, whilst in Glasgow the city tramways have been largely constructed with the monies and loans raised on the security of the Common Good, to which in return contributions from the tramways aggregating over a million pounds sterling had been made in 1926.

Local Government (Scotland) Act (1929).—The Scottish bill goes much farther than the English Act, to which it is generally similar, in the proposal to abolish a large number of existing local authorities, with other changes in the character and constitution of the new bodies.

Administrative Changes (Part I).—The Act makes a new classification of all burghs into "large burghs," containing a population of 20,000 or over, and "small burghs," meaning all other burghs. The administrative county will include all small burghs, and the reconstituted county councils and town councils of large burghs will become the local authorities for poor law, major public health services, town planning, maintenance of classified roads, police, valuation, and lunacy and mental deficiency. All large burghs which do not maintain a separate police at present will be included for police purposes in the county. Police burghs will cease to be electoral divisions of the county and (as in the case of royal and parliamentary burghs at present) will nominate representatives to the county councils with voting power in respect of those services in which they are interested. County councils may delegate some of their functions with regard to classified roads to the small burghs, who will continue to administer their own water supply, drainage and housing services. The following existing authorities are to be abolished: Parish councils, district committees, district boards of control, education authorities, distress committees, standing joint committees, commissioners of supply and (where the county council may require) landward committees. Statutory committees will be appointed for police, poor relief and education. The education area will be the county as before, but the duties of the former *ad hoc* authorities will be transferred to the education committees. Six groups of burghs are named that are to be compulsorily united, and the counties of Kinross and Perth, Moray and Nairn, and Bute with Renfrew and Ayr, are to be combined for administrative purposes. The new county and town councils (1929) will prepare and submit schemes to the Scottish secretary for his approval of the administrative arrangements proposed to be made throughout their areas for all the changes to be effected. County councils may be required to divide the county (except for education) into areas to be administered by local committees or sub-committees. Town and county councils are to be put on the same basis of audit. Rates are to be consolidated over the whole area of the rating authority, except in the case of differential rating for special parish and special district rates. Payment of travelling expenses and allowances to members of the county councils and committees and sub-committees attending meetings is introduced.

An important new provision (s. 12) authorizes the co-option of non-elected persons to any committee or sub-committee of a town or county council (other than an education or school management committee under s. 3 of the 1918 Act) to an extent not exceeding one-half of the members, and the first poor relief and education committees to be appointed must include one or more members of the outgoing bodies. Education committees must provide for a majority of the members of the council, the inclusion of women, and the appointment of persons of experience in education and in the needs of the area, including in all cases at least one person "conversant with the custom which has prevailed in the public schools of Scotland of giving instruction in religion to children whose parents do not object to the instruction so given," and including also in the case of any "transferred" or denominational school at least one representative of the church or denominational body. The derating and exchequer grant clauses in the Scottish Act are similar to those in the English Act. (*See* LOCAL GOVERNMENT IN ENGLAND AND WALES and IRELAND, NORTHERN.)

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SOCIAL AND ECONOMIC CONDITIONS

Poor Relief.—Before the Reformation, relief of the poor had been the duty of the Church, for early legislation aimed at suppressing rather than aiding poverty. Those who were absolutely dependent on alms might receive a licence to beg within the bounds of their own parish, but the able-bodied poor were severely dealt with. The act of 1579 directed the magistrates in towns and the justices in rural parishes to prepare a register of the aged and impotent poor and to levy a tax on the inhabitants of every parish for their support. One consequence of the denial of relief to the able-bodied was that the workhouse of the English poor-law system was not established in Scotland, though almshouses are found in many towns, and poorhouses, where those indigent who are alone in the world without any one to care for them find food and shelter, began to be general in the 19th century. Hence arises the prevalence of out-relief, one of the distinctive features of the Scottish poor law. The act of 1579, however, proved largely inoperative, and even in 1842 about half of the parishes were yet unassessed to the poor. The inadequacy of the voluntary system to cope with genuine distress, in respect both of contributions and of the dispensing of alms, led in 1845 to the passing of an Act which made the parish the poor-relief area, substituted the parochial board for the kirk-session where recourse was had to a rate, made the appointment of inspectors of the poor and medical officers compulsory, and set up a system of central administrative control known as the Board of Supervision for the Relief of the Poor. In 1894 a change in the governing body was effected, the Local Government Board for Scotland replacing the Board of Supervision, while the parochial boards made way for parish councils. As the authorities could not give relief to those able to work, there were no casual wards in Scotland, vagrants having to pay for their night's lodging, or find it in the police station or elsewhere, but this was altered in 1922. A Scottish Board of Health (now the Department of Health for Scotland) was created in 1919, and took over the powers and duties of the Local Government Board, the Scottish Insurance Commissioners, etc. It was entrusted with all measures concerning the health of the people, including the supervision of local housing schemes under the Housing (Scotland) Act of 1919. The district lunacy boards (practically joint-committees of the county and burgh councils) were reconstituted in 1913 as a General Board of Control, charged with the upkeep of mental hospitals, the poor-law authorities defraying only the maintenance of their own patients.

For the extensive changes in the administration of public assistance effected by the Local Government Act, 1929, *see* POOR LAW. Responsibility for the general administration of relief, and for the provision, maintenance and management of all public institutions for the cure of disease was placed on the county and county borough authorities.

Police.—It was not till the middle of the 19th century that a regular police force was established in Scotland. Till then dwellers in rural districts had practically to provide for their own safety as best they could, while some towns maintained a

paid watch and others enrolled volunteer constables, every citizen being expected to take his turn in patrolling the streets to protect person and property. At first an adoptive Act was introduced, under which the commissioners of supply, who then managed county business—resident landowners in possession of landed estate to the annual value of £100—were empowered to raise a police force in the counties; but the want of common policy and initiative led in 1857 to the compulsory institution of a police force throughout the country. Burghs having a population of more than 7,000 might furnish their own police, and smaller burghs were policed as part of the county to which they belonged.

The police forces, of which there were 31 county and 27 city and burgh in 1927 (excluding Orkney and Shetland which do not come under the Act of 1857) are paid for partly from the county rates and partly by Government subsidies.

Education. (*a*) *Elementary Schools.*—The system of schools which prevailed till the Education Act of 1872 dated from 1696, when the Act of Settling of Schools was passed—one of the last but not the least of the achievements of the Scots Parliament—providing for the maintenance of a school in every parish by the kirk-session and heritors, with power to the commissioners of supply to appoint a schoolmaster in case the primary authorities made default. The schoolmaster held his office for life, co-education was the rule, and the school was undenominational. The various religious secessions in Scotland led to the founding of a large number of sectarian and subscription schools, and at the Disruption in 1843 the Free Church made provision for the secular as well as the religious instruction of the children of its members. The Education Act of 1872 abolished the old management of the parish schools and provided for the creation of districts (burgh, parish or group of parishes) under the control of school boards, elected every three years by the ratepayers. School fees for the compulsory standards were abolished in 1889. The Education (Scotland) Act, which accompanied the English Act of 1918, brought great educational changes. The school boards were swept away in favour of larger administrative areas. The counties, with the exception of Edinburgh, Leith (now incorporated with Edinburgh), Glasgow, Aberdeen and Dundee, were made separate educational areas. The educational authorities, who are elected by the local government electors, expend the Education Fund, which is raised from Government grants or loaned and from local rates. Expenditure or education has grown enormously, owing to the operation of the Act and to a large increase in teachers' salaries.

(*b*) *Secondary Schools.*—Records of the existence of schools in the chief towns occur as early as the 13th century. They were under the supervision of the chancellor of each diocese, and were mainly devoted to studies preparatory for the Church. Before the Reformation schools for general education were attached to many religious houses, and in 1496 the first Scottish Act was passed requiring substantial householders to send their eldest sons to school from the time they were eight or nine years old until they were "competentlie founded and have perfite Latin." In 1560 John Knox propounded in his *First Book of Discipline* a comprehensive scheme of education from elementary to university, but neither this proposal nor a School Act passed by the privy council in 1616 for the establishment of a school in every parish was carried into effect. In several burghs grammar schools have existed from a very early date, and some of them, as the Royal High School of Edinburgh and the High School of Glasgow reached a high standard of proficiency. They were largely supported by the town councils, who erected the buildings, kept them in repair, and usually paid the rector's salary. By the Act of 1872 their management was transferred to the school boards. There were in 1928, 252 secondary schools, including higher-class public schools, such as the old grammar schools and the liberally endowed schools of the Merchant Company in Edinburgh. In 1885 the Scottish Education Department was reorganized. It was separated from the English Department, and undertook the inspection of higher class schools (public, endowed and voluntary), and two years later instituted a leaving certificate examination, the pass of which is accepted for most of the university and professional authorities in lieu of their preliminary examinations. In 1923 new regulations were made for secondary schools. A Technical Schools Act, passed in 1887, was applied by a few local authorities; but in 1890 funds were by chance made available from an unexpected source, and devoted to the purposes of technical and secondary education. Parliament had introduced a measure of public-house reform along with a scheme for compensating such houses as lost their licences. This feature was so stoutly opposed that the bill did not pass, although the chancellor of the exchequer had provided the necessary funds. Government proposed to distribute this money among local authorities and expend the balance in relief of rates, but a clause was inserted in this bill giving burgh and county councils the option of spending the balance on technical education as well as in relief of rates. Advantage was largely taken of this power, and the grant came to be succinctly described as the "residue" grant. There were in 1928 11 Central Institutions under the Scottish Education Department and 5 under the Department of Agriculture for Scotland, including the Glasgow Veterinary College, which is not in receipt of a government grant. Among the more important are the Heriot-Watt College, Edinburgh; the Royal Technical College, Glasgow; the West of Scotland Agricultural College; the Edinburgh and East of Scotland Agricultural College; Robert Gordon's Technical College, Aberdeen; and the Dundee Technical College. A new system of continuation classes was brought in under the 1918 Act, and nearly a thousand classes were in existence in 1928.

The leading public schools on the English model are Trinity College, Glenalmond, Perthshire; Loretto School, Musselburgh, and Fettes College, Merchiston College and the Academy in Edinburgh.

(*c*) *Universities and Colleges.*—There are four universities in Scotland, namely (in the order of foundation), St. Andrews (1411), Glasgow (1450), Aberdeen (1494) and Edinburgh (1583), in which are the customary faculties of arts, divinity, law, medicine and science. In 1901 Andrew Carnegie gave £2,000,000 to the universities. The administration of the fund was handed over to a body of trustees, who devote the annual income partly to the payment of students' fees and partly to buildings, apparatus, professorships and research. State financial assistance to the universities has been very largely increased since the Education Act of 1918, and a number of new chairs have been founded by private benefactions, and from further grants by the Carnegie trustees.

The court of each university is the supreme authority in regard to finance, discipline, and the regulation of the duties of professors and lecturers. The universities are empowered to affiliate other academical institutions, and women students are admitted on an equal footing with men. Under the Act of 1899 the University College of Dundee was incorporated with St. Andrews University, and Queen Margaret College became a part of the University of Glasgow; the buildings and endowments, used for women students exclusively, being handed over to the University Court. St. Mungo's College, Glasgow, incorporated in 1889 under a Board of Trade licence, has a medical faculty, and Anderson's College Medical School, Glasgow, was instituted in 1887. These are on the same basis as the extra-mural medical schools in Edinburgh, their medical curricula qualifying for licence only and not for Scottish university degrees. The United Free Church maintains colleges at Aberdeen, Edinburgh and Glasgow, and there are Roman Catholic colleges at Blairs near Aberdeen and at Glasgow, besides a monastery and college at Fort Augustus, and Episcopal, Baptist and Congregational colleges. The Episcopal Church and the Roman Catholic Church have training colleges for teachers.

Agriculture.—Though Scotland still contains many great estates, this circumstance possesses less significance from the agricultural than from the historical standpoint. The excessive size of the properties may to some extent be accounted for by the fact that most of the surface is so mountainous and unproductive as to be unsuitable for division into smaller estates, but two other causes have also operated, namely, first, the wide territorial authority of

such Lowland families as the Scotts and Douglases, and such Highland clans as the Campbells of Argyll and Breadalbane, and the Murrays of Athol and the duke of Sutherland; and secondly, the stricter law of entail introduced in 1685. Thus many of the largest estates remain in the hands of the old hereditary families, but since the World War a large number have been sold. The proportion of persons farming their own land has become much greater and is still increasing. The almost absolute power formerly wielded by the landlords, who within their own territories were lords of regality, hindered independent agricultural enterprise, and it was not till after the abolition of hereditable jurisdictions in 1748 that agriculture made real progress. The Society of Improvers in the Knowledge of Agriculture, founded in 1723, ceased to exist after the rebellion of 1745, and the introduction of new and improved methods, where not the result of private energy and sagacity, was chiefly due to the Highland and Agricultural Society, established in 1784. Further stimulus was also supplied by the high prices that obtained during the Napoleonic wars. The system of 19 years' leases had proved distinctly superior to the system of yearly tenancy so general in England, although prejudicially affected by customs and conditions which, for a considerable time, seriously strained the relations between landlord and tenant. But the abolition of the law of hypothec in 1879—under which the landlord had a lien for rent upon the produce of the land, the cattle and sheep fed on it, and the live stock and implements used in husbandry—the Ground Game Act of 1880, the several Agricultural Holdings Acts, and the construction of light railways improved matters and established a better understanding. The period of general depression which set in before 1885 was surmounted in Scotland with comparatively little trouble. A large amount of capital was lost by tenants, and a few farms were thrown here and there upon the landlords' hands, but in no district was rent extinguished or were holdings abandoned. The sub-commissioners who reported to the Royal Commission on Agriculture in 1895 found nearly everywhere a demand, sometimes competition for farms, persisting throughout the crisis. Afterwards, owing to the increased attention given to stock-fattening and dairying, and to a rise in prices, farming reached a condition of equilibrium, and the most noticeable residuum of the period of depression was the large intrusion of the butcher and grazier class into the farmer class proper.

During and after the World War agriculture experienced a period of marked prosperity, giving place to a period of depression in more recent years. The decline in the value of land has been very great.

The crofters of the Highlands and islands had special grievances of their own. During the first half of the 19th century wholesale clearances had been effected in many districts, and the crofters were compelled either to emigrate or to crowd into areas already congested, where, eking out a precarious living by following the fisheries, they led a hard and miserable existence. At last after agitation and discontent had become rife, government appointed a royal commission to inquire into the whole question in 1883. It reported next year, and in 1886 the Crofters' Holding Act was passed. Amending statutes of succeeding years added to the commissioners' powers of fixing fair rents and cancelling arrears, the power of enlarging crofts and common grazings. Since then political agitation has practically died out. In 1911 the Scottish Land Court and Board of Agriculture (now the Department of Agriculture for Scotland) were constituted, and the provisions of the earlier Crofters Acts were extended to other Small Landholders (Scotland) Act. The Department of Agriculture has expended considerable sums in recent years on development, including education and research work. Under the Congested Districts (Scotland) Act of 1897, £35,000 a year was devoted within certain districts of Argyll, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney and Shetland, to assisting migration, improving the breeds of live stock, building piers and boat-slips, making roads and bridges, developing home industries, etc.

In 1927 there were 16,787 holdings under 5 acres in extent, and 50,340 under 50 acres. Holdings under 50 acres constituted two-thirds of the total, though the larger portion of cultivated land was held in farms between 50 and 300 acres. There were 603 holdings of mountain and heath land only. The average holding in 1927 was 61·7 acres. The total number of holdings has fallen during the last 40 years, there being fewer small and very large holdings, while the number of medium-sized farms remains fairly constant.

The following table shows the cultivated area and the area under grain, green and miscellaneous crops.

Acreage Under Cultivation

Total area, excluding water, 19,069,683 acres

Crops	Average 1917–26	1927
	Acres	Acres
Total area under crops and grasses	4,732,114	4,681,221
Permanent pasture . .	..	..
For hay	.	167,212
Not for hay	.	1,345,385
Total	1,403,608	1,512,597
Arable land	3,328,506	3,168,624
Grain crops—		
Wheat . . .	61,494	66,577
Barley	160,329	117,369
Oats	1,021,800	897,370
Rye	5,945	3,868
Beans	4,842	3,574
Peas	427	422
Mixed grain	1,678	1,240
Total	1,256,346	1,090,420
Potatoes	150,479	147,184
Turnips and swedes . . .	407,965	376,693
Mangolds	1,819	1,124
Cabbage	3,839	4,197
Rape	11,199	12,916
Sugar beet	..	10,352
Other crops	11,683	11,809
Total	586,984	564,275

During the last half-century the total acreage under crops and grass has remained comparatively stationary, but the acreage under crops has diminished, while land under permanent pasture has increased. Only a little more than one-fourth of the total area of Scotland is cultivated; but it should be borne in mind that permanent pasture does not include the mountainous districts, which not only form a large proportion of the surface, but also, in their heaths and natural grasses, supply a scanty herbage for sheep and cattle, 9,896,854 ac. being used for grazing in 1927. Since 1914 mountain and heath land thus used has increased by 750,000 ac., but the size of this figure is partly due to the inclusion of land previously used as deer forest. Oats remain the staple grain crop, but the acreage of arable land, as also that of land under oats, turnips and barley was in each case the smallest on record in 1927, and considerably below the average of the previous ten years. The areas under wheat and potatoes have, however, increased in recent years, and the acreage of sugar beet, stimulated by a government subsidy, grew from 4 in 1923 to 10,352 in 1927. In the same year there were 1,496,363 ac. under rye grass and other rotation grasses and clover. The yield per acre of grain crops in Scotland is extremely high, as an offset to the limited area cultivated. The average yield of wheat, barley and oats in the ten years from 1917 to 1927 was 39·1, 36·3 and 40·2 bushels respectively.

The following table shows the number of live stock in 1927, with the average for the period 1917–1926. The breeds include the Ayrshire, noted milkers and specially adapted for dairy farms (which prevail in the south-west); Galloway Shorthorns; the polled Angus or Aberdeen, fair milkers, but valuable for their beef-making qualities, and the West Highland or Kyloe breed, a picturesque breed with long horns, shaggy coats and decided colours, that thrives well on wild and healthy pasture. The special breeds of sheep are the fine-woolled of Shetland, the blackfaced of the Highlands, the Cheviots, natives of the hills from which

they are named, a favourite breed in the south, though Border Leicesters and other English breeds, as well as a variety of crosses, are kept for winter feeding on lowland farms. The principal breeds of horses are the Shetland and Highland ponies, and the Clydesdale draught.

Stock	Average 1917–26	1927
Horses—		
Used for agricultural purposes, including mares kept for breeding	137,505	129,526
Unbroken (over 1 year)	32,127	16,778
Unbroken (under 1 year)	10,439	5,671
Total	180,071	151,975
Cattle—		
Cows and heifers in milk or in calf	449,103	460,317
Other cattle, 2 years and above	237,141	225,994
Other cattle, under 2 years	247,322	231,100
Total	933,566	917,411
Sheep—		
Ewes kept for breeding	2,937,817	3,239,143
Other sheep, 1 year and above	1,099,789	1,085,706
Other sheep, under 1 year	2,748,278	3,210,628
Total	6,785,884	7,535,477
Pigs	150,830	196,613

Orchards and Forests.—The acreage devoted to orchards, which was 1,560 in 1880 and 2,482 in 1905, fell to 1,282 in 1927, with 8,064 acres under small fruit. The chief areas for tree and small fruit are Clydesdale and the Carse of Gowrie. Market-gardening has developed in the neighbourhood of the larger towns.

Fisheries.—The Scottish seaboard is divided for administrative purposes into twenty-seven fishery districts, namely, on the east coast, Eyemouth, Leith, Anstruther, Montrose, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, Wick (15); on the north, Orkney, Shetland (2); on the west, Stornoway, Barra, Loch Broom, Loch Carron and Skye, Fort William, Campeltown, Inverary, Rothesay, Greenock, Ballantrae (10). The whole of the fisheries are controlled by the Fishery Board for Scotland. In 1928 the number of fishermen directly employed in fishing was 25,943, there were 41,633 engaged in curing and preserving the fish landed and in subsidiary industries on shore, making a total of 66,676 persons engaged in the fisheries and dependent industries. This may be compared with a total of 86,271 in 1913. In 1928 the herring fishery yielded 4,235,567 cwts. The most prolific districts are Shetland in the north, Fraserburgh, Peterhead, Wick in the east, and Stornoway in the west. The principal herring market is continental Europe, Germany being the largest consumer. In 1928 the catch of fish of all kinds (excepting shellfish) amounted to 7,333,218 cwts. The annual value of the shellfish (lobsters, crabs, oysters, mussels, clams, etc.) was £97,974. The weight of salmon carried by Scottish railways and steamers in 1927 was 2,910 ton. In the last few years there has been a steady rise in the salmon catch, and the figure for 1927 was the highest since 1896. There were 7 whalers operating in 1927; 459 whales were caught in 1926, 314 in 1927, and 184 in 1928.

Roads.—In the 12th century an Act was passed providing that the highways between market-towns should be at least 20 ft. broad. Over the principal rivers at this early period there were bridges near the most populous places, as over the Dee near Aberdeen, the Esk at Brechin, the Tay at Perth and the Forth near Stirling. Until the 16th century, however, traffic between distant places was carried on chiefly by pack-horses. The first stage-coach in Scotland was that which ran between Edinburgh and Leith in 1610. In 1658 there was a fortnightly stage-coach between Edinburgh and London, but afterwards it would appear to have been discontinued for many years. Separate Acts enjoining the justices of the peace, and afterwards along with them the commissioners of supply, to take measures for the maintenance of roads were passed in 1617, 1669, 1676 and 1686. These provisions had reference chiefly to what afterwards came to be known as "statute labour roads," intended primarily to supply a means of communication within the several parishes. They were kept in repair by the tenants and cotters, and, when their labour was not sufficient, by the landlords, who were required to "stent" (assess) themselves, customs also being sometimes levied at bridges, ferries and causeways. By separate local Acts the "statute labour" was in many cases replaced by a payment called "conversion money," and the General Roads Act of 1845 made the alteration universal. The Roads and Bridges (Scotland) Act of 1878 entrusted the control of the roads to royal and police burghs and in the counties to road trustees, from whom it was transferred by the Local Government Act of 1889 to county councils. Many of the counties were divided into separately rated districts for road-making purposes, and there were 106 highway authorities in existence in 1928, including 7 burghal authorities. The Local Government (Scotland) Bill of that year, however, was designed to centralize the administration by reducing the authorities to one for each county. The Highlands had good military roads earlier than the rest of the country. The project, begun in 1725 under the direction of General George Wade, took ten years to complete, and the roads were afterwards kept in repair by an annual parliamentary grant. In the Lowlands the main roads were constructed under the Turnpike Acts, the earliest of which was obtained in 1750. As elsewhere in Great Britain, large sums from the Road Fund have been expended in recent years on road-reconstruction and widening and the building of by-pass roads. Work on the Glasgow-Inverness, the Perth-Inverness, and the Glasgow-Edinburgh roads was in progress in 1928. The roads were numbered in 1922.

Canals.—There are four canals in Scotland, the Caledonian, the Crinan, the Forth and Clyde and the Union, of which the Caledonian and Crinan are national property. (*See* CALEDONIAN CANAL.) The Forth and Clyde Navigation (opened in 1790) runs from Bowling on the Clyde, through the north-western part of Glasgow and through Kirkintilloch and Falkirk to Grangemouth on the Forth, a distance of 35 m. There is also a branch, 2¾ m. long, from Stockingfield to Port Dundas in the city of Glasgow, which is continued for the distance of 1 m. to form a junction with the Monkland canal. The reconstruction of the Forth and Clyde Canal to take larger vessels has been much discussed from time to time, but no steps had been taken in the matter by 1929. The Monkland canal (opened in 1792) has a length of 12¼ m., and runs from the north-east of Glasgow through Coatbridge to Woodhall in the parish of Old Monkland. In 1867 both undertakings passed into the hands of the Caledonian Railway Company. The Union canal, 31½ m. long, starts from Port Downie, on the Forth and Clyde canal near Falkirk, and runs to Port Hopetown in Edinburgh. Completed in 1822, it was vested in 1849 in the Edinburgh and Glasgow Railway Company, which in turn was absorbed by the North British Railway Company, and in 1923 by the London and North Eastern Railway. The Aberdeen canal, 18¼ m. long, running up the Don valley from Aberdeen to Inverurie, the Glasgow, Paisley and Johnstone Canal, 11 m. long, and the Forth and Cart Junction canal have been abandoned.

Railways.—The first railway in Scotland for which an Act was obtained was that between Kilmarnock and Troon (9¾ m.), opened in 1812, and worked by horses. A similar railway, of which the chief source of profit was the passenger traffic, was opened between Edinburgh and Dalkeith in 1831, branches being afterwards extended to Leith and Musselburgh. By 1840 the length of the railway lines for which bills were passed was 191¼ m., the capital being £3,122,133. The chief companies were the Caledonian, formed in 1845; the North British, of the same date; the Glasgow and South-Western, formed by amalgamation in 1850; the Highland, formed by amalgamation in 1865; and the Great North of Scotland, 1846. By the Railway Act of 1921 the Caledonian, Glasgow and South-Western, and Highland lines were taken over by the London, Midland and Scottish Company, and the North British and Great North of Scotland by the London and North Eastern Company.

Mining Industry.—Coal and iron, generally found in convenient proximity to each other, are the chief sources of the

mineral wealth of Scotland. The principal coalfields are Lanarkshire, which yields over ⅓ of the total output, Fifeshire, Ayrshire, Stirlingshire and Midlothian, but coal is also mined in the counties (usually reckoned as forming part of one or other of the main fields) of Linlithgow, Haddington, Dumbarton, Clackmannan, Dumfries, Renfrew, Argyll and Peebles, while a small quantity is obtained from the Oolite at Brora in Sutherlandshire. The earliest records concerning coalpits appear to be the charters granted, towards the end of the 12th century, to William Oldbridge of Carriden in Linlithgowshire, and in 1291 to the abbot and convent of Dunfermline conferring the privilege of digging coal in the lands of Pittencrieff. The monks of Newbattle Abbey also dug coal at an early date from surface pits on the banks of the Esk, but it was not used for domestic purposes till about the close of the 16th century. In 1606 an Act was passed binding colliers to perpetual service at the works where they were employed, and they were not fully emancipated till 1799. An Act was passed in 1843 forbidding the employment of children of tender years and women in underground mines. In 1927 there were 502 mines of all kinds in operation, employing 113,061 hands (87,620 below ground). The total output of coal in that year amounted to 34,597,694 tons. The quantity of coal exported in 1927 from the principal Scottish ports was 5,476,722 tons. Since the World War the position in the coal trade has been one of grave difficulty. Between 1913 and 1927 Scotland lost 39 per cent of her foreign trade, and the inland demand was also below normal.

The rise of the iron industry dates from the establishment of the Carron ironworks near Falkirk in 1760, but it was the introduction of railways that gave the production of pig-iron its greatest impetus. In 1865 when the industry was at the height of its prosperity, 1,164,000 tons were produced. In 1927 only 692,100 tons of pig-iron were made. In 1905, 832,388 tons of iron ore were raised but in 1927 only 28,345. The ore came mostly from Linlithgow, Stirling and Dumfries.

The oil shale industry is wholly modern and attained to considerable magnitude after its establishment (in 1851 and following years). Linlithgowshire yields nearly three-fourths of the total output and Midlothian nearly one-fourth. The mineral is chiefly obtained from seams in the Calciferous Sandstone at the base of the Carboniferous rocks. The total production in 1927 was 2,047,263 tons. In the previous four years production had fallen by nearly 800,000 tons Stirling. Better results were hoped for in 1928, as a result of improved refining methods.

Fire-clay is produced in Lanarkshire, which yields between ¼ and ⅓ of the total output, Stirling (nearly ⅓), and, less extensively, in Fifeshire, Ayr, Dumbarton, Linlithgow and a few other shires. With the exception of the counties of Orkney, Shetland and Caithness, granite is quarried in every shire in Scotland, but chiefly in Aberdeenshire, Midlothian, Ayr, Fife and Lanark; limestone is quarried in half of the counties, but especially in Midlothian and Fife; large quantities of paving-stones are exported from Caithness and Forfarshire, and there are extensive slate quarries at Ballachulish and other places in Argyllshire, which furnishes about three-fourths of the total supply. Sandstone, of which the total production in 1927 was 251,715 tons, is quarried in nearly every county, but particularly in the shires of Lanark and Dumfries. Lead ore occurs at Wanlockhead in Dumfriesshire and Leadhills in Lanarkshire. In 1927 there were produced 4,352 tons of dressed lead ore. A small quantity of zinc is mined in Dumfriesshire: over 24,000 tons of barytes were raised in Ayr in 1927, and nearly 48,000 tons of ganister, largely in Stirling. The precious metals were once worked at Abington in Lanarkshire and in the Ochils. Schemes for the utilization of water-power are in operation at Foyers (where alumina is treated) and Loch Leven, and in process of construction in the Lochaber district (1928).

Iron and Steel.—In 1921 35,167 persons were engaged in working of the raw material, in steel smelting and founding, blast furnaces for pig-iron, etc. All the great iron foundries and engineering works are situated in the Central Lowlands, in close proximity to the shipbuilding yards and coalfields, especially in the lower and part of the middle wards of Lanarkshire, in certain districts of Ayrshire and Renfrewshire, at and near Dumbarton, in south Stirlingshire and in some parts of East and Midlothian and Fife. Since the World War the iron industry has reached a condition of stagnation, and in 1928 only 21 of the blast furnaces in existence were at work. The electrical industry, on the other hand, has largely increased in importance, and employed in its various ramifications some 2,000,000 workers in 1928. Steel-work manufacturers have been faced with severe competition in recent years, and have been working under great difficulties. In 1921 the number of persons employed in engineering and machine-making (not marine or electrical) was 92,894 (in 1901 it was nearly 119,000). Ship-building and marine engineering employ 125,026. The metal, machinery and allied trades employed in 1921 354,735 persons.

Manufactures. (*a*) *Wool and Worsted.*—Although a company of wool weavers was incorporated by the town council of Edinburgh in 1475, the cloth worn by the wealthier classes down to the beginning of the 17th century was of English or French manufacture, the lower classes wearing "coarse cloth made at home," a custom still prevalent in the remoter districts of the Highlands. A company of Flemings was established in the Canongate (Edinburgh) in 1609 for the manufacture of cloth under the protection of the king, and an English company for the manufacture of woollen fabrics near Haddington in 1681, but the industry for long made little progress. In fact its importance dates from the introduction of machinery in the 19th century. The most important branch of the trade, that of tweeds, first began to attract attention shortly after 1830; it still has its principal seat in the district the Tweed, including Galashiels, Hawick, Innerleithen and Selkirk. Woollens are also manufactured elsewhere, especially at Stirling, Aberdeen, Elgin, Inverness, Stirling, Bannockburn, Dumfries and Paisley. Carpet manufacture has had its principal seat in Kilmarnock since 1817, but is also carried on in Elderslie, Ayr, Glasgow, Stirling and elsewhere. Fingering and many other kinds of woollen yarns are manufactured at Alloa, the headquarters of the industry. In 1921 the number of operatives in the woollen industry amounted to 22,870.

(*b*) *Flax, Hemp and Jute.*—The manufacture of cloth from flax is of very ancient date, and towards the close of the 16th century Scottish linen cloths were largely exported to foreign countries, as well as to England. Regulations in regard to the manufacture were passed in 1641 and 1661. To encourage the trade it was enacted in 1686 that the bodies of all persons, excepting poor tenants and cotters, should be buried in plain linen only, spun and made within the kingdom. The Act was renewed in 1693 and 1695, and in the former year another Act was passed prohibiting the export of lint and permitting its import free of duty. At the time of the Union the annual amount of linen cloth manufactured in Scotland is supposed to have been about 1,500,000 yards. The Union gave a considerable impetus to the manufacture, as did also the establishment of the Board of Manufactures in 1727, which applied an annual sum of £2,650 to its encouragement, and in 1729 established a colony of French Protestants in Edinburgh, on the site of the present Picardy Place, to teach the spinning and weaving of cambric. The counties in which linen is now most largely carried on are Forfar, Perth, Fife, Aberdeen, Renfrew, and Midlothian. Dundee is the principal seat of the manufacture of coarser fabrics, Dunfermline of the table and other finer linens, while Paisley is widely known for its sewing threads. The allied industry of jute is the staple industry of Dundee. In 1921 the operatives in the flax, jute and hemp industry numbered 55,035.

(*c*) *Cotton.*—The first cotton mill was built at Rothesay by an English company in 1779, though Penicuik also lays claim to priority. The Rothesay mill was soon afterwards acquired by David Dale, who also established cotton factories in 1785 at New Lanark, afterwards so closely associated with the socialistic schemes of his son-in-law, Robert Owen. The counties of Lanark and Renfrew are now the principal seats of the industry. The great majority of the cotton factories are concentrated in Glasgow, Paisley and the neighbouring towns, but the industry extends in other districts of the west and is also represented in the counties of Aberdeen and Perth. As compared with England, however, the manufacture has stagnated. The number of hands employed in

1850 was 34,325, in 1901 it was 34,057, and in 1921 (including bleachers, dyers, printers, calenderers, etc.) it was 41,212.

(*d*) *Silk and other Textiles.*—The principal seats of the silk manufacture are Paisley and Glasgow. In 1901 the number employed amounted to 2,424, but in 1921 it was only 680, including those engaged in artificial silk manufacture, an industry which has increased in importance since that date. The weaving of lace curtains has made considerable progress. Hosiery manufactures, a characteristic Border industry, has its chief seat at Hawick. In 1921 34,493 persons were engaged in the production of miscellaneous textiles, such as rope, carpets, lace, etc. The textile industry has been comparatively prosperous in recent years, and the output in 1928 was probably greater than before the World War.

(*e*) *Whisky and Beer.*—Scotland claims a distinctive manufacture in whisky. Though distillation was originally introduced from England, by 1771 large quantities of spirits were already being consigned to the English market. The legal manufacture of whisky was greatly checked in the earlier part of the 19th century by occasional advances in the duty, but after the reduction of 2s. 4¾d. per proof gallon in 1823 the number of licensed distillers rapidly increased, to the discouragement of smuggling and illicit distillation. In 1900 31,798,465 proof gallons were made, but in 1927 only 18,988,437. In that year all but 7 of the distilleries of the United Kingdom were in Scotland, but the number had fallen from 128 in 1923 to 84. The leading distilling counties are Argyll, Banff and Inverness. Brewing is extensively carried on in Edinburgh, whose ales are in high repute, Alloa and elsewhere. The Temperance Act (Scotland), which came into force in 1920, provided for a poll by local authorities in burghs, wards of large burghs, and parishes with reference to the limitation or abolition of liquor licences, or the retention of the existing licences. In the result 60% of the votes were for no change.

(*f*) *Miscellaneous.*—Paper, stationery and printing are industries in which Scotland has always occupied a foremost position. A paper mill was erected in 1675 at Dalry on the Water of Leith in which French operatives were employed to give instruction, with the result, in the words of the proprietors, that "grey and blue paper was produced much finer than ever was done before in the kingdom." Midlothian has never lost the lead then secured. There are paper mills at Penicuik and elsewhere in the vale of the Esk and around Edinburgh and the industry is also conducted near Aberdeen. Stationery is largely manufactured at Glasgow, Aberdeen and Edinburgh. In 1921 the number of persons employed in the paper and stationery industries amounted to 19,953. Ever since it was established early in the 16th century, the Edinburgh press has been renowned for the beauty and excellence of its typography, a large proportion of the books issued by London publishers emanating from the printing works of the Scottish capital. Printing is also extensively carried on in Glasgow. The number of persons engaged in the production of books and kindred occupations amounted in 1921 to 26,919.

The first sugar refinery was erected in 1765 at Greenock, which, despite periodical vicissitudes, has remained the principal seat of the industry. The making of preserves and confectionery flourishes in Dundee. Kirkcaldy is the seat of the oil floor-cloth and linoleum industries, the latter introduced in 1877. The headquarters of the chemicals manufacture are situated in Glasgow and the vicinity, while explosives are chiefly manufactured at Stevenston and elsewhere in Ayrshire, and at certain places on the Argyll coast. Among occupations providing employment for large numbers were trades in connection with building and works of construction and furniture and timber, while transport (including railways, roads, sea, rivers, docks, harbours, etc.) employed 160,218 persons in 1921.

Commerce and Shipping.—The following table between 1855 and 1927 illustrates the development that took place in the shipping trade with foreign countries and British possessions, as well as the expansion of the coasting trade.

Foreign trade has shown rapid growth. In 1755 the imports were worth £464,411, and the exports £535,576. By 1851 the figures were £8,921,108 and £5,016,116. In 1900 they were £38,691,245 and £32,166,561, and in 1927 £80,822,241 and £62,670,566.

Foreign and Coastwise Trade: Tonnage of Vessels.

Year	Coastwise		Foreign		Total	
	Entered	Cleared	Entered	Cleared	Entered	Cleared
1855	1,963,552	2,057,936	668,078	840,150	2,631,630	2,898,086
1900	7,213,574	6,791,959	5,657,200	6,602,545	12,870,774	13,394,504
1927	8,575,156	8,267,694	9,484,068	12,041,955	18,059,224	20,309,649

Though the value of imports into Scotland is less than one-thirteenth of that into England, this does not represent the due proportion of foreign wares used and consumed in Scotland, for the obvious reason that large quantities of goods are brought into the country by rail, nearly all the tea, for example, consumed in Great Britain being imported into London, while several ports have almost a monopoly of certain other imports. The customs revenue rose from £1,965,080 in 1894 to £3,399,141 in 1903.

Chief Ports—1927

Port	Order	Imports and exports of produce of the U. K.	Order	Tonnage of vessels in foreign trade	Order	Tonnage of vessels in coasting trade
Glasgow	1	76,362,693	1	8,844,258	1	3,491,913
Leith	2	25,545,968	3	3,037,054	4	1,299,055
Grangemouth	3	12,915,297	4	1,842,402	5	1,151,713
Dundee	4	10,830,017	6	1,223,727	8	575,700
Aberdeen	5	3,108,167	7	642,031	3	1,301,503
Greenock	6	2,824,590	2	3,305,958	6	1,124,898
Ardrossan	7	1,492,004	9	402,121	2	1,345,655
Methil	8	1,457,093	5	1,291,091	7	1,065,659
Burntisland	9	904,029	8	629,985	9	304,487

Shipbuilding.—Many of the most important improvements in the construction of ships, especially steam vessels, are due to the enterprise and skill of the Clyde shipbuilders, who, from the time of Robert Napier of Shandon who built and engined the first steamers for the Cunard Company, formed in 1840, have enjoyed an unrivalled reputation for the construction of liners. The principal Clyde yards are situated in the Glasgow district (Govan, Scotstoun, Fairfield, Clydebank, Dalmuir), Dumbarton, Port Glasgow and Greenock. At several of the ports on the lower firth, as at Ardrossan and Fairlie, famous for its yachts, the industry is also carried on. On the east coast the leading yards are at Dundee, Peterhead, Fraserburgh and Aberdeen, which, in the days of sailing ships, was renowned for its clippers built for the tea trade. There are yards also at Inverness. After rising to a "peak" year in 1913, shipbuilding fell off during the World War; and since then its fortunes have been fluctuating and uncertain. The industry was fairly active in 1928, but towards the end of the year the unemployment figures were higher than in any other of the basic industries of the country. (O. J. R. H.)

HISTORY

The Kingdom of Scotland was founded in the early years of the 11th century by an amalgamation of four tribal kingdoms—Scots, Picts, British and Angles, two of which, Scots and Picts, had been united at an earlier period. The Scots were an Irish tribe who settled, about the beginning of the 6th century, in the district known later as Argyll; the Angles, in the second half of the same century, colonized what became the Lothians and the counties of Selkirk, Peebles and Roxburgh. The British, who occupied the country between the Solway Firth and the Firth of Clyde, were akin to the Welsh, and were probably driven into north Britain by the Anglo-Saxon invasions in the south. Three, therefore, of the four constituent parts of the historic kingdoms of Scotland date back no farther than the 6th century. The identification of the Picts and Caledonians whom the Romans found in the country in the first centuries of the Christian era has been for generations a subject of controversy. For Scotland in Roman days *see* CALEDONIA, also BRITAIN.

Christian Scotland.—Scottish history is often said to begin with the mission of St. Columba in 563. Columba was an Irishman of noble birth who became a monk and a priest and settled in Iona to undertake the conversion of the portions of North

Britain which were still heathen. Iona belonged to the small kingdom of Dalriada, which had, comparatively recently, been founded by the race to which Columba belonged, and its ruler was his kinsman. The Scots had come from Ireland, a Christian land, and had brought their religion with them, and Christianity had persisted from Roman times, or had been revived, in Strathclyde. In the beginning of the 5th century, St. Ninian had preached in Strathclyde and had sent his disciples to convert Pictland, and it is probable that many of the religious foundations in the north-east of Scotland, generally ascribed to St. Columba, really date from an older missionary effort.[1] Some years before St. Columba landed in Iona, a great Christian teacher, known as St. Kentigern or St. Mungo, was labouring in Strathclyde, and to his mission is traced the foundation of the future city of Glasgow. St. Columba, therefore, cannot be said to have converted Scotland, but he laboured as a missionary in Pictland and he made Iona the centre of Scottish Christianity. In the century succeeding his death in 597, the most important contribution made by Scotland to the history of Great Britain was the direct result of his work—the re-conversion of the North of England to Christianity. A pagan reaction in the second quarter of the 7th century had dethroned the Christian king, Edwin of Northumbria, who ruled from the Humber to the Forth. Edwin's nephew, Oswald, had been educated at Iona, and, when he recovered the kingdom of Northumbria by a victory won in 655, he brought Scottish missionaries to rebuild the shattered fabric of Christianity. The influence of Scotland upon English Christianity was, however, short-lived. There were some differences of method, organization and ritual between the Irish Church and the Roman Church. Oswald's successor, Oswy, declared in favour of Roman custom, and the Scottish missionaries abandoned Northumbria in accordance with the decision of the Synod of Whitby (664).

Picts, Scots and Norse.—The kingdom of Northumbria had, by this date, reached the height of its greatness, and its rulers were ambitious of conquering the north of the island. In 685 a great Northumbrian army invaded Pictland and was defeated at the battle of Nectansmere, fought near Dunnichen in Forfarshire. The expedition proved to be the ruin of Northumbrian supremacy in England; the centre of English power shifted southwards and the menace of an English conquest was removed. North Britain was to be left, for some centuries, to work out its own destiny. The Picts became supreme in the north, and gained control over both the Scots of Dalriada and the British of Strathclyde. Then the Picts were weakened by the attacks of the Norsemen, who first attacked the coasts in the end of the 8th century, and, about 835, began to make permanent settlements. Dalriada threw off Pictish control, and in 844, when the Norsemen were attacking Pictland, Kenneth MacAlpine, King of the Scots, established a claim to the Pictish throne. There seems to have been something in the nature of a conquest, but the resources of Pictland were so much greater than those of Dalriada that it is difficult to credit the smaller country with a military conquest of the larger.

Kenneth MacAlpine's claim was in right of his mother, and the Picts preferred maternal to paternal descent. The union of Picts and Scots was followed by an attempt to snatch the Lothians from Northumbria, then devastated by the Danish invasions; but the effort was unsuccessful, and Kenneth's successors were themselves engaged in struggles with the Norsemen, who occupied the Hebrides and the Orkney and Shetland islands and made settlements along the western and northern coasts and on the east coast as far south as the Moray Firth. They also attacked the kingdom of Strathclyde and founded colonies between the rivers Esk and Dee. The islands became definitely Scandinavian, as also did a large part of Caithness. During the long conflict with the Norsemen, the Scots sometimes allied themselves with the English against the common enemy, and these alliances constituted, long afterwards, a ground of the English claim to the overlordship of Scotland, but there were other occasions upon which the Scots joined the Norsemen against the English.

[1] W. D. Simpson, *The Historical St. Columba* (1927).

Conquest of Lothian.—The most important attempt of the latter kind occurred in 937 when the Scottish king, Constantine III., was defeated by Athelstan of England at Brunanburh (probably Burnswark on the Solway). Constantine's object was the realization of a persistent ambition which is, perhaps, the most remarkable feature of Scottish history in the two centuries following the union of the Picts and Scots—the severance of the Lothians from the kingdom of Northumbria. These attempts continued throughout the 10th century but did not attain any permanent success till, in 1018, Malcolm II. completely defeated the Northumbrians at the battle of Carham, near Coldstream. The victory was followed by the gradual extension of Scottish rule to the Tweed. Malcolm was followed, in 1034, by his grandson, Duncan, who had already succeeded, by inheritance, to the throne of Strathclyde, and thus Scots, Picts, Angles and British were all included within the kingdom which came to be known as Scotland. The Norsemen still held the islands; the Hebrides were not recovered till after the middle of the 13th century, and the Orkneys and Shetlands not till the middle of the 15th century, when they passed from Denmark to Scotland through the marriage of a Danish princess to James III.

ANGLICIZATION AND FEUDALIZATION

Macbeth and Malcolm III.—Duncan, the Duncan of Shakespeare's "Macbeth," the first ruler of the historical kingdom of Scotland, did not experience the "plenteous joys" which brought tears into his eyes in the play. He met with defeats both from the Northumbrians and from the Norsemen, and in 1040 he was slain in a civil war by his own general, Macbeth, who had a claim to the succession, probably in his own right, and also as the representative of his wife and stepson. Macbeth was almost certainly in alliance with the Norwegian earl of Caithness and Sutherland, a cousin of Duncan, named Thorfinn. While Thorfinn lived, attempts to dethrone Macbeth, who proved himself an efficient ruler, were unsuccessful, at all events in Pictland, though Strathclyde and the Lothians may have acknowledged Malcolm Canmore (Bighead) the son of Duncan. After Thorfinn's death, Malcolm, in 1057, defeated and slew Macbeth at Lumphanan in Aberdeenshire. The kingdom of which Malcolm III. took possession was a Celtic kingdom, though one of its provinces was peopled by Angles. Local and tribal custom prevailed alike in Scotland proper (the district north of the Forth and Clyde) and in Galloway; the speech was Celtic; the court and the administrative system, so far as the latter can be said to have existed, were Celtic. The church still retained, to a large extent, the structure and customs of Irish Christianity, although, in the beginning of the 8th century, a powerful Pictish monarch had ordered his people to keep the Roman date for Easter (one of the points disputed at the Synod of Whitby) and this rule had afterwards been followed in Dalriada and probably in Strathclyde. The Irish Church did not repudiate papal authority, but there was no opportunity for the exercise of papal jurisdiction. Diocesan organization did not exist. There was only one bishop of the Scots; his see was St. Andrews and he could enjoy little influence outside his own neighbourhood. Such organization as the Columban Church had originally possessed was based upon powers claimed by the abbots of the monasteries, but the abuse of appointing lay abbots had destroyed the early monasticism, and a later order of monks, the Culdees, which had developed in the 9th century, had no administrative authority.

Queen Margaret.—The disorganized state of the Scottish Church, and some peculiar customs which marked its ritual, shocked the conscience of Malcolm's wife, an English princess, Margaret, who, after the Norman Conquest, sought refuge in Scotland. Margaret was a woman of saintly life—she was canonized a century and a half after her death—and her own desire was to be a nun. She would have been the glory of a cloister, but she accepted her mission to redeem an ignorant and almost schismatic nation. She was not destined to fulfil that mission herself, but its accomplishment was, none the less, her work. There were many difficulties in her way. She could not introduce a diocesan system till there was a vacancy in the one Scottish bishopric, and none

occurred in her lifetime. She could not reform the monastic system and bring it into line with European monasticism, because Malcolm, though amenable in many ways to his wife's influence, refused to surrender the gains which he and other laymen, the great men of the land, enjoyed from the secularization of monastic revenues. She did succeed in changing some Scottish customs. She brought English clergy to convince the Scots of the error of their ways (Malcolm who had been in exile in England, acting as interpreter); she restored the monastery of Iona which had been destroyed by the Northmen; and she encouraged the Culdees as the nearest approach to the religious life which she admired. Her most important personal achievements were the introduction of an English-speaking court and of English-speaking clergy, and the education of her children in English ways and traditions. She bore six sons to Malcolm, but he was not allowed to give any one of them his own name, or the name of any of his predecessors; four of them were named after Saxon kings of England.

Anglicization of the Church.—Margaret's three sons who successively came to the throne had all some personal experience of English life. Malcolm III. and his eldest son, Edward, were killed in 1093 in one of the raids on the north of England from which his pious wife vainly tried to restrain him. After his death there was a Celtic reaction against the Anglicizing influences introduced by Margaret (who was herself dying when her son Edgar brought her the news of the deaths of his father and brother). The English who had followed the queen to Scotland were driven out, and Edgar and his brothers, Alexander and David, took refuge in England. It was with English help that Edgar regained his throne in 1107; he died ten years later and was succeeded by Alexander, and he in turn by David (1124–53). The three brothers were all their mother's sons, and they continued her work. All three were pious and all three were English in tastes and sympathies, and were bent upon converting Celtic Scotland into a feudal kingdom of the Anglo-Norman type. Piety and policy both pointed in one direction; the church was to be one of the most powerful instruments of Anglicization. Edgar abandoned Malcolm's palace at Dunfermline and held an English court at Edinburgh. Alexander suppressed a Celtic rebellion in Moray and Mearns so efficiently that he earned the description "the Fierce," and he followed up his victory by founding a house of Austin Canons at Scone (the coronation place of the Pictish kings and their Scottish successors) and filling it with English monks. The Anglicization of the country, outside the western and northern Highlands, was to a very considerable extent the result of ecclesiastical influences. Alexander I. and David I. planted English monasteries in many districts of Scotland, south of the Moray Firth, and endowed them so liberally that David acquired a popular reputation for sanctity. However, the political motive of the new foundations is indicated by the suppression of the Culdees, the form of religious life associated with the Gaelic speech and with Celtic customs.

The plantation of monasteries was accompanied by a diocesan organization of the church. This was essential for efficient ecclesiastical administration and for the exercise of papal supremacy, but it was also useful as a means of furthering royal policy. The new bishops were English, their sees were richly endowed with lands, and their religious authority was enhanced by their position as territorial magnates. Diocesan organization was delayed by claims asserted by the sees of Canterbury and York to possess superiority over the church in Scotland. Two Englishmen in succession, Turgot, the chaplain and biographer of Queen Margaret, and Eadmer, the ecclesiastical historian, were elected to the see of St. Andrews, but Turgot acknowledged the superiority of York and Eadmer that of Canterbury, and neither was allowed to reside in Scotland. Alexander I. would not tolerate pretensions which, apart from introducing complications into the relations between Church and State, were likely to compromise the independence of the Scottish Crown. Ultimately, on Eadmer's death in 1124, the English prior of the new monastery at Scone was consecrated to the see of St. Andrews by the Archbishop of York, without prejudice either to the claims of York or to the freedom of the Church in Scotland. Under David I. the process of organization went on rapidly, and all the mediaeval Scottish dioceses had been founded by the end of his reign.

Anglicization of the Administrative System.—David I. was more familiar with English ways than any of his brothers. His sister was married to Henry I. and he spent some years of his youth at the English court, made friends with Anglo-Norman barons and married the widow of one of them. He changed the system of land tenure in Scotland by making to his English friends grants of land, on the model of the charters granted by the Anglo-Norman kings of England. The first of the Scottish Bruces, for example, received by charter a grant of over 200,000 acres in Annandale, and the progenitor of the House of Stuart came to Scotland as the recipient of charters conveying great tracts of land in Ayrshire and Renfrewshire. There was no dispossession of the existing landowners; they held their rights, in future, from the new lord instead of directly from the Crown. Such charters were granted not only to newcomers, but also to great landlords who had hitherto held their lands by tribal custom and were glad to receive written guarantees of their possessions and privileges. Gradually, the whole of the land, outside the Highlands, came to be held under feudal law, and the landowners, whether Anglo-Normans or representatives of the old Scottish families (who intermarried with David's new nobility), were, like the monks and the bishops, inevitably instruments of the royal policy of Anglicization. The civil, as well as the ecclesiastical, organization was gradually remodelled in accordance with English (and European) institutions, and, under David and his successors, great officers of the household (whose functions were analogous to the duties of later administrative departments) came into existence, the English office of sheriff was borrowed for purposes of local government, and the old tribal laws of the component parts of the kingdom were replaced by adaptations of English legislative measures. To the influences of an English court, an English Church, and an English system of law and land-tenure were added the effects of English trade. Commerce was mostly with England and from England was adopted the institution of the burgh. The early Scottish burgh charters were all founded on English models, and colonies of English merchants settled in Scottish towns. These processes, initiated under the sons of Queen Margaret, had a continuous development until the outbreak of the War of Independence. A series of Celtic revolts against the Anglicizing policy of the Crown occurred in the course of the 12th century and in the beginning of the 13th, but they were all suppressed (sometimes with English help), and, before the death of Alexander III. in 1286, the organization of Lowland Scotland, from the Moray Firth to Tweed and Solway, was definitely English, and the English tongue was spoken in a large portion of the area.

Relations with England.—While this process of Anglicization was in progress, political relations with England were not, for many years, entirely friendly. The border-line between the two countries had not been definitely ascertained. As the rulers of Strathclyde, the Scottish kings imagined themselves to possess a claim to Cumberland and Westmorland, and they cherished an ambition of annexing portions of the old Northumbrian kingdom beyond the Tweed. The raids of Malcolm III. (Canmore) had led William I. to found Newcastle-on-Tyne in 1079 and William II. to fortify Carlisle in 1091, and the boundary line might be regarded as stretching from the Tyne to the Solway, although the English did not admit Scottish claims between Tweed and Tyne. The wife of David I. was the heiress of two English earldoms, of which Northumbria was one. Henry I. recognized his brother-in-law's claim to the earldom of Huntingdon, which descended to the Scottish queen from her father, but refused to acknowledge that Northumbria had passed to her from her grandfather (Earl Siward, who had played an important part in the reign of Edward the Confessor). When the English throne was disputed between Stephen and the Empress Matilda, David invaded England in support of the empress, who was his niece. His real purpose was to take possession of Northumberland, and he succeeded in effecting it in spite of his defeat at the Battle of the Standard, fought near Northallerton in Aug. 1138. Stephen, whose wife was also a niece of David, granted Northumberland as an English fief to Prince

Henry, the heir to the Scottish throne. The gift did not secure David's loyalty, for when the future Henry II. made his first, and unsuccessful, attempt to gain the English throne in 1149, David aided him and was promised the whole area north of the Tyne. This promise was repudiated by Henry II. on his accession in 1154. David had died in 1153, his son had predeceased him, and his grandson, Malcolm IV. (1153–65), had to surrender David's territorial gains.

Treaty of Falaise.—The ambition of annexing Northumbria continued to guide Scottish policy, and William the Lion (1165–1214), the brother and successor of Malcolm IV., hoped to attain it by joining the English rebels against Henry II. in 1173–74. His capture, near Alnwick Castle, in July 1174, not only put an end to such expectations but resulted in the temporary loss of Scottish independence. The 10th-century alliances against the Danes, in which the English king had been "father and lord" of the king of Scots, were by this time interpreted in England as having involved a feudal subjection of Scotland to England, and since the time of William the Conqueror, the Scottish kings had held English fiefs and had done homage for them. The precise nature of this homage had not been defined and the meaning of the ceremony was left deliberately ambiguous. What the Scottish kings gave as homage for English lands, English kings could receive as homage for the crown of Scotland. Henry released William only after forcing him to consent to the Treaty of Falaise (1174) by which he did homage avowedly for the Scottish crown. The treaty was cancelled 15 years later by an agreement between William and Richard I., who sold the rights extorted by his father, receiving in return a sum of money, required for the Third Crusade. The bargain (which forms almost the only link between Scotland and the Crusading movement) merely annulled the Treaty of Falaise and left the question of homage precisely where it had been in 1174. One ancient controversy was, however, settled immediately after the agreement was made. The Treaty of Falaise had expressly admitted the subordination of the Scottish to the English Church, but its provisions had not come into operation because it had failed to discriminate between the rival claims of Canterbury and York. In 1192, after the close of a controversy between William the Lion and the papacy, Pope Celestine III. issued a Bull declaring the Scottish Church to be the special daughter of the Holy See, "with mediation of none."[1] The church in Scotland was still denied the privilege of a metropolitan see, although in 1225 Honorius III. granted the clergy permission to hold regular provincial councils under the presidency of an elected "Conservator of the Privileges of the Scottish Church." It was not till 1472 that St. Andrews was given metropolitan jurisdiction in Scotland; 20 years later a province was detached and placed under the newly founded archbishopric of Glasgow.

The Golden Age.—William the Lion (the ascription of that title to him is an unsolved problem) continued to hope for the restoration of Northumberland. He offered to purchase it in 1194, but refused to accept it when Richard I. proposed to exclude from the bargain the right of holding fortified castles; and he made further unavailing efforts, including an admission of the right of King John to choose a wife for his son Alexander, the heir to the Scottish throne as well as to the possessions of the Scottish Royal House in England and to their Northumbrian claims—a dangerous expedient in view of English pretensions to overlordship. Alexander II. (1214–49) tried to seize Northumberland during the struggle which followed the grant of Magna Carta; but in 1236, by the Treaty of York, he resigned his claims to the earldom of Northumbria, and also his possessions in Huntingdon, in return for a grant of lands in the north of England. His reign witnessed the last of the Celtic revolts against the policy of Anglicization, and in his later years Scotland entered upon a period of consolidation and prosperity which continued throughout the reign of his son, Alexander III. (1249–86). The recovery of the Western Isles, which had been under Norse rule, was achieved by Alexander III. after the battle of Largs (1263), in which the Norwegians were defeated. In 1266 Eric of Norway surrendered the Hebrides in return for a money payment. There was continuous peace with England. Alexander was the nephew and also the son-in-law of Henry III., and his relations both with him and with his brother-in-law, Edward I., were friendly. The Borders, about to be the scene of almost incessant fighting for two and a half centuries, were quiet and peaceful. Later tradition did not err in regarding the reign of the last of the old line of Scottish kings as a golden age. His death closed the period of Anglicization and in the later middle ages Scotland drew its inspiration rather from France than from England.

[1]The date 1192 was established by Prof. R. K. Hannay in an article on the subject in the *Scottish Historical Review*, April 1926.

THE WAR OF INDEPENDENCE

The Succession Problem.—Alexander III. was killed by a fall from his horse in March 1286. His two sons and his daughter had predeceased him and his only living descendant was his daughter's infant child, Margaret, daughter of Eric of Norway. Her age, her sex and her nationality would have combined to prevent the succession of the little Maid of Norway, if there had been any adult male claimant nearly related to the late king. But Alexander left neither brother, nephew nor cousin, and there was no living legitimate descendant of any Scottish monarch later than David I. Of the three grandsons of David, two, Malcolm and William, had succeeded to the throne. The third, David, who had been given the English earldom of Huntingdon, had left a son and three daughters. The son had died without issue; the eldest daughter had married an Anglo-Scottish baron, and her grandson (through her daughter, Devorguilla, the foundress of Balliol college at Oxford) was, by the theory of primogeniture, the direct heir to the Crown. But the rule of succession by primogeniture was not yet established either in Scotland or in England, and the claim of John Balliol was disputed by Robert Bruce, the son of the second daughter of David of Huntingdon. Bruce argued that a grandson, being closer in descent to the grandfather from whom the claim was derived, was his true representative, rather than a great-grandson who was separated from him by an additional generation. Years before, when Alexander II. was childless, Bruce had been recognized as heir presumptive, and the birth of Alexander III. had deprived him of a chance which, in 1286, he held to have recurred. The Scots were thus faced by a choice between the minority of a baby girl who was the daughter of a foreign sovereign, and a civil war between two Scottish claimants. The nobles decided that the former was the lesser of the two evils, and the Great Council of Scottish tenants-in-chief, clerical and lay, appointed guardians to conduct the Government in the name of Margaret of Norway.

Agreement with England.—At first, it seemed as if the choice were to involve the country in both evils, for the Bruce party began to raise a rebellion, but Edward I. of England, a great-uncle of the baby queen, intervened to secure her throne. This intervention was welcome in Scotland; in the late king's minority, his father-in-law, Henry III., had taken part in Scottish politics, asserting no claim to overlordship, and describing himself as principal counsellor to the king of Scots. Edward I. similarly made no pretension to the right and duty of an overlord to act as guardian during a minority. The long continuance of peace with England, and the two centuries' tradition of the adoption of English speech, manners and institutions, made it natural for him to offer, and for the Scots to accept, a guarantee of the succession of the little Maid. Edward had, in fact, devised the statesmanlike scheme of a union of the two Crowns by the marriage of the heiress of Scotland to his son Edward (afterwards Edward II.). English, Scottish and Norwegian commissioners met to discuss the question, and in the summer of 1290, the Treaty of Birgham-on-Tweed defined the conditions of the marriage. In proposing his scheme, and in the terms of the treaty, Edward showed every consideration for Scottish feelings, and it was provided that, after the marriage, and even after the succession of a son of the marriage to both Crowns, the two kingdoms should remain separate organizations—doubtless Edward hoped that a union of the kingdoms would follow a union of the Crowns, but he was content to lay the foundations of that union. Further, it was agreed in the Treaty that, should there be no heir of the marriage, the Crown of

Scotland was to revert to the proper heirs, and the kingdom of Scotland was to be "free in itself, without subjection, as it hath hitherto been." Any rights pertaining to the Crown of England were reserved, but these rights were neither asserted nor defined.

The English Claim to Overlordship.—The agreement promised a peaceful future for both countries, as far as their relations with each other were concerned, but within two months, the Maid of Norway died on her way to Scotland (Sept. 1290). Civil war between the Bruces and the Balliols was inevitable, and each party wished to secure Edward's support. During the minority of Alexander III., the Bruce family had supported the policy of Henry III. in Scotland, and Robert Bruce, the claimant, was an English landowner, had held high official positions in England, and had fought with Edward during the Barons' Wars. There are indications that he would have acknowledged English overlordship in return for Edward's support, but such a bargain would not have fulfilled the purpose which Edward had begun to cherish—the reduction of Scotland to the position of a vassal kingdom of England. A compact with the Bruces would only have resulted in placing behind Balliol all who upheld Scottish claims to independence, and Edward was determined to obtain an acknowledgment of his paramount authority from all the claimants—there were rivals to Balliol and Bruce, but with clearly inferior pretensions. After collecting evidence from monastic chronicles about the history of the overlordship controversy, Edward asked the Scottish nobles to meet him at Norham-on-Tweed in May 1292. There he at once announced his intention of establishing his claim to be the feudal overlord of the kingdom of Scotland, and he gave the Scottish magnates some days to consider their attitude. Meanwhile, a great English army was assembling on the opposite bank of the Tweed. Edward's claim was not entirely repugnant to an assembly consisting largely of Anglo-Norman barons, some of whom held lands in England as well as in Scotland, and, after a protest had been entered in the name of the "community" of Scotland, the English overlordship was admitted and the admission was duly recorded. The Lord Paramount then ordered an enquiry into the pretensions of the various competitors, who were reminded that any symptoms of recalcitrance would be followed by a declaration that the kingdom, owing to failure of heirs, had reverted to the overlord. Edward then made a progress, as far north as Perth, through the kingdom of his (as yet unidentified) vassal.

Balliol's Revolt.—In Nov. 1292, Edward, after a judicial investigation, gave his decision in favour of John Balliol, thus defining right of succession in accordance with the later rules of primogeniture. Within three years the vassal king was in revolt against his overlord, who had subjected him to ignominious treatment. Whether Edward deliberately intended to produce this result is uncertain. Balliol's character and disposition suggested that he would submit to almost any humiliation rather than face Edward's wrath, and, if the English king did contemplate a conquest of Scotland, he cannot have wished to undertake it in 1295, when he had on his hands a Welsh rebellion, a French war and serious domestic quarrels. The remark attributed to him when news was brought of Balliol's alliance with France, "Has the fool done this folly?" indicates that he was surprised by the audacity of his vassal, and he was so far right that Balliol seems to have been compelled by Scottish opinion to take action. Edward at once assembled a powerful army to give effect to a new claim—that Scotland, as the fief of a disobedient vassal, had passed by forfeiture into the direct possession of the feudal superior. The strength of Scottish feeling is illustrated by the stubborn resistance offered by the Anglian population of the prosperous mercantile town of Berwick-on-Tweed, where English rule might have been expected to be more welcome than in any other province of Scotland. Edward took vengeance by a merciless massacre (the first act of warfare for nearly a century) and gave a precedent for a cruel and relentless struggle. At first, it seemed as if the conquest were to be a very simple process. Scotland was divided—the Bruces denied support to Balliol—and Edward, easily defeating a Scottish army at Dunbar (April 1296), made a triumphal march through Scotland. The annexation of the country, and its loss of the status even of a vassal kingdom, was emphasized by the destruction of the Great Seal, and by the removal to London of the national records and of the "Stone of Fate" upon which the Scottish kings were crowned. In October the English king returned home, leaving Scotland under a military occupation.

William Wallace.—English soldiers and officials were far from tactful, but the explanation of the revolt that followed is not to be found in garrison outrages. The lay magnates who had accepted the English overlordship were largely of Anglo-Norman blood; the smaller landowners and the lower classes of the population nourished a stronger dislike to English rule than did their natural leaders who had deserted the cause of independence. They found at once a new leader in Sir William Wallace, a younger son of a Renfrewshire landowner, and it was soon proved that only leadership was wanted to enlist an army of soldiers drawn from all parts of Scotland, including the Highlands. On Sept. 11, 1297, Wallace, as commander of "the army of the commons of Scotland," routed the English army of occupation at Stirling bridge, and for a year he ruled Scotland in the capacity of guardian for John Balliol. Meanwhile, Edward I., relieved both of foreign and of domestic anxieties, prepared to lead an army to Scotland in person. At Falkirk, on July 22, 1298, he defeated Wallace, who escaped but resigned his office of guardian. The victory did not, however, restore the English to the position they had held in 1296. The spirit of resistance, thoroughly awakened, was not dismayed by defeat. New guardians were appointed, including Robert Bruce, grandson of the Competitor (the future King Robert), and Edward, summoned to London by fresh domestic complications, had to leave Scotland unconquered. It was not till the autumn of 1303 that he was able to undertake operations on a scale adequate for his purpose. He brought a great army to Scotland in September, traversed the country, met with little resistance, and spent the winter in Scotland. In the summer of 1304, having captured Stirling Castle, which had been taken by the Scots after their defeat at Falkirk, he again left behind him what he believed to be a conquered country. In 1305 he captured Wallace and put the noblest of Scottish patriots to the cruel death prescribed by English law for a traitor.

Robert Bruce.—Wallace was executed in Aug. 1305. Six months later, Robert Bruce and John ("the Red") Comyn, both of them ex-guardians of Scotland, met secretly in the Greyfriars church at Dumfries. Comyn was a nephew of Balliol and was regarded as the representative of the Balliol claims. A meeting of the only two possible candidates for the Scottish throne must have been held for the purpose of adjusting their claims with a view to further resistance. The result of the conference was to make resistance inevitable and immediate. There was a quarrel, and Bruce stabbed Comyn; his followers despatched the wounded man. It was impossible for Bruce to conceal his real aims from Edward, and, though he had made no preparations for resistance, he was crowned in March 1306 at Scone. His chances of success seemed slight, for the kindred and friends of the great families of Balliol and Comyn were violently hostile to him; and the clergy, who had hitherto supported the cause of independence, were likely to be alienated by a crime which combined murder with sacrilege. A defeat at Methven, near Perth, in June, might well have put an end to the rising, and Bruce's failure in the battlefield was followed by other misfortunes. He spent the winter of 1306–07 as a fugitive—his adventures are described in Barbour's *Bruce* and in Sir Walter Scott's *Lord of the Isles* and *Tales of a Grandfather*. But Bruce was to prove himself a great national leader, the determination of the Scots to regain their independence had been strengthened by the death of Wallace, and even the clergy did not desert the new monarch in spite of a papal excommunication. In the spring, Bruce appeared on his own lands in Ayrshire, and in May he won a victory at Loudoun Hill in the same county. Then an event happened which changed the whole situation. Edward I. had spent the winter at Lanercost Abbey in the north of England, and had moved to Carlisle, where, in March, he sentenced to death two of Bruce's brothers who had fallen into his hands. On hearing the news of Loudoun Hill he resolved to lead

his army to Scotland in person, but he died at Burgh-on-Sands on July 7, and his successor abandoned the campaign.

Bannockburn.—Edward II. probably had adequate reasons for returning to London, but he missed a great opportunity in Scotland. One of his father's great difficulties had been that Scottish barons and bishops were ready to take, and just as ready to break, oaths of allegiance to the sovereign of England. He could not rely upon the unfailing support of any Scottish family or faction. The murder of Comyn had accomplished what all the first Edward's oaths had failed to achieve—the creation of an English party in Scotland which could be trusted unswervingly to maintain English interests. There was an irreconcilable blood-feud between King Robert and the friends and adherents of the murdered Comyn. Edward II. left this party without support and without any definite plan of campaign, and between 1307 and 1310 Bruce crushed its members individually. A futile and half-hearted invasion led by Edward in person in 1310 did nothing to retrieve the balance, and for the next four years, Bruce, with the help of his brother Edward, and of the "Black" Douglas, not only expelled English garrisons from Scottish castles but was able to inflict great damage by raids upon the northern counties of England. At last, in 1314, Edward II. made a serious effort to recover his father's conquest and suffered at Bannockburn (June 24) the greatest disaster which an English army had ever sustained. The fight was not of Bruce's seeking; he had avoided a general action in 1310 in accordance with the usual Scottish policy of guerrilla warfare. A pitched battle was too great a risk in view of the comparative resources of the two countries, and it was an imprudent challenge accepted by Edward Bruce from the English governor of Stirling Castle in the summer of 1313 that led to what proved to be the only successful battle on a great scale ever won by the Scots over the English. But Bannockburn was won, and it was sufficient for the vindication of Scottish independence. Edward II. stubbornly declined to admit the accomplished fact, and for many years Bruce carried terror into the northern counties, and he also dealt a serious blow to English dominion in Ireland. It was not till after the deposition and murder of Edward II. that the regents for his son, Edward III., agreed to the Treaty of Northampton (1328), by which England acknowledged the independence of the Kingdom of Scotland.

Revival of the Conflict.—In the following year, King Robert died, leaving as his heir a son, David II. (1329–71), who, though only a child of five, had already been married, in accordance with a provision of the Treaty of Northampton, to Joanna, a daughter of Edward II. In 1330, Edward III. threw off the yoke of his mother and her paramour, Mortimer, who had deposed his father, and a new phase of the War of Independence began. It was then that the most disastrous effects of the murder of Comyn began to operate. Bruce had vanquished the Scottish opponents whose bitter enmity that deed had provoked, but they had resolutely refused to acknowledge his sovereignty or, in the mediaeval phrase, to "come into his peace." Their estates had been forfeited and they had taken refuge in England. Thus, when England had again a strong king and Scotland a weak one, there was at the English court a body of "Disinherited Knights," as they were called, who urged the young Edward to wipe out the shame of Bannockburn, deeply felt by his people, and to reconquer Scotland. The Treaty of Northampton, confirmed by an English Parliament, stood in the way, but the conditions of the treaty had not been fully carried out by the Scots. It provided for the restoration of the estates of a few of the disinherited, and the Scottish regent, Randolph, earl of Moray, a nephew of King Robert, felt that it was not safe to take this step while the exiles were in favour at the English court. It was an ominous circumstance that the new English king had invited from France Edward Balliol, the heir of John Balliol, who was known to be contemplating an attempt to regain his father's vassal throne. In the summer of 1332, while England and Scotland were officially at peace, Edward III. permitted Balliol to lead an army of the disinherited for the recovery of Scotland. The earl of Mar, who had just succeeded to the regency on Randolph's death, was defeated by Balliol at Dupplin Moor (Aug. 12, 1332), and, in September, Balliol was crowned at Scone as Edward I. of Scotland. The English king then openly espoused Balliol's cause and, abandoning his grandfather's final policy of complete annexation, reverted to the earlier project of a vassal kingdom.

Before Edward III. could come to Balliol's assistance his vassal had been ignominiously driven out of Scotland, but he led a large army to the siege of Berwick-on-Tweed, which had been recovered by Bruce in 1318. The Scots suffered a crushing defeat at Halidon Hill, near Berwick (July 19, 1333), and the town fell into English hands. Edward then modified his consent to the revival of the vassal kingdom by extorting from Balliol a cession of most of the south of Scotland (including the counties of Linlithgow, Edinburgh, Haddington, Berwick, Selkirk, Peebles and Roxburgh). This district passed under the administration of English officials, but Balliol, in spite of successive invasions of Scotland by his overlord in the years 1334–37, never established himself as a vassal king. Then there occurred another change in the political situation, involving effects similar to those which had followed the death of Edward I., 30 years earlier. In the autumn of 1337, Edward III. put forward his claim to the throne of France, and he at once lost interest in Edward Balliol's feeble pretensions and even in the defence of the ceded territory. The Scottish regents were left, as Robert Bruce had been left, to suppress Scottish traitors and expel English garrisons, and by 1341, Perth, Stirling and Edinburgh were in Scottish hands, the English had been driven out of a large area in southern Scotland, and the young David II. was brought back from France, whither he and his English queen had been sent for safety in 1334.

Scotland and France.—The diversion of English ambition from Scotland to France really marks the close of the War of Independence, but it also inaugurated a new series of hostile relations between England and Scotland. Although John Balliol had made his original defiance of Edward I. in the assurance of support from Philip IV. of France, the help given by the French in the earlier stage of the struggle for independence had been negligible. In 1298, Philip agreed to a truce, and again in 1303, the darkest hour in Scottish history, he had concluded a permanent peace with England. When the struggle began again, however, the French, under Philip VI., had given refuge to the young David II., and French support of Scotland was one of the reasons for the English attack upon France. When that attack began in earnest, in 1346, Edward III. offered to restore the portions of Scotland which were still in English hands on condition of Scottish neutrality in the Anglo-French war. The Scots made a decision which, as time went on, they declined, on several occasions, to revoke. The explanation of their persistent adherence to a Franco-Scottish alliance lies in their conviction that no peace with England could possibly be permanent. If the English became the masters of France, they were not likely long to acquiesce in the existence of a small independent kingdom on their northern borders. If they failed to establish English dominion in France, they were equally sure to seek such compensation as a conquest of Scotland would afford, and the Scots, if they deserted France in her hour of need, could expect no help in their own. The Franco-Scottish alliance, as a factor in European history, began in 1346, when David II., invading the north of England in the interests of France, was defeated and captured at the battle of Neville's cross, fought near Durham on Oct. 17, about two months after Crecy. The English at once re-occupied a large area of southern Scotland and thus provided an unanswerable reason for the maintenance of Franco-Scottish friendship. While England held portions of France and of Scotland, an alliance of her two victims was inevitable. There was, indeed, no other bond of union between French and Scots, and the political alliance was by no means always a happy or cordial arrangement, although France took, in the development of Scottish civilization, the place which had been held by England before the War of Independence, and profoundly influenced Scottish law and institutions as well as manners and customs.

The Ransom of David II.—Scottish intervention in the Anglo-French war proved to be rather irritating than actually dangerous to England, and Edward III. made a remarkable attempt to get

rid of the complications which it involved. His prisoner, David II., was childless and extravagant; he hated his heir, Robert the Steward, the son of his half-sister and his own senior by some years. David was released in 1357 and the Scots undertook to pay a heavy ransom in instalments spread over many years. The Scottish Crown was thus impoverished, and David, who had been kindly treated in London and had made many friends in England, listened to a suggestion of the English king that the ransom should be commuted for an acknowledgment of an English prince as the heir to the throne of Scotland. The son of Robert Bruce actually made this proposal to the Scottish parliament, which contemptuously repudiated it. The long-continued negotiations for the ransom of David II. brought about an important change in the parliamentary constitution of Scotland. Whatever it may have derived from the Celtic heritage of the Kingdom, the Great Council of the land has been organized by the descendants of Malcolm Canmore upon an English model. It was both the supreme court of law and an advisory council of the sovereign, and it was composed of the tenants-in-chief, clerical and lay. To these two estates of the realm, the clergy and the barons, was added in the middle of the 14th century a third estate, consisting of representatives of the royal burghs. The financial help of the burghs was required for the payment of the ransom, and it was therefore necessary to secure their concurrence in the decisions taken by parliament. The presence of burgess representatives in parliament, or in the less formal meetings of the estates known as general councils, cannot be shown to have exercised any notable influence upon either the authority or the policy of the Crown, but it may be traced in a long series of legislative measures dealing with trade, commerce and police.

THE CONFLICT BETWEEN THE CROWN AND THE BARONS

The Early Stuart Kings.—The War of Independence, and the subsequent warfare with England, deeply affected the relations between the Crown and the great baronial families. The distribution of the estates of the "disinherited" among Bruce's supporters was one of the causes of the dangerous greatness of the House of Douglas and of other Scottish families, and, in the course of the English wars, the Crown was frequently weakened by the premature deaths of monarchs and by the recurrence of minorities. The initial weakness of the Crown, after the death of Robert I., was, however, due not to such accidents, but to the personality of his first three successors. David II. was a futile ruler and a worthless man, and the determination of the Scots to maintain their independence receives additional proof from the circumstance that his reign did not witness its loss. When he died in 1371, the nephew who succeeded him, Robert II. (1371–90), the first monarch of the House of Stuart, was 55 years of age, and already worn out by a strenuous public life. His reign was largely spent in conflict with England, but he took no part in the warfare. Scotland had been included in truces between England and France, and when the Anglo-French struggle entered on a new phase in 1377, the Scots renewed their efforts to expel the English from the occupied country in the south, and their success provoked invasions by John of Gaunt and by Richard II., which resulted solely in devastations of Scottish soil. The best remembered incident was the battle of Otterburn (1388), a chivalrous and romantic episode, but negligible as a military event. The next king, Robert III. (1390–1406), was a lame old man who with some reason described himself as "the worst of kings and the most wretched of men." His legitimacy was doubtful, and he made no effort to repress the disorders which were rampant in the country. During the early years of his reign the Government was in the hands of his younger brother, the earl of Fife, whom he created duke of Albany, but in 1399 his eldest son, the duke of Rothesay, ousted his uncle from the regency. There was a bitter feud between Rothesay and Albany, the latter of whom recovered power in 1401. In the following year Rothesay died mysteriously at Falkland (the story is told in Scott's *Fair Maid of Perth*), and rumour, which has crystallized into tradition, ascribed his death to Albany. The old king was alarmed by the fate of his heir, and, early in 1406, he sent his remaining son, Prince James, to be educated in France. The boy was captured by the English at sea, and Robert III. died when the news reached him. The reign of James I. nominally covers the years 1406–37, but he was a prisoner in England till 1424, and during this period Scotland was governed by Albany until his death in 1420 and thereafter by his son, Murdoch, 2nd duke. The regency of the elder Albany witnessed the foundation of the first Scottish university (St. Andrews, 1411)—partly an endeavour to repress the Lollard heresy which had reached Scotland—and the battle of Harlaw, which has frequently been misinterpreted as a decisive struggle between Celt and Saxon in Scotland. It was, in fact, a fiercely fought skirmish between Donald of the Isles, a grandson of Robert II., who claimed the earldom of Ross in right of his wife, a member of a Lowland family, and the burghers of Aberdeen, reinforced by the earl of Mar and other Aberdeenshire lairds. Donald, having defeated the Mackays and the Frasers, Highlanders who opposed his claim, was marching to plunder the town of Aberdeen. Like other disaffected Scottish barons, he had made an alliance with England, and Harlaw was an episode in Anglo-Scottish warfare. Albany made considerable progress in the recovery of southern Scotland from the English, and he also encouraged the recruitment of Scottish soldiers for the struggle in France. In the year after his death the Scots rendered their most distinguished service to the French in helping to win the victory of Baugé (1421), the first French success since the invasion of France by Henry V. of England.

The first two Stuart kings had been feeble rulers, and though the elder Albany was a strong man, his position, and possibly his personal ambitions, prevented him from suppressing the feudal anarchy which threatened the monarchy and paralyzed the central administration. James I., who was released on payment of a ransom in 1424, was fearless and determined, and he resolved to establish order and good government—in his own words, to "make the key keep the castle and the bracken bush the cow." He was merciless in his treatment of the great barons, and he roused many enemies. He tried to find support for his reforms in widening the membership of the Great Council or Parliament by establishing a representative system for the lesser barons whose technical obligation to attend its meetings had never been enforced, but the statute passed in 1428 for this purpose was inoperative. None the less, the parliaments of the reign passed a long series of beneficent legislative measures; the king's difficulty lay in enforcing them. In 1437 he fell a victim to a conspiracy organized by the earl of Athol, a relative who, if the legitimacy of Robert III. had not been recognized, would have been the rightful occupant of the throne. His son and successor James II. (1437–60) was a child of six, and the advance made by the central government during the personal rule of James I. was lost in the intrigues and factions of a minority. When James II. began his personal rule, the great House of Douglas, in spite of sustaining a severe blow by the murder of its young chief in the course of the royal minority, was a grave danger to the supremacy of the Crown. James found a pretext for invading the Douglas dominions while the 8th earl of Douglas was on a pilgrimage to Rome, and Douglas, on his return, made a league with his three brothers, Archibald, earl of Moray, Hugh, earl of Ormond, and John, lord of Balveny, and with a great northern magnate, the earl of Crawford. The king heard of the league and sent for Douglas to Stirling Castle, giving him a safe-conduct. The earl refused to break the bond into which he had entered, and James, losing his temper, stabbed him and wounded him fatally (Feb. 1452). An obedient parliament found that the Earl was "guilty of his own death by resisting the king's gentle persuasions to aid him against rebellious subjects," but the murder was necessarily the signal for a final conflict between the Crown and the House of Douglas. James defeated the Douglases on the battlefield and captured their strongholds, and the 9th earl fled to England to reappear in Scotland in the next reign.

Recovery of Southern Scotland.—The Douglases had been involved in many intrigues with England, but they had played a notable part in the recovery of southern Scotland, and by the year 1460 this task had been completed except for the town of Berwick-on-Tweed and the castle of Roxburgh; the town of

Roxburgh, once one of the leading Scottish burghs, had been entirely destroyed in the course of more than 160 years of almost continuous warfare. The outbreak of the Wars of the Roses in England afforded a suitable opportunity for the recovery of the castle, and James besieged it in the summer of 1460. He himself, interested in the growing use of artillery, was watching the operations of his gunners, when he was hit and killed by "a piece of mis-framed gun that brak in the shooting," and Scotland was again plunged into the woes of a minority. Roxburgh Castle was taken a few days after the king's death, and with the expulsion of the English from Scotland, the real reason for the Franco-Scottish alliance had come to an end. While the English held large portions of France and of Scotland alike, an alliance of their two enemies was inevitable, and James I. had repeated the Scottish refusal of English offers of friendship on condition of Scottish neutrality in the French war. The Scots had rendered greater military assistance to the French than they had received from them, but it was the French who bore the brunt of the conflict against the common enemy, and, in negotiations with the English, they never failed to protect Scottish interests. By 1460 the alliance had served the purpose for which it was formed; the English held only Calais in France and Berwick in Scotland.

The Reign of James III.—During the minority of James III. (1460–88), the Scots took advantage of the civil war in England to obtain the cession of Berwick-on-Tweed from Margaret of Anjou, the wife of Henry VI., giving in return some help to the Lancastrian cause. Edward IV. retaliated by an intrigue with the Lord of the Isles, but the Scots recognized the accomplished fact of Yorkist supremacy in England and a truce was made in 1463 and converted into a peace in 1464. During the first years of the minority of James III., Scotland was ruled by a statesman, Bishop Kennedy of St. Andrews, and though there were troubles after his death, the young king, when he assumed the government in 1469, began his reign in fortunate conditions. There was peace with England; his father had destroyed the perilous greatness of the Douglases; his marriage with Anne of Denmark led to the recovery of the Orkney and Shetland islands, which had been Scandinavian for centuries; and the prestige of the kingdom was enhanced by the creation of the metropolitan see of St. Andrews in 1472. Four years later the Lord of the Isles was reduced to submission by an army led by some of the great barons whose ambitions had hitherto been dangerous to the Crown. Yet James III. was one of the most unfortunate of the Stuart kings. His nobles complained that he "delighted mair in music and policy of building than in the government of his realm," and they preferred his brother, the duke of Albany. The brothers quarrelled, Albany fled to France, and James was sufficiently unwise to break the peace with England, where the 9th earl of Douglas was still in receipt of an English pension. With Douglas as an intermediary, Edward IV. made a treaty with Albany for his establishment on the Scottish throne as an English vassal, and for the restoration of the House of Douglas. Albany, calling himself Alexander, king of Scots, led an army to the Borders, accompanied by Richard, duke of Gloucester (afterwards Richard III.). Gloucester retook the town and castle of Berwick-on-Tweed, which thus passed finally out of Scottish hands (1482), and Albany invaded Scotland. The army which James led to meet him brought about a revolution; the nobles, under the leadership of the earl of Angus, the head of the Red Douglases who had risen on the ruins of the older or Black Douglases, seized and hanged the musicians and architects who were the king's friends, and made an agreement with Albany. The amusing story of how Angus gained his nick-name, Archibald-Bell-the Cat, is told in Scott's *Tales of a Grandfather*. In the following year, Albany was again an exile in England, and in 1484 he and Douglas again invaded Scotland with a small English force, but were defeated. Albany escaped to France, where he was killed in a tournament in 1485, and the 9th and last earl of Douglas died a prisoner in the monastery of Lindores.

Four years later James III. was killed in a civil conflict. The faction of the nobility which conspired against him and defeated him at Sauchieburn, near Stirling (June 1488), had seized the person of his son and heir, the prince of Scotland, and brought him to the field against his father. This circumstance indicates the permanent character of the change in Scottish politics brought about by the victory of James II. over the Douglases. Neither of the two rebellions against James III. was directed against the dynasty, and each of them was the result of widespread political opposition to the king's conduct of public affairs, and not of secret conspiracies inspired by jealousy of the House of Stuart. It is also significant that, in 1488, the rebels made a defence of their action on political grounds; rebellion, for the first time, admittedly required an excuse capable of being stated openly. The revolution was followed by indications of a tendency towards constitutional government and an assertion of parliamentary authority, but this tendency did not survive the assumption of power by James IV. (1488–1513) in person. He was an able and strenuous ruler, and he soon acquired complete control over the traditionally amenable Scottish parliament. He humbled rebellious barons, who, either as partisans of the late king, or for other reasons, resisted him, and he annexed to the Crown the title of Lord of the Isles and by personal visits established royal authority in the Hebrides.

SCOTLAND, ENGLAND AND FRANCE

Union of the Thistle and the Rose.—James IV. aimed at acquiring for Scotland a place in European politics. The causes which, for nearly two centuries, had compelled his kingdom to follow the policy of France had ceased to operate, he was himself related to the rulers of Denmark and Burgundy, and he was ambitious of a marriage alliance with Spain, then under Ferdinand and Isabella. He built a Scottish navy and challenged England on the seas. In alliance with the Emperor Maximilian and the duchess of Burgundy, he supported Perkin Warbeck's pretensions to the throne of Henry VII., and made a half-hearted invasion on his behalf. The Spanish sovereigns were in frequent communication with James and sent to Scotland an envoy who has left an interesting account of the social condition of the country in the last years of the 15th century. Failing to obtain a Spanish bride, he accepted Henry VII.'s offer of the hand of his elder daughter, Margaret, whom he married in 1503. The marriage, celebrated by the poet Dunbar as the Union of the Thistle and the Rose, implied a fresh orientation of Scottish policy and dealt a blow to the tradition that Scotland must always be on hostile terms with its great neighbour, and a period of some 15 years of peace brought a great increase of commercial prosperity to Scotland. But James, on more than one occasion, indicated to Henry VII. that he had no intention of being ruled by his father-in-law, and he continued to build a great navy. Peace was maintained while Henry VII. lived, but the accession of Henry VIII. soon placed before James the old alternative of friendship with England or with France.

Flodden Field.—The formation of the Holy League against France alarmed the Scottish king, who dreaded the effect upon Scotland of the destruction of France by a great European combination. That France was in no such danger as he imagined is proved by the circumstance that, a year later, Henry VIII. married his sister to Louis XII., but it is easy to understand James's alarm. He was willing to yield to his brother-in-law on other points of dispute which had arisen between the two sovereigns, but he resolved to maintain the traditional Scottish policy of helping France in her hour of need. It is, however, significant that the royal decision was persistently opposed by the older and wiser councillors, who, though themselves trained in the French tradition and bound to France by many personal ties, realized that circumstances had changed, and that what had been wisdom less than a century earlier was likely to be folly in the new conditions. This view found expression, a few years later, in the *History of Greater Britain*, by a famous Franco-Scottish scholar, John Major, who urged the expediency of a union of Scotland with England. James took his own way and in Sept. 1513 he was defeated and killed in the battle of Flodden. His heir was an infant, and Scotland, overwhelmed by a great national disaster, was again subjected to the intrigues of a minority. The navy,

upon which James IV. had lavished care and money, was sold to France, and the country did not recover, for at least a century, the prosperity which had marked his reign.

The Regency of the Duke of Albany.—James, by will, had left his English wife as the guardian of his infant son, James V. (1513–42), and she might have secured the regency if she had not married a Scottish nobleman, the earl of Angus, in 1514. Her second marriage rendered her position impossible and the Scots invited Alexander, duke of Albany, the son of the traitor duke of the reign of James III., to become regent. Albany, who had been born and educated in France, spoke no language but French and he spent a considerable portion of his regency (1515–24) in Paris. If Margaret and Angus had set themselves resolutely to champion English influence in Scotland, they could have smoothed the way of English diplomacy. But Margaret, a true sister of Henry VIII., quarrelled with her second husband and tried to obtain an annulment of her marriage, disregarding Henry's remonstrance that she had chosen her husband and, by the laws of God and man, was bound to stick to him. Angus maintained the Douglas tradition of intrigue with England, but Margaret, dominated by hatred of her husband, frequently acted in the interests of France and checkmated English designs in Scotland. In July 1524, Margaret, in conjunction with the earl of Arran, heir-presumptive to the throne, declared the young king to be old enough to rule in person, but Arran deserted her and made friends with Angus, who governed the kingdom until 1528, when James, who hated his stepfather, made a romantic escape from his control.

James V. and Henry VIII.—Under the influence of his mother, who had been freed from Angus by a decision of the Papal Court in 1527 and had therefore no reason for hostility to Henry VIII., James, for a few years, was on friendly terms with his uncle. After the English breach with Rome, when Henry felt his isolation in Christendom, he urged his nephew to follow his example and enrich himself with the spoils of the monasteries. The Reformation was, by this time, making some progress in Scotland, but James, though he recognized the need of a reformation of the lives of the clergy, had no sympathy with the new doctrines, and he was not prepared to adopt Henry's methods. He made two French marriages; after his first wife, a daughter of Francis I., died, as a bride, in 1537, he married Mary of Guise, widow of the duc de Longueville. Henry, however, persevered in trying to detach James from his French alliance and to alienate him from Cardinal Beaton, the leader of the Church Party; he continued to urge him to dissolve the monasteries, and made various attempts to arrange a personal interview; we now know that he intended to kidnap him. James declined his uncle's overtures and refused to give him a chance of seizing his person, and Henry broke off friendly relations, revived the claim of homage, and sent armies to invade Scotland.

James was not supported by his nobility. His conflict with Angus had embittered his relations with the great families at the beginning of his reign; he offended the Border chiefs by restoring order in the Borders, and in carrying out his father's policy in the Western Isles, he quarrelled with the earl of Argyll. The result was that he had come more and more to rely upon the support of the clergy, and by this and by the employment of favourites he still further alienated the nobles. The opposition of the Scottish nobility to James V. was stimulated by the Tudor methods of bribery, and their eyes were fixed on the spoils of the church. They refused to support James in what they called a French war, and it was Beaton and the ecclesiastical party that furnished James with the army that was routed at the battle of Solway Moss in Nov. 1542. The king's health had prevented his taking part in the fighting, and he returned to Falkland Palace, where he died on Dec. 14, six days after the birth, at Linlithgow, of his daughter and heiress, Mary Queen of Scots.

The Minority of Queen Mary.—The death of his nephew gave Henry VIII. a great opportunity which he failed to use, for the new rulers of Scotland might have been persuaded to accept the Reformation and seize the lands of the Church. The regent, the earl of Arran (a son of the Arran of the preceding reign, and, like his father, heir-presumptive to the throne) was appointed in defiance of the efforts of Beaton and was known to incline to the new doctrines. Henry succeeded in negotiating, in July 1543, the preliminaries of a marriage treaty between his heir (afterwards Edward VI.) and the infant Queen of Scots, but he followed up this success by making demands which the Scots indignantly refused, and he was known to have plotted to kidnap the regent and the queen-mother, Mary of Guise. The result was a reconciliation between Arran and Beaton and the repudiation of the English marriage treaty (Dec. 1543). If Henry had been patient he might have won in the end, for Arran and Beaton were likely to quarrel, and the temptation to dissolve the monasteries during a minority of the Crown would have been very strong. But Henry lost his temper, and his brother-in-law, the earl of Hertford (afterwards Protector Somerset), ravaged southern Scotland in 1544 and 1545—his merciless campaigns were derisively known as "the English Wooing." Scotland was thus thrown once more into the arms of France, and the murder of Beaton, the leader of the French party, in his own episcopal castle of St. Andrews (1546) did not affect the political situation. His murderers were glad to have English help in defending the castle of St. Andrews, but a national alliance with England was impossible for the time.

Protector Somerset carried on the policy of Henry VIII. His personal attitude to the Scottish problem was wiser than that of his late master; he aimed at a union on equal terms, and, if he had come into power in 1542 instead of in 1547, the course of events might have been widely different. As it was, all that he could do was to employ force in an endeavour to sever the Franco-Scottish alliance, and in this he completely failed, though he gained some military reputation by his third invasion of Scotland and his victory at Pinkie in Sept. 1547—the last of the old battles between England and Scotland. Meanwhile, the Scottish Government had, with French help, captured the castle of St. Andrews (July 1547), and the Regent Arran entered into negotiations for a marriage of the girl queen to the heir of the French throne. In Aug. 1548 Mary was sent to France, where she remained for 13 years. The French continued to assist the Scots to recapture strongholds taken by the English, and the Auld Alliance seemed to be more firmly cemented than ever when peace was made with England in 1551.

End of the French Alliance.—But France had become too great a Power to treat Scotland on equal terms, and Henry II. was determined to make the country a province of France. Arran was bribed to resign the regency in favour of Mary of Guise, and the new regent, as her recently published correspondence shows, became an agent of French policy. She was surrounded by French advisers—a Frenchman shared with the earl of Huntly the dignity of the chancellorship—and she relied upon the services of French soldiers, who had always been unpopular in Scotland. The Scots were alarmed. They spoke of Scotland as threatened with the fate of Brittany, and parliament in 1555 had to pass an act against slanderers of the queen regent and of the French troops "sent for the common weal and suppressing the auld enemy." There were several outbreaks against the French garrisons. Anti-French feeling was stimulated by the growth of the Reformed doctrines, which had been spread by the "cartloads of Bibles" that Somerset is recorded to have brought with him. In 1557, the Scottish Protestants formed a league which they called "the Congregation of the Lord," and signed the first National Covenant in the interests of Protestantism.

The marriage of Queen Mary to the Dauphin in April 1558 was celebrated with due rejoicings in Scotland, but it rather injured than assisted the French cause, for there was a suspicion, which is now known to have been well-founded, that agreements signed by the girl-queen on her marriage formed a danger to the independence of the country. Mary had, in fact, been induced to sign documents which, in the event of her decease without issue, transferred the succession to the French king and his heirs, a stipulation which directly contravened assurances solemnly given by Henry II. to the Scottish parliament.

The Lords of the Congregation.—The revolt of the Scot-

tish Protestants against the French alliance and the Roman Church was hastened by events in England. While Mary Tudor lived, they could form no English alliance, in spite of the English queen's hostility to France. When Elizabeth succeeded in Nov. 1558, Henry II. was guilty of the foolish insult of asserting the claim of his daughter-in-law to the English throne as the nearest heir of Henry VII.—Elizabeth being, in the eyes of Roman Catholic Europe, an illegitimate child. It was, therefore, in the interests of England to help the Scottish Protestants against the Scottish Government, and it happened that the queen regent chose this unfortunate moment for severe measures. In 1559 she denounced the Protestant leaders as heretics, and their reply came in the form of the destruction of the religious houses at Perth. Alarmed by the outbreak, Mary of Guise promised not to send a French garrison to the city, but her arrival at Perth with a personal bodyguard of French soldiers was interpreted as a breach of her promise. The destruction of religious buildings continued, and the Protestant leaders, known as the Lords of the Congregation, invited English help. Henry II. was killed in the summer of 1559, and the king of France, Francis II., became, in right of his wife, king of Scots. The Guises were the Government of both France and Scotland, and France, just released from the burden of a Spanish war, was free to prosecute its policy in Scotland. But the Lords of the Congregation gave the Scottish Government no time for preparation. In Oct. 1559 they announced the deposition of the queen regent, and asked Elizabeth "to accept the realm of Scotland into her protection and maintenance, only for preservation of them in their old freedom and liberties, and from conquest, during the time the marriage shall continue between the Queen of Scots and the French King."

QUEEN MARY IN SCOTLAND

The alliance between Elizabeth and the Protestants marks the end of the Franco-Scottish League and the triumph of the Reformation in Scotland. An English fleet besieged Leith, and the queen regent, stricken with mortal illness, took refuge in the castle of Edinburgh, where she died in June 1560. There was no one to represent the authority of the Crown, and a Scottish parliament, the legality of the summons of which was doubtful, abolished Roman Catholicism and prohibited under severe penalties (culminating in capital punishment) the celebration of Mass. The parliament of 1560 secured the *de facto* establishment of Protestantism, though its legislation was not ratified by the Crown. Mary's husband died in Dec. 1560, and she returned to Scotland in Aug. 1561. At first she was guided by her half-brother, whom she made earl of Murray. Any attempt to restore her own religion was out of the question. The utmost that Mary could seriously hope for was a toleration for Roman Catholics, and her efforts to secure this were unsuccessful. She could not even protect the worship of her own attendants in her own chapel, and John Knox afterwards said that on her first arrival, he could have "executed God's judgments upon her" if he had chosen to do so. England and Protestantism were definitely in the ascendant, and the new Church became stronger than ever when, in 1562, Murray secured Mary's acquiescence in the suppression of the earl of Huntly, the most powerful Roman Catholic nobleman in Scotland.

Darnley and Rizzio.—A marriage with a foreign prince might have strengthened Mary in Scotland, but she was restrained from this course by her position as heiress-presumptive to the English Crown. Nine years younger than Elizabeth, Mary judged that she would outlive her, and the main aim of her policy was to secure a recognition of her claim to the succession in the event of Elizabeth dying without issue. Elizabeth threatened that if Mary made a marriage with a foreign prince, steps would be taken to debar her succession to the English Crown, and, for some years, she amused herself with insincere suggestions for the Scottish queen's marriage. In July 1565, Mary married her cousin, Henry, Lord Darnley, who, as the representative of their grandmother, Margaret Tudor, by her second marriage (with the earl of Angus), stood next to Mary herself in the succession to the English throne. He was also next to the Hamiltons in the succession to the Scottish throne. Elizabeth had allowed Darnley (who had been brought up in England) to go to Scotland, and the marriage was in no way antagonistic to English interests; but she declared herself offended and secretly sent aid to Murray, who raised a rebellion against the marriage. Her people supported Mary, and Murray fled to England. Darnley proved an impossible husband, and his foolish ambition sought a somewhat mysterious right known as the Crown Matrimonial, which would have secured the throne to him for life and might even have given his children by a second wife precedence over the Hamiltons in the succession to the throne. He had made many enemies, and no friends, in Scotland, and Mary's Italian secretary, David Rizzio, was known to have advised Mary to refuse her husband's request. Darnley became involved in a plot for the murder of Rizzio. The murder was only a small part of the design of the conspirators, who included Murray and the other exiles in England and their friends in Scotland. Darnley was led to believe that his accomplices would give him the authority of a king regnant. Rizzio was murdered on the evening of March 9, 1566, and, the same night, Murray arrived from England, where Elizabeth had been cognizant of the plot. Then Mary, in an interview with her husband, persuaded him that he was the dupe of his accomplices, and, on the night of March 11, husband and wife escaped from Holyrood, and fled to Dunbar. Public opinion again supported Mary, and, while Murray remained in Scotland, the nobles who had taken part in the Rizzio murder had to flee to England. Darnley disavowed any knowledge of the plot, and bitterly opposed any suggestion of pardon for his fellow-conspirators, who supplied Mary with full evidence of his guilt.

Mary's two successes alarmed the Protestants, and if Mary could have retained her hold over Darnley, the Reformed Church might have been in some danger. But the birth of a son, Prince James, in June 1566, was followed by a violent and permanent quarrel between the unhappy parents. Darnley's enemies were resolved to have his life, and when the accomplices whom he had betrayed were allowed to return to Scotland at the end of 1566, he was a doomed man. But the enemies of Darnley were also the enemies of Mary, and they found in the earl of Bothwell, a tool for the destruction of both. Darnley was murdered on Feb. 10, 1567, at Kirk-of-Field, in the outskirts of Edinburgh, and his murderers, by blowing up the house with gunpowder, made sure that no alternative explanation of his death should be feasible. Bothwell was known to be a principal actor in the crime, and a collusive trial did nothing to weaken the belief in his guilt. On May 15 Mary married Bothwell. There was another rebellion, the queen had been discredited by the Darnley murder and the Bothwell marriage, and she had no option but to surrender to the rebels (June 15). The question of Mary's guilt or innocence of her husband's murder is rather biographical than historical (*see* CASKET LETTERS). Guilty or innocent, she could not retain her authority after what had happened. If, as in the present state of the controversy unfortunately seems probable, there was a domestic conspiracy between Mary and Bothwell, Darnley's death was not merely the result of a plot between a guilty wife and her paramour. If Mary was an accomplice of Bothwell, she was also the unconscious tool of a wider conspiracy, the members of which, after she and Bothwell were both out of the way, fell to accusing each other of a share in the murder of Darnley.

Mary's Abdication.—The insurgent lords imprisoned Mary in Lochleven Castle and forced her to abdicate in favour of her infant son, and Murray extorted from her an assent to his own appointment as regent. Within a year, she escaped from Lochleven, and a few days later her army was defeated at Langside. Relying on an invitation sent by Elizabeth to her in Lochleven, Mary took refuge in England, where she was imprisoned by the English Queen (May 1568). Her vigorous and attractive personality had introduced a new element into Scottish politics, for, in her army at Langside were Protestants whose interest in the struggle was loyalty to the queen, and during the first years of her English imprisonment, her party in Scotland, which gave considerable trouble to successive regents, was, for a variety of reasons, maintained by two Protestants, Maitland of Lethington

and Kirkcaldy of Grange. Her fall meant the complete triumph of English influence, for Elizabeth had only to threaten to release her prisoner in order to exert pressure on the regents. The Regent Murray (1567–70), the Regent Lennox (1570–1), the Regent Mar (1671–2) and the Regent Morton (1572–8) were all on friendly terms with Elizabeth, and they had English help in the civil war between the king's party and the queen's party. The troubled state of the country, until the capture of Edinburgh Castle in 1573 put an end to the resistance of Mary's adherents, is illustrated by the fate of the first two regents. Murray was assassinated and Lennox died of wounds received in a skirmish at Stirling.

THE STRUGGLE BETWEEN THE CHURCH AND THE CROWN

Andrew Melville.—Mary's fall also meant the complete triumph of Protestantism, and the Protestant Church was legally established by parliament in 1567. Its early organization was the work of John Knox, and the presbyterian system which became its characteristic feature was introduced by Andrew Melville, under whose guidance the General Assembly (*see* SCOTLAND, CHURCH OF) insisted upon the essential parity or equality of all ministers and abolished a modified form of episcopal government which had originated in Knox's institution of superintendents charged with the oversight of districts corresponding to the old dioceses. The superintendents, who had come to be known as bishops, were purely administrative officers and did not claim to possess orders superior to those of the ordinary clergy. Their administrative powers were conferred in 1580–81 upon the courts of the Church known as Presbyteries. Under Melville, the Church developed a claim which had been less rigidly advanced by Knox—that the ecclesiastical authority, the Power of the Keys, is different from, and independent of, the civil power. This theory was bound to produce a conflict between Church and State, and it was maintained so thoroughly that the ministers claimed to be responsible for their pulpit utterances to the Church courts and to them alone, and this at a time when ecclesiastical considerations affected every question both of domestic and foreign policy. The claims of the Church caused friction with the earl of Morton, and, after his fall, the young James VI. (1567–1625) waged an incessant struggle against them, and, even before his accession to the English throne, had established a royal control over the Church.

James VI., Mary and Elizabeth.—Morton was compelled to resign the regency in 1578. He made a temporary recovery of influence, but in June 1581 he was executed for his share in the Darnley murder, and James, at the age of 15, became responsible for the Government. He roused opposition by relying upon a Roman Catholic favourite, Esmé Stuart, a cousin of Darnley, whom he made duke of Lennox. The favourite professed a conversion to Protestantism and James tried to suppress any alarm by initiating a new National Covenant (1581) which denounced "the usurped authority of that Roman Anti-Christ," but the extreme Protestants kidnapped James in the raid of Ruthven (1582), and Lennox had to flee. In 1583 James escaped from his captors and fell under the influence of a new favourite, whom he created earl of Arran. A rebellion was nipped in the bud, and the earl of Gowrie, one of the leaders of the raid of Ruthven, was executed. During this time James was in friendly negotiations with his mother, and he intrigued with the duke of Guise, and even with the pope. Elizabeth, on her part, was encouraging the opposition to James, as she had encouraged the opposition to his mother and grandmother. But James was alarmed by the rise of the Catholic League in France, his success in dealing with Gowrie made him less desirous of possible aid from Roman Catholic powers, and Arran persuaded him that his best chance of the English succession, on which his heart was set, lay in friendly relations with Elizabeth. Arran fell a victim to his own advice, for Elizabeth distrusted him, and when James came to terms with her, he dismissed him. In the end of 1585, James made an offensive and defensive league with England, and when, a year later, Mary's life was in danger, he refused to risk his chance of the succession by threatening to break the league if Elizabeth should put his mother to death. The approaching Spanish invasion made the friendship of Scotland more important to England than it had ever been before, but James made no real effort on Mary's behalf and apologized for such efforts as he did make. The execution (Feb. 1587) caused intense indignation in Scotland, but James succeeded in keeping the country quiet, and in the following year he took steps to resist the Armada.

James and Spain.—While James would not imperil his English claims for the sake of his mother's life, his impatience with Elizabeth's longevity led him to take grave risks by intrigues with the enemies of England. In 1589 he aroused suspicion by his lenient treatment of two Roman Catholic earls, Huntly and Errol, whom Elizabeth's ministers had detected in correspondence with Spain, and in 1592, the English Government came into possession of the "Spanish Blanks," a series of papers bearing only the signatures of Huntly, Errol and Angus. Letters from these earls which accompanied the blank forms showed that the "Blanks" were intended to contain a treaty with Spain for the invasion of England, and it was proved that James was aware of the project. His views on what could be said for and against it are preserved in a document in the *Hatfield Papers*, vol. iv., p. 214. It was only because Cecil regarded James as the least of the possible evils from among which England would have to choose on Elizabeth's death, that action was not taken to incapacitate him from succeeding her. Elizabeth meanwhile retorted by intrigues with James's Protestant opponents in Scotland, and it was not till the last year of her life that the relations between the two sovereigns were really friendly.

James and the Church.—Meanwhile, James had been pursuing his quarrel with the Church. After the execution of Gowrie in 1584, he took vengeance on the earl's Presbyterian supporters by persuading parliament to pass the "Black Acts," which asserted a royal headship over the church and empowered the sovereign to appoint bishops and to decide when assemblies should meet. He tried to meet the challenge to the civil power which was involved in the authority claimed and exercised by the assembly, by means of an increase in the prestige of parliament, and in 1587 an act was passed instituting a representative system for the smaller barons in the counties. But the parliament was, at the same time, brought so completely under royal control that it never rivalled the influence of the assembly. The Spanish intrigues of the Catholic earls strengthened the Presbyterian Party and James in 1592 had to permit parliament to pass the "Golden Act" which gave a legal status to the church courts and repealed the legislation of 1584 in so far as it interfered with the freedom of the Church. Two years later he was compelled to suppress the Catholic earls, but a quarrel with the Church in the end of 1596, in which the ministers adopted an untenable position, gave him what proved to be a permanent victory. He acquired a large measure of control over the general assembly, and he obtained its sanction for the appointment of titular bishops, to whom he gave seats in parliament.

Plots and Conspiracies.—Up to the year 1603 James conducted his administration of Scotland under serious difficulties. The revenues of the Crown were insufficient to meet the expenses of Government, and, though, in 1596, a commission of eight leading Scottish statesmen, known as the Octavians, brought the royal finances into something like order, the king's political action and his personal expenditure were under the restraint of an impoverished exchequer. In 1587 pecuniary necessities led him to pass an act annexing ecclesiastical property to the Crown, an expedient which he soon found to be inconsistent with his ambition of restoring episcopacy in the Church. Like his predecessors, he had to be on guard against conspiracies. The raid of Ruthven was the only successful plot in the reign, but the outrages of Francis, earl of Bothwell (a nephew of Queen Mary's third husband), caused James some alarm, and, as late as 1600, the Gowrie conspiracy, if the king's very doubtful statements about it can be credited, was an attempt by the sons of the 1st earl of Gowrie to repeat the raid of Ruthven. It is to James's credit that he succeeded in introducing something like order into the Borders and the Highlands, even if the methods which he employed to attain

this end were cruel and unscrupulous.

The Union of the Crowns.—The accession of James to the English throne in March 1603 entirely altered his position in Scotland. Intrigues with the sovereign of England were no longer possible either for rebellious Scottish barons or for discontented Scottish preachers. The absence of English support rendered rebellion a dangerous expedient, popular opinion, absorbed in religious controversy, did not respond to the appeal of the traditional family feuds, and the nobles were more interested in the distribution of Church lands than in bands and conspiracies. The king was strong enough to punish private quarrels which led to disorder and bloodshed, and to dragoon the Highlands into something like obedience to the law. James, in governing Scotland, relied upon the Privy Council, but it was no part of his plan to establish a powerful bureaucracy, and it was the king's personal policy that the council carried out. But the experiences of his youth made him conscious of the limits of national acquiescence in a despotic rule.

The King's Victory over the Church.—That limit was most likely to be reached in ecclesiastical affairs. James was resolved upon transforming the titular episcopacy which he had established into an episcopate possessed of Anglican consecration and exercising real control over the clergy. His desire for episcopacy was purely political. He looked upon the form of church government as being, in itself, a "thing indifferent," but he held that church government in any State ought to harmonize with the civil government, and episcopacy agreed best with monarchy. His opponents, led by Andrew Melville, regarded episcopacy as unscriptural and therefore unlawful in a Christian Church, and believed Presbytery to be of divine institution. There was, therefore, no possibility of compromise, and, by a series of clever and unscrupulous tricks, James defeated the Presbyterian Party in the Church itself and secured complete control over the General Assembly. Parliament, which was always a facile instrument in his hands, passed in 1606 an act to acknowledge the sovereign authority of the Crown over all estates, persons and causes, ecclesiastical as well as secular, and repealed an act of 1587 which had annexed diocesan revenues to the Crown, thereby indirectly "abolishing the estate of bishops." In 1610 a General Assembly approved of an episcopal constitution of the Church, provided that the new bishops should be subject to the assembly. In the same year, James appointed bishops with Anglican consecration, and in 1612 parliament ratified the Acts of the Assembly of 1610, without reference to the authority of the assembly over the bishops. Such authority was, indeed, inconsistent with the powers enjoyed by the bishops both individually and in a court of high commission which James instituted on the English model.

Ecclesiastical Policy of Charles I.—The ecclesiastical policy of James VI., which did not include the abolition of the lower church courts of the presbyterian system, was successful. He had grafted bishops on to a Presbyterian Church, and, if no other considerations had intervened, his compromise might well have endured. He once disturbed it himself when, in 1618, he got a general assembly at Perth to sanction some innovations in ritual known as the Five Articles of Perth. This was the last occasion upon which he summoned an assembly; he intended that its place should be taken by the bishops. Parliament in 1621 ratified the Perth articles, though after an unusual display of opposition, and while the articles were willingly observed in the north-east, they led elsewhere to irreverent wranglings in church and to the deprivation of ministers and imprisonment of both ministers and laymen. In spite of some explosions of temper there are indications that James realized the danger, and, in his last years, refusals to conform to the Five Articles were frequently ignored. This cautious policy was at first maintained by Charles I. (1625–49), but when the new king visited Scotland for his coronation in 1633, he got parliament to pass an act ordering the clergy to wear white surplices in place of the Genevan black gown. In 1635 a Book of Canons for the Church of Scotland was issued by royal authority. The canons were intended to destroy the Jacobean compromise by making new provision for the discharge of the duties hitherto assigned to the lower presbyterian courts, and by making the government and ritual of the Church uniform with those of the Church of England. A prayer-book designed to supersede an optional service book which had been drawn up by John Knox was published in 1637, and the public use of *ex tempore* prayer was forbidden to ministers under pain of deprivation.

The National Covenant.—The challenge to Scottish custom thus made was ignorantly believed to be part of a scheme for the introduction of popery, and a riot against the new prayer-book in St. Giles's cathedral, Edinburgh, on July 23, 1637, proved to be the beginning of a revolution. The ecclesiastical quarrel came at a time when Charles had roused the opposition of the Scottish nobility by the provision which he made for the sustentation of the clergy and by the confidence which he reposed in the bishops, and when unusually heavy taxation had provided the middle classes with a grievance specially felt in Edinburgh, the burgesses of which had been forced to contribute to the erection of a new parliament house and to the expenses incurred in the foundation of the Bishopric of Edinburgh in 1633. It is possible that an immediate withdrawal of the prayer-book might have saved the situation, but Charles, in spite of warnings from the Privy Council, refused to give way, and his opponents formed an organization known as the Tables, which almost superseded the timorous Privy Council as the executive of the kingdom. In reply to a royal threat made in Feb. 1638, there was sent for signature throughout the country the National Covenant of 1638. It was the document to which James VI. had invited signatures in 1581, but it included an appended protest against recent innovations. Charles was at last alarmed and offered to withdraw the service book and to permit a free assembly and a free parliament to meet, but it was too late. The assembly was duly summoned, and it met at Glasgow in Dec. 1638. It proved to be a meeting of extreme Presbyterians—only Covenanters were admitted to its membership—and it defied the Royal Commissioner, pronounced sentence of deposition upon the bishops, and repealed all the legislation of former assemblies by which James VI. and Charles I. had established episcopacy.

THE CIVIL WAR AND THE COMMONWEALTH

The "Bishops' Wars."—An appeal to arms was inevitable, but the Covenanters (*q.v.*) were prepared for it and ready to send one army to force the Covenant upon the episcopal north-east and another to the Borders to meet such levies as Charles, then ruling England without a parliament, could raise. King and Covenanters met at Berwick in June 1639, and made a compromise by which the questions at issue were reserved for the decision of another parliament and assembly. Neither party was prepared to go to extremities. Charles was unwilling to summon an English parliament, without which he could not hope to coerce the Scots, and the Covenanters did not know what action an English parliament might take. The meeting of the Short parliament in the spring of 1640 convinced them that Charles had more to fear from an English parliament than they had, and when he was unwise enough to hesitate about carrying out the terms of the Pacification of Berwick, a Scottish force, under Alexander Leslie and the young earl of Montrose, invaded England in Aug. 1640 and occupied Newcastle. Charles had no force to bring against them, and by the Treaty of Ripon they remained at Newcastle, and a body of Scottish commissioners went to London to discuss terms of evacuation. The king at first hoped that the Scottish invasion would lead the Long parliament to give support to the Crown, but he soon found that the Commons regarded the Scots as allies, and, after the execution of Strafford, he tried to obtain Scottish support by yielding on all the points at issue. For this purpose he visited Scotland in 1641. He assented to the abolition of episcopacy, and agreed that the officers of State, the Privy Council, and the judges should be appointed with the sanction of the Scottish parliament. He showered honours upon his opponents, made the earl of Argyll a marquis and created Leslie earl of Leven. But, except for the adhesion of the earl (afterwards marquis) of Montrose, he failed to create a Royalist Party, and his visit was worse than useless.

The Solemn League and Covenant.—The royal surrender on all the points at issue left the Scots without any quarrel with Charles or any pretext for joining the English parliament in the civil war. But some Scottish ecclesiastics, who had been resident in London as Commissioners under the Treaty of Ripon, had become impressed with the Presbyterian atmosphere of the City of London and of the House of Commons, and had formed an ambition of establishing a Presbyterian uniformity between the Churches of England and Scotland. When, after the early campaigns of the civil war, both king and parliament asked for Scottish help, the advocates of this policy decided Scottish action. By the Solemn League and Covenant the Scots agreed to send an army into England to oppose the king, and the English parliament agreed to accept a reformation of the English Church. An assembly of English divines, with some Scottish assessors, was to meet at Westminster to settle the new constitution of the Church, but by the terms of the Solemn League, popery, episcopacy and schism (independency) were expressly excluded from the settlement. These terms included every known form of Church government except Presbytery, and, though the assembly of divines was nominally free to deal with the English ecclesiastical problem in its own way, it was really bound to accept the Presbyterian solution. The Scottish army, under Leven, made a substantial contribution to the parliamentary victory at Marston Moor, in July 1644, but the parliament, even with the help of the Scots, was unable to beat the royalists. That task was accomplished in 1645 by the New Model Army, but Cromwell and his soldiers were Independents, and though they, like other inhabitants of both England and Scotland, had been compelled to take the Solemn League, they were determined not to establish Presbytery as the only form of church government permitted in the island. Meanwhile, a large portion of the Scottish army was recalled to Scotland to defend the Covenanting parliament against Montrose, whose brilliant campaign in 1644–45 revived royalist hopes of victory. After Montrose's defeat at Philiphaugh (Sept. 1645) the king's cause was hopeless, and in May 1646 he surrendered to the Scottish army at Newark.

The Scots hoped to secure the assent of Charles to the Solemn League and a consequent union of king, parliament, and Scots against the army, but Charles, apart from his personal conscientious scruples, could not desert the Anglican Cavaliers who had fought for him. When he refused, the Scots surrendered him to the parliament, on condition of payment of part of the arrears due to the Scottish army for its expenses in the war. The development of events in England made it clear that the parliament could not fulfil the terms of the Solemn League, for power passed from the two Houses to the army. Chagrined at the failure of the scheme of a covenanted uniformity, under which Scotland had already abandoned its own Catechisms and Confession of Faith in favour of the documents produced by the Westminster Assembly of Divines, the Scottish parliament in 1647 entered into what was known as the Engagement with the king, then a prisoner in the Isle of Wight. The General Assembly with which the parliament had hitherto acted in harmony, strongly disapproved of this agreement by which Charles was to allow a three years' trial of the establishment of Presbytery in England—an insulting suggestion for what the Scots held to be a divine institution. The quarrel between Engagers and Anti-Engagers affected Scottish history for years to come. The army under the duke of Hamilton which, in accordance with the Engagement, invaded England, was defeated by Cromwell at Preston in Aug. 1648. The victory was also a triumph for the assembly over the parliament, and the Anti-Engagers, led by the marquis of Argyll, entered into friendly relations with Cromwell, and, obtaining a parliamentary majority, proscribed the defeated Engagers in the statute known as the "Act of Classes" which placed them in a class or category with the royalists as men incapable of holding any civil office or serving in the army.

Cromwell.—The execution of Charles I. created a revulsion of feeling in Scotland, and a proclamation of Charles II. as King of Great Britain offered defiance to the new English Commonwealth. The Scots, however, would not receive Charles in Scotland or give him regal authority until he signed both the National Covenant and the Solemn League. He hesitated for some time, but the execution of Montrose, who was captured after an abortive invasion in 1650, convinced him that he had no alternative but subscription to the Covenants, and he landed at the mouth of the Spey in June 1650, to find himself practically a prisoner in the hands of the Anti-Engaging section of the Covenanters. The defeat of the Scottish army by Cromwell at Dunbar (Sept. 3, 1650) went far to destroy the influence of the assembly and the Anti-Engagers, and not only Engagers, but even royalists, were exempted from the Act of Classes by a series of public resolutions passed in parliament in 1651. These resolutions produced a fresh division between Resolutioners and Protesters or Remonstrants. The breach thus produced survived the defeat of the army which Charles II. led to Worcester (Sept. 3, 1651) and also the rule of the Commonwealth and Protectorate.

For nearly nine years Scotland was under a military occupation, though the naked rule of the sword was partially disguised by the admission of Scotland into the United Commonwealth of England, Scotland and Ireland. Scottish administration, under Gen. Monck, was vigorous and efficient, but the impoverished condition of the country prevented it from reaping the full benefit either of the restoration of law and order or of the institution of free trade with England and the English colonies. The civil war, followed by Cromwell's campaigns, had serious economic results which were aggravated by the confiscation of royalist estates and by the introduction of a burdensome system of taxation, which, however, did not nearly cover the expenses of administration. On the religious side, the Cromwellian Government forbade the general assembly to meet, and insisted upon a toleration of Independents.

RESTORATION AND REVOLUTION

The Second Episcopacy.—Though the Protectorate was unpopular, Scotland had no direct share in the Restoration and merely accepted the accomplished fact. The chief problem of Charles II. (1660–85) and his ministers was the religious question. Presbytery was legally established in Scotland by acts of parliament to which Charles I. had given the royal assent, and the new king began his reign by promising to "protect and preserve the government of the Church of Scotland as it is settled by law." But a Scottish parliament passed in March 1661 a General Act Rescissory which annulled all legislation since 1633, and episcopacy automatically became the government of the Church "as settled by law." Scottish bishops were appointed, but Charles II. did not follow his father's example in prescribing a prayer-book or in superseding the lower courts of the church, which were placed under the supervision of the bishops. But lay patronage of livings was restored by the repeal of an act of 1648 which had abolished it, every one admitted to office of any kind had to renounce the covenants, and penalties were prescribed for preaching (or praying in public) against the episcopal government of the church. A few years later fines were imposed for non-attendance at parish churches, lists of absentees were required from the incumbents, and soldiers were quartered in non-conformist districts to collect the fines.

The result was that conscientious Presbyterians began to worship in secret conventicles, and further repressive measures were therefore necessitated. Ejected ministers were forbidden to reside within 20 miles of their former parishes, and masters, and even landlords, were held responsible for the attendance, at such field-meetings, of their servants or tenants. A rebellion was expected by the Government, and it came in the end of 1666. It originated in the south-west; and the insurgents marched upon Edinburgh, but were easily defeated at Rullion Green in the Pentland Hills. A cruel vengeance was taken by the Privy Council, the president of which, James Sharpe, had deserted the Presbyterian cause in order to become Archbishop of St. Andrews. Under the first two royal commissioners through whom Charles II. ruled Scotland the earl of Middleton and the earl of Rothes, the bishops had exercised a powerful influence over the administration. The next commissioner, the duke of Lauderdale, who was in power from

1667–79, disliked the episcopal system which he was bound to maintain and his jealousy of the influence of the bishops was illustrated by his insistence upon the royal supremacy over the Church. He began his rule by treating the recalcitrant Covenanters more mildly, but an increase in the number of conventicles was followed first by savage measures of repression and then by a renewal of efforts at conciliation. These again failed and Lauderdale, like Rothes, began to desire a rebellion. He had his wish, but the result was his fall from power.

Bothwell Bridge and Drumclog.—On May 3, 1679, Archbishop Sharpe was murdered by a small body of fanatics. A few years earlier the murder would have been an isolated outrage, but Lauderdale's measures had created sympathy for the murderers, and on May 29 some 80 Covenanters at Rutherglen proclaimed their defiance of the king. They collected an army which was unsuccessfully attacked by James Graham of Claverhouse (afterwards Viscount Dundee) at Drumclog on June 1, and, flushed with victory, they marched on Glasgow but failed to enter it. For three weeks they held the country round Hamilton. An organized movement would have been a serious matter for the Government, but the rebels were looked upon by the majority of the Presbyterians as extreme fanatics and only a few outlaws joined them. On June 22 the duke of Monmouth defeated them at Bothwell bridge. Both by instinct and from policy, Monmouth was inclined to leniency, but he was soon replaced by the duke of York, who ruled, with intervals of absence, during the years 1680–2. York had some ideas of moderation and his encouragement of trade does him some credit, but the period of his rule was distinctively known as the Killing Time. Parliament put the penal laws passed against Roman Catholics into force against the Covenanters, and by the Test Act it imposed upon all persons in public trust an oath which emphasized the royal supremacy over the Church so strongly that 80 of the episcopal clergy gave up their livings rather than take it. After York left Scotland, things grew worse, and the torture of the thumbscrew was called in to supplement the use of another instrument of torture, the boot.

The Reign of James VII.—When the duke of York succeeded to the throne as James VII. (1685–88), the earl of Argyll, an exile under sentence of death for a "treasonable" refusal to take the Test Act, raised a rebellion in combination with Monmouth. He landed in Argyll and crossed to the neighbourhood of Glasgow, where his small army quarrelled and dispersed; its leader was captured and executed. The rising gave the Government little trouble, but it was the excuse for a ferocious act which appointed a death penalty for mere attendance at a conventicle. The Tory Parliament which passed this act could not, however, in its second session (1686), be persuaded to accept a measure for toleration of Roman Catholics, upon which the king had set his heart. James, therefore, resolved to employ the royal prerogative for this purpose as he was doing in England, and in 1687 he issued a Declaration of Indulgence which brought the Killing Time to an end. Fear of popery diminished the gratitude felt for this boon, and in 1687–8 the measures adopted by James to place Roman Catholics at the head of affairs raised widespread alarm. But the Revolution, like the Restoration, was distinctively an English movement, and it was not until the prince of Orange had been for more than a month on English soil, that a body of Edinburgh rioters sacked Holyrood, which had been given as a place of Roman Catholic worship and education. In various districts in the south and south-west bands of ruffians "rabbled" the manses of the episcopal clergy.

A Convention of Estates, summoned by the prince of Orange, met in April 1689, and, by a majority, declared that James had forfeited the Crown. It was offered to, and accepted by, William and Mary and entailed upon their issue and then upon the Princess Anne and her issue. Stipulations similar to those of the English Bill of Rights were made, and the new sovereigns had to accept another limitation; viz., that prelacy was an insupportable grievance and ought to be abolished. The Crown was accepted on these conditions and the convention was converted into a parliament in June. But the promised abolition of episcopacy turned the Scottish episcopalians into a Jacobite Party, and, in the early summer of 1689, Edinburgh Castle was holding out timorously for King James, and Viscount Dundee was raising an army to carry out a famous threat which he had made to the convention. The castle surrendered on June 13. On July 27 Dundee was killed in the hour of victory at Killiecrankie. With his death, the danger of a Jacobite restoration came to an end. Presbytery was re-established in 1690, and the general assembly met that same year. for the first time since 1653.

The Massacre of Glencoe.—The reign of William was marked by two serious disputes, which embittered feeling between Scotland and England. The Highlanders were opposed to the revolution settlement, and the Government, apprehensive of a French invasion, tried by money payments to induce the chiefs to take the oaths to William and Mary. Dec. 31, 1691, was fixed as the last day on which the submission of the recalcitrant chiefs could be received; those who had not qualified by that date were to be liable to the terrors of the law. Alexander MacDonald of Glencoe delayed his acceptance of the terms to the last moment, and then presented himself before a Government official who was not authorized to administer the oath. Owing to this accident, he did not take the oath until January 6. The Under-Secretary of State, Sir John Dalrymple, Master of Stair, was glad to have an opportunity of making an example, and, in accordance with precedent, "letters of fire and sword" were issued against the MacDonalds of Glencoe. The penalty contemplated by the law seems to have been the expulsion of the clan from its territory and a consequent dispersion of its members, as the MacGregors had been rooted out and scattered in the reign of James VI. But the Government devised a scheme of murder committed in circumstances of revolting treachery. A small body of troops, under Campbell of Glenlyon, was sent to Glencoe, and the soldiers were for nearly a fortnight the guests of the clansmen, while Glenlyon was arranging to guard the passes by which his hosts might escape. Shortly after midnight on Feb. 12-13, 1692, the signal for a massacre was given. The military plans miscarried and a large proportion of the MacDonalds escaped (some of them to perish from cold and exposure), but between 30 and 40 were murdered. The crime evoked an indignation which indicates the development of a sympathy for the Highlanders that had been foreign to Lowland feeling for more than a century, and the Jacobites naturally availed themselves of it for political purposes, but it was not till 1695 that the Scottish parliament demanded an enquiry and, on receiving an official report, voted that "the killing of the Glencoe men was a murder." The responsibility for the crime lay with William's Scottish ministers, but the king was guilty (in Macaulay's words) of "a great breach of duty" in shielding the Master of Stair from any punishment beyond dismissal from the Secretaryship of State which he held in 1695, and the massacre of Glencoe contributed to the rise of an anti-English feeling even in the Lowlands.

The Darien Scheme.—Another tragedy of William's reign was much more directly attributable to English influence. Scottish commerce, which had been seriously affected by the civil war, the Dutch wars, and the war with France, was attempting to find new outlets, and William Paterson, the founder of the Bank of England, suggested a project for the colonization of the Isthmus of Darien. The scheme involved a challenge to Spain, which claimed the territory on which the Scottish emigrants were to settle, but the "African Company" formed to trade with Africa and the Indies, received a charter conferring powers of military colonization as well as trading privileges. The venture was unfortunate from the first. A strenuous and remarkable effort made by the Scots to raise capital was to be supplemented by English subscriptions, but the jealousy of English merchants was aroused, and the House of Commons compelled the withdrawal of the English shareholders. The Scots persevered and in the end of 1698, about 1,200 Scottish colonists landed in the pestilential region of Darien. There were two further expeditions, but disease, famine and Spanish attacks combined to render the adventure hopeless. At the time the chances of preserving peace in Europe depended upon William's successfully negotiating the Partition

Treaties, and he could not give the Scots support against Spain. In March 1700 the remnants of the Scottish colony evacuated Darien; their vessels were shipwrecked and few of the survivors reached home. It was the greatest disaster in Scottish commercial history, and the calamity which had overtaken the nation was ascribed to English hostility and to the refusal of William to maintain the privileges originally granted to the African Company.

THE UNION

The Constitutional Position After the Revolution.—When William died, in March 1702, the hostility between England and Scotland was so bitter that the continuance of a Union of the Crowns after the death of Queen Anne was in danger. The revolution settlements in the two countries had, in fact, made the existing constitution unworkable. Before 1689, the Scottish parliament, except during the civil war (1638–51), had exercised only a slight influence upon the national history. It was much less representative than the English House of Commons, and its methods of procedure were such as to make it a tool in the hands of the Government. Its efficient powers were entrusted to a committee known as the Lords of the Articles, which, though consisting of members of parliament, was not elected by the whole House. The choice of its members was manipulated by the Government and on many occasions a majority of its members were also members of the Privy Council, the executive of the country. But, after the revolution, the Committee of the Articles was abolished, and the Scottish parliament, having secured the rights for which the English parliament had long contended, could compel the sovereign to act in accordance with its demands in domestic affairs, and claimed also to control foreign policy. In the days of personal government, a monarch ruling over two independent kingdoms had no difficulty in securing unity of policy, but the new constitutional monarchy found it hard to reconcile the aims of two separate parliaments. A mere union of the Crowns could not suffice to meet the necessities of government.

Proposals for union had been made on several occasions since 1603. James VI. had tried to bring about a complete incorporating union with "one worship of God, one kingdom entirely governed [*i.e.*, with a single government], one uniformity of law," but had been compelled by the opposition of the English Commons to abandon his projects. Cromwell had forced a union upon the Scots, and, after the Restoration, they suffered from the loss of the trading privileges which a union had involved. In 1667 commissioners from the two countries met to negotiate a commercial treaty, and when the English commissioners refused to exempt Scotland from the operation of the Navigation Act, Charles II. proposed a scheme of union which was discussed in 1670, but without result. At the revolution, the Scottish parliament itself appointed commissioners "to treat the terms of an entire and perpetual union between the two kingdoms," but though William did his best to encourage the scheme, his English parliament would not appoint English commissioners. William remained an enthusiastic advocate of union, and recognized in the bitter temper of both nations after the failure of the Darien scheme a reason for accelerating it. But again (1700) the English Commons would not agree to the appointment of a commission, and William, from his deathbed in 1702, sent a royal message to the English parliament urging the necessity of a union for the preservation of peace between the two countries. As a mark of respect for his memory, Anne invited the two parliaments to appoint commissioners. A commission sat in the winter of 1702–3, but the negotiations failed because of the opposition of the English merchants to a scheme which involved reciprocal freedom of trade.

The Problem of Union.—A union was recognized to be desirable both for constitutional and for commercial reasons, but it was a political necessity that compelled the ministers of Queen Anne to take further action. In spite of the Act of Settlement, the Hanoverian succession could not be regarded as safe even in England. The Scots had made no settlement of the Crown after the death of Anne, and a Jacobite triumph in Scotland, on the occurrence of that event, would have meant a large increase of strength to the English Jacobites. It was therefore essential to bring about, in Anne's lifetime, a complete incorporating union on the basis of the Protestant succession, so that there would be, on the Queen's death, no legal means whereby the Scots, by themselves, could alter the succession. Such a union must involve freedom of trade, and to this the English Whigs, largely composed of the mercantile classes, were opposed. In Scotland, the desire for a union which had been shown in 1689 had almost entirely disappeared, and its vehement opponents included not only the Jacobites but also a "Patriot" or "Country" Party, led by Andrew Fletcher of Saltoun, which championed the independence of Scotland from French and English influence alike. A combination of Jacobites and Patriots brought about in 1703–4 a dangerous legislative warfare between the two parliaments, and an outbreak of hostilities between the two nations was well within the bounds of possibility.

The English Whig ministry, strengthened by Marlborough's victory at Blenheim, resolved to defy the prejudices of their own supporters and to offer a union on the basis of freedom of trade combined with securities for the safety of the Presbyterian Established Church and for the maintenance of Scots law and of the Scottish Courts of Justice. The Scottish Whigs responded to the offer and commissioners from both countries met in April 1706. The subject which gave rise to most discussion was the representation of Scotland in the future parliament of Great Britain. The numbers as finally settled gave Scotland the inadequate representation of 45 members in the Commons and 16 in the Lords. In Jan. 1707 the proposed Treaty of Union was confirmed by the Scottish parliament by a majority of 110 votes to 68, and the terms were embodied in legislative measures carried by each of the two parliaments. The union was distinctly unpopular, but the Jacobite assertions that it was carried by bribery have been challenged.

THE JACOBITE RISINGS

"The Fifteen."—The first General Election for the British parliament (1708) gave something like national sanction for the Union, possibly because of the alarm caused by an attempted French invasion in the beginning of the year. But the process of carrying out the financial provisions of the Union caused considerable friction; the Scots resented the introduction into Scotland of the English law of treason, and the Presbyterians disliked a grant of toleration to Scottish Episcopalians and had more reasonable ground for indignation at the restoration of lay patronage in the Church. It had been abolished in 1690, and the patrons had been compensated, and the act of 1712 was a breach of the agreement made at the Union. Thus, by Anne's death in 1714, the party which had brought about the Union seemed to have suffered most from its effects. It was the strength of Protestant feeling among the Scottish Whigs that prevented these disappointments from bringing large reinforcements to the Jacobites on the accession of George I. The Tory ministers of the end of Anne's reign had been suspected of an intention of restoring the Stuarts in the person of the Old Chevalier, then a man of 26, and the Whig ministry of George I. was supported, in the election held at the beginning of 1715, by a large proportion of Scottish Whigs. In the same summer the earl of Mar raised the first Jacobite rebellion, but failed to win Lowland support, except in the north-east, which had always been a stronghold of episcopacy. "James III. and VIII." was proclaimed at Aberdeen, and Mar led his army to Perth. But the death of Louis XIV. led to the withdrawal of French support which had been promised, and Mar, instead of marching at once upon Edinburgh, remained at Perth till Nov. 10. On Nov. 13 his march upon Edinburgh was intercepted by Government troops under John, duke of Argyll, at Sherifmuir, near Dunblane, and, though the battle was technically a drawn one, it compelled Mar to retire to Perth. A rising in the north of England was defeated on Nov. 14, the day after Sherifmuir. James, who had been prevented by the change of policy in France from joining his troops, landed near Peterhead on Dec. 22, spent three weeks in Perth, and then fled with Mar to France.

Argyll proved a merciful victor and the number of executions

was only about 30, but some hundreds of prisoners were transported to the American colonies, and many of them were tried, under an act of parliament passed for the purpose, at Carlisle, Scottish juries, even in the lowlands, being unwilling to find them guilty. The sale of confiscated Jacobite estates involved injustice to innocent sufferers, but an Act of Indemnity was passed in 1717. In order to provide for future emergencies, Gen. Wade was entrusted with the task of constructing roads in the Highlands, the military purpose of which did not diminish their economic value. A new Jacobite attempt was planned for 1719, and aid was promised by Sweden, but the death of Charles XII. prevented the fulfilment of the promise. An outbreak of war between Great Britain and Spain in 1718 raised hopes of Spanish help, but the Spaniards sent only a small raiding force. The Spaniards were joined by a few Highlanders and were defeated at Glenshiel (June 1719).

The Porteous Riots.—During the long rule of Walpole (1721–42), the gradual growth of trade and commerce began to reconcile Scotland to the Union, but the period was marked by two outbreaks of violence. A tax upon malt roused so much Scottish opposition that it was only after some years that the authorities, in 1725, attempted to enforce it. There were fierce riots in Glasgow when excise-officers tried to enter the malt houses, and the Edinburgh brewers, encouraged by the mob, announced their intention of refusing to brew with taxed malt. This remarkable form of "strike" lasted for a week, and, in the end, Scotland paid the tax and enjoyed its beer. A more famous Edinburgh riot has been immortalized in *The Heart of Midlothian.* Two smugglers under sentence of death made an effort to escape, and one of them succeeded in doing so with the help of the other, a man named Wilson. The sympathy generally felt for smugglers was increased by the circumstances, and the City Guard, under Captain Porteous, was warned to expect an attempt to rescue Wilson at his execution. There was no attempt at rescue, but, after the execution, the mob attacked the guard, who fired and killed a small number of onlookers. Porteous was sentenced to death for murder, but Queen Caroline, who was regent during an absence of George II. in Hanover, granted a reprieve for six weeks and was believed to intend to follow the reprieve by a pardon. On the night of the day originally fixed for the execution (Sept. 7, 1736), a mob broke into the Tolbooth prison, seized Porteous and hanged him on a dyer's pole. There was no riot in the ordinary sense of the word, and the murderers of Porteous were never detected.

Prince Charles Edward and "the 'Forty-five."—The Jacobite movement in Scotland was, by this time, moribund, but it was galvanized into activity by the ambition of the young Prince Charles Edward to recover the throne which his grandfather had lost. Walpole had always believed that the exiled house would make another attempt, and this belief had been one of his reasons for maintaining a policy of peace. After his fall, the existence of hostile relations with Spain and France afforded an opportunity for which Jacobite exiles had been watching. The French Government assembled troops for an invasion of Scotland in 1744, but a storm destroyed their transports, and, in July 1745, Charles Edward was allowed to try his fortune without any French aid except a small quantity of munitions. The adventure was inspired by exiles and there was no enthusiasm for it in Scotland; Charles had to persuade even the Highland chiefs to join him, and he was not always successful. The troops he commanded were never so numerous as the army which Mar had collected 30 years before. The charm and daring of the young prince, and the absence of Government troops on the Continent, produced, however, a much more dangerous and a much more dramatic result than that of "the 'Fifteen."

The commander-in-chief in Scotland, Sir John Cope, instead of guarding Edinburgh, marched to intercept the prince and his Highlanders, but, probably wisely, refused a chance of giving him battle, and the Jacobite force made its way to Edinburgh. On Sept. 17, Charles, as prince-regent of the three Kingdoms, took up his quarters in Holyrood. Cope, having marched to Inverness and thence to Aberdeen, took ship to Dunbar, disembarked his troops and was immediately defeated at Prestonpans (Sept. 21). The prince expected this success to be followed by a large adhesion of followers, but he waited in vain at Edinburgh for the expected recruits. Then, deciding to attempt a march upon London, he crossed the Border on Nov. 9, hoping to be joined by the Lancashire Jacobites. His expectation was again disappointed, but he continued his southward march as far as Derby (Dec. 4). By that time troops had been recalled from the Continent, the duke of Cumberland was at Lichfield with one army, and Marshal Wade commanded another in the north of England. Charles had reluctantly to accept the opinion of his officers that a further advance was useless, and the retreat began on Dec. 7. The Jacobites marched by Carlisle and Dumfries to Glasgow, and thence to Stirling, where they besieged the castle. On Jan. 17, 1746, the prince attacked a relieving force under Gen. Hawley at Falkirk and won his second and last victory. The state of feeling in the Lowlands rendered a further retreat inevitable, and Charles, having taken Inverness and Fort Augustus, indulged in hopes of help from France. It did not come, and on April 17 Cumberland destroyed the Jacobite army on Culloden Moor. The prince, after many adventurous wanderings, escaped to France in September. The ferocity with which Cumberland treated the prisoners gained him his nickname of the Butcher. The Government had been desperately alarmed, and less mercy was shown than in 1716. About 80 Jacobites were executed, and the Highlanders were forbidden to carry arms, to wear their distinctive dress, or to play the bagpipes; the prohibition of the kilt was maintained until 1782. The part played by the Episcopalians of the north-east in the rising led to acts which punished with transportation for life any Episcopal clergyman who did not pray in express words for King George, denied protection under the Toleration Act of Queen Anne to clergy ordained by Scottish bishops, and subjected to fine and imprisonment laymen who attended services held by such clergy. This attempt to restrict toleration to Scottish Episcopalians who were members of the Church of England was not abandoned until 1792.

The results of the suppression of the "Forty-five" were, however, not all evil. The abolition of hereditary jurisdictions in 1747 was a reform long overdue, for the administration of justice by magistrates whose tenure of office was not dependent upon the central government was incompatible with good administration. The owners of the hereditary jurisdictions received compensation, and many of them used the money to effect great improvements in agriculture. The period marks a new era in the history of Scottish farming. A few years later, William Pitt tried the successful experiment of raising two regiments of Scottish Highlanders for the army. This device had been suggested to Walpole by Duncan Forbes of Culloden, a statesman whose influence afterwards prevented some of the clans from joining Prince Charles, and Walpole had recognized its wisdom, but had been prevented from acting upon it by parliamentary dislike to an increase of the standing army.

REFORM

Scotland Under George III.—During the reign of George III. the history of Scotland merges in that of the United Kingdom, in the politics of which Scotland began to take a prominent part, and only a few points need be mentioned. It was a disgrace to the country that, in the second half of the 18th century, servile conditions still existed in coal-mines and salt-pits. The old feudal serfdom had died out earlier in Scotland than in England, and a judicial decision in 1775 had declared that a slave brought to Scotland was thereby emancipated, but, in spite of this, workers in coal-mines and salt-pits remained under ancient obligations scarcely distinguishable from serfdom. Having once entered a mine, at however early an age, a miner was bound to remain at work there to the end of his life, and his services were sold along with the mine in which he worked. Henry Dundas, who was the actual, though not the official, minister for Scotland almost continuously from 1775 to 1801, abolished this evil system by acts passed in 1775 and 1799. His period of rule witnessed a large extension of Scottish commerce, in spite of a check to the pros-

perity of the rapidly growing city of Glasgow through the American War and the repudiation of American debts to Great Britain after the Declaration of Independence. The Forth and Clyde canal was begun in 1768 and other canals, roads and bridges were constructed in various parts of the country. The outbreak of the French Revolution, which soon put an end to the short period of peace that followed the American War, at first created considerable sympathy in Scotland, but, as the violence of the revolutionaries progressed, the sympathy became confined to the Societies of the Friends of the People, which, like similar Societies in England, began to demand universal suffrage and annual parliaments. A convention of delegates from these societies, held at Edinburgh in Dec. 1792, was followed by the trial of Thomas Muir for sedition. The development of events in France brought about a panic, and it is admitted that Muir did not have a fair trial; he was sentenced to transportation for 14 years. A similar convention in the following year was believed to contemplate inviting foreign troops into the country and was suppressed by the authorities, but the seditious element among the Friends of the People was very much smaller than the Government imagined. Most of them were constitutional reformers who advocated changes which had received considerable support before the massacres in France created a general aversion to any alteration in the constitution. The fear of sedition, fed by the activities of a small number of extremists, continued throughout the first years of the Great French War, and volunteers were enlisted in 1794 for the preservation of order at home as well as for defence. The most important political event which affected Scotland during the war was the impeachment of Henry Dundas, Lord Melville, in 1805. He was acquitted in the following year, but his prosecution introduced into Scottish politics an intense bitterness, illustrations of which may be found in Lockhart's *Life of Sir Walter Scott.*

The Reform Acts.—After the conclusion of the war, Scotland shared in the discontent of the troubled years 1815–20, and the name of the "Radical War" has been given to a series of political riots in Paisley, Glasgow and Greenock in 1819–20; the Government again over-estimated the danger of an outburst which was closely related to unemployment and agricultural distress. In the reign of George IV. (whose visit to Edinburgh in 1822 was the first state visit of a sovereign to Scotland since the time of Charles I.) the discontent passed into a constitutional agitation for parliamentary reform. The representation of Scotland in the British parliament had been settled in 1707 on the lines of the then existing system. The country electorate was so small that, in 1822, when the population of Scotland was nearly 2,100,000, the total number of county voters was under 3,000. The burgh members were returned by the town councils, themselves self-elected bodies. The Reform Act of 1832, which added eight to the number of Scottish members, extended the franchise in the counties to owners of lands or houses of the yearly value of £10 and to certain classes of tenants. In the burghs a vote was given to occupiers of houses valued at £10 a year. Further extensions were made, as in England, by the Reform Acts of 1867–68 and 1884–85. The change made by the act of 1832 is illustrated by the circumstance that Scotland, which in 1831 returned 24 Reformers and 21 anti-Reformers, sent to the first Reformed parliament 41 Whigs and 12 Tories. That parliament passed in 1833 a Scottish Burgh Act which swept away the old corrupt burghal constitutions, against which Reformers had been waging war for nearly half a century, and restored to the citizens a long-lost right of electing their own municipal rulers.

19TH AND 20TH CENTURIES

The Church.—The middle of the 19th century was marked by a great ecclesiastical struggle, culminating in 1843 in the disruption of the Church of Scotland and the foundation of the Free Church. After 57 years of separate existence it united in 1900 with the United Presbyterian Church, itself an amalgamation of small churches which had seceded from the Church of Scotland, frequently on some dispute connected with lay patronage, an institution which troubled Scotland from the passage of the Patronage Act of 1712 until the repeal of that act in 1874. A minority of the Free Church disapproved of the Union of 1900, and their claim to retain the property of the church was upheld, on appeal, by the House of Lords in 1904. The obviously inequitable character of the legal decision led to the appointment of a royal commission to allocate the property between the Free Church and the United Free Church, and its recommendations were embodied in an act of parliament in 1905 (*see* SCOTLAND, CHURCH OF).

A movement for a still wider union of the Presbyterian Churches in Scotland began about 1912. Negotiations between the Church of Scotland and the United Free Church were interrupted by the World War, and, after their resumption, the Church of Scotland obtained in 1921 an act of parliament the effect of which was to transform the relations of the Established Church with the State and to give the church liberty both "to adjudicate finally in all matters of doctrine, worship, government and discipline," and to interpret and modify (within the limits of Trinitarian Protestantism) the Articles of the Constitution, which were scheduled in the act. This legislation removed the historical difficulties which, in conjunction with patronage, had led to the disruption of 1843, but it was felt that the system of endowment also required readjustment, after the lapse of nearly three centuries since it was settled by Charles I. This object was effected by the Church of Scotland (Property and Endowments) Act of 1925, and a body of Scottish Ecclesiastical Commissioners was appointed to give effect to a number of its provisions, including the transfer of endowments to general trustees of the Church. The two acts of 1921 and 1925 were promoted by the Church of Scotland avowedly for the purpose of removing "the main causes keeping the two Churches apart," and, while the act of 1925 was passing through its last stages in parliament, the general assembly of the United Free Church passed, by a majority, a resolution recognizing the progress achieved in this direction. The General Assemblies, both of the Church of Scotland and of the United Free Church, in 1928 gave definite approval to the basis of a scheme for union, to be constituted in 1929 or 1930.

Poor Law and Education.—Two years after the disruption, a Poor Law was introduced into Scotland. Up to 1845, the relief of the poor had been entirely in the hands of the Kirk Sessions of the various parishes, which possessed, but seldom used, powers of local taxation for the purpose. Social and economic developments, as well as the ecclesiastical separation produced by the disruption, necessitated a change in the traditional methods, and a Poor Law (Scotland) Act was passed in 1845. It followed in many respects the English Act of 1834 and established parochial boards under a central Board of Supervision, but it did not impose the English workhouse test, though it forbade relief to able-bodied poor. A Compulsory Education Act followed in 1872. Acts of the Scottish parliament had long ago ordered the provision of a school in every parish, but at the beginning of the 19th century this requirement had not been universally fulfilled, though educational facilities were better than in England. There was a considerable advance in the early 19th century, and from 1833 Scotland received a parliamentary grant for education. It was entrusted to the church, which remained in control of the schools; the Free Church, after 1843, established schools of its own. Church control was diminished by more direct Government supervision in 1861, and, after the act of 1872 was passed, the Presbyterian churches gave up their schools to the newly established School Boards. The Scottish Episcopal Church and the Roman Catholic Church retained voluntary schools until the Education Act of 1919 replaced the School Boards by education authorities elected over a wider area and made provision for the transfer of voluntary schools. The teachers in such transferred schools are, in accordance with the act, appointed by the local authority after being approved, as regards character and religious belief, by the denomination concerned. Electors to education authorities are persons registered as local government electors, and voting is conducted on the principle of proportional representation. Education authorities are empowered to expend money on the provision of food and books for children, and also to give assistance to qualified persons attending a university or training

college. This last provision has been followed by a large increase in the number of students at the Scottish universities. The act contemplated an extension of the compulsory school age to 15 years and an elaborate system of continuation schools, but its provisions have only been partially carried out.

The Scottish Secretaryship.—The administration of Scotland has been conducted since 1885 by a Secretary for Scotland, and since 1926 by a Secretary of State for Scotland. Soon after the Union of 1707, an additional Secretary of State had been appointed for Scottish affairs, and this arrangement continued until 1746, except for an interval from 1725–42, during which Scotland was governed nominally by one of the other two Secretaries of State, but really by Lord Islay, afterwards duke of Argyll. In 1746, in the middle of the Jacobite Rising, the Secretary of State for Scotland was involved in an intrigue against the Prime Minister, and had to resign. His place was not filled, and till 1885 Scotland was under the charge of the Home Secretary, who was always advised by some unofficial "Minister for Scotland"—in the later portion of the period, the Lord Advocate. The government of Scotland by a law officer, under the supervision of the Home Secretary, was an arrangement which could not survive the wide extension of governmental action and responsibilities which took place in the 19th century, and the arrangement was resented in Scotland. A Scottish National Convention, held in Edinburgh in 1884, demanded the creation of a Scottish Office, and in 1885 an act was passed creating a Scottish Secretaryship. In 1926 the office was raised to the dignity of a Secretaryship of State, during the tenure of office of Sir John Gilmour.

The World War.—Scotland was only slightly affected by the military operations of the war; considerable damage was done at Edinburgh by a Zeppelin raid on April 2, 1916, and the remote island of St. Kilda was bombarded by German naval units on Nov. 21, 1918. But, for the first time in history, the main activities of the Grand Fleet were conducted in Scottish waters, from Aug. 1914 to the surrender of the German fleet on Nov. 21, 1918. It was in Scapa Flow that the crews of 70 German men-of-war scuttled their ships on June 21, 1920; some of them have since been salved. The Clyde took a large share in British naval construction, and in various districts munition factories came into existence—the largest was built at Gretna in 1915. The expansion of industry during the war period and its diversion to unproductive activities had effects which were seriously felt after the conclusion of peace. The country, and especially the "heavy" industries in the Clyde valley have experienced the deepest and longest depression of trade in their history, and it is also in the Clyde area that the shortage of houses has been most severely felt. The failure of Scottish local authorities to solve the housing problem led to Government intervention at the end of 1925, and, since then, considerable progress has been made.

Political.—Since the conclusion of the World War a great change has occurred in the political complexion of the country. The Representation of the People Act (1918) increased the number of electors from 800,448 at the General Election of Dec. 1910 to 2,211,178 at the General Election of Dec. 1918. With the change in the electorate came a break in the traditional fidelity of Scottish constituencies to the Liberal party. In Dec. 1910 Scotland returned 58 Liberal, 11 Conservative and three Labour members; in 1918, when a proportion of Liberals supported the Coalition Government, there were 58 Coalition, seven Liberal, seven Labour and two Independent members. After the break-up of the Coalition in 1922 the Liberals held 28, Labour 29, and Unionists 15 seats; in 1923 the figures were 22, 35, and 16 respectively; and in 1924 the Liberals were reduced to nine and Labour 24, while the Conservative holding was increased to 40. During 1922–24 Motherwell was represented by a Communist.

The electorate in 1929 had increased to 2,937,067 and of the 74 seats Labour held 37, the Unionists 22, and the Liberals 14, while one was represented by an Independent Prohibitionist.

A Local Veto Experiment.—An important experiment in social legislation was tried in 1920, in accordance with the provisions of the Temperance (Scotland) Act of 1913, which provided that local authorities, on the receipt of signed requisitions from electors in their areas, should take a poll on three alternative resolutions dealing with the number of licences to sell alcoholic liquors in an area, viz., (1) that there should be no change in the system of licensing; (2) that the licensing court should grant not more than 75% of the licences previously in existence; (3) that all licences in the area should be withdrawn. Polls were taken in 584 out of 1,221 polling areas; in about 300 of the remaining areas no licences were in existence in 1920. Five hundred and nine areas voted for no change, 35 for limitation, and 40 for no licence. The contest of 1920 was fought by the Temperance Party upon a prohibition programme, and the result was rather a repudiation of prohibition than an indication of satisfaction with existing licensing conditions. Subsequent polls taken on requisitions made in accordance with the act of 1913 have not seriously modified the results ascertained in 1920, and it has been generally felt that the act requires amendment, especially in the definition of an "area" as a single ward in the larger burghs, which must be treated as a whole in order to render possible a more equal distribution in any reduction of licences; in Glasgow, the withdrawals of licences after the polls of 1920 were chiefly in middle-class residential districts.

The most important municipal developments have been the inclusion of the burghs of Govan, Partick, Pollokshaws, and some suburban districts within the city of Glasgow by an act of 1912, and a further extension of Glasgow municipal boundaries by an act of 1925; the amalgamation of Edinburgh with Leith, and the absorption of the suburban districts of Liberton, Colinton, Corstorphine and Cramond by the city of Edinburgh in 1920; and the amalgamation of Motherwell with Wishaw in 1920. There has been a remarkable series of gifts of historical buildings to the nation, including Dryburgh abbey by the late Lord Glenconner; Melrose abbey by the duke of Buccleuch; the farm of Ellisland (occupied by Robert Burns from 1788–91); and Duddingston Loch, near Edinburgh. Other buildings, including Kelso abbey, Inchcolm abbey and Restenneth priory, have also been placed under national custody.

The National Library.—The greatest of these gifts was made by the Faculty of Advocates in 1925. The library of the Faculty of Advocates, founded in the reign of Charles II., was given the copyright privilege of the Copyright Act of Queen Anne, and it became one of the great public libraries of the United Kingdom. It was open to the public, but the members of the faculty, whose property it was, bore the whole responsibility for maintenance and upkeep. Even before the World War, this burden was too heavy for a small body of professional men, and the subsequent rise in prices rendered it impossible to maintain the library on the old scale and to continue the facilities given to the public. In 1922 the faculty offered to transfer the library, with the exception of the collection of legal books, to the nation, but the Government replied that in the existing state of the national finances it could not undertake the responsibility of maintenance, and it was not until June 1923, when Sir Alexander Grant, Bt., intimated a gift of £100,000, the sum for which the Treasury had stipulated, that the project became feasible. Negotiations with the Government were at once resumed, but arrangements for the transfer, and two changes of Government, delayed the passage of a bill which became in 1925 the National Library of Scotland Act. The great library is now administered by a body of trustees, some of whom are *ex officio*, and others are appointed by the Crown or by administrative and educational authorities, or are co-opted by the trustees. The books continue meanwhile to be housed in the premises belonging to the Faculty of Advocates, which has included in its gift such portions of the buildings as are not needed for its own administrative purposes.

BIBLIOGRAPHY.—*General Histories.* The best general histories of Scotland are those of Patrick Fraser-Tytler (1841–43), John Hill Burton (1867–70), Peter Hume Brown (1899–1909) and Andrew Lang (1900–07). Tytler's History, which ends in 1603, is based on thorough research in mss., but many documents now available, such as the reports of diplomatic agents were not accessible when he wrote. Hill Burton's ends in 1746 and is of unequal merit, being best in points of development of law, but his anti-Celticism, and scepticism with regard to archaeology make his work inadequate in the earlier parts. Hume Brown's original work ended with the Disruption of 1843, but

an illustrated edition (1911) brings the story down to the date of publication. It is a judicious narrative, critical and cautious in its use of evidence and brings out the factors which affected the political development of the country. Lang, who carried his narrative down to 1746, was deeply interested in controversial issues and in secret history, and he described his book as a "study of spies and traitors." *See* also Sir Walter Scott's *Tales of a Grandfather,* which, in spite of its date, remains an excellent introduction to Scottish history.

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Special Topics. Constitutional History: Cosmo Innes, *Scotch Legal Antiquities* (1872) and *Scotland in the Middle Ages* (1860), R. S. Rait, *Parliaments of Scotland* (1924); James MacKinnon, *Constitutional History of Scotland* (1924). The best history of the Mediaeval Church is A. McEwan, *History of the Church in Scotland* (1912); for the organization of the Mediaeval Church *see* Bishop Dowden *Mediaeval Church in Scotland* (1910). For later church history, John Cunningham, *Church History of Scotland* (2nd ed. 1882), has still no rival. Social history: Cosmo Innes, *Sketches of Early Scotch History and Social Progress* (1861); John Mackintosh, *History of Civilization in Scotland* (1877–88); Hume Brown, *Scotland in the Time of Queen Mary* (1904); Henry Grey Graham, *Social Life in the 18th Century* (1899), and the topic is well illustrated in Robert Chambers, *Domestic Annals of Scotland* (1858–61). *See* also W. M. Mackenzie, *The Castle in Scotland* (1927). For the Highlands, Dr. Gregory's *History of the Highlands* (1881) is excellent, but it ceases at 1603.

Biographies. Only a few of the more important biographies can be mentioned—Sir Herbert Maxwell, *Robert Bruce* (1897); Hume Brown, *George Buchanan* (1890) and *John Knox* (1895); Hay Fleming, *Mary Queen of Scots* (1897); Thomas McCrie, *John Knox* (1811) and *Andrew Melville* (1819); C. S. Terry, *Claverhouse* (1905); W. C. MacKenzie, *Lauderdale* (1923); Andrew Lang, *Sir George MacKenzie* (1909) and *Prince Charles Edward* (1900).

State Papers and Society Publications. The most important additions to current knowledge are being made through the documents in course of publication in a large variety of series by H.M. Stationery Office (including Registers of the Privy Council, the Great Seal and the Privy Seal, the Exchequer Rolls and the Accounts of the Lord High Treasurer) and through the publications of the learned societies, such as the Scottish History Society and the Scottish Text Society, which are continuing the work accomplished a century ago by the Bannatyne, Maitland, Abbotsford and other clubs. A large number of important articles will be found in the *Scottish Historical Review* (1904–28). Some of the earlier series of State papers require to be checked by the original mss. (R. S. R.)

SCOTLAND, CHURCH OF. The purpose of this article is to trace the growth of the Scottish "Kirk" as a whole, defining the views on which it was based and the organization in which they took form. The controversies within the Church of Scotland have not arisen out of matters of faith but out of practical questions of church government and of the relation of church and state. Holding a church theory to which the rulers of the country were for a century strongly opposed, Scotland became the leading exponent of Presbyterianism (*q.v.*); and this note has been the dominant one in her religious history even in recent times.

Scottish Reformation.—The Scottish Reformation came out of a covenant in which the barons, inspired by John Knox, then abroad, bound themselves in 1557 to oppose the Roman Catholic religion and to promote the cause of the Reformation. When parliament, on the 24th of August 1560, passed the acts abolishing the papal jurisdiction and the mass in Scotland, it was able, as Knox had been preparing for this crisis, to sanction a new confession of faith for the Reformed church. Other documents of the new system were quickly forthcoming. The *First Book of Discipline* set forth the whole of the proposed religious and educational constitution, and this book speaks of "the order of Geneva which is now in use in some of our churches." This order, afterwards with some modifications known as John Knox's Liturgy, and used in the church down to the reign of Charles I., is a complete directory of worship, with forms of all the services to be held in the church. The type of religion found in these documents is that of Geneva, the unit being the self-governing congregation, and the great aim of the system the pure preaching of the Word; but the First Book of Discipline does not set forth any complete scheme of church government. Its arrangements are in part provisional. In addition to the minister, who is its most definite figure and proved to be the most permanent, it recognizes the superintendent, the lay elder and the reader. The superintendent was a parish minister whose added function was to plant churches, and place ministers, elders and deacons where required. Whether the superintendents were meant to be permanent in the church is not clear. The lay elder was very much what he is still. The reader was to conduct service when no minister was available, reading the Scriptures and the Common Prayer. A noble scheme of education was sketched for the whole country, but neither this nor the provision made for ministers' stipends was carried out, the revenues of the old church, from which the expenses of both were to be paid, being in the hands of the barons.

The system naturally took time to get into working order. The old clergy, bishops, abbots and priests were still on the ground, and were slow to take service in the new church. In 1574 there were 289 ministers and 715 readers. As the ranks of the clergy slowly filled, questions arose which the Reformation had not settled, and it was natural that the old system with which the country was familiar should creep in again. Presbytery was never much in favour with the crown; and when the crown, so weak at the Reformation, gained strength, encroachments were made on the popular character of the kirk, while the barons also had obvious reasons for not wishing the kirk to be too strong. The first parliament of the Regent Moray (1567), while confirming the establishment of the Reformed church as the only true church of Christ, settling the Protestant succession, and doing something to secure the right of stipend to ministers, reintroduced lay patronage, the superintendent being charged to induct the patron's nominee—an infringement of the reformed system against which the church never ceased to protest. Andrew Melville (*q.v.*) came to Scotland at this time, and became the leader of the church in place of Knox, who died in 1572. He brought with him from Geneva, where he had been the colleague of Beza, a fervent hatred of ecclesiastical tyranny and a clear grasp of the Presbyterian church system. The Scottish church, hitherto without a definite constitution, soon espoused under his able leadership a logical and thorough Presbyterianism, which was expressed in the *Second Book of Discipline,* adopted by the assembly in 1577, and was never afterwards set aside by the church when acting freely. It recognizes four kinds of office in the church, and no one can lawfully be placed in any of them except by being called to it by the members. Pastor, bishop and minister are all titles of the same office, that of those who preach the word and administer the sacraments, each to a particular congregation. The doctor is a teacher in school or university; he is an elder and assists in the work of government. Elders are rulers; their function also is spiritual, though practical and disciplinary. The fourth office is that of the deacons, who have to do with matters of property and are not members of church courts. Kirk-sessions and presbyteries are not named, but the principles are clearly laid down on which these institutions are to rest.

Presbyterian Principle.—By committing herself to this system the Church of Scotland established between herself and the

Church of England a division which became more and more apparent and was the cause of much of her subsequent sufferings. It is no doubt strange that she should have endured so much not for any great Christian principle, but for a question of church government. On the other hand, Presbyterianism stood in Scottish history for freedom, and for the rights of the middle and lower classes against the crown and the aristocracy; and it might not have been held with such tenacity or proved so incapable of compromise but for the opposition and persecution of the three Stuart kings. The history of the Scottish church for a century after the date of the Book of Discipline is that of a religious struggle between the people and the crown.

For some years after its inception Presbyterianism carried all before it. The presbyteries came quickly into existence; that of Edinburgh dates from 1580. In that year it was found that there were 924 parishes in Scotland, but not nearly all supplied with ministers; it was proposed that there should be 50 presbyteries and 400 ministers. A great part of the country, especially in the north and west, had not yet been reached by the Reformation. At this time began the long series of attempts made by James VI. in the direction of curbing Presbyterian liberty and of the restoration of Episcopacy. For a few years his attitude was different. A Roman Catholic rising threw James into the arms of the kirk; in 1592 the Second Book of Discipline was legalized and Presbytery set up. The church was at the time very powerful, the people generally sympathizing with her system, and her assemblies being attended by many of the nobles and the foremost men. Discipline was strict; the temper of the church was in accordance with the Old rather than the New Testament. On his accession to the throne of England in 1603 James entered on a new set of attempts to assimilate the Scottish church to that of England. In 1609 two courts of high commission were set up by the royal authority with plenary powers to enforce conformity to the new arrangements. In 1612 the act of 1592 which established Presbytery was rescinded, and Episcopacy became the legal church system of Scotland.

National Covenant.—In all this it was the position and rights of the clergy that were assailed. The people had been less interfered with; the change of church government involved no change in the conduct of worship. But the articles of Perth, passed by a packed assembly in 1618, foreshadowed what was soon to be the policy of the crown. During the first years of his reign Charles was occupied in other directions; but when he came to Scotland in 1633 to be crowned, Laud came with him, and though like his father he showed himself kind to the clergy in matters of stipend, and adopted measures which caused many schools to be built, he also showed that in the matter of worship the policy of forcing Scotland into uniformity with England was to be carried through with a high hand. A book of canons and constitutions of the church which appeared in 1636, instead of being a digest of acts of assembly, was English in its ideas, dealt with matters of church furniture, exalted the bishops and ignored the kirk-session and elders. The liturgy was ordered to be used, which had not yet appeared, but which proved to be a version, with somewhat higher doctrine, of the Anglican Common Prayer. The introduction of this service book in St. Giles's Church, Edinburgh, on the 16th of July 1637, occasioned the tumult of which Jenny Geddes will always figure as the heroine. The sentiment was echoed throughout Scotland. Petitions against the service book and the book of canons poured in from every quarter; the committee formed to forward the petition rapidly became a powerful body at the head of a national movement, the action of the crown was temporizing, and on the 28th of February the National Covenant was signed in the famous scene in Greyfriars church and churchyard. This document recited the covenant, signed by King James and his household in 1580, to uphold Presbyterianism and to defend the state against Romanism, and then declared a new covenant of nobles, barons, gentlemen, burgesses, ministers and commons to continue in the reformed religion, to defend it and resist all contrary errors and corruptions. The Covenant was no doubt an act of revolt against legal authority, and can only be justified on the ground that the crown had for many years acted oppressively and illegally in its attempt to coerce Scotland into a religious system alien to the country, and that the subjects were entitled to free themselves from tyranny. The crown was unable either to check the popular movement or to come to any compromise with it, and the Glasgow assembly of 1638, the first free assembly that had met for thirty years, proceeded to make the church what the Covenant required, and effected the "second Scottish reformation." The assembly contained many influential laymen and was carried on the crest of a great national movement. The Covenant was accepted by parliament in 1639.

The succeeding decennium is the culminating period of Scottish Presbyterianism, when, having successfully resisted the crown, it not only was supreme in Scotland but exercised a decisive influence over England. The causes which brought about this state of affairs are to be sought to a large extent in the civil history of England. The English parliament sought the alliance of the assembly, while the Independents, though in the event Presbytery was as little to their liking as Episcopacy, joined in the wish to get rid of the episcopal system. In its period of triumph the Presbyterianism of Scotland displayed its character. After the injustice and persecution it had suffered it could scarcely prove moderate or tolerant; it showed a vehement determination to carry out the truth it had vindicated with such enthusiasm, to the full extent and wherever possible. The Covenant, at first a standard of freedom, was immediately converted into a test and made the instrument of oppression and persecution. All policy was to be determined by the Covenant; the king and every official was to be obliged to take it. The mind of the nation being so preoccupied with the Covenant, it naturally followed that those who carried their fanaticism farthest were ready to denounce and to unchurch those who showed any inclination to moderation and political sanity, and that the beginnings of schism soon appeared in the ranks of the Covenanters.

In 1643, when the full legal establishment of Presbytery had just been consummated, the General Assembly, asked by the English parliament to arrange a league to be signed in both countries for the furtherance of reformed religion, agreed, but asked that the league should be a religious one. The result was the Solemn League and Covenant. It did not mention Presbyterianism; but the Assembly had refused to hear of any recognition of independency; if religion were thoroughly reformed, they considered the result must be Presbyterianism in England as in Scotland. In the Westminster Standards also, which were the fruit of the Scottish desire for a religious uniformity, Scotland did not obtain by any means all it desired in its church documents. The Scottish divines in the Westminster Assembly were only five in number, while the assembly contained effective parties of Erastians and Independents. The Confession of Faith contains no approval of any system of church government, and when she adopted it in 1647 the kirk gave up her old confession in which the principles at least of true church order are laid down. In accepting in 1645 the Westminster Directory of Public Worship she tacitly gave up her own liturgy which had been in use till recently, and committed herself to a bald and uninviting order of worship, in which no forms of prayer were allowed to be used.

Struggle Against Episcopacy.—If the mismanagement of Scottish religious affairs under James and Charles I. is a melancholy story, what took place under Charles II. is infinitely sadder. From the first Charles showed himself determined to force Episcopalianism on Scotland, and not too scrupulous in the choice of methods for securing his ends. The attempt was nearly successful. In the greater part of the country little change took place in the religious services. The service book was not read nor kneeling at communion required, and it made no immediate difference to the people that the clergy should be under bishops. The inferior church courts still sat, though not the assembly. At the Restoration it was a question whether the bulk of the population was in favour of Presbytery or of Episcopacy; but the matter was handled in such a way in the west of Scotland that an extreme Covenanting spirit arose, nourished on intolerable grievances,

and the nation as a whole decided against the system which had been promoted by such means.

The Rescissory Act of 1661 swept away the legislation of the preceding twenty years, and so disposed of the Presbyterian polity of the church. Episcopacy was restored by a letter from the king on the 5th of September 1661 (*see* Scotland, Episcopal Church of). An act requiring all ministers appointed during the period when patronage was abolished to get presentation from their patrons and institution from their bishops was applied in the west of Scotland in such a way that 300 ministers left their manses. Their places were filled with less competent men whom the people did not wish to hear, and so conventicles began to be held. The attempts to suppress these, the harsh measures taken against those who attended them or connived at them, or refused to give information against them, the military violence and the judicial severities, the confiscations, imprisonments, tortures, expatriations, all make up a dreadful narrative. Indulgences were tried, and were successful in bringing back about 100 ministers to their parishes and introducing a new cause of division among the clergy. On the other hand, the Covenanting spirit rose higher and higher among the persecuted till the armed risings took place and the formal rebellion of a handful of desperate men against the ruler of three kingdoms.

When William landed in England in 1688, the scene changed in Scotland. The soldiery was withdrawn from the west, and the people at once showed their feelings by the "rabbling" or ejection of the curates who occupied the manses of the ousted ministers, in which, however, no lives were lost. William would have decided for Episcopacy in Scotland, as the great body of the nobles and gentry adhered to it, but only on condition that the Episcopalians agreed to support him and that they had the people with them. Neither of these conditions was fulfilled. On the 22nd of July 1689 the Convention which declared the throne vacant and called William and Mary to fill it, declared in its Claim of Right that prelacy and the superiority of any office in the church above ministers had been a great and insupportable grievance to Scotland. Effect was given to this; and in April 1690 the act was passed on which the establishment of the Church of Scotland rests, the Westminster Confession being recognized, the laws in favour of Episcopacy repealed, though the Rescissory Act remained on the statute book, and the assembly appointed to meet. Three years later the formula of subscription, to be signed by all ministers, was fixed.

From this time forward the church, while jealously asserting her spiritual independence, was on the side of the crown against the Jacobites, and became more and more an orderly and useful ally of the state. The difficulties which threatened to arise about the union were skilfully avoided; the Act of Security provided that the Confession of Faith and the Presbyterian government should "continue without any alteration to the people of this land in all succeeding ages," and the first oath taken by Queen Anne at her accession was to preserve it. The Act of Toleration of 1712 allowed Episcopalian dissenters to use the English liturgy. This had not hitherto been done, and the claim of the Episcopalians for this liberty had been the occasion of a bitter controversy. The same parliament restored lay patronage in Scotland, an act against which the church always protested and which was the origin of great troubles.

Patronage Difficulties.—Presbytery, being loyal to the house of Hanover, while Episcopacy was Jacobite, was now in enjoyment of the royal favour and was treated as a firm ally of the government. But while the church as a whole was more peaceful, more courtly, more inclined to the friendship of the world than at any former time, it contained two well-marked parties. The Moderate party, which maintained its ascendancy till the beginning of the 19th century, sought to make the working of the church in its different parts as orderly and regular as possible, to make the assembly supreme and to enforce on presbyteries respect for its decisions. The Popular party, regarding the church less from the side of the government, had less sympathy with the progressive movements of the age, and desired greater strictness in discipline. The main subject of dispute arose at first from the exercise of patronage. Presbyteries in various parts of the country were still disposed to disregard the presentations of lay patrons, and to settle the men desired by the people; but legal decisions had shown that if they acted in this way their nominee, while legally minister of the parish, could not claim the stipend. To the risk of such sacrifices the church, led by the Moderate party, refused to expose herself. By the new policy inaugurated by Dr. William Robertson (1721–1793), the assembly compelled presbyteries to give effect to presentations, and in a long series of disputed settlements the "call," though still held essential to a settlement, was less and less regarded, until it was declared that it was not necessary, and that the church courts were bound to induct any qualified presentee. The substitution of the word "concurrence" for "call" about 1764 indicates the subsidiary and ornamental light in which the assent of the parishioners was now to be regarded. It was in the power of the church to give more weight than she did to the feelings of the people; but her working of the patronage system drove large numbers from the Establishment. A melancholy catalogue of forced settlements marks the annals of the church from 1749 to 1780, and wherever an unpopular presentee was settled the people quietly left the Establishment and erected a meeting-house.

Growth of Dissent.—In 1763 there was a great debate in the Assembly on the progress of schism, in which the Popular party laid the whole blame at the door of the Moderates, while the Moderates rejoined that patronage and Moderatism had made the church the dignified and powerful institution she had come to be. Nor was a conciliatory attitude taken up towards the seceders. The ministers of the Relief (*see* United Presbyterian Church) desired to remain connected with the Establishment, but were not suffered to do so. Those ministers who resigned their parishes to accept calls to Relief congregations, in places where forced settlements had taken place, and who might have been and claimed to be recognized as still ministers of the church, were deposed and forbidden to look for any ministerial communion with the clergy of the Establishment. The growth of dissent steadily continued and excited alarm from time to time; and it may be questioned whether the peace of the church was not purchased at too high a price. The Moderate period is justly regarded as in some respects the most brilliant in the history of the church. Her clergy included many distinguished Scotsmen, among them Thomas Reid, George Campbell, Adam Ferguson, John Home, Hugh Blair, William Robertson and John Erskine. The labours of these men were not mainly in theology; in religion the age was one not of advance but of rest; they gained for the church a great and widespread respect and influence.

Revival.—With the close of the 18th century a great change passed over the spirit of the church. The new activity which sprang up everywhere after the French Revolution produced in Scotland a revival of Evangelicalism. Moderatism had cultivated the ministers too fast for the people, and the church had become to a large extent more of a dignified ruler than a spiritual mother. About this time the brothers Robert and James Haldane devoted themselves to the work of promoting Evangelical Christianity, James making missionary journeys throughout Scotland and founding Sunday schools; and in 1798 the eccentric preacher Rowland Hill visited Scotland at their request. In the journals of these evangelists dark pictures are drawn of the religious state of the country, though their censorious tone detracts greatly from their value; but there is no doubt that the efforts of the Haldanes brought about or coincided with a quickening of the religious spirit of Scotland. The assembly of 1799 passed an act forbidding the admission to the pulpits of laymen or of ministers of other churches, and issued a manifesto on Sunday schools. These acts helped greatly to discredit the Moderate party, of whose spirit they were the outcome. In 1810 the *Christian Instructor* began to appear under the editorship of Dr. Andrew Thomson, a churchman of vigorous intellect and noble character. It was an ably written review, in which the theology of the Haldanes asserted itself in a somewhat dogmatic and confident tone against all unsoundness and Moderatism, clearly proclaiming that the former things had passed away. The question of pluralities began to be

agitated in 1813, and gave rise to a long struggle, in which Dr. Thomas Chalmers (*q.v.*) took a notable part, and which terminated in the regulation that a university chair or principalship should not be held along with a parish which was not close to the university seat.

The growth of Evangelical sentiment in the church, along with the example of the great missionary societies founded in the end of the 18th and the beginning of the 19th century, led to the institution of the various missionary schemes, and their history forms the chief part of the history of the church for a number of years. The education scheme, having for its object the planting of schools in destitute Highland districts, came into existence in 1824. The foreign mission committee was formed in 1825, at the instance of Dr. John Inglis (1763–1834), a leader of the Moderate party; and Dr. Alexander Duff (*q.v.*) went to India in 1829 as the first missionary of the Church of Scotland. The church extension committee was first appointed in 1828, and in 1834 it was made permanent. It was originally formed to collect information regarding the spiritual wants of the country, and to apply to the government to build the churches found to be necessary. As the population of Scotland had doubled since the Reformation, and its distribution had been completely altered in many counties, while the number of parish churches remained unchanged, and meeting-houses had only been erected where seceding congregations required them, the need for new churches was very great. The application to government for aid, however, proved the occasion of a "Voluntary controversy," which raged with great fierceness for many years and has never completely subsided. The union of the Burgher and the Anti-burgher bodies in 1820 in the United Secession (*see* UNITED PRESBYTERIAN CHURCH) added to the influence of the voluntary principle in the country, while the political excitement of the period disposed men's minds to such discussions. The government built forty-two churches in the Highlands, providing them with a slender endowment; and these are still known as parliamentary churches. Under Thomas Chalmers, however, the church extension committee struck out a new line of action. The great philanthropist had come to see that the church could only reach the masses of the people effectively by greatly increasing the number of her places of worship and abolishing or minimizing seat-rents in the poorer districts. In his powerful defence of establishments against the voluntaries in both Scotland and England, in which his ablest assistants were those who afterwards became, along with him, the leaders of the Free Church, he pleaded that an established church to be effective must divide the country territorially into a large number of small parishes, so that every corner of the land and every person, of whatever class, shall actually enjoy the benefits of the parochial machinery. This "territorial principle" the church has steadily kept in view ever since. With the view of realizing this idea he appealed to the church to provide funds to build a large number of new churches, and personally carried his appeal throughout the country. By 1840 over 200 new churches had been built.

The zealous orthodoxy of the church found at this period several occasions to assert itself. John M'Leod Campbell (*q.v.*), minister of Row, was deposed by the assembly of 1830 for teaching that assurance is of the essence of faith and that Christ died for all men. He has since been recognized as one of the profoundest Scottish theologians of the 19th century, although his deposition was never removed. The same assembly condemned the doctrine put forth by Edward Irving (*q.v.*), that Christ took upon Him the sinful nature of man and was not impeccable, and Irving was deposed five years later by the Presbytery of Annan, when the outburst of supposed miraculous gifts in his church in London had rendered him still more obnoxious to the strict censures of the period (*see* CATHOLIC APOSTOLIC CHURCH).

The Disruption—and After.—The influence of dissent also acted along with the rapidly rising religious fervour of the age in quickening in the church that sense of a divine mission, and of the right and power to carry out that mission without obstruction from any worldly authority, which belongs to the essential consciousness of the Christian church. An agitation against patronage, the ancient root of evil, and the formation of an anti-patronage society, helped in that direction. For the Ten Years' Conflict, which began in 1833 with the passing by the Assembly of the Veto Act, *see* the article FREE CHURCH OF SCOTLAND; it is not necessary to dwell further in this place on the consequences of those acts. The Assembly of 1843, from which the exodus took place, proceeded to undo the acts of the church during the preceding nine years. The Veto was not repealed but ignored, as having never had the force of law. The Assembly addressed a pastoral letter to the people of the country, in which, while declining to "admit that the course taken by the seceders was justified by irresistible necessity," they counselled peace and goodwill towards them, and called for the loyal support of the remaining members of the church. Two acts at once passed through the legislature in answer to the claims put forward by the church. The Scottish Benefices Act of Lord Aberdeen, 1843, gave the people power to state objections personal to a presentee, and bearing on his fitness for the particular charge to which he was presented, and also authorized the presbytery in dealing with the objections to look to the number and character of the objectors.

Development Since 1843.—The Disruption left the Church of Scotland in a sadly maimed condition. Of 1203 ministers 451 left her, and among these were many of her foremost men. A third of her membership is computed to have gone with them. In Edinburgh many of her churches were nearly empty. The Gaelic-speaking population of the northern counties completely deserted her. All her missionaries left her but one. She had no gale of popular enthusiasm to carry her forward, representing as she did not a newly arisen principle but opposition to a principle which she maintained to be dangerous and exaggerated. For many years she had much obloquy to endure. But she at once set herself to the task of filling up vacancies and recruiting the missionary staff. A lay association was formed, which raised large sums of money for the missionary schemes, so that their income was not allowed seriously to decline. The good works of the church, indeed, were in a few years not only continued but extended. All hope being lost that parliament would endow the new churches built by the church extension scheme of Dr. Chalmers, it was felt that this also must be the work of voluntary liberality.

Agitation on the subject of patronage went on in the Assembly from 1857 to 1869, when by a large majority patronage as restored by the Act of Queen Anne was condemned, and a petition sent to parliament for its removal. The request was granted, and the right of electing parish ministers was conferred by the Patronage Act 1874 on the congregation; thus a grievance of old standing, from which all the ecclesiastical troubles of a century and a half had sprung, was removed and the church placed on a thoroughly democratic basis. This act, combined with various efforts made within the church for her improvement, secured for the Scottish Establishment a large measure of popular favour, and in the last half of the 19th century she grew rapidly both in numbers and in influence. This revival was largely due on the one hand to the improvement of her worship which began with the efforts of Dr. Robert Lee (1804–1868), minister of Old Greyfriars, Edinburgh, and professor of Biblical criticism in Edinburgh university. By introducing into his church a printed book of prayers and also an organ, Dr. Lee stirred up vehement controversies in the church courts, which resulted in the recognition of the liberty of congregations to improve their worship. The Church Service Society, having for its object the study of ancient and modern liturgies, with a view to the preparation of forms of prayer for public worship, was founded in 1865; it has published eight editions of its "Book of Common Order," which, though at first regarded with suspicion, has been largely used by the clergy. Church music has been cultivated and improved in a marked degree; and hymns have been introduced to supplement the psalms and paraphrases; in 1898 a committee appointed by the Church of Scotland, the Free Church, the United Presbyterian Church and the Presbyterian Church in Ireland issued *The Church Hymnary*, which was authorized for use in all these churches alike, and after 30 years a new hymnary is being compiled.

The "Committee on Christian Life and Work," was appointed in 1869 with the aim of exercising some supervision of the work of

the church throughout the country, stimulating evangelistic efforts and organizing the labours of lay agents. This committee publishes a magazine of "Life and Work," which has a circulation of over 100,000, and has organized young men's gilds in connection with congregations and revived the ancient order of deaconesses. It was to reinforce this element of the church's activity, as well as to strengthen her generally, that James Baird (1802–1876) in 1873 made the munificent gift of £500,000. This fund is administered by a trust which is not under the control of the church, and the revenue is used mainly in aid of church building and endowment throughout the country.

Subscription and Re-union.—The church has greatly increased of late years in width of view and liberality of sentiment, and shelters various tendencies of thought; and for this and other reasons the question of subscription has been more or less before the church for many years. The formula adopted by the assembly of 1711 had still to be signed by ministers, and was felt to be much too strict. After debates extending over many years, the assembly of 1889 fell back on the words of the act of parliament 1693, passed to enable the Episcopalian clergy to join the establishment, in which the candidate declared the Confession of Faith to be the confession of his faith, owned the doctrine therein contained to be the true doctrine and promised faithfully to adhere to it. This was accompanied by a Declaratory Act in which the church expressed its desire to enlarge rather than curtail the liberty hitherto enjoyed. Ten years later the assembly was again debating the question of subscription. A committee appointed in 1899 to inquire into the powers of the church in the matter reported that the power of the church was merely administrative—it was in her power as cases arose to prosecute or to refrain from prosecuting, but that she had no power to modify the confession in any way. Here the matter might have remained, but that the approach to parliament of the United and the Free Churches after the decision of the House of Lords in 1904 (*see* FREE CHURCH and UNITED FREE CHURCH) offered an opportunity for asking parliament to remove a grievance the church herself had no power to deal with. The Scottish Churches Bill of 1905 left it to the Church of Scotland to frame a new formula for her ministers and professors, an undertaking to which she is seriously addressing herself.

Since 1909—when the quater-centenary of the birth of Calvin brought the Church of Scotland and United Free Church Assemblies together in a memorial service in St. Giles's, and a joint-committee on union was appointed—the two bodies have been moving towards reunion. The negotiations, interrupted by the War, have been resumed, and the main causes of keeping the Churches apart have been removed.

The leaders of the Church of Scotland have already twice gone to Parliament in order to secure Acts which might remove the scruples of the other Church; the first Act (in 1921) ratified a Constitution drawn up by the Church declaring her spiritual freedom, with Nine Articles outlining an acceptable doctrinal basis; the second (in 1925) ratified a financial arrangement between the Church and the heritors, relating to the teinds. Finally the General Assemblies of the Church of Scotland and the United Free Church, at their meetings held in Edinburgh in May, 1929, both resolved on an incorporating union of the two Churches. The incorporating resolution was passed by the Assembly of the Church of Scotland with practical unanimity and by the Assembly of the United Free Church with an overwhelming majority. The union was consummated at a meeting of the Assemblies held on October 2, 1929, at the Cathedral of St. Giles, according to the plan formulated in May.

BIBLIOGRAPHY.—For the earlier history of the kirk the outstanding authorities are the histories of Knox, Calderwood, Baillie's *Letters*, and Wodrow's *History:* Knox's liturgy has been edited by Dr. Sprott, and on the Westminster Standards the reader may consult Dr. Mitchell's *Minutes of the Westminster Assembly*, and Baird lectures on the same subject. Modern histories of the church have been written by Cook, Hetherington and Principal Cunningham; Dr. Story's *Church of Scotland* in 5 vols. contains information on every side of the subject. Among books professedly dealing with the Free Church question, the most valuable are Sydow's *Die Schottische Kirchenfrage* (Potsdam, 1845), and *The Scottish Church Question* (London, 1845); Buchanan's *Ten Years' Conflict* (1849); Hanna's *Life of Chalmers* (1852); and Taylor Innes on *The Law of Creeds in Scotland* (1867). *See* also Cockburn, *Memorials of His Time* (Continuation, 1874); Walker, *Dr. Robert Buchanan: an Ecclesiastical Biography* (1877); *Annals of the Disruption* (published by authority of a committee of the Free Church (1876–77). On the United Presbyterian Church *see* McKerrow, *History of the United Secession Church* (1841); Struthers, *History of the Relief Church* (1843); McKelvie, *Annals and Statistics of the United Presbyterian Church* (1873); and on re-union, A. Martin, *Church Union in Scotland* (1910).

(A. Ms.; X.)

SCOTLAND, EPISCOPAL CHURCH OF, a Scottish Episcopal church in communion with, but historically distinct from, the Church of England, and composed of seven dioceses: Aberdeen and Orkney; Argyll and the Isles; Brechin; Edinburgh, Glasgow and Galloway; Moray, Ross and Caithness; and St. Andrews, Dunkeld and Dunblane. All, except Edinburgh, founded by Charles I., are pre-Reformation sees. The bishops constitute the episcopal synod, the supreme court of appeal, whose president, elected by the members from among themselves, has the style, not the functions, of a metropolitan, being called primus. The legislature is the provincial synod, consisting of the bishops, at whose discretion it is summoned, and a lower chamber of presbyters. The canons have the authority of this synod. The representative church council, including laymen, administers finance. Each diocese has its synod of the clergy. Its dean is appointed by the bishop, and, on the voidance of the see, summons the clerical and lay electors, at the instance of the primus, to choose a bishop, who is presented to the episcopal synod for confirmation and to the primus for consecration. There are cathedrals at Perth, Inverness, Edinburgh and Cumbrae; the sees of Aberdeen, Brechin and Glasgow have no cathedrals. The Theological College was founded in 1810, incorporated with Trinity College, Glenalmond, in 1848, and re-established at Edinburgh in 1876.

The bishops of the Episcopal Church are direct successors of the prelates consecrated to Scottish sees at the Restoration. After the Revolution, the Comprehension Act of 1690 allowed episcopalian incumbents, on taking the Oath of Allegiance, to retain their benefices, though excluding them from any share in the government without a further declaration of presbyterian principles. The extruded bishops were slow to organize the episcopalian remnant under a jurisdiction independent of the state, regarding the then arrangements as provisional, and looking forward to a reconstituted national kirk under a "legitimate" sovereign. But at length the hopelessness of the Stuart cause and the growth of congregations outside the establishment forced the bishops to dissociate canonical jurisdiction from royal prerogative and to reconstitute for themselves a territorial episcopate. The act of Queen Anne (1712), which protects the "Episcopal Communion," marks its virtual incorporation as a distinct society. But matters were still complicated by a considerable, though declining, number of episcopalian incumbents holding the parish churches. Moreover, the Jacobitism of some of the clergy provoked a state policy of repression in 1715 and 1745, and fostered the growth of new Hanoverian congregations, served by clergy episcopally ordained but amenable to no bishop, who qualified themselves under the act of 1712. These causes reduced the Episcopalians, who included at the Revolution a large section of the people, to what is now, save in a few corners of the west and north-east of Scotland, a small minority; but the chief bar to progress had been removed by the official recognition of George III. on the death of Charles Edward in 1788. The latest statistics show 421 churches and mission stations, 321 clergy, and 60,495 communicants.

On the history, *see* Carstares, *State Papers;* Keith, *Historical Catalogue of the Scottish Bishops* (Russel's edition, 1824); Lawson, *History of the Scottish Episcopal Church from the Revolution to the Present Time* (1843); Stephen, *History of the Church of Scotland from the Reformation to the Present Time* (4 vols., 1843); Lathbury, *History of the Nonjurors* (1845); Grub, *Ecclesiastical History of Scotland* (4 vols., 1861); Dowden, *Annotated Scottish Communion Office* (1884).

SCOTS GREYS, THE ROYAL (2nd Dragoons). This famous corps was raised in Scotland in 1678 and derives its title from the colour of its original facings—stone grey. They have also always been mounted on grey horses for a great number

of years. As the Scots Dragoons they served under William III. in Flanders. In 1702 as the Grey Dragoons they served in the Low Countries. The regiment was at the battle of Blenheim, captured a standard of the French *Régiment du Roi* at Ramillies, and was also with the victorious army at Oudenarde and Malplaquet. In 1736 it bore the title of Royal North British Dragoons which it retained until March 1877, when it became the 2nd Dragoons (Royal Scots Greys). At Waterloo Napoleon referred to the Greys as *ces terribles chevaux gris* owing to their fine fighting qualities. Here they captured an "eagle" (standard) of the 45th French Line Regiment. Their long roll of battle honours also shows service in the Crimean War, South Africa 1899–1902, and the World War.

SCOTS LAW. At the union of the parliaments of England and Scotland, in 1707, the legal systems of the two countries were as disparate as was reasonably possible in two civilizations approximately equal. Scotland, mainly in the preceding century, had adopted Roman law, as developed, and in some respects altered, by the jurists of Holland and France, as her main guide; English lawyers had forgotten, or refused to acknowledge, the debt owed to Rome both by common law and equity. The law of Scotland, again, had recently been set forth in the *Institutions* of Lord Stair, a masterpiece of lucidity and orderly arrangement; in England the student or practitioner had little to guide him through a maze of precedents and forms of pleading beyond the difficult pages of Coke. And the Scots lawyer might have pointed, with pardonable pride, to the fact that in the court of session there was no separation of law and equity.

Historical Development.—The legal history of the succeeding centuries has been one of gradual assimilation, almost exclusively by the penetration of English rules into the law of Scotland.

The process of assimilation is by no means complete, but the apparent disparities are to a certain extent due to the difference in legal terminology. Thus there is little real distinction between the English "estoppel" and the Scotch "personal bar"; between "set-off" and "compensation"; between "merger" and *confusio;* between the doctrine of "advancement" and *collatio inter liberos.*

Causes of Assimilation.—Various causes have contributed to the gradual assimilation of English and Scots law. One main cause is that much of the existing law depends on statutes applicable to both countries. The House of Lords until 1876 almost exclusively English lawyers acting as the supreme court of appeal from Scotland, had a tendency to apply English law to Scotch appeals, and in some cases seems to have forgotten the distinction between its legislative and its judicial functions. Thus in *Jaffray* v. *Allan* (1790) 3 Paton 191, the House decided that the law of stoppage *in transitu* was applicable to Scotland, without any evidence that it had ever been suggested in Scots law.

The citation of English cases in Scotland, now of daily occurrence in practice, was very rare in the 18th century, and may be traced to Prof. Bell. Judicial remonstrances against the citation of English authorities, which the judges professed themselves unable to understand, persisted for the next 30 years. The reforms in English procedure, between 1830 and 1860, did much to make English authorities more intelligible in Scotland. Much remained to be done; the separation of law and equity was a constant stumbling-block; but at least the Scotch lawyer was no longer perplexed by the question of what John Doe and Richard Roe had to do with the case. The result has been, with some aid from legislation, that in many leading branches of commercial law, such as the law of bills of exchange and negotiable instruments, suretyship or cautionary, agency, insurance, carriers by land and sea, the difference between English and Scots laws is now negligible.

In attempting to indicate the main points on which English and Scots law still differ it would be hopeless to deal, within the limits of an article, with courts and procedure. In these respects any resemblance is accidental.

Land Tenure.—In the law of tenure of land there is no reason to suppose (though the early history of tenure in Scotland is very obscure) that any material difference existed in Norman times. But there are no statutes in Scotland equivalent to *Quia Emptores,* and while subinfeudation remained lawful and usual, the right of the vassal to alienate his feu without the superior's consent was not recognized by the legislature until 1747, although conveyancing expedients to enable him to do so had been devised at a much earlier date. The consequence has been that the rights of subject superiors has bulked much more largely in Scotland than in England. A series of statutes, culminating in the Feudal Casualties Act 1914, have abolished all prestations except feu-duty, and it may now be said that a "feu"—the normal tenure in Scotland—is equivalent to an English "freehold," subject, in cases where there is a feu-duty, to a perpetual rent charge. There is, however, a very important distinction in the system of registration of title, only partially and imperfectly developed in England. In Scotland, since the establishment of the registers of sasines, in 1617, all deeds relating to land may be recorded in that register, and it has for long been established that a purchaser, or a lender on heritable security, is entitled to trust to the registers, and is not affected by any conveyance or burden which is not there recorded.

Leases for any period exceeding 21 years, though not unknown, have never been common in Scotland. Recent legislation—the Crofters Act 1886 and the Small Landholders Act 1911—has established a system of leasehold in agricultural subjects not exceeding 50 acres, with security of tenure and the right to have the rent fixed judicially, and in this respect there is no English analogy. In other respects the law of leases is, in its main aspects, the same in England and Scotland. The Agricultural Holdings Acts (13 and 14 Geo. V. ch. 9 and 10) which respectively apply, differ only in minor details.

Husband and Wife.—In the law of husband and wife, the enfranchisement of married women has reached an approximately equal stage in each country. But the laws as to the constitution of marriage differ. While in England some form of official recognition or ceremony is necessary to the validity of a marriage, Scots law has preserved the rule that the mere interchange of consent (which may be verbal, and in certain cases is implied) is sufficient. Such marriages, where there is no religious ceremony, are termed irregular, but are fully binding in Scotland. By the Marriage (Scotland) Act 1856 no irregular marriage in Scotland is to be recognized by the English courts unless one or other of the parties has his or her usual residence in Scotland, or had resided there for the preceding 21 days. By the Matrimonial Causes Act 1923 the English law of divorce is so far assimilated to that of Scotland that adultery by either spouse is recognized as a sufficient ground of action. Scots law, however, recognizes, while English law does not, wilful desertion for four years by either spouse. In Scotland a decree of divorce dissolves the marriage at once; in England neither party is free to re-marry until, in any event, six months have expired.

Succession.—In the law of succession the Administration of Estates Act 1923, by establishing a general order in intestate succession in England, has created a fundamental difference. In Scotland the order of succession in heritable (real) and movable (personal) property remains separate. And Scots law has never admitted absolute freedom of bequest in cases where there is a surviving husband, wife or child. A widow has a legal right, known as *ius relictae,* to one half of her husband's movable property if there is no surviving child; if there is, to one third. A widower, by the Married Woman's Property Act 1881, has a similar right in the movable property of his wife (*ius relicti*). Children have a legal right to legitim in the movable estate of each parent, one half if there is no surviving spouse, one-third if there is. All rights may be excluded by ante-nuptial marriage contract; any particular claim by post-nuptial contract between husband and wife, or between parent and child. They cannot, however, be excluded or limited by will. In heritable property a widow has a legal right (tierce) to a liferent of one-third; a widower, under certain limitations, has a right of courtesy, which gives him a liferent of the whole of the wife's estate.

Wills.—In testate succession English authorities on the construction of wills are constantly cited in Scotland. Three points of difference may be noted. (1) Scots law recognizes the validity

of a will in the testator's handwriting (holograph), without witnesses. (2) It demands in every case subscription. There are legislative provisions (Conveyancing [Scotland] Act 1924) under which, when a testator cannot write, his will may be subscribed for him by a law agent, justice of the peace or parish minister. (3) The validity of a will is, in Scots law, in no case affected by the subsequent marriage of the testator.

Contracts.—In the general law of contract the most important distinction is that Scots law has never recognized the English doctrine of consideration. Perhaps a very important result is that Scots law admits the principle of *ius quaestium tertio, i.e.*, that C. may have a title to sue on a contract between A. and B. if made for his benefit; a right of action excluded in England by the principle that consideration must move from the promisee. In the contingency of contractual questions where the element of consideration does not enter, such as the effect of error, fraud, misrepresentation or illegality, the law, although not in all points identical, allows the citation of decisions in one country as authorities in the other. This cannot be said of the question as to the necessity of writing in the constitution or proof of an obligation; there, the law, depending on different statutes, seems completely dissimilar. And it has recently been established that where one party is precluded from performing his obligation through some cause beyond his own control, the law of Scotland (following Roman law) will enforce the return of any payment in advance that may have been made (*Cantiere San Rocco* v. *Clyde Shipbuilding Co.*, 1923, S.C. [H.L.] 105); whereas English authorities hold that matters must remain as they were when the invalidating causes became operative (*Krell* v. *Henry*, 1903, 2 K.B. 740).

Sale of Goods.—In the contract of sale of goods the law of Scotland, until 1894, held that the property in goods sold did not pass until delivery. But in this respect the law has been completely altered by the Sale of Goods Act 1893, which provides rules on this subject applicable to both countries, and derived from English law. The Act, however, leaves certain points of variance. Thus s. 4, providing for a memorandum in writing in sales of the value of £10, is not applicable to Scotland, where parole evidence is in all cases sufficient. In cases of breach of contract the distinction between conditions and warranties, in the technical meaning given to these terms in English law, is not recognized in Scotland. It may be said that in English law the remedies of a buyer depend upon whether the seller's failure is in fulfilment of a condition or of a warranty; in Scots law the question is whether the seller's failure is, in the particular circumstances, material.

In the law of securities the conveyancing expedients for the constitution of a security over land differ so greatly that any comparison would be futile. In the constitution of securities over movables there is no provision, in Scotland, in any way analogous to the Bills of Sale Act 1882. And it is established law, with exceptions of little importance, that no security over movables which will give the creditor any preference in bankruptcy, or in a question with other creditors using diligence, can be created without delivery of the subjects, actual or constructive. Attempts to evade the rule by framing the security as a sale have met with little success. And the English law of equitable mortgage finds no counterpart in Scotland. At least since the decision in *Christie* v. *Ruxton* (1862, 24 D. 1182) it has been regarded as settled law that the mere deposit of documents of the nature of title deeds, which are not negotiable instruments, or documents of title under the Factors Acts (as to which the law is not free from doubt) will not give the party who takes them any security. And a memorandum or written statement of the object of the deposit, unless it amounts to an assignation of the property represented by the titles, does not affect the question.

Tort.—Apart from the mercantile contracts already mentioned the law as to liability for wrongful and negligent acts is the subject in which there is the least difference between England and Scotland. The provisions of 9 and 10 Vict. c. 93 (Lord Campbell's Act) give a right of action to the wife, husband, parent or child of a deceased person, which approximates closely to that allowed by the common law of Scotland.

In the case of defamation the distinctions are of some importance. Between defamation in "words" (slander) and defamation in "writing" (libel) the law of Scotland draws no distinction. It treats either merely as a civil wrong, not, except in the special case of parliamentary elections, as a criminal offence. It is not necessary, in any case, to prove that special damage has resulted, though this will be taken account of in the award of damages. And on the principle of allowing *solatium* for injured feelings an action is admitted in Scots law even although the defamatory statement is not made known to anyone except the person himself.

Criminal Law.—In criminal law the English law of high treason was expressly made applicable to Scotland by 7 Anne ch. 21. With regard to other crimes the terms used often differ, but there is no case of serious importance in which an act is criminal in the one country and not in the other. The procedure, however, differs greatly. Private prosecution, at the instance of the injured party, though competent, is in Scotland very rare except in minor statutory offences. It requires the consent and concurrence of the Crown (given through the agency of the lord advocate, or, in minor offences, of the procurator fiscal) and, although the High Court of Justiciary has power to dispense with this requirement, the case of Coats (1909, S.C. [J] 29) is the only modern instance of the exercise of that power. There is no institution in Scotland analogous to the English grand jury; the question whether there is a *prima facie* case for prosecution being always one for the discretion of the criminal authorities. In the trial of criminal offences the jury in Scotland numbers 15, as opposed to the English 12, and the verdict may be given by a majority. The Scotch verdict of "not proven," having the same legal effect as a verdict of "not guilty," has no English counterpart. A defect in the Scotch legal system, which had no provision for any public inquiry in cases of death under doubtful or suspicious circumstances, analogous to the English coroner's inquest, has been partially remedied by the Fatal Accidents Inquiry Acts of 1895 and 1906, under which a public inquiry by a sheriff and jury is held in all cases of fatal accidents in any industrial employment, and may be directed by the lord advocate in the case of any sudden or suspicious death.

Bibliography.—For the law of Scotland generally, *see* Stair, *Institutions* (1681; More's ed. 1832); Erskine, *Institutes* (1773; new ed. 1871); Bell, *Principles* (1824; 10th ed. 1899); Bell, *Commentaries* (1810; 7th ed. 1894); Green, *Encyclopaedia of the Law of Scotland* (3rd ed. in course of publication). For criminal law, *see* Hume on *Crimes* (4th ed. 1844); Macdonald, *Criminal Law* (3rd ed. 1894). For the differences between English and Scots law, *see* Bankton, *Institute of the Law of Scotland* (1751); Paterson, *Compendium of English and Scotch Law* (2nd ed. 1865); Brodie-Innes, *Comparative Principles of the Laws of England and Scotland* (Courts and Procedure) (1903); Burn Murdoch, *Notes on English as Differing from Scots Law* (1924); Gloag and Hudson, *Introduction to the Law of Scotland* (1927).

(W. M. G.)

SCOTT, ALEXANDER (*fl.* 1550), Scottish poet, was probably a Lothian man, but particulars of his origin and of his life are entirely wanting. It is only by gathering together a few scraps of internal evidence that we learn that his poems were written between 1545 and 1568 (the date of the Bannatyne MS., the only MS. authority for the text). Allan Ramsay was the first to bring Scott's work to the notice of modern readers, by printing some of the poems in his *Ever Green*.

No early Scots poet comes nearer than Scott to the quality of the Caroline love-lyric. His *Justing and Debait vp at the Drum betwix W*[*illiam*] *Adamsone and Johine Sym* follows the literary tradition of *Peblis to the Play* and *Christis Kirk on the Grene*. He has left verse-renderings of the 1st and 50th Psalms.

The first collected edition was printed by D. Laing in 1821; a second was issued privately at Glasgow in 1882. The latest edition is that by James Cranstoun (Scottish Text Society, 1 vol., 1896).

SCOTT, CHARLES PRESTWICH (1846–), British editor and journalist, born at Bath, Somersetshire, on Oct. 26, 1846, was the youngest son of Russell Scott. He was educated privately and at Corpus Christi college, Oxford, where he graduated with a first class in 1869. After training under Alexander

Russell of *The Scotsman,* he, in 1871, began a long connection with *The Manchester Guardian,* of which his brother-in-law, J. E. Taylor, was proprietor. He himself became editor in 1872, and, after the death of Taylor in 1905, also chief proprietor. He enlisted the services of W. T. Arnold and many of the leading critics of literature, art and music of two generations, so that the paper became one of the foremost journals of the day. Gradually developing from Whiggism to advanced Liberalism, *The Manchester Guardian,* as directed by Scott, was always sober in tone and scrupulous in policy. He retired in 1929. Always active in local politics, after three unsuccessful contests for the representation of North-East Manchester, Scott was elected Liberal M.P. for the Leigh division of Lancashire in 1895 and sat till 1906.

SCOTT, CYRIL MEIR (1879–), English musical composer, pianist and author, was born at Oxton, Birkenhead, on Sept. 27, 1879, and studied music at the Hoch conservatorium, Frankfurt-on-Main. On his return to England, Hans Richter produced his orchestral Heroic Suite at Liverpool, and an overture to *Pelléas and Mélisande* was shortly afterwards played at Frankfurt, but both of these and several of his other early works were afterwards withdrawn by the composer as immature. Among the more important of his works may be named a piano concerto, a violin concerto, a piano quartet, a piano quintet, a violin sonata, many pianoforte pieces, three operas and many songs. He has also written and published some verse and a volume of autobiography, *My Years of Indiscretion.*

SCOTT, SIR GEORGE GILBERT (1811–1878), English architect, was born in 1811 at Gawcott near Buckingham, where his father was rector; his grandfather, Thomas Scott (1747–1821), was a well-known commentator on the Bible. Scott was apprenticed to a London architect, filled various staff posts, and designed his first church in 1838. But his real artistic education dates from his study of Pugin's works on mediaeval architecture. The first result of this new study was his design for the Martyrs' Memorial at Oxford, erected in 1840, a clever adaptation of the late 13th-century crosses in honour of Queen Eleanor.

In 1844 Scott won the first premium in the competition for the new Lutheran church at Hamburg, a noble building with a very lofty spire, designed strictly in the style of the 13th century. In 1847 he was employed to renovate and refit Ely cathedral, the first of a long series of English cathedral and abbey churches which passed through his hands. In 1851 he visited and studied the architecture of the chief towns in northern Italy. In 1856 a competition was held for designs of the new government offices in London; Scott obtained the third place in this, but the work was afterwards given to him on the condition (insisted on by Lord Palmerston) that he should make a new design, not Gothic, but Classic or Renaissance in style. In 1862–1863 he was employed to design and construct the Albert Memorial, a costly and elaborate work, in the style of a magnified 13th-century reliquary or ciborium, adorned with many statues and reliefs in bronze and marble. On the partial completion of this he was knighted. In 1866 he competed for the new London law-courts, but the prize was adjudged to his old pupil, G. E. Street. In 1873, owing to illness caused by overwork, Scott spent some time in Rome and other parts of Italy. The mosaic pavement which he designed for Durham cathedral soon afterwards was the result of his study of the 13th-century mosaics in the old basilicas of Rome. He died on March 27, 1878.

An incomplete list of his works from 1847 in the *Builder* for 1878 (p. 360) ascribes to Scott 732 buildings with which he was connected as architect, restorer or the author of a report. These include 29 cathedrals, British or colonial, 10 minsters, 476 churches, 25 schools, 23 parsonages, 58 monumental works, 25 colleges or college chapels, 26 public buildings, 43 mansions and a number of small ecclesiastical accessories. While a member of the Royal Academy, Scott held for many years the post of professor of architecture, and gave a long series of able lectures on mediaeval styles, which were published in 1879. He wrote a work on *Domestic Architecture,* and a volume of *Personal and Professional Recollections,* which, edited by his eldest son, was published in 1879.

SCOTT, SIR GILES GILBERT (1880–), British architect, born Nov. 9, 1880, was the son of George Gilbert Scott and grandson of Sir George Gilbert Scott, R.A. Educated at Beaumont College, Old Windsor, he began to practise in London in 1902. In the following year his designs for the projected cathedral at Liverpool, the expression of the architect's hope for a revival of Gothic architecture through the true understanding of its spirit, were accepted, but, in consideration of his youth, G. F. Bodley, R.A., was associated with him as joint architect. In July 1904 the foundation was laid by King Edward, the corner stone of the chapter-house by the Duke of Connaught in 1906, and the Lady Chapel was completed in 1910. After some delay occasioned by the World War, the consecration took place on July 19, 1924, in the presence of King George V. and Queen Mary. Designed in Gothic style it was the first Anglican cathedral built in the northern provinces since the Reformation, and when completed, will be the largest church in Great Britain. The design for the tower was considerably altered in 1924. The exterior is of red sandstone and the building is specially adapted for lighting by electricity. Its massive bulk dominates the city and the seaway. Chief among the other works of the architect, which are almost entirely ecclesiastical, are the Church of the Annunciation, Bournemouth; St. Manghold's Church and Presbytery, Ramsey, Isle of Man; the Chapel of the Visitation Convent, Harrow; new buildings at Clare College Cambridge, and many war memorials. Scott also did restoration work on Chester Cathedral. He was elected A.R.A. in 1918, R.A. in 1922, and was president of the Architectural Association in 1920–21. He was knighted after the consecration of Liverpool Cathedral in 1924. (*See* ARCHITECTURE.)

SCOTT, SIR PERCY MORETON (1853–1924), British sailor, was born on July 10, 1853. He entered the navy in 1866 and served in the Ashantee War (1873–74), the Congo Expedition 1875 and the Egyptian campaign of 1882. In 1893 he was promoted to captain and in the following year became a member of the ordnance committee. In 1896 he took command of the cruiser "Scylla" and came into prominence as the inventor of the "dotter" and "deflection teacher" devices, which signified an important advance in the evolution of naval gunnery. He served with the Naval Brigade in the South African War, when he got the naval 6-in. guns up to Ladysmith and in 1900 assisted the International Brigade in China during the Boxer Rebellion. In 1903 he took command of the gunnery school ship "Excellent," in 1905 became rear-admiral and inspector of target practice and in 1908 was promoted vice-admiral. Created K.C.B. in 1910, he was made a baronet in 1913. He retired in 1913 with the rank of admiral. On the outbreak of the World War he returned to the service and was for some time in charge of the air force defences of London. Sir Percy Scott later became an advocate of the submarine, and was strongly opposed to the building of battleships. He died on Oct. 18, 1924. He wrote *Fifty Years in the Royal Navy* (1919).

SCOTT, ROBERT (1811–1887), English divine and lexicographer, was born on Jan. 26, 1811, at Bondleigh in Devonshire. Educated at Shrewsbury school and Christ Church, Oxford, he was elected fellow of Balliol, where he was tutor from 1835 to 1840. In 1854 he was elected master of Balliol. This office he held, together (from 1861) with that of the professorship of the exegesis of Holy Scriptures, down to 1870, when he became dean of Rochester. As a Greek scholar, he had few equals among his contemporaries. His great achievement was his collaboration with Dean Liddell in the Greek lexicon (1843), of which a new edition, revised by H. S. Jones and R. McKenzie, was published in 1925. He died at Rochester on Dec. 2, 1887.

SCOTT, ROBERT FALCON (1868–1912), British sailor and explorer, was born at Devonport on June 6, 1868. Educated at Stoke Damerel and Stubbington House, Fareham, he passed into H.M.S. "Britannia" in 1880, and in 1882 became a midshipman on the "Boadicea." In 1897 he was promoted first lieutenant, and two years later he was recommended as commander of the National Antarctic Expedition. On taking up his duties in the "Discovery," in 1900, he was promoted commander. During the four years which followed, Scott proved both an intrepid and able leader, and a competent scientific investigator; and on his return in 1904 he was promoted to the rank of captain. For the next six years he served in the navy, commanding successively,

the "Victorious," the "Essex," and the "Bulwark," until, in 1909, he announced his intention of organizing another Antarctic expedition, for the purpose of continuing the work of the "Discovery" and of reaching the South Pole.

Backed financially by the British and Dominion Governments, Scott set sail in June 1910 in the "Nova Terra," and in Nov. 1911, began his southern sledge journey. Though delayed by bad weather, Scott and his four companions reached the Pole on Jan. 18, 1912, to find that they had been forestalled by Amundsen. Sickness, insufficiency of food, and the severity of the weather, made travelling very slow on the return journey, and on Feb. 17, Petty Officer Evans broke down under the strain and died. A month later, Oates, who was too ill to travel further, walked out into a blizzard, hoping, by his sacrifice, to save his companions; but the weather prevented all possibilities of advancing, and the remainder of the party perished on or about March 27, 1912. On Nov. 12, 1912, a search party found Scott's tent, containing the bodies of Scott, Dr. E. A. Wilson and Lieut. H. R. Bowers, as well as Scott's records and diaries, in which was given a full account of the journey and the deaths of Capt. Oates and Petty Officer Edgar Evans. A memorial service was held in St. Paul's cathedral, London, on Feb. 14, 1913, and a Mansion House fund was subsequently raised to make provision for the surviving relatives of the lost explorers. The rank and precedence of the wife of a K.C.B. were by royal warrant conferred on Captain Scott's widow.

See R. F. Scott, *The Voyage of the "Discovery"* (1905); L. Huxley, *Scott's Last Expedition* (1913); E. R. G. R. Evans, *South with Scott* (1921); *British Antarctic Expedition (Terra Nova) 1910–1913: Scientific Results* (1914); *Geographical Journal* (1902–13) *passim.*

SCOTT, SIR WALTER, Bart. (1771–1832), Scottish poet and novelist, was born at Edinburgh on Aug. 15, 1771. He came of an old Border family, and it was his pride in their real or supposed feudal dignity and their rough marauding exploits that first directed him to the study of Border history and poetry, the basis of his fame as a poet and romancer. His father, Walter Scott, a writer to the signet (or attorney) in Edinburgh—the original of the elder Fairford in *Redgauntlet*—was the first of the family to adopt a town life or a learned profession. His mother was the daughter of Dr. John Rutherford, a medical professor in the University of Edinburgh, who also traced descent from the chiefs of famous Border clans.

Scott's health in boyhood was uncertain; an attack of fever in infancy had left him permanently lame, and his nature was so lively and excitable that it was considered dangerous to press him and prudent rather to keep him back. He was therefore left very much to himself in the matter of reading, and began at an early age to accumulate the romantic lore of which he afterwards made such splendid use. At ten his collection of chap-books and ballads had reached several volumes, and he was a connoisseur in various readings. Thus he took to the High School, Edinburgh, when he was strong enough to be put in regular attendance, an unusual store of miscellaneous knowledge and an unusually quickened intelligence. Throughout his school days and afterwards when he was apprenticed to his father, attended university classes, read for the bar, took part in academical and professional debating societies, Scott steadily and ardently pursued his own favourite studies. He was still a schoolboy when he mastered French sufficiently well to read through collections of old French romances, and not more than 15 when, attracted by translations to Italian romantic literature, he learnt the language in order to read Dante and Ariosto in the original. In one of the literary parties brought together to lionize Burns, when the peasant poet visited Edinburgh, the boy of 15 was the only member of the company who could tell the source of some lines affixed to a picture that had attracted the poet's attention—a slight but significant evidence both of the width of his reading and of the tenacity of his memory. But he was far from being a cloistered student, absorbed in his books. In spite of his lameness and his serious illnesses in youth, his constitution was naturally robust, his disposition genial, his spirits high: he was always well to the front in the fights and frolics of the High School, and a boon companion in the "high jinks" of the junior bar. At home he had to behave as became a member of a Puritanic, somewhat ascetic, well-ordered Scottish household, but from any tendency to the pedantry of over-culture he was effectually saved by the rougher and manlier spirit of his professional comrades. They were the first mature audience on which he experimented, and it was to this market that he brought the harvest of the vacation rambles which it was his custom to make every autumn for seven years after his call to the bar and before his marriage. His staid father did not much like these escapades, and told him bitterly that he seemed fit for nothing but to be a "gangrel scrape-gut." But, as the companion of "his Liddesdale raids" happily put it, "he was *makin' himsell* a' the time."

His father intended him originally to follow his own business, and he was apprenticed in his 16th year; but he preferred the upper walk of the legal profession, and was admitted a member of the faculty of advocates in 1792. He seems to have read hard at law for four years at least, but almost from the first to have limited his ambition to obtaining some comfortable appointment such as would leave him a good deal of leisure for literary pursuits. In this he was not disappointed. In 1799 he obtained the office of sheriff-depute of Selkirkshire, with a salary of £300 and very light duties. In 1806 he obtained the reversion of the office of clerk of session, which kept him hard at work, his biographer estimates, for at least three or four hours daily during six months out of the twelve, while the court was in session. He discharged these duties faithfully for 25 years, during the height of his activity as an author. He did not enter on the emoluments of the office till 1812, but from that time he received from the clerkship and the sheriffdom combined an income of £1,600 a year, being thus enabled to act in his literary undertakings on his often-quoted maxim that "literature should be a staff and not a crutch."

The Poems.—It was as a poet that he was first to make a literary reputation. According to his own account, he was led to adopt the medium of verse by a series of accidents. The story is told by himself at length and with his customary frankness and modesty in the *Essay on Imitations of the Ancient Ballad,* prefixed to the 1830 edition of his *Border Minstrelsy,* and in the 1830 introduction to the *Lay of the Last Minstrel.* The first link in the chain was a lecture by Henry Mackenzie on German literature, delivered in 1788. This apprized Scott that there was a fresh development of romantic literature in German, and while he was in the height of his enthusiasm for the new German romance, Mrs. Barbauld visited Edinburgh, and recited an English translation of Bürger's *Lenore.* Scott was moved to attempt such poetry himself, and the impulse was strengthened by his reading Lewis's *Monk* and the ballads in the German manner interspersed through the work. He hastened to procure a copy of Bürger, at once executed translations of several of his ballads, published *The Chase,* and *William and Helen,* in a thin quarto in 1796 (his ambition being perhaps quickened by the unfortunate issue of a love affair), and was much encouraged by the applause of his friends. Soon after he composed *Glenfinlas, The Eve of St. John,* and the *Gray Brother,* which were published in Lewis's collection of *Tales of Wonder* (2 vols., 1801). But he soon became convinced that "the practice of ballad-writing was out of fashion," and his study of Goethe's *Götz von Berlichingen,* of which he published a translation in 1799, gave him wider ideas. Why should he not do for ancient Border manners what Goethe had done for the ancient feudalism of the Rhine? He was engaged at the time preparing a collection of the *Minstrelsy of the Scottish Border,* the first instalment of which was published in two volumes in 1802, and was still hesitating about subject and form for a large original work, when chance at last threw in his way both a suitable subject and a suitable metrical vehicle. The countess of Dalkeith, happening to hear the legend of a tricksy hobgoblin named Gilpin Horner, asked Scott to write a ballad about it. He agreed with delight, and the subject grew in his fertile imagination, till incidents enough had gathered round the goblin to furnish a framework for his long-designed picture of Border manners. At the same time a friend of his who had met Coleridge in Malta brought home sufficient reminiscences of the still unpublished poem of *Christabel* to con-

vey to Scott that its metre was the very metre of which he had been in search. Scott introduced still greater variety into the four-beat couplet; but it was to *Christabel* that he owed the suggestion, as one line borrowed whole and many imitated rhythms testify.

The *Lay of the Last Minstrel* appeared in Jan. 1805, and at once became widely popular. Its success finally decided that literature was to be the main business of Scott's life, and he proceeded to arrange his affairs accordingly. Since his marriage in 1797 with Charlotte Charpentier, daughter of a French refugee, his chief residence had been at Lasswade, about six miles from Edinburgh. But on a hint from the lord-lieutenant that the sheriff must live at least four months in the year within his county, and that he was attending more closely to his duties as quartermaster of a mounted company of volunteers than was consistent with the proper discharge of his duties as sheriff, he had moved his household in 1804 to Ashestiel. When his uncle's bequest fell in, he determined to buy a small property on the banks of the Tweed within the limits of his sheriffdom. There, within sight of Newark castle and Bowhill, he proposed to live like his ancient minstrel, as became the bard of the clan, under the shadow of the great ducal head of the Scotts. But this plan was deranged by an accident. It so happened that an old schoolfellow, James Ballantyne (1772–1833), a printer in Kelso, whom he had already befriended, transplanted to Edinburgh, and furnished with both work and money, applied to him for a further loan. Scott declined to lend, but offered to join him as sleeping-partner. Thus the intended purchase money of Broadmeadows became the capital of a printing concern, of which by degrees the man of letters became the overwrought slave, milch-cow and victim.

When the *Lay* was off his hands, Scott's next literary enterprise was a prose romance—a confirmation of the argument that he did not take to prose after Byron had "*bet* him," as he put it, in verse, but that romance writing was a long-cherished purpose. He began *Waverley*, but a friend to whom he showed the first chapters decided that the work was deficient in interest and unworthy of the author of the *Lay*. Scott accordingly laid *Waverley* aside. We may fairly conjecture that he would not have been so easily diverted had he not been occupied at the time with other heavy publishing enterprises calculated to bring grist to the printing establishment. In 1806 he collected from different publications his *Ballads and Lyrical Pieces*. Between 1806 and 1812, mainly to serve the interests of the firm, he produced his elaborate editions of Dryden (18 vols., 1808), Swift (19 vols., 1818), the Somers Tracts (13 vols., 1809–15), and the *State Papers and Letters of Sir Ralph Sadler* (2 vols., 1809).

Marmion, begun in Nov. 1806 and published in Feb. 1808, was written as a relief to "graver cares," and was even more popular than the *Lay*. Scott's resuscitation of the four-beat measure of the old "gestours" afforded a signal proof of the justness of their instinct in choosing this vehicle for their recitations. The four-beat lines of *Marmion* took possession of the public like a kind of madness, and the critics, except Jeffrey, who may have been offended by the pronounced politics of the poet, were on the whole better pleased than with the *Lay*. Scott was now *facile princeps* among living poets, and touched the highest point of prosperity and happiness. Presently after, he was irritated and tempted by a combination of little circumstances into the great blunder of his life, the establishment of the publishing house of John Ballantyne and Co. A quarrel occurred between Scott's printing firm and Constable, the publisher, who had been the principal feeder of its press. Then the tempter appeared in the shape of Murray, the London publisher, anxious to secure the services of the most popular *littérateur* of the day. The result of negotiations was that Scott set up, in opposition to Constable, the publishing house of John Ballantyne and Co., to be managed by John Ballantyne (d. 1821), James's younger brother. Scott interested himself warmly in starting the *Quarterly Review*, and in return Murray constituted Ballantyne and Co. his Edinburgh agents. Scott's trust in the Ballantynes, and in his own power to supply all their deficiencies, is as strange a piece of infatuation as any that ever formed a theme for romance or tragedy. Their devoted attachment to the architect of their fortunes and proud confidence in his powers helped forward to the catastrophe, for whatever Scott recommended they agreed to, and he was too immersed in multifarious literary work and professional and social engagements to have time for cool examination of the numerous rash speculative ventures into which he launched the firm.

The *Lady of the Lake* (May 1810) was the first great publication by the new house, and next year the *Vision of Don Roderick* followed. The *Lady of the Lake* was received with enthusiasm; it made the Perthshire Highlands fashionable for tourists, and raised the post-horse duty in Scotland; but it did not make up to Ballantyne and Co. for their heavy investments in unsound ventures. The *Edinburgh Annual Register*, meant as a rival to the *Edinburgh Review*, though Scott engaged Southey to write for it and wrote for it largely himself, proved a failure. In a very short time the warehouses of the firm were filled with unsaleable stock, but, so far from understanding the real state of their affairs, Scott considered himself rich enough to make his first purchase of land at Abbotsford. He had hardly settled there in the spring of 1812, and begun his schemes for building and planting and converting a bare moor into a richly wooded *pleasaunce*, when his business troubles began, and he found himself harassed by fears of bankruptcy. The proceeds of *Rokeby* (Jan. 1813) and of other labours of Scott's pen were swallowed up, and bankruptcy was inevitable, when Constable, still eager at any price to secure Scott's services, came to the rescue. With his help three crises were tided over in 1813.

The Novels.—It was in the midst of these embarrassments that Scott opened up the rich new vein of the Waverley novels. He chanced upon the ms. of the opening chapters of *Waverley* which he had written in 1805, and resolved to complete the story. Four weeks in the summer of 1814 sufficed for the work, and *Waverley* was published by Constable without the author's name in July. Many plausible reasons might be given and have been given for Scott's resolution to publish anonymously. The reason given by Lockhart is that he considered the writing of novels beneath the dignity of a grave clerk of the Court of Sessions. The secret was an open one to all his Edinburgh acquaintances, yet why he kept up the mystification until the disclosure of the year 1827, is easily understood. He enjoyed it, and his formally initiated coadjutors enjoyed it; it relieved him from the annoyances of foolish compliment; and it was not unprofitable—curiosity about "the Great Unknown" keeping alive the interest in his works. Meanwhile he kept on producing in his own name as much work as seemed humanly possible for an official who was to be seen every day at his post and as often in society as the most fashionable of his professional brethren. His treatises on chivalry, romance and the drama, besides an elaborate work in two volumes on Border antiquities, appeared in the same year with *Waverley*, and his edition of Swift in 19 volumes in the same week. In 1813 he published the romantic tale of *The Bridal of Triermain* in three cantos, enlarged from an earlier poem, printed in the *Edinburgh Annual Register* of 1809. The *Lord of the Isles* was published in Jan. 1815; *Guy Mannering*, written in "six weeks about Christmas," in February; and *The Field of Waterloo* in the same year. *Paul's Letters to his Kinsfolk* and *The Antiquary* appeared in 1816; the first series of the *Tales of My Landlord*, edited by "Jedediah Cleishbotham"—*The Black Dwarf* and *Old Mortality*—in the same year; *Harold the Dauntless* in 1817; the two volumes of *The Border Antiquities of England and Scotland* in 1814 and 1817. No wonder that the most positive interpreters of internal evidence were mystified. Scott's fertility is not absolutely unparalleled; Anthony Trollope claimed to have surpassed him in rate as well as total amount of production, having also business duties to attend to. But in speed of production combined with variety and depth of interest and weight and accuracy of historical substance Scott is unrivalled.

The immense strain of this double or quadruple life as sheriff and clerk, hospitable laird, poet, novelist, and miscellaneous man of letters, publisher and printer, though the prosperous excitement sustained him for a time, soon told upon his health. Early in 1817 began a series of attacks of agonizing cramp of the stomach,

which recurred at short intervals during more than two years. But his appetite and capacity for work remained unbroken. He made his first attempt at play-writing (*The Doom of Devorgoil*) as he was recovering from the first attack; before the year was out he had completed *Rob Roy,* and within six months it was followed by *The Heart of Midlothian,* which filled the four volumes of the second series of *Tales of My Landlord,* and has remained one of the most popular among his novels. *The Bride of Lammermoor, the Legend of Montrose,* forming the third series by "Jedediah Cleishbotham," and *Ivanhoe* (1820) were dictated to amanuenses, through fits of suffering so acute that he could not suppress cries of agony.

Throughout those two years of intermittent ill-health, which was at one time so serious that his life was despaired of and he took formal leave of his family, Scott's semi-public life at Abbotsford continued as usual—swarms of visitors coming and going, and the rate of production, on the whole, suffering no outward and visible check, all the world wondering at the novelist's prodigious fertility. The first of the series concerning which there were murmurs of dissatisfaction was *The Monastery* (1820); but its sequel, *The Abbot* (1820), in which Mary, Queen of Scots, is introduced, was generally hailed as fully sustaining the reputation of "the Great Unknown." *Kenilworth* (1821), *The Pirate* (1822), *The Fortunes of Nigel* (1822), *Peveril of the Peak* (1822), *Quentin Durward* (1823), *St. Ronan's Well* (1824), *Redgauntlet* (1824) followed in quick succession in the course of three years, and it was not till the last two were reached that the cry that the author was writing too fast began to gather volume. *St. Ronan's Well* was very severely criticized and condemned, yet none of Scott's stories is of more absorbing or more brilliantly diversified interest. There must, of course, always be inequalities in a series so prolonged. The author cannot always be equally happy in his choice of subject, situation and character. Naturally also he dealt first with the subjects of which his mind was fullest. But any theory of falling off or exhaustion based upon plausible general considerations has to be qualified so much when brought into contact with the facts that very little confidence can be reposed in its accuracy. *The Fortunes of Nigel* comes comparatively late in the series and has often been blamed for its looseness of construction, yet some competent critics prefer it to any other of Scott's novels. An attempt might be made to value the novels according to the sources of their materials, according as they are based on personal observation, documentary history or previous imaginative literature. On this principle *Ivanhoe* and *The Tales of the Crusaders* (1825, containing *The Betrothed* and *The Talisman*) might be adjudged inferior as being based necessarily on previous romance. But as a matter of fact Scott's romantic characters are vitalized, clothed with a verisimilitude of life, out of the author's deep, wide and discriminating knowledge of realities, and his observation of actual life was coloured by ideals derived from romance. He did not exhaust his accumulations from one source first and then turn to another, but from first to last drew from all as the needs of the occasion happened to suggest.

During the years 1821–25 he edited Richard Franck's *Northern Memoirs* (1821), *Chronological Notes of Scottish Affairs from the Diary of Lord Fountainhall* (1822), *Military Memoirs of the Great Civil War* (1822), and *The Novelists' Library* (10 vols., 1821–24), the prefatory memoirs to which were separately published in 1828.

Financial Ruin.—Towards the close of 1825, after 11 years of brilliant and prosperous labour, encouraged by constant tributes of admiration, homage and affection such as no other literary potentate has ever enjoyed, realizing his dreams of baronial splendour and hospitality on a scale suited to his large literary revenues, Scott suddenly discovered that the foundations of his fortune were unsubstantial. He had imagined himself clear of all embarrassments in 1818, when all the unsaleable stock of John Ballantyne and Co. was bargained off to Constable for Waverley copyrights, and the publishing concern was wound up. Apparently he never informed himself accurately of the new relations of mutual accommodation on which the printing firm then entered with the great but rashly speculative publisher, and drew liberally for his own expenditure against the undeniable profits of his novels without asking any questions, trusting blindly in the solvency of his commercial henchmen. Unfortunately, "lifted off their feet" by the wonderful triumphs of their chief, they thought themselves exempted like himself from the troublesome duty of inspecting ledgers and balancing accounts, till the crash came. From a diary which Scott began a few days before the first rumours of financial difficulty reached him we know how he bore from day to day the rapidly unfolded prospect of unsuspected liabilities. "Thank God," was his first reflection, "I have enough to pay more than 20s. in the pound, taking matters at the worst." But a few weeks revealed the unpleasant truth that, owing to the way in which Ballantyne and Co. were mixed up with Constable and Co., and Constable with Hurst and Robinson, the failure of the London house threw upon him personal responsibility for £130,000.

How Scott's pride rebelled against the dishonour of bankruptcy, how he toiled for the rest of his life to clear off this enormous debt, declining all offers of assistance and asking no consideration from his creditors except time, and how nearly he succeeded, is one of the most familiar chapters in literary history, and would be one of the saddest were it not for the heroism of the enterprise. His wife died soon after the struggle began, and he suffered other painful bereavements; but, though sick at heart, he toiled on indomitably, and, writing for honour, exceeded even his happiest days in industrious speed. If he could have maintained the rate of the first three years, during which he completed *Woodstock* (1826); *Chronicles of the Canongate* (1827), which included three tales—"The Highland Widow," "The Two Drovers" and "The Surgeon's Daughter"; *The Fair Maid of Perth* (1828, in the second series of *Chronicles of the Canongate*); *Anne of Geierstein* (1829); the *Life of Napoleon* (9 vols., 1827); part of his *History of Scotland* (2 vols., 1829–30, for *Lardner's Cabinet Cyclopaedia*); the Scottish series of *Tales of a Grandfather* (four series, 1828–29–30–31), besides several magazine articles, some of them among the most brilliant of his miscellaneous writings, and prefaces and notes to a collected edition of his novels—if he could have continued at this rate he might soon have freed himself from all his encumbrances. The result of his exertions from Jan. 1826 to Jan. 1828 was nearly £40,000 for his creditors. But the terrific labour proved too much even for his endurance. Ugly symptoms began to alarm his family in 1829, and in Feb. 1830 he had his first stroke of paralysis. Still he was undaunted, and not all the persuasions of friends and physicians could induce him to take rest. "During 1830," Lockhart says, "he covered almost as many sheets with his ms. as in 1829," the new introductions to a collected edition of his poetry and the *Letters on Demonology and Witchcraft* being amongst the labours of the year. He had a slight touch of apoplexy in November and a distinct stroke of paralysis in the following April; but, in spite of these warnings and of other bodily ailments, he had two more novels, *Count Robert of Paris* and *Castle Dangerous* (constituting the fourth series of *Tales of My Landlord*), ready for the press by the autumn of 1831. He would not yield to the solicitations of his friends and consent to try rest and a change of scene, till fortunately, as his mental powers failed, he became possessed of the idea that all his debts were at last paid and that he was once more a free man. In this belief he happily remained till his death. When it was known that his physicians recommended a sea voyage for his health, a Government vessel was put at his disposal, and he cruised about in the Mediterranean and visited places of interest for the greater part of a year before his death. But, when he felt that the end was near, he insisted on being carried across Europe that he might die on his beloved Tweedside at Abbotsford, where he expired on Sept. 21, 1832. He was buried at Dryburgh Abbey.

Scott's wife had died in 1826. His eldest son, Walter, succeeded to the baronetcy which had been conferred on his father in 1820, and the title became extinct on his death in 1847; the elder daughter Charlotte Sophia (d. 1837) was the wife of his biographer, J. G. Lockhart (*q.v.*); and their daughter Charlotte (d. 1858) married J. R. Hope-Scott, and was the mother of Mary Monica, wife of the Hon. J. C. Maxwell, who in 1874 took the additional name of Scott on his marriage with the heiress of

Abbotsford. Mrs. Maxwell-Scott inherited some of the family literary talent, and among other books wrote two volumes about Abbotsford (1893 and 1897).

BIBLIOGRAPHY.—*The Miscellaneous Prose Works of Sir Walter Scott* (6 vols., 1827) were subsequently printed in 30 vols. (1834–71) and in 3 vols. (1841–47). The collected editions of the novels and tales are very numerous. Among them are that known as the "author's favourite edition" (48 vols., 1829–33), for which Scott wrote new prefaces and notes, and the "Border" edition (48 vols., 1892–94), with introductory essays and notes by A. Lang. His *Poetical Works* were printed in 12 vols. (1820); they were edited by J. G. Lockhart (12 vols., 1833–34); by F. T. Palgrave for the "Globe" edition (1866); by W. Minto (2 vols., 1888); by J. Logie Robertson (Oxford complete edition, 1904). Many of the novels have been adapted for the stage, the most famous of these dramatizations being the libretto of Donizetti's *Lucia di Lammermoor* and the *Ivanhoe* of Sir Arthur Sullivan and J. R. Sturgis. His *Minstrelsy of the Scottish Border* (3 vols., 1802–03) was edited (4 vols., 1902) by T. F. Henderson.

The standard life by his son-in-law, J. G. Lockhart, *Memoirs of the Life of Sir Walter Scott* (7 vols., 1837–38), was supplemented by the publication (2 vols., 1890) of Scott's *Journal*, covering the years from 1825 to 1832, and of his *Familiar Letters* (2 vols., 1894), both edited by David Douglas. *See* also James Hogg, *The Domestic Manners and Private Life of Sir Walter Scott* (1834), and R. P. Gillies, *Recollections of Sir Walter Scott* (1837). Shorter lives are by R. H. Hutton ("English Men of Letters," 1878); G. E. B. Saintsbury ("Famous Scots" Series, 1897); Andrew Lang ("Literary Lives," 1906); G. le Grys Norgate (1906), and J. Buchan (1925). For the Ballantyne controversy *see* also *The Ballantyne Press and its Founders* (1909). *See* also W. Brewer, *Shakespeare's Influence on Sir Walter Scott* (1925); A. Caplan, *The Bibliography of Sir Walter Scott* (1928); W. S. Crockett, *The Religion of Sir Walter Scott* (1929).

SCOTT, WINFIELD (1786–1866), American general, was born near Petersburg (Va.) on June 13, 1786. In 1805 he entered the College of William and Mary where he studied law. In 1807 he removed to Charleston (S.C.), but as war with England seemed imminent he soon left for Washington and offered his services. In 1808 he was commissioned as a captain of artillery, recruited a company in Richmond and Petersburg, and was ordered to New Orleans. In July 1812, as a lieutenant-colonel of artillery, he was sent to the Niagara frontier and fought at Queenston, where he was taken prisoner. He was exchanged in Jan., 1813, became colonel in the following March, was promoted to the rank of brigadier-general in March 1814, and in July received the brevet of major-general. In the battles of Chippewa (July 5, 1814) and Lundy's Lane (July 25) he took a conspicuous part, and was twice wounded in the Lundy's Lane engagement. For his services he was presented with a gold medal by Congress and with a sword by the State of Virginia.

Among the difficult tasks that he was called upon to perform between 1815 and 1861, for the last 20 years of which period he was the commanding general of the United States Army, were: an expedition to the Middle West in 1832, where, after the end of the Black Hawk War, he negotiated treaties of peace with the Sauk, Fox, Winnebago, Sioux, and Menominee Indians; a journey to Charleston to watch the progress of the nullification movement, and to strengthen the garrisons of the forts in the harbour; an expedition in 1836 against the Seminole Indians in Florida; the supervision of the removal in 1838 of the Cherokee Indians from Georgia, North Carolina, Alabama and Tennessee to the reservation set apart for them by treaty west of the Mississippi river; a visit to the Niagara river in 1838 to put an end to the acts by Canadian insurgents in violation of American neutrality; a similar mission to Maine in 1839 to restore tranquillity between the citizens of Maine and New Brunswick, who were disputing the possession of land along the Aroostook river; and a journey to the north-west in 1859 to adjust a dispute between American and British officers concerning the joint occupation of San Juan island in Puget sound.

His greatest achievement was the brilliant Mexican campaign of 1847. As the senior officer of the army, he was placed in command of the invading expedition, and after capturing Vera Cruz (March 29, 1847), and winning victories at Cerro Gordo (April 18), Contreras-Churubusco (Aug. 19–25), Molino del Rey (Sept. 8), and Chapultepec (Sept. 13), he crowned his campaign by the capture, on Sept. 14, of the Mexican capital. In March 1848 he received a vote of thanks from Congress, which ordered a gold medal to be struck in commemoration of his services. His nomination for the presidency by the Whigs had been suggested in 1839 and in 1848, and in 1852 he received it; but the Whigs, divided on the slavery question, gave only half-hearted support to their compromise platform; and Scott made several unfortunate extemporaneous addresses. He received the electoral votes of only Kentucky, Virginia, Massachusetts and Vermont. This defeat, however, detracted nothing from his popularity, and in 1852 the brevet rank of lieutenant-general was created specially for him. At the outbreak of the Civil War, though a Virginian, he remained at the head of the United States armies and directed operations from Washington until Nov. 1861. He then visited Europe for a short time, and after returning wrote his *Memoirs*, published in 1864. He died at West Point (N.Y.) on May 29, 1866.

See *Memoirs of Lieutenant-General Scott, LL.D.* (1864); Raphael Semmes, *The Campaign of General Scott in the Valley of Mexico* (Cincinnati, 3rd ed., 1852); Edward D. Mansfield, *Life and Military Services of General Scott* (1862); and Marcus J. Wright, *General Scott* (1894), in the "Great Commanders" series.

SCOTTISH LITERATURE. In a survey of the whole stream of Scottish literature two main currents may be recognized, the one *literary* and often of an artificial or academic type; the other *popular*. The former is represented by the group known as the Scottish Chaucerians, by the 17th century court poets, by the "English" writings of Edinburgh *literati* of the 18th century; the latter by the domestic and "rustic" muse from *Christis Kirk on the Grene* to the work of the 18th century revival begun in Ramsay. There is, of course, frequent interaction between these two movements, but recognition of their separate development is necessary to the understanding of such contemporary contrasts as the *Thrissil and the Rois* and *Peblis to the Play,* Drummond and Montgomerie, Ramsay and Hume. In our own day, when the literary medium of Scotland is identical with that of England, the term Scottish literature has been reserved for certain dialectal revivals, more or less bookish in origin, and often as artificial and as unrelated to existing conditions as Chaucerian "Ynglis" of the 15th century was to the popular speech of that time.

IN ENGLISH

The Early Period.—Down to the earlier decades of the 15th century the vernacular remains show the main characteristics of "Northern English," and deal with the familiar mediaeval kinds of romance and rhymed chronicle. After the Wars of Independence a national or Scottish sentiment is discernible, but it does not colour the literature of this age as it does that of later periods when political and social conditions had suffered serious change.

The earliest extant verse has been associated with Thomas of Erceldoune (*q.v.*), called The Rhymer, but the problem of the Scot's share in reworking the Tristram saga is in some important points undetermined. Uncertainty also hangs round the later Huchown (*q.v.*). Contemporary with the work of the latter are a few anonymous fragments such as the verses on the death of Alexander II., first quoted by Wyntoun in the 15th century, and the snatches on the "Maydens of Englelonde" and "Long beerdys," quoted by Fabyan. The type of alliterative romance shown in the work ascribed to Huchown continued to be popular throughout the period (e.g., *The Knightly Tale of Golagros and Gawane*), and lingered on in the next in *The Buke of the Howlat* by Holland (*q.v.*), the anonymous *Rauf Coilȝear* of the third quarter of the 15th century and in a few pieces of burlesque. Independent of this group of alliterative romances is the not less important body of historical verse associated with the names of John Barbour (*q.v.*), Andrew of Wyntoun, and, in the middle period, Harry the Minstrel (*q.v.*). Barbour, called the father of Scottish poetry, apparently for no other reason than that he is the oldest writer who has held place in popular esteem, is without literary influence. Later political fervour has grouped him with the author of the *Wallace*, and treated the unequal pair as the singers of a militant patriotism, but the "Scottish prejudice" which Burns tells us was "poured" into his veins from the *Wallace* is not obvious in the *Brus*.

The Middle Period.—To this period (extending, roughly,

throughout the 15th and 16th centuries) belongs the important group of Middle Scots "makars" or poets who, in the traditional phrase of the literary historians, made "the Golden Age of Scottish Poetry." It is in the writings of this time that we find the practice of the artificial literary dialect known as Middle Scots; but there is also in this period the first clear indication of other literary types of great prospective interest. The prevailing influence in the writers of greater account is Chaucerian. These writers, to whom the name of "The Scottish Chaucerians" has been given, carried over from the south much of the diction and not a little of the literary habit of the master-poet. In these respects they are superior to Lydgate, Occleve and other southern contemporaries; and not rarely they approach Chaucer in sheer accomplishment. The first example of this new style is the *Kingis Quair* of James I. (*q.v.*), in which the indebtedness, even when full allowance is made for the young poet's individuality, is direct and clear. The language, like that of the later *Lancelot of the Laik* and the *Quare of Jelousy,* represents no spoken dialect. Whether it is to be explained by the deliberate adoption of southern literary forms by the author, which his enthusiasm for Chaucer and the circumstances of his sojourn in England made inevitable, or whether the single text is a Scottish scribe's rendering, is still a problem. The balance of evidence is in favour of the former, which is the traditional view.

The later Chaucerian type is less directly derivative in its treatment of allegory and in its tricks of style, and is less southern in its linguistic forms. The greater poets who represent this type are Robert Henryson, William Dunbar, Gavin Douglas and Sir David Lyndsay. A critical tradition has exaggerated the importance of the minor writers who shared in this poetical outburst. Of some of the best known minors, such as Walter Kennedy (*q.v.*) and Quintyn Schaw, it would be hard to say that they are not as dull as their southern contemporaries. The greater portion of this Middle Scots "Chaucerian" literature is courtly in character, in the literary sense that it continues the verse of the *cours d'amour* type; and in the personal sense that it was directly associated with the Scottish court and conditioned by it. What is not strictly allegorical after the fashion of the *Romaunt of the Rose* or Chaucer's exercises in that kind is for the most part occasional, dealing with courtiers' sorrow and fun, with the conventional plaints on the vanity of the world and with pious ejaculation. Even Henryson, perhaps the most original of these poets, is in his most original pieces strongly "Chaucerian," notably in his remarkable series of *Fables* and in his *Testament of Cresseid;* and in the satire and Reformation heat of Lyndsay we have the old manner persisting in his *Testaments* and in his tale of *Squyer Meldrum.* There are, as might be expected, points of contact between the work of the "makars" and the more native and "popular" material. Each of the greater poets has left one example of the old manner of the alliterative romance-poem; but the fact that in each case their purpose is strongly burlesque is significant of the change in literary outlook.

The non-Chaucerian verse of this period is represented by (a) alliterative romance-poems and (b) verse of a rustic and domestic character. Of the historical romance-poem there is little or nothing beyond Henry the Minstrel's *Wallace* (*supra*). Pieces of the general description of Holland's (*q.v.*) *Buke of the Howlat* and the anonymous poems *The Awntyrs of Arthur, Rauf Coilȝear* and *The Pistill of Susan* represent outworn forms. Strong as the Chaucerian influence was, it was too artificial to change the native habit of Scots verse; and though it helps to explain much in the later history, it offers no key to the main process of succeeding centuries. Our knowledge of the non-Chaucerian material, as of the Chaucerian, is chiefly derived from the manuscript collections of Asloan, Bannatyne (*q.v.*) and Maitland (*q.v.*). The historical student will find anticipations of the manner of Ramsay, Fergusson and Burns, which criticism has too often treated as the exclusive expression of later Scotticism. It would not be difficult to show that the reaction in the 18th century against literary and class affectation (however editorial and bookish it was in the choice of subjects and forms) was in reality a re-expression of the old themes in the old ways. It is impossible here to do more than to point out the leading elements and to name the leading examples. These elements are, briefly stated (1) a strong partiality for subjects dealing with humble life, in country and town; (2) a whimsical, elfin kind of wit, delighting in extravagance and topsy-turviness; (3) a frank interest in the pleasures of good company and good drink. The reading of 15th- and 16th-century verse in the light of these will bring home the critical error of treating such poems as Burns's *Cottar's Saturday Night,* the *Address to the Deil* and *Scotch Drink* as entirely expressions of the later poet's personal predilection. Of the more "ethical" or "theological" mood which counts for so much in the modern estimate of Scottish literature, there is little evidence in the middle period. Even in the deliberately religious and moral work of the more academic poets this seriousness is never more oppressive than it is elsewhere at the time. If it becomes an obsession of many of the post-Reformation writers, it becomes so by the *force majeure* of special circumstances rather than in the exercise of an old habit.

Among examples of this rustic style are *Peblis to the Play* and *Christis Kirk on the Grene,* ascribed by some to James V. (*q.v.*), *Sym and his Brudir, The Wyf of Auchtirmuchty* and the *Wowing of Jok and Jynny.* The more elfin quality, familiar in Dunbar's *Ballad of Kynd Kittok* and his *Interlude of the Droichis Part,* appears in such pieces as *Gyre Carling* (the mother-witch), *King Berdok* and *Lichtounis Dreme.* The convivial verse, at its best in Dunbar's *Testament of Mr. Andrew Kennedy,* may be studied in *Quhy sould nocht Allane honorit be,* one of many eulogies of John Barleycorn before Burns's well-known piece. In the collections there are few examples of the simple *fabliau,* the best being the *Thrie Priestis of Peblis* and *The Dumb Wyf,* or of the social variety of the same as shown in *Rauf Coilȝear* and *John the Reeve.* For the latter Sir David Lyndsay remains the chief exponent. Of historical and patriotic verse there are few specimens, but some of the lyrics and love-songs, more or less mediaeval in *timbre* and form, are of importance. Of these, *Tayis Bank* and *The Murning Maiden* are perhaps the best.

Vernacular prose was, as might be expected, and especially in Scotland, late in its appearance. The main work continued to be done in Latin, and to better purpose by Hector Boece (*q.v.*), John Major (*q.v.*) and George Buchanan (*q.v.*) than by the earlier annalists Fordun (*q.v.*) and Bower (*q.v.*). It is not till the middle of the 15th century that we encounter any works seriously undertaken in the vulgar; before that time there is nothing but an occasional letter (*e.g.,* that of the earl of March to Henry IV.), a few laws, and one or two scraps in the Asloan and other mss., all of the plainest and without any effort towards style. Nor can it be said that the first works of a more deliberate character show the awakening artistic consciousness found in contemporary writings in England. The earliest books are Sir Gilbert Haye's *Buke of the Law of Arms, Buke of the Order of Knighthood* and *Government of Princes,* preserved in a single ms. at Abbotsford. The dull treatise of John of Ireland (*q.v.*) lays claim to originality of a kind. The author's confession that, being "thretty ȝeris nurist in Fraunce, and in the noble study of Paris in Latin toung," he "knew nocht the gret eloquens of Chauceir," and again that he had written another work in Latin, "the tounge that I knaw better," is valuable testimony to the difficulties in the way of a struggling Scots prose. Other preliminary efforts are the *Portuus of Nobilnes;* the *Spectakle of Luf,* translated by G. Mill (1492); and the *Schort Memoriale of the Scottis Corniklis,* an account of the reign of James II. In the early 16th century the use of the vernacular is extended, chiefly in the treatment of historical and polemical subjects, as in Murdoch Nisbet's version of Purvey, a compromise between northern and southern usage; Gau's *Richt Vay;* Bellenden's (*q.v.*) translation of Livy and *Scottish History;* the *Complaynt of Scotlande,* largely a mosaic of translation from the French; Ninian Winzet's *Tractates;* Lesley's (*q.v.*) *History of Scotland;* Knox's (*q.v.*) *History;* Buchanan's (*q.v.*) *Chamaeleon;* Lindesay of Pitscottie's (*q.v.*) *History;* and the tracts of Nicol Burne and other exiled Catholics. In these works, and especially in Knox, the language is strongly southern. The Scriptures, which had an important bearing on literary style,

were, with the exception of Nisbet's version, accepted in the southern text. It was not till the publication of Bassandyne's Bible in 1576–79 that a Scottish version was used officially. Lyndsay in the midst of passages in Scots quotes directly from the Genevan version. The *Complaynt of Scotlande* is the most striking example of "aureate" Middle Scots, the prose analogue of the verse of the "Chaucerians"; but the manner is rare in prose, even at this time. The last and most extravagant illustration of it is the *Rolment of Courtis* by Abacuck Bysset, as late as 1622.

Towards the close of the period certain verse-writers appear who, though differing from their Middle Scots predecessors, belong as much to this period as to the next. In language they are still Scottish; if they show any southern affectations, it is (all echoes of the older "aureate" style notwithstanding) the affectation of Tudor and Elizabethan English. This poetry, like that of the early half of the period, is courtly; its differences are the differences between the atmosphere of the reigns of the first and fourth Jameses and that of the sixth. When the sixth James becomes the first of England, a more thorough transformation is discernible. In the centre of this group is the king himself, poet and writer of prose; but he yields in competence to Alexander Scott (*q.v.*) and Alexander Montgomerie (*q.v.*). Their interest on the formal side is retrospective, but it is possible to find, even in the persistent reiteration of mediaeval sentiment and methods, a fresh feeling for nature and a lyrical quality of later *timbre*. With these may be named the minors, William Fowler (*q.v.*), Alexander Arbuthnot (*q.v.*) and John Rolland (*q.v.*).

The Third Period.—Strict accuracy would place the date of transition to the third period earlier than 1600 or 1603, for there is evidence in the 16th century, even outside diplomatic and official correspondence, of the intermingling of the north and south. It is, however, when James is established on his new throne that we have clear signs of the changes at work. The recital of the names of the Anglo-Scots poets will make this clear: Robert Ker, earl of Ancram, best known for his *Sonnet in Praise of a Solitary Life;* Sir David Murray of Gorthy, who wrote *The tragicall Death of Sophonisba;* Sir William Alexander (*q.v.*) afterwards earl of Stirling; William Drummond, laird of Hawthornden (*q.v.*); Sir Robert Aytoun (*q.v.*); James Grahame, marquess of Montrose; Patrick Hannay; and the covenanting Sir William Mure of Rowallan (*q.v.*). In prose there is Drummond and that strange genius Sir Thomas Urquhart (*q.v.*); a crowd of polemical writers, mostly ecclesiastics; all the historians, including Spotswood and Calderwood. Outside this transformed Scots the activities of the Latinists continued; as shown in the publication by the poet Arthur Johnston (*q.v.*) of the two volumes of *Delitiae poëtarum Scotorum huius aevi illustrium* (1637), and in the writings of John Barclay (*q.v.*) author of the *Argenis,* Sir Robert Aytoun, Thomas Dempster (*q.v.*), David Hume of Godscroft, Sir John Scot of Scotstarvet, best known for his *Staggering State,* Sir Thomas Craig, author of the *Jus Feudale* and Andrew Melville.

There is nothing in Scots to balance this English and Latin list. The play *Philotus,* a poor example in a *genre* rarely attempted in the North, is indebted to the South for more than its subject. The philological tractate *Of the Orthographie and Congruitie of the Britan Tongue* by Alexander Hume (not the verse writer) is in its language a medley; and William Lithgow had travelled too widely to retain his native speech in purity, even in his indifferent verse. Scraps may be unearthed as mediocre as the *Answer to Curat Caddel's Satyre upon the Whigs,* which attempts to revive the mere vulgarity of the Scots "flyting." The only contributions which redeem these 100 years and more from the charge of disrespect to the native muse come from the pen of the Sempills.

We are attracted to Beltrees and his kinsmen less by their craftsmanship than by the fact that they supplied the leaders of the vernacular revival of the 18th century with many subjects and verse-models, and that by their treatment of these subjects and models, based on the practice of an earlier day, they complete the evidence of the continuity of the domestic popular type of Scots verse. In the 18th century the literary union of the North and South is complete. The Scot, whatever dialectal habits marked his speech, wrote the English of Englishmen. The story of this later expression is part of the story of English literature: to it we leave James Thomson, Adam Smith, David Hume, James Boswell and Sir Walter Scott. In the vernacular revival begun by Allan Ramsay, continued by Fergusson and completed by Burns, these later Scots restored a tradition, not so much because it was national, as because it directly helped the general protest against the artificiality of the century. Yet even they did not abjure the "southern manner," and their work in it is a matter of some critical significance, whatever may be said of its inferiority in craftsmanship.

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IN GAELIC

It is not until after the Forty-five that we find any great manifestation of originality in the literature of the Scottish Highlands. The reasons for this are not far to seek. Scotch Gaelic was from the outset seriously handicapped by the great activity of the professional literary class in Ireland. We may say that down to the beginning of the 18th century the literary language of the Highlands was the Gaelic of Ireland. During the dark days of the penal laws and with the extinction of the men of letters and their patrons in Ireland, an opportunity was given to the native Scottish muse to develop her powers. Further, after Culloden the causes of the clan feuds and animosities of the past were removed. The Highlands, perhaps for the first time in history, formed a compact whole and settled down to peace and quietude. A remarkable outburst of literary activity ensued, and the latter half of the 18th century is the period which Scottish writers love to call the golden age of Gaelic poetry. But before we attempt to deal with this period in detail, we must examine the scanty literary products of Gaelic Scotland prior to the 18th century.

Highland Mss.—The earliest document containing Gaelic matter which Scotland can claim is the *Book of Deer,* now preserved in the Cambridge university library. This ms. contains portions of the Gospels in Latin written in an Irish hand with illuminations of the well-known Irish type. Inserted in the margins and blank spaces are later notes and memoranda partly in Latin, partly in Gaelic. The Gaelic entries were probably made between 1000 and 1150. They relate to grants of land and other privileges made from time to time to the monastery of Deer (Aberdeenshire). The language of these entries shows a striking departure from the traditional orthography employed in contemporary Irish documents. The Advocates' library in Edinburgh contains a number of mss. probably written in Scotland between 1400 and 1600 but with one exception the language is Irish.

The solitary exception just mentioned is the *Book of the Dean of Lismore.* The pieces contained in this volume are written in the crabbed current Roman hand of the period, and the orthography is phonetic, both of which facts render the deciphering of this valuable ms. difficult. The contents are almost entirely verse compositions collected by Sir James Macgregor, dean of Lismore in Argyllshire, and his brother Duncan, between the years 1512 and 1526. A disproportionate amount of space is allotted to the compositions of well-known Irish bards, but native bards are also represented. We can mention Allan MacRorie, Gillie Calum Mac an Ollav, John of Knoydart, Finlay MacNab, and Duncan Macgregor, the transcriber of the greater part of the volume. A few other poems are by Scottish authors such as Campbell, Knight of Glenorchy (d. 1513), the earl of Argyll and Countess Isabella. A number consist of satires on women. These Scottish writers are still under the influence of Irish metric but frequently use the freer forms of the old metres.

Among the pieces which represent the Scottish vernacular of the day are the *Ossianic Ballads.* These, 28 in number, extend to upwards of 2,500 lines, and form by far the most important part of the collection. Nine of the poems are directly attributed to Ossian, two to Ferghus File, one to Caoilte Mac Ronan, and one to Conall Cearnach, whilst others are ascribed to Allan MacRorie, Gillie Calum Mac an Ollav and Caoch O'Cluain, who

are otherwise unknown. Thomas MacLauchlan published the text of the Ossianic ballads with modern Gaelic and English renderings in 1862. In the same volume W. F. Skene gave a useful description of the ms. and its contents. Alexander Cameron published in his *Reliquiae Celticae,* vol. i., a selection partly coinciding with MacLauchlan's.

Between the Book of the Dean and the Forty-five we find another great gap, which is only bridged over by a collection which presents many points of resemblance to Macgregor's compilation. The *Book of Fernaig,* also written in a kind of phonetic script, was compiled by Duncan Macrae of Inverinate between 1688 and 1693. The ms. contains about 4,200 lines of verse of different dates and by different authors. The contents of the collection are mainly political and religious, with a few poems which are termed didactic. In State politics the authors are Jacobite, and in church politics Episcopalian. The Ossianic literature is represented by 36 lines. There are a number of poems by 16th-century writers, among whom is Bishop Carsewell. The text of the *Book of Fernaig* is printed in its entirety with a transcription in standard orthography, by M. Macfarlane, 1923.

Two other Highland mss. remain to be noticed. These are the *Red* and *Black Books of Clanranald,* which are largely taken up with the histories of the families of Macdonald and with the achievements of Montrose, written in the ordinary Irish of the period by the Macvurichs, hereditary bards to the Clanranald chiefs. During the Ossianic controversy the *Red Book of Clanranald* was supposed to contain the originals of much of Macpherson's famous work; but, on the book coming into the hands of the enthusiastic Gaels of the closing years of the 18th century, and on its contents being examined and found wanting, the ms. was tampered with.

Mary Macleod.—Mackenzie's *Beauties of Gaelic Poetry* contains poems written by a number of writers who flourished towards the end of the 17th century and at the beginning of the 18th. Among them are Mary Macleod, John Macdonald (Iain Lom), Iain Dubh MacIain 'Ic. Ailein (b. *c.* 1665), the Aosdan Matheson (one of his poems was rendered in English by Sir Walter Scott under the title of "Farewell to Mackenzie, High Chief of Kintail"), Roderick Morrison and John Mackay of Gairloch, but we can here only notice the first two. The famous Mary Macleod, better known as Mairi Nighean Alastair Ruaidh (*c.* 1588–1693), was family bard to Sir Norman Macleod of Bernera, and later to John "Breac" Macleod of Macleod, in honour of whom most of her poems were composed. Her pieces, all of them composed after 1660, are composed in the modern Irish metres with the characteristic vowel rhymes of the accented syllables. Mary Macleod's best-known pieces comprise a dirge on the drowning of Iain Garbh (Mac'Ille Chalum) in the Minch, a song "An Talla 'm bu ghnath le MacLeoid," and an ode to Sir Norman Macleod of Bernera, produced during her exile in Mull, which begins "S mi'm shuidhe air an tulaich." For the details of her career, the reader may be referred to the *Transactions of the Gaelic Society of Inverness,* vol. xxii. pp. 43–66. A number of poems belonging to this period have been published in *The Macdonald Collection of Gaelic Poetry* (1911).

John Macdonald, better known as Iain Lom (d. *c.* 1710), was a vigorous political poet whose verses exercised an extraordinary influence during his lifetime. His best-known poems are *Mort na Ceapach,* on the murder of the heir of Keppoch, and a piece on the battle of Inverlochay (1645). However great the inspiration of Mary Macleod and Iain Lom, they were after all but political or family bards. In succession to them there arose a small band of men with loftier thoughts, a wider outlook and greater art. The literature of the Scottish Highlands culminates in the names of Alexander Macdonald, Duncan Bàn MacIntyre and Dugald Buchanan.

Alexander Macdonald.—Alexander Macdonald, commonly called Alasdair MacMhaighstir Alasdair (b. *c.* 1700), was the son of an Episcopalian clergyman in Moidart. He was sent to Glasgow university, but an imprudent marriage caused him to abandon his studies, and about 1729 he received an appointment as a Presbyterian teacher in his native district. About 1740 he was invited to compile a Gaelic vocabulary, which was published in 1741. Macdonald has thus the double distinction of being the author of the first book printed in Scotch Gaelic and of being the father of Highland lexicography. After the landing of the Pretender he was given the rank of captain, but rendered greater services to the Jacobite cause with his stirring poems than with the sword. In 1751 he visited Edinburgh and brought out a collection of his poetry, which was the first original work printed in Scotch Gaelic, and was therefore entitled *Ais-eiridh na Seann Chanain Albannaich* (Resurrection of the Ancient Scottish Tongue). Macdonald's compositions naturally fall into three groups—love-songs, descriptive poems and patriotic and Jacobite poems. In his love-songs and descriptive poems Macdonald struck an entirely new note in Gaelic literature. His *Moladh Mòraig* and *Cuachag an Fhàsaich* (also called *A'Bhanarach Dhonn*) are his best-known love-songs. But he is distinctly at his best in the descriptive poems.

His verse is always musical, and his skilful use of epithet, often very lavishly strewn, enables him to express with marvellous effect the various aspects of nature in her gentler and sterner moods alike. His masterpiece, the *Birlinn of Clanranald,* which is at the same time, apart from Ossianic ballads, the longest poem in the language, describes a voyage from South Uist to Carrickfergus. Here Macdonald excels in describing the movement of the ship and the fury of the storm. In *Allt an t-Siucair* (The Sugar Brook) we are given an exquisite picture of a beautiful scene in the country on a summer morning. Other similar poems full of melody and colour are *Failte na Mòr-thir* (Hail to the Mainland), *Oran an t-Samhraidh* (Ode to Summer), and *Oran an Gheamhraidh* (Ode to Winter). Among the Jacobite poems we may mention *Oran nam Fineachan Gaelach* (The Song of the Clans), *Brosnachadh nam Fineachan Gaidhealach* (A Call to the Highland Clans), and various songs to the prince. But incomparably the finest of all is *Oran Luaighe no Fucaidh* (Waulking Song). Here the prince is addressed as a young girl with flowing locks of yellow hair on her shoulders, and called Morag. She had gone away over the seas, and the poet invokes her to return with a party of maidens (*i.e.,* soldiers) to dress the red cloth, in other words, to beat the English red-coats. Macdonald's works have gone through several editions, the last of which is dated 1924.

Duncan Bàn.—The only poet of nature who can claim to rival Macdonald is a man of a totally different stamp. Duncan Bàn MacIntyre (Donnachadh Bàn, 1724–1812) was born of poor parents in Glenorchy, and never learned to read and write or to speak English. He was present on the English side at the battle of Falkirk, on which he wrote an ode, and shortly afterwards he was appointed gamekeeper to the earl of Breadalbane in Coire Cheathaich and Ben Dorain, where he lived for many years until he accepted a similar appointment from the duke of Argyll in Buachaill-Eite. In addition to his poems descriptive of nature MacIntyre composed a number of Jacobite martial songs, songs of love and sentiment, and comic and satiric pieces. The poem *Màiri bhàn òg* addressed to his wife is, on account of its grace and delicate sentiment, generally held to be the finest love-song in the language. But it is above all as the poet of ben and corrie that MacIntyre is remembered. He has been called the Burns of the Highlands, but the bitterness and intellectual power of the Ayrshire poet are absent in MacIntyre.

Duncan Bàn describes fondly and tenderly the glories of his native mountains as only one can who spends his life in daily communion with them. His two great compositions are styled *Ben Dòrain* and *Coire Cheathaich.* The former, which might be called the "Song of the Deer," has been well done into English by J. S. Blackie. *Coire Cheathaich* (The Misty Corrie), a much shorter poem than *Ben Dòrain,* gives a loving description of all the prominent features in the landscape—the flowers, the bushes, the stones, the hillocks with the birds and game, and the whirling eddies with the glistening salmon. MacIntyre's works, first published in 1768, went through three editions in his lifetime. The most recent edition, by G. Calder, appeared in 1912.

From Duncan Bàn we pass on to consider the compositions of two men who hailed from the outlying parts of Gaeldom, Robert

Mackay, or, as he is generally called, Rob Donn (1714–78), was a native of Strathmore, Sutherlandshire. He left behind a large number of poems which may be roughly classified as elegiac, love, and satiric poems. His best-known elegy is "The Death-Song of Hugh." Having just heard of the death of Pelham, the prime minister, Mackay finds a poor friend of his dying alone amid squalor in the heart of the mountains. In a poem composed on the spot the poet contrasts the positions of the two men and reflects on the vanity of human existence. Among his love-poems the "Shieling Song" is deservedly famous. But it was above all as a satirist that Mackay excelled during his lifetime. Indeed he seems to have had the sharpest tongue of all the Highland bards, but many of Rob Donn's compositions have lost their point, and opinions have been greatly divided as to his merits as a poet. His collected poems were first published in 1829, a second edition appeared in 1871, and in 1899 two new editions were issued simultaneously. Another satirical poet who enjoyed a great reputation in his own day was John MacCodrum, a native of North Uist and a contemporary of the men just mentioned. A number of his compositions are addressed to his patrons, but one delightful poem entitled *Smeòrach Chlann-Domhnuill* (The Mavis of Clan Donald) describes in verses full of melody the beauties of his beloved island home.

Dugald Buchanan.—In the lyrical outburst which followed the Forty-five religious poetry is well represented. The first religious poem to be printed in Scotch Gaelic was a long hymn by David Mackellar, published in 1752. But incomparably the greatest writer of hymns and sacred poems is Dugald Buchanan (1716–68). Buchanan was born in Strathyre in Perthshire and was the son of a miller. He received a desultory kind of education and tried his hand at various trades. He was selected to assist Stewart of Killin in preparing the first Highland version of the New Testament for the Society for Propagating Christian Knowledge (published 1767), and at the same time he issued an edition of his own poems. Of all Gaelic books this has been far and away the most popular, having gone through no less than 40 editions, the last in 1913. Buchanan seems to have been very susceptible to religious influences, and the stern Puritan doctrines of retribution and eternal damnation preached around him so worked on his mind that from his 9th to his 26th year he was a prey to that mental anguish so eloquently described by Bunyan. The awful visions which presented themselves to his vivid imagination find expression in his poems. In the "Day of Judgment," a poem of about 120 stanzas, we are given a vivid delineation of the crack of doom as the archangel sounds the last trump. But Buchanan's masterpiece is admittedly "The Skull," the subject of which, it seems certain, was suggested by Shakespeare. The poet seated by a grave espies a skull. He takes it up and muses on its history. This poem in 44 stanzas concludes with a picture of the torments of hell and the glories of heaven.

Macpherson's "Ossian."—The writers whom we have been discussing are practically unknown save to those who are able to read them in the original. Now we turn our attention to a man who plays a prominent part in the history of European literature. Though the precise origin of the Fenian cycle may remain a moot point to all time, the interest taken in Celtic studies since the middle of the 19th century in Ireland and Scotland and elsewhere has accumulated a body of evidence which has settled for all time the dispute as to the authenticity of Macpherson's *Ossian.* James Macpherson (1736–96), a native of Kingussie, showed a turn for versification whilst yet a student at college. Whilst acting as tutor at Moffat he was asked by John Home as to the existence of ancient Gaelic literature in the Highlands. After some pressing Macpherson undertook to translate some of the more striking poems, and submitted to Home a rendering of "The Death of Oscar." Blair, Ferguson and Robertson, the foremost men in the Edinburgh literary circles of the day, were enthusiastic, and at their instance Macpherson published anonymously in 1760 his *Fragments of Ancient Poetry, collected in the Highlands of Scotland and translated from the Gaelic or Erse Language,* containing 15 translations, preceded by a preface from the pen of Blair. In the preface it was stated that an epic of considerable length existed in Gaelic, and that, given sufficient encouragement, the author of the versions would undertake to recover and translate it. A subscription was raised and after a tour of exploration, on which he was accompanied by two or three competent Gaelic scholars, Macpherson published in London in 1762 his epic *Fingal* with 15 other smaller poems. In the following year a still larger epic in eight books appeared with the title of *Temora.*

The authenticity of Macpherson's translations was soon impugned by Dr. Johnson, Hume and Malcolm Laing, and the author was urged by his friends to publish the originals. Macpherson at different times seems to have had some intention of publishing the Gaelic of his *Ossian,* but he was naturally deterred by the feeling that his knowledge of Gaelic was becoming shakier with his continued absence from the Highlands. At any rate he left behind a quantity of Gaelic matter in ms. which was ultimately published by the Highland Society of London in 1807. This ms., however, was revised and transcribed by Ross and afterwards destroyed, so that we are ignorant of its nature. Macpherson's claims still found ardent advocates, such as Clark, in the '70s, but the question was finally disposed of in papers by Alexander Macbain (1885) and L. C. Stern (1895). We can here only summarize briefly the main lines of argument. (1) Macpherson's *Ossian* is full of reminiscences of Homer, Milton and the Hebrew prophets. (2) He confuses the Ulster and the Fenian heroic cycles in unpardonable fashion. (3) The Gaelic text of 1807 only represents one-half of the English versions (11 poems out of 22 poems). Some Gaelic fragments from different pens appeared prior to 1807, but these differ considerably from the "official" version. (4) In the Gaelic text of 1807 the version of the passage from *Temora* is quite different from that published in 1763. (5) Macpherson's Gaelic is full of offences against idiom and unnaturally strained language. (6) The names Morven and Selma are entirely of his own invention. (*See* also MACPHERSON, JAMES.)

Later Poets.—The men we have dealt with above created a kind of tradition which others have attempted to carry on. Ewen Maclachlan (1775–1822), the first transcriber of the Dean's Book, translated the greater part of seven books of Homer's *Iliad* into Gaelic "verse," and he also had a large share in the compilation of the Gaelic-English part of the Highland Society's *Dictionary.* His poems, published in 1816, consist of poems of nature, e.g., *Dàin nan Aimsirean, Dàn mu Chonaltradh, Smeòrach Chloinn-Lachuinn,* and of a well-known love-song, the *Ealaidh Ghaoil.* William Ross (1762–90), a schoolmaster at Gairloch, composed, among other popular poems, *Feasgar Luain* and *Moladh na h-Òighe Gaelich.* Another exquisite song *Cuachag nan Craobh,* is usually attributed to this poet, but it seems to go back to the beginning of the 18th century. A fifth edition of Ross's poems appeared in 1902. The most popular writer of sacred poems after Buchanan is undoubtedly Peter Grant, a Baptist minister in Strathspey, whose *Dàin Spioradail* (first published in 1809) reached a 20th edition in 1904. Two other well-known hymn-writers spent their lives in Nova Scotia—James Macgregor (1759–1830), and John Maclean, a native of Tiree. The compositions of the latter have been published under the title *Clarsach na Coille* (Glasgow, 1881). But John Morrison (1790–1852), the poet-blacksmith of Rodel, Harris, is the most worthy of the name of successor to Buchanan. His works have been carefully edited in two volumes by George Henderson (2nd ed. 1896). Two of his most characteristic poems are *An Iondruinn* and *Tha luin' òg agus seann duin' agam.* William Livingston or MacOhunleibhe (1808–70) was a native of Islay. He was ever a fierce Anglophobe, and did his best to make up for the deficiencies of his early training. His poems, which have been at least twice published (1858, 1882), are powerful in the expression of ruthless fierceness and tearful sorrow. Livingston's contemporary, Evan Maccoll (1808–98), the son of a small farmer on Lochfyneside, is remembered for his *Bàs Màiri* and *Duanag Ghaoil.* We can do no more than mention the names of John Maclachlan of Rahoy (1804–74), James Munro (1794–1870), well known as a grammarian, Dugald Macphail (b. 1818), and Neil Macleod (b. 1843), author of a popular collection *Clarsach an Doire* (1st ed., 1883; 3rd ed., 1904). Neil Macleod

is also the writer of the popular song *An Gleann's an robh mi òg.* *The Poetry of Badenoch* (1906) may be mentioned here. It is natural to compare the state of affairs at the beginning of the 20th century with that obtaining in 1800. In the dawn of the 19th century every district in the Highlands had its native poet, whilst a century later not a single Gaelic bard of known reputation existed anywhere within its borders. It is only too evident that the new writers prefer English to Gaelic as a medium of literature, partly because they know it better, but also because in it they appeal to a far wider public.

Prose Writers.—It will have been observed that we have said nothing about prose works written in Gaelic. The first printed work is the translation of Knox's *Liturgy* by Bishop Carsewell, published in 1567 (reprinted in 1873). Calvin's Catechism is said to have been issued in 1631. The Psalms and Shorter Catechism appeared in 1659, while two other psalters saw the light before the end of the century, one by Kirke (1684), the other issued by the Synod of Argyll (1694). The language of all these publications is, however, Irish. Apart from reprints of the catechism and psalter, the only other Gaelic matter which appeared in print before 1750 were Kirke's Irish version of the Bible in Roman type with a vocabulary (1690), and the *Vocabulary* by Alexander Macdonald (1741). But from the middle of the 18th century translations of the works of English religious writers streamed from the various presses. Alleine, Baxter, Boston, Bunyan, Doddridge and Jonathan Edwards were all prime favourites, and their works have gone through many editions. There are also translations of parts of *The Arabian Nights* and of *Robinson Crusoe.* James Stewart of Killin's version of the New Testament, published by the Society for Propagating Christian Knowledge, was followed by a translation of the Old Testament (1783–1801), the work of John Stewart of Luss and John Smith of Campbeltown. The whole Gaelic Bible saw the light in 1807. But the revision of 1826 is regarded as standard. Of original prose works we can mention two. The one is a *History of the Forty-five* (*Eachdraidh a' Phrionnsa, no Bliadhna Thearlaich*), published in 1845 by John Mackenzie, the compiler of the *Beauties of Gaelic Poetry* (1806–48). A second edition of this book appeared in 1906. The other is the more famous *Caraid nan Gaedheal,* by Norman Macleod (new ed. 1899). This volume consists mainly of a number of dialogues dealing with various departments of Highland life, which were originally contributed to various magazines from 1829 to 1848. In recent years there have been two or three attempts at fiction and drama, but the achievement has not been noteworthy.

In conclusion we must take notice of the more important collections of folklore. Gaelic, like Irish, is extraordinarily rich in proverbs. A collection of Gaelic proverbs, published in 1785 by Donald Macintosh, was supplemented and enlarged in 1881 by Alexander Nicolson, whose book contains no fewer than 3,900 short sayings. A large collection of Gaelic folk-tales was published by J. F. Campbell under the title of *Popular Tales of the West Highlands* (4 vols., 1862). Alexander Carmichael published a version of the *Táin Bó Cualnge,* called *Toirioc na Táine,* which he collected in South Uist (*Transactions of the Gaelic Society of Inverness,* ii. 25–42), also the story of Deirdre and the sons of Uisneach in prose taken down in Barra (*ib.* xiii. 241–257). Five volumes of popular stories, collected by J. G. Campbell, D. MacInnes, J. Macdougall and Lord Archibald Campbell, have been published (1889–95) by Nutt under the title *Waifs and Strays of Celtic Tradition.* Seven ballads dealing with the Ulster cycle were collected and printed by Hector Maclean under the title *Ultonian Hero-ballads* (Glasgow, 1892). Macpherson gave a fillip to collectors of Ossianic lore, and a number of mss. going back to his time are deposited in the Advocates' library at Edinburgh. J. F. Campbell spent 12 years searching for variants, and his results were published in his *Leabhar na Feinne* (1872). The Edinburgh mss. were transcribed by Alexander Cameron, and published after his death by Alexander Macbain and John Kennedy in his *Reliquiae Celticae.* Finally the charms and incantations of the Highlands have been collected and published by Alexander Carmichael in two volumes under the title *Carmina Gadelica* (1900).

Bibliography.—The standard work is Magnus Maclean, *The Literature of the Highlands* (1904); *see* also various chapters in the same writer's *Literature of the Celts* (1902); L. C. Stern, *Die Kultur der Gegenwart,* i. xi. 1, pp. 98–109; Nigel MacNeill, *The Literature of the Highlanders* (Inverness, 1892); John Mackenzie, *Sàrobair nam Bàrd Gaelach,* or *The Beauties of Gaelic Poetry* (new ed. 1904); A. Sinclair, *An t-Oranaiche* (Glasgow, 1879); Alexander Macbain, *Transactions of the Gaelic Society of Inverness,* vols. xi. and xii.; *The Book of the Dean of Lismore,* edit. by T. Maclauchlan (1862); Alexander Cameron, *Reliquiae Celticae* (Inverness, 1892–94); John Reid, *Bibliotheca Scoto-Celtica* (Glasgow, 1832); J. S. Smart, *James Macpherson, An Episode in Literature* (1905); L. C. Stern, *Die Ossianischen Heldenlieder,* translated by J. L. Robertson in *Transactions of the Gaelic Society of Inverness,* xxv. 257–325; M. C. Macleod, *Modern Gaelic Bards* (Stirling, 1908). (E. C. Q.; J. Fra.)

SCOTTSBLUFF, a rapidly growing city of Scotts Bluff county, Nebraska, U.S.A., on the North Platte river, 20 m. from the western boundary of the State, at an altitude of 3,880 ft.; on Federal highway 26, and served by the Burlington (railway) Route. The population was 6,912 in 1920 (83% native white) and was 8,465 in 1930 by the Federal census. It is the metropolis of a fertile irrigated region, and has one of the largest beet-sugar factories in the country. Near by are an experiment station of the U.S. Department of Agriculture and the Scotts Bluff National Monument (1,894 ac., set aside in 1919), a tract of historic and scientific interest, through which passed many of the trails used by the pioneers. Scottsbluff was founded and incorporated as a village in 1901, and was chartered as a city in 1911.

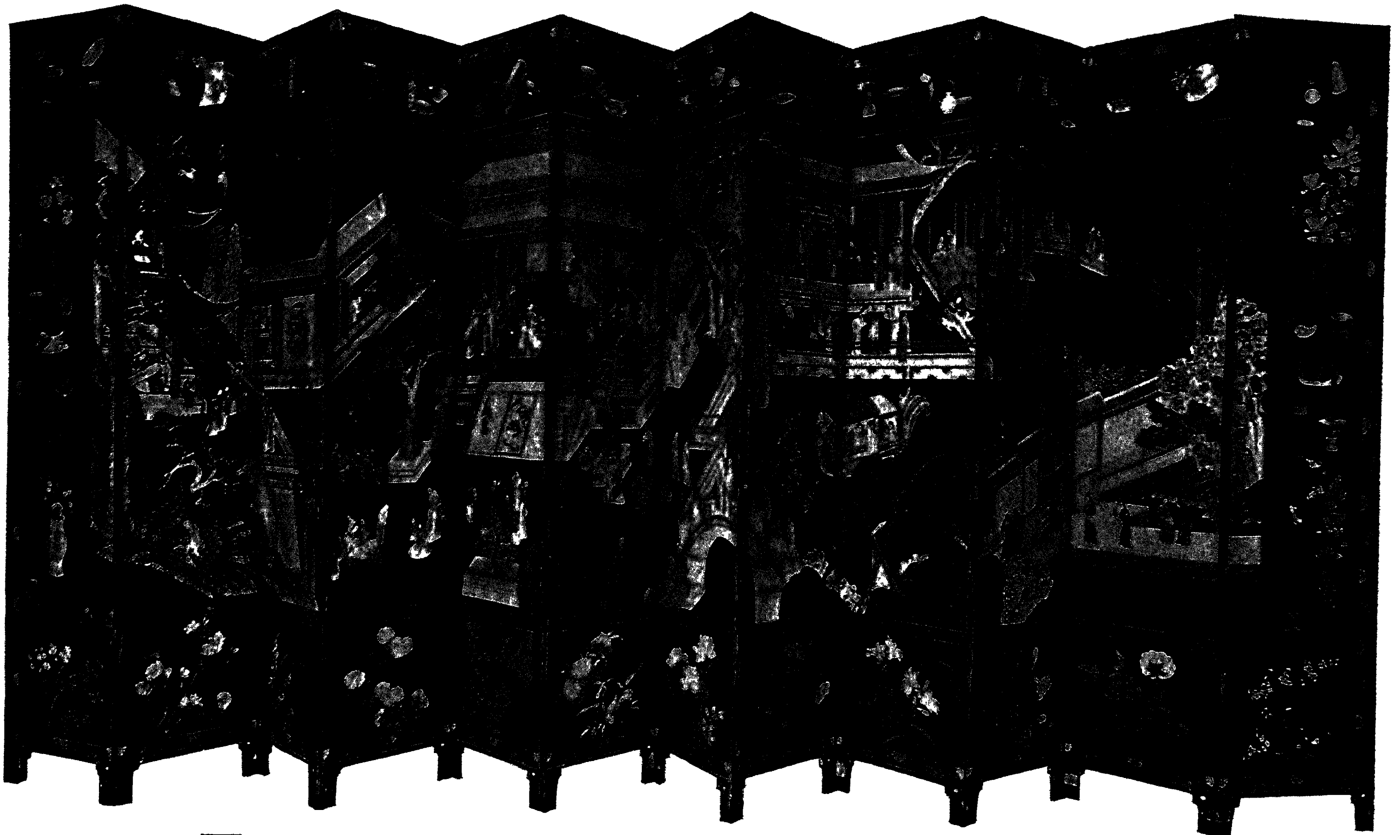
SCOUT, a soldier sent out to watch the enemy and bring information of his numbers, movements, whereabouts, etc. For boy scouts *see* Boy Scouts.

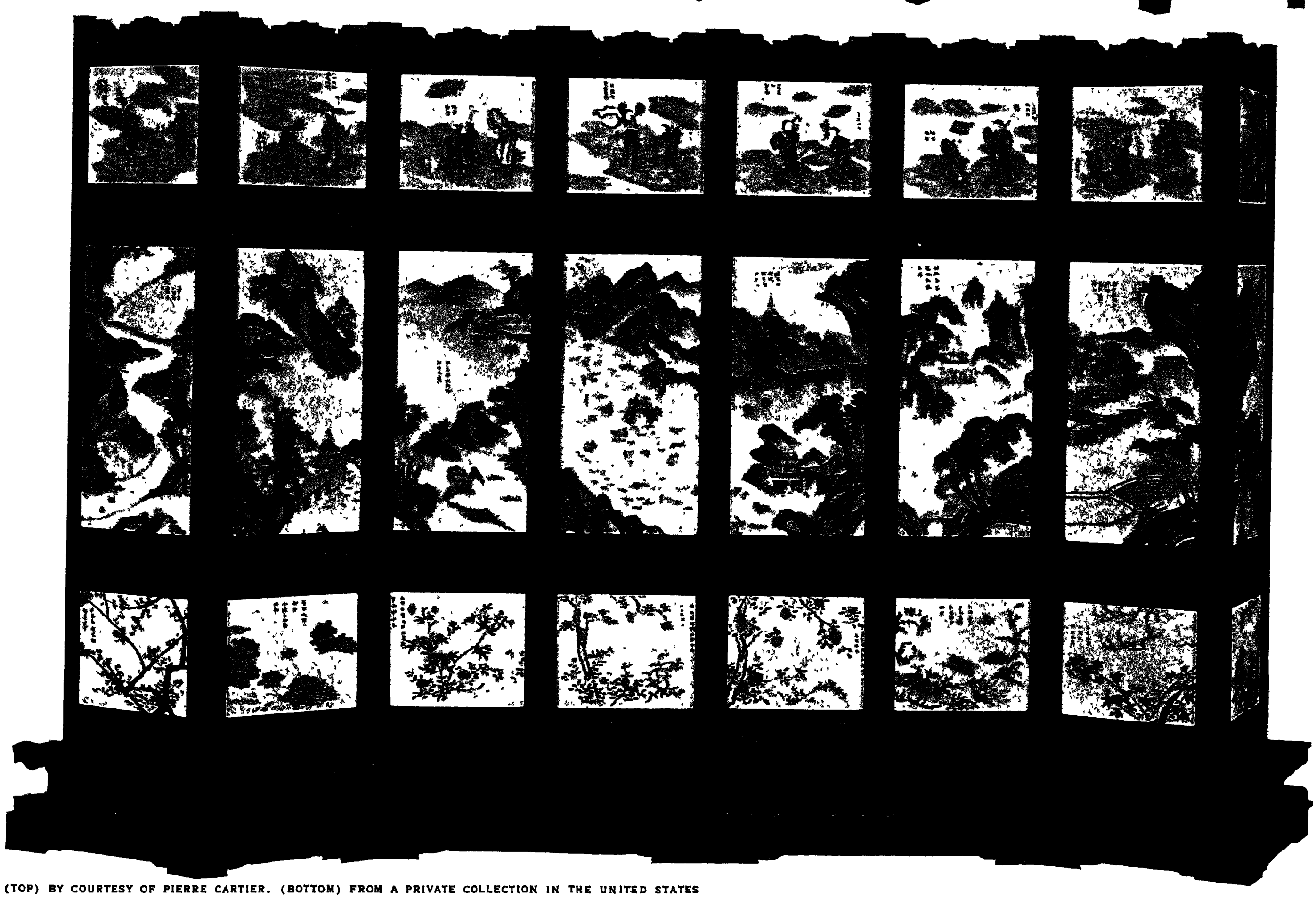
SCRANTON, a city of north-eastern Pennsylvania, U.S.A., the county seat of Lackawanna county; 134 m. W.N.W. of New York city, on the Lackawanna river and Federal highways 6, 11 and 611. It is served by the Central of New Jersey, the Delaware and Hudson, the Erie, the Lackawanna, and the New York, Ontario and Western railways, two inter-urban electric lines, and several motor-bus lines. Pop. (1920) 137,783 (21% foreign-born white, over half from Russia, Lithuania, Poland, Austria, Italy and Ireland); 1930 Federal census 143,433. More than half a million people live within a radius of 15 m.

Scranton is the metropolis of the great anthracite region of north-eastern Pennsylvania, which contains nearly all the anthracite deposits of the United States and produces in a normal year over 75,000,000 gross tons. It occupies 20·5 sq.m. in the Lackawanna valley, at an elevation ranging from 800 to 1,800 ft. above sea-level, and is surrounded by a region of great natural beauty (mountains, lakes and streams). There are several pleasure resorts and sanatoria in the immediate vicinity. The business section of the city is compactly built up with substantial structures, largely of modern type. The 12 public parks cover 160 ac., and the municipal recreation bureau provides facilities for a great variety of sports and amusements at all seasons of the year. In Nay Aug park are the picturesque falls of Roaring Brook (which crosses the city to empty into the Lackawanna river), a zoological garden, the Everhart museum of natural history (which contains a fine exhibit of birds and reptiles and the Hollister collection of Indian relics) and a small-scale mine, in a 5 ft. vein of coal, constructed so as to demonstrate the actual methods of mining anthracite.

The educational institutions of the city include 50 public and 12 parochial schools, several private schools and business colleges, a conservatory of music, St. Thomas college for men (Roman Catholic; 1888), Marywood College for Women (Roman Catholic; 1917), extension centres of the University of Pennsylvania and Pennsylvania State college, and the International Correspondence Schools and Woman's institute. In the adjoining borough of Dunmore is the Pennsylvania State Oral School for the Deaf (1882). The International Correspondence Schools now occupy two of the largest and finest buildings in the city.

There are about 140 churches in the city, representing 28 or 30 denominations, including Greek Catholic, Reformed Polish and Russian Orthodox.



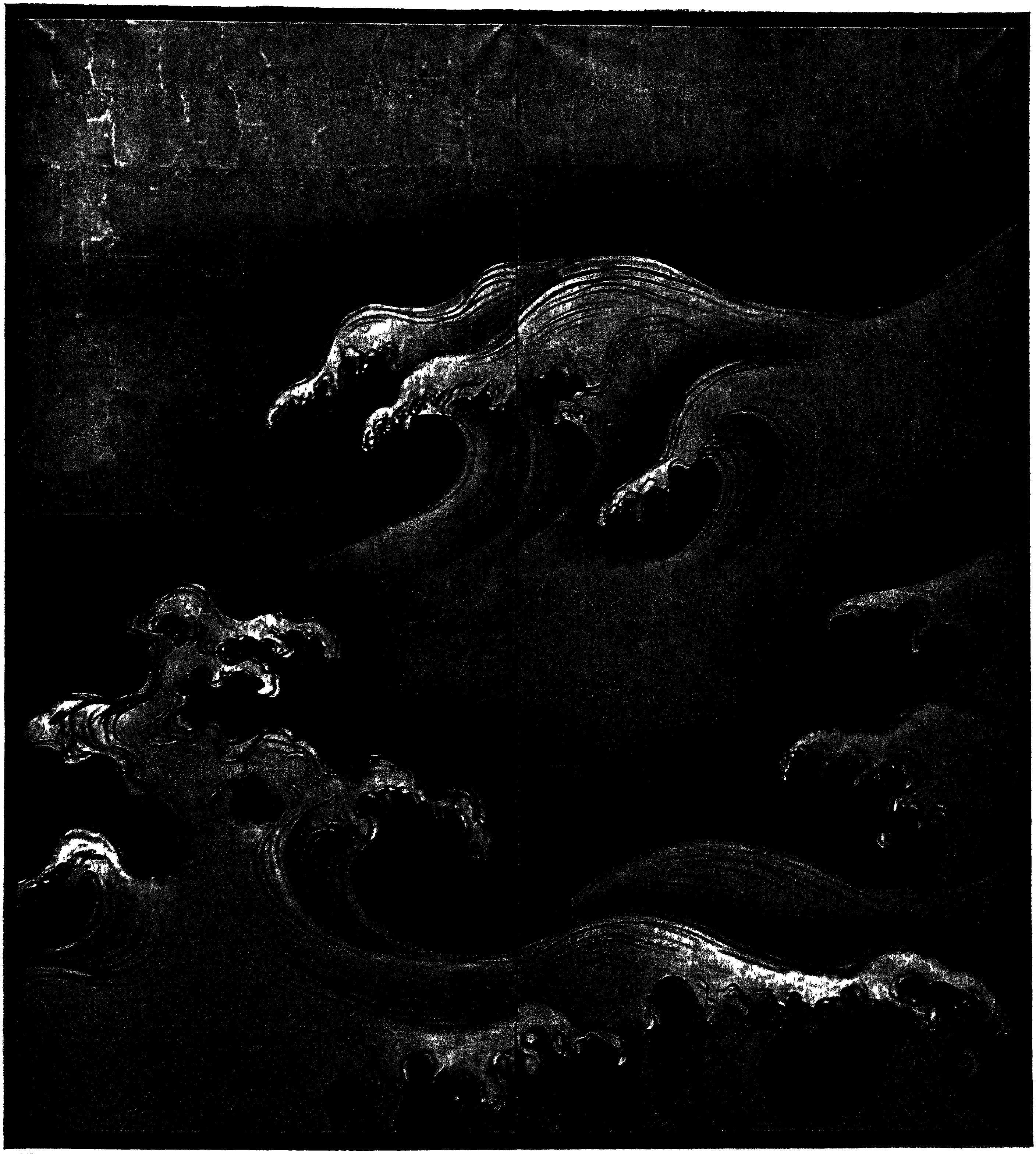


(TOP) BY COURTESY OF PIERRE CARTIER. (BOTTOM) FROM A PRIVATE COLLECTION IN THE UNITED STATES

CHINESE IMPERIAL PALACE SCREENS

Above: Carved and lacquered wooden screen, dated 1673, showing the Imperial Palace ground during a ceremony at which the Emperor Kanghsi is officiating

Below: Porcelain screen of the Ch'ien-Lung period (1736–95). The central panel is painted in famille verte, and the upper and lower in famille rose



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK

JAPANESE "WAVE SCREEN" OF THE 17TH CENTURY, PAINTED BY OGATA KORIN

This screen, with its design of waves dashed on a gold ground between stretches of smooth water, is one of the most prized productions of Korin. It is characteristic of the artist in its combination of simplicity with daring composition. Korin painted folding screens, fans and lacquers of great beauty. The "Wave Screen" is signed "Hokkyō Kōrin," accompanied by one of his seals "Dōsū"

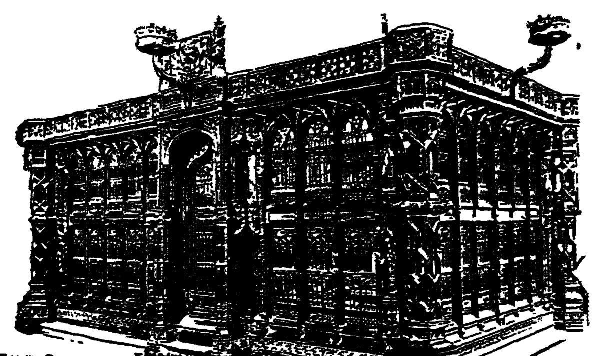
Scranton has a large retail, wholesale and jobbing trade, and its manufacturing industries have increased in importance and diversity until the wage-earners in factories outnumber the coal miners. Anthracite-mining is still, however, the dominating industry, engaging a fifth of all the persons employed in gainful occupations in 1920. Much of the city's area is undermined. In some sections, surface subsidence and occasionally a cave-in give visible evidence of the work in progress underground, and whenever a long suspension or strike occurs (as in 1902, 1912, 1922 and 1925) the economic fabric of the city is seriously affected. Silk manufacturing ranks next to the anthracite industry in importance, with two score mills in Scranton and Dunmore, employing 4,500 persons and using about a third of all the raw silk imported into the country. Building permits for the ten years 1918–27 represented values aggregating $40,369,406. The output of the city's factories in 1927 was valued at $55,704,206.

Permanent settlement on the site of Scranton dates from 1788. A grist-mill, a sawmill and a charcoal iron-furnace were built in the next few years, but there was little further development until 1840, when the Lackawanna Iron Company bought a large tract (the greater part of the city's present territory) for $8,000, and began the manufacture of iron, getting ore from the deposits in the near-by hills, and using for the first time the anthracite hot blast. Initial difficulties were overcome largely through the persistent efforts of George Whitefield Scranton (1811–61), aided by his brother Selden and their cousin, Joseph Hand Scranton. By 1850 a rolling mill, a nail factory and a steel-rail works were in operation, and transportation facilities had been provided. Scranton was incorporated as a borough in 1853, as a city in 1866. Before the iron ore was exhausted, the anthracite industry was well established. Skilled miners were attracted from England, Wales and Germany, whose descendants are an important element in the present population, though Poles and Russians now predominate among the foreign-born miners. The development of the silk industry and other manufactures has taken place largely since 1900. The population of the city was 9,223 in 1860; 45,850 in 1880; and 102,026 in 1900. In the decade following the World War bank deposits, postal receipts, and the number of telephones in use (indices in a general way of the volume of business) all increased about 100%.

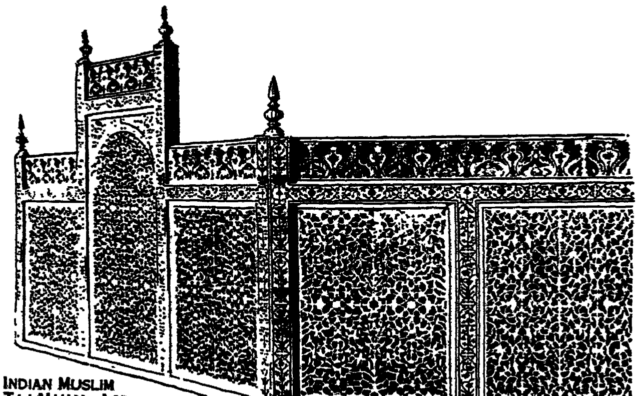
SCREAMER (*Palamedea cornuta*), a bird inhabiting Guiana and the Amazon valley. About the size of a turkey, it is remarkable for the slender "horn" more than 3in. long, on its crown, the two sharp spurs on each wing, and its long toes. Its plumage is mainly greyish-black above with some white and reddish-brown, while the lower parts are white. Related to this bird is *Chauna chavaria*, the "Crested Screamer," a name first bestowed on the Seriema (*q.v.*). This bird inhabits the lagoons and swamps of Paraguay and Southern Brazil, where it is called "Chajá" and is smaller than the preceding, wanting its "horn," but having a crest of feathers; the plumage is mainly grey. Its nest is of dry rushes, having its foundation in the water, and contains six eggs, which are white tinged with buff. The young are covered with yellowish-brown down. A singular habit of this bird is that of soaring in circles at an immense altitude in flocks uttering at intervals their far-reaching and melodious cry. They also sing on the ground (*see* W. H. Hudson, *Naturalist in La Plata,* who also records hearing over a hundred thousand burst into song together). The young are often reared by the people to defend their poultry, a duty which is faithfully and, owing to its spurs, successfully discharged. Another curious property of this bird is a layer of air-cells between the skin and the muscles, so that on the body being pressed a crackling is heard. In Central America the darker *C. derbiana* occurs. It is a smaller bird than the others, with slate-gray plumage and white throat.

The *Palamedeidae* are by many authors placed in a distinct order, *Palamedeiformes*, near the *Anseres*. (*See* ORNITHOLOGY.)

SCREEN, in architecture, any one of various types of subdivisions between adjacent portions of the same open space. Thus the colonnades under the great arches in the tepidaria of certain Roman baths formed screens, mainly decorative, between the central space and alcoves or recesses at the ends and sides. The term is especially used in ecclesiastical architecture for the railings, barriers or other dividing elements between chapels and the aisle or nave or around the choir. Chapel screens were usually open and consisted of an arcade of tracery or of a metal grille. Choir screens, on the other hand, were, in north and west Europe, largely solid, although relatively small in height, so that the services held behind them could be heard by those in the nave although the clergy and choir remained unseen. Of choir screens of this type, those of the cathedrals of Amiens and Chartres, both of the 15th century, are especially rich; in England, that of York (1475–1505), Canterbury (15th century) and Exeter (first half 14th century) are noteworthy. In Italy the tradition of the early Christian bemas, ambones and low chancel railings dictated an entirely different type of screen; the chancel front of S. Miniato, near Florence, with its elaborately inlaid marble parapet of the late 11th and early 12th century is typical. With the coming of the Renaissance even this amount of separation was abandoned and in the great Renaissance churches of Italy the use of the screen as a separation for the choir disappears. In Spain the high development of ironwork led to the extensive use of that material for both choir and chapel screens. This iron screen work, termed *rejeria* (*q.v.*), constitutes one of the most glorious adornments of the Spanish churches. (*See* JUBÉ; STALL.) (T. F. H.)



TOMB SCREEN FROM HENRY 7TH CHAPEL WESTMINSTER ABBEY EARLY 16TH CENTURY



INDIAN MUSLIM TAJ MAHAL, AGRA TOMB SCREEN 17TH CENTURY

SCREENS OF CHINA AND JAPAN

Because of their fragile nature, no screens of great antiquity have survived, but references to them are not wanting in ancient literature. Folding screens were known in China as early as the 2nd century B.C., at which period glass or mica panellings for them are noted as of much value, their transparent nature affording both enjoyment of an outdoor view and shelter from the elements. Then, in the century preceding the Christian era, screens carved and inlaid with jade and other precious materials seem to have been produced. Already in this early period the art of painting screens was practised, for it is recorded that

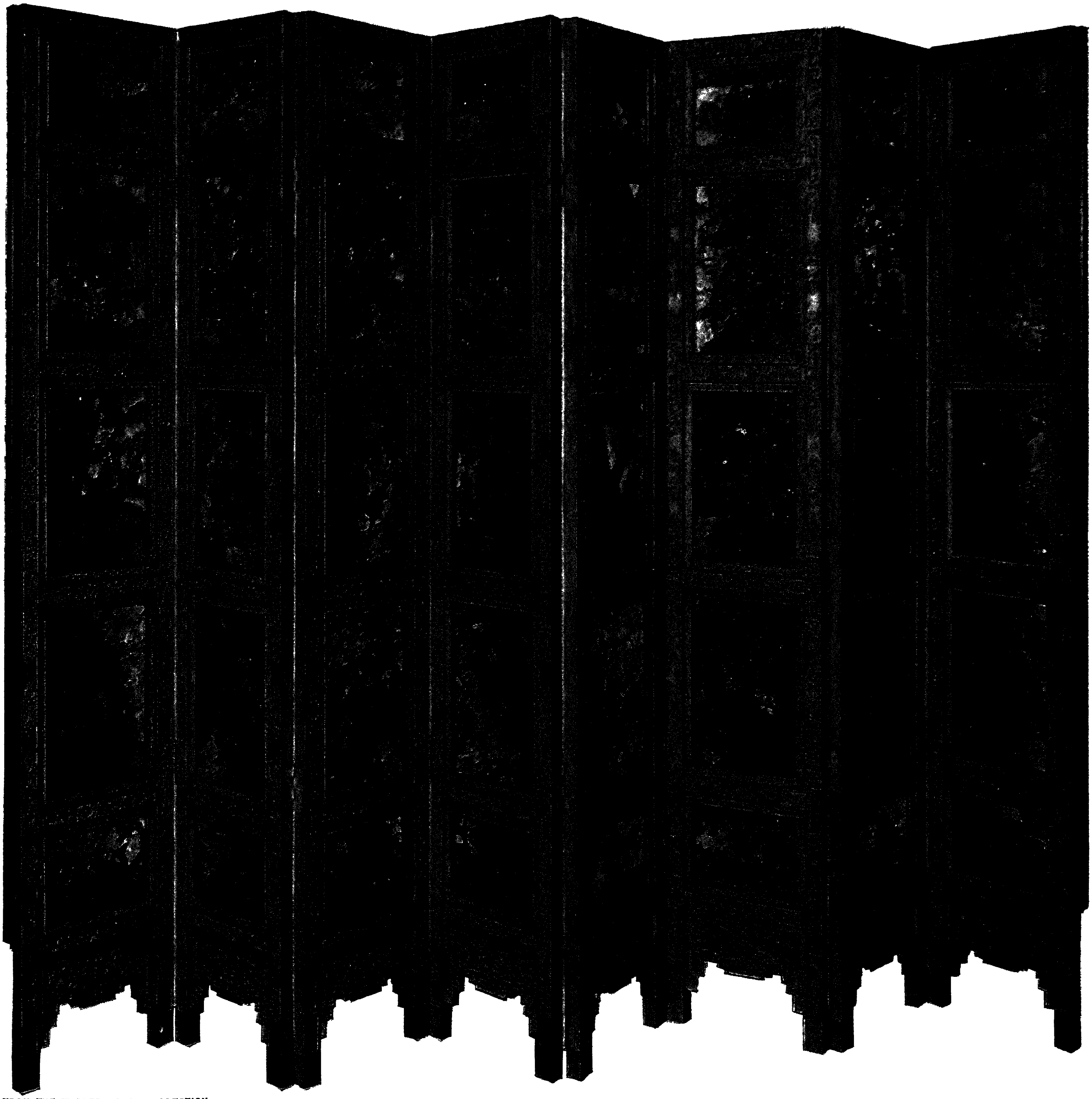
"Figures of Exemplary Women," illustrating the good or evil effects from right or wrong-doing were depicted on a screen. The Chinese artist Ts'ao Pu-hsing (3rd century) having dropped ink upon a screen while painting, turned it into a fly which Sun Ch'üan (A.D. 181–252) tried to brush away. Shih Hu (3rd century) made a folding screen covered with silk and painted with hermits, birds and animals, to which he added a long inscription. Chang Mo (4th century) depicted on screens the Buddhist saint, Vimalakirti, and a scene entitled "Beating Newly-woven Silk." In passing, mention may be made of a 14-fold screen in the scroll attributed to Ku K'ai-chih (4th century), owned by the British Museum, confirming the accuracy of contemporary accounts that screens consisted of numerous leaves, sometimes as many as 40. In the 5th century, Lu T'an-wei painted a lion and Fang Huai-chên the "Paragons of Filial Piety." Landscapes were not unknown in these early centuries as themes for screens, for they are referred to in old poems and other writings. Screens of tapestry, of embroidery, of crystal and of lacquer are also recorded in contemporary literature. Moreover, fine calligraphy inscribing moral teachings or auspicious sentiments was executed on screens from the 5th century, if not earlier. It is said that Fang Hsüang-ling (A.D. 578–648) collected precepts from all sources and inscribed them on screens which he distributed among his children as reminders of proper conduct.

The T'ang Period.—In the luxurious days of the T'ang dynasty (618–906), screens were in constant demand to adorn palaces and mansions. Those which were bedecked with gold and silver, pearl and tortoise shell, or those of fine textiles woven or dyed, bearing characteristic patterns, must have imparted great splendour to the habitations of rulers and princes. Horses sent from foreign tribes to the imperial stables furnished themes for screens, and a fabulous animal called *mo* which is supposed to eat bad dreams was deemed an appropriate subject for boudoir screens. Then, too, such noted painters as Pien Luan (who treated flowers and birds), Chang Tsao (pines and rocks), and Chou Fang (court beauties), and such accomplished calligraphers as Li Yang-ping and Chang Hsü all decorated screens. Some emperors had about them screens setting forth worthy and moral deeds performed by men of the past, in order that they themselves, as well as their subjects, might derive benefit from these constant reminders.

But for actual examples of T'ang art on screens we have to turn to Japan where, in the Imperial repository called the Shōsōin, at Nara, are still preserved relics of the art of that golden epoch. This treasure-house contains principally the personal belongings of the Emperor Shōmu, which were given to the Great Buddha of the Tōdaiji by the Empress Kōmyō, in 756. The list of donations mentions, among other objects, 100 screens, to which several more were added, at three different times, between the years 756 and 758. Among this large number of screens were examples of Chinese, Korean or Japanese origin which included paintings of landscapes, palaces, figures and flowers; others of batik and of block-resist dyeing, figuring birds, animals and flowers; and, in addition, some screens on which Chinese ideographs formed the chief decoration. Of these 100 odd screens but few remain at present, in whole or in part, among them no painted screens. Nevertheless, the pictorial accomplishments of the 8th century may still be seen in this collection in a six-fold screen, in each leaf of which is shown a figure of a woman standing under a tree. The subject was originally worked in birds' feathers which have disappeared, leaving only the preliminary drawings. Despite the sketchy nature of the drawings of the figures, trees and rocks, one may detect the mature brush-strokes, the importance of which is so much emphasized in the art of painting in the Far East. The screen is probably Japanese, yet its conception and execution are based upon contemporary Chinese patterns. There are also two six-fold screens in this imperial collection, the chief decorative features of which are Chinese inscriptions in large characters. One (Plate III., fig. 1) contains a precept for a ruler, consisting of 48 Chinese ideographs, each written twice, once in the *chuan* ("seal") style and once in the *hsing* ("running") style. The backgrounds are of silk dyed in green and red—alternating in the six panels—bearing designs of conventionalized clouds, birds, animals, trees, plants and rocks, all in white reserve. The screen is very likely Chinese, one of many gifts sent to the Japanese court from China, although it is said that at one time there was discovered upon it a Japanese date corresponding to the year 751—a fact lacking substantiation. In the Orient, to use writing on a large scale for a decorative scheme is no less frequent than to employ a picture for the purpose. Indeed, good calligraphy (*q.v.*) is considered an art of as great importance as good painting, both being the result of brush-work and both presenting images of mental conception.

An example of the pictorial art of the T'ang as reflected in the art of Japan may be seen in a screen (Plate III., fig. 2), preserved in the Buddhist monastery of Tōji in Kyoto. It treats a landscape in polychrome: among trees surrounded by hills and water is a rustic abode within which sits a hermit who is being visited by nobles with their servants. According to an old tradition, the screen was one of the treasures brought back by Kōbō Daishi from China in 806. However, some authorities now regard the painting as a Japanese production of the 11th century, based upon a T'ang original. For, despite its Chinese design, in it are discernible certain technical peculiarities of the early Yamato-é (literally "Japanese picture") style which was developed during the Fujiwara period (900–1189) and is characterized by over-refinement of drawings. Such a landscape screen was used in the baptismal rituals of esoteric Buddhism which required a pictorial representation of a mountain scene in lieu of the natural setting in which the religious service took place in old India. No screens of a secular nature dating from the Fujiwara period are now extant, but literary sources disclose the thousands of screens painted for the use of the Japanese court and for the mansions of nobles. As in the preceding epoch, the need for screens was pressing, because of the peculiar style of the architecture of those days—wide openings on the sides of a building which were closed by wooden doors at night but which during the day needed screening arrangements. Regular and occasional State functions also required special screens appropriate to the events. That a large number of screens was produced may be gathered from the record that Yoshichika (11th century) painted 200 screens on Lord Yoshimichi's order. A story is told about Hirotaka (10th century) who delineated a scene of hell containing a demon who proved so lifelike as to convince the artist that the call to the unknown region was immediate. The subjects, some Chinese and some Japanese, mentioned in this period are varied and numerous: landscapes of the four seasons, monthly observances, trees and plants, falconry, picnics, polo-playing, the paragons of noble deeds, the descent of the Amitābha, the ten Buddhist regions, etc. In Japan, during the Kamakura period (1190–1336), in making screens they followed the preceding Fujiwara in the main, both pictorially and technically.

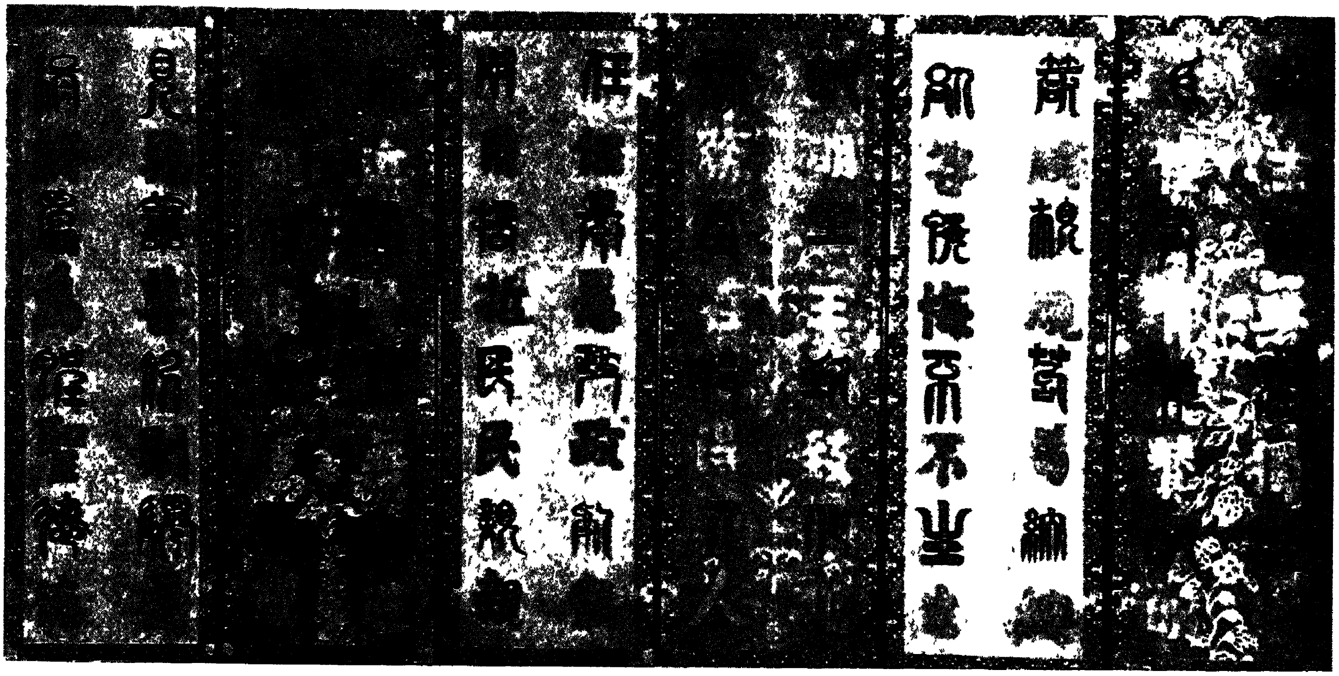
The Sung Period.—In China itself in the Sung period (960–1279), the practice among prominent masters of painting and inscribing screens was not abandoned. On the contrary, painters like Tuan Yüan, Yen Hsiao, Wên T'ung and Hsü Tao-ning are known to have thus expressed their art; and noted calligraphers applied their brushes after the time-honored custom. The most significant branch of the art of the Sung period was the so-called Idealistic school of painting which was closely followed by the artists of the Yüan (1280–1367) and Ming (1365–1643) dynasties. Painters of this school attempted to express in their works certain noble thoughts and ideals. A landscape-painting, for example, was an essay which suggested the sublimity of nature and invited the beholder to identify himself with it. The inherent love of nature of the orientals, coupled with the teaching of *Ch'an* (in Japanese, *Zen*), produced artists who showed remarkable aptitude for depicting natural phenomena. *Ch'an* means "abstract meditation," the chief aim of its followers being to seek to separate the real from the unreal by divesting themselves of earthly thoughts and desires and by communing directly with nature. Inspired by this teaching, the artists developed marked individuality and their paintings were characterized by purity and suggestiveness. For their themes, the painters of the Idealistic school chose, be-

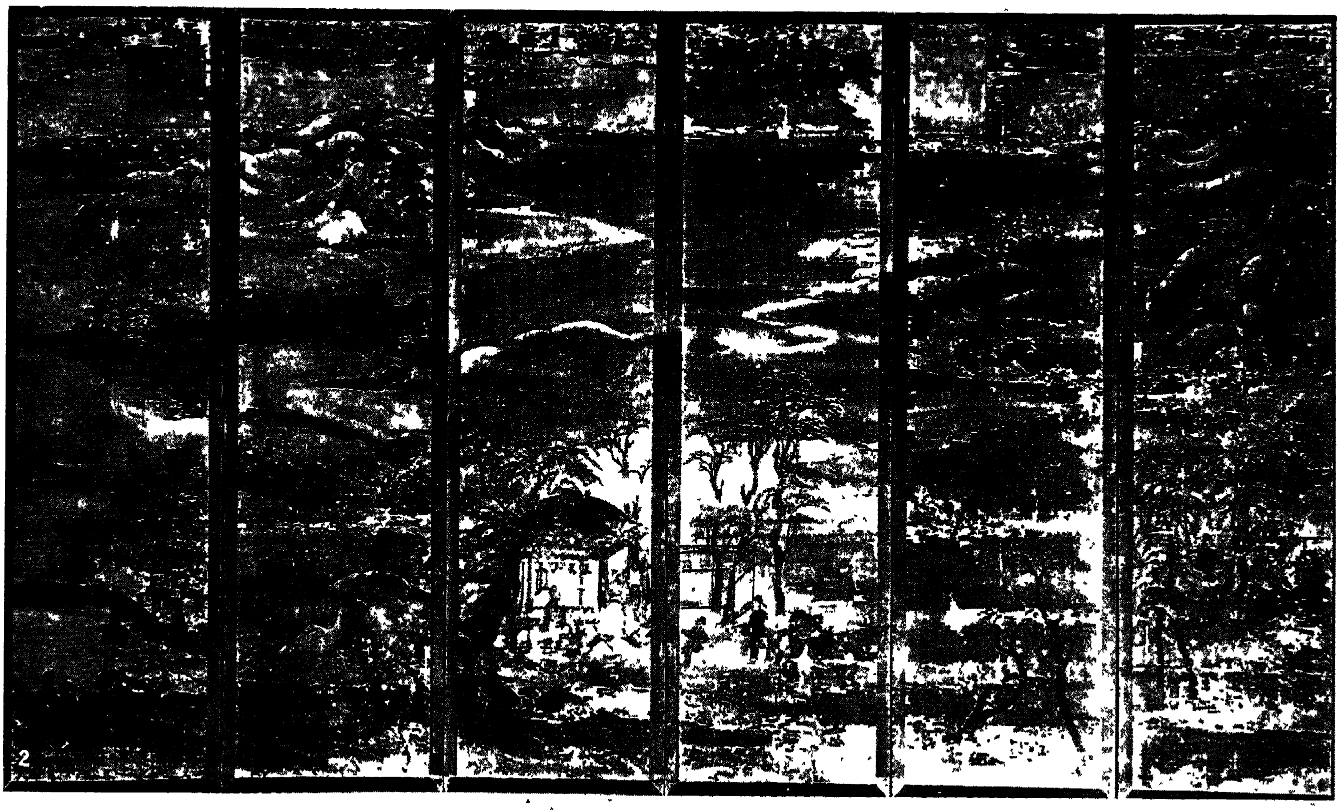


FROM THE WALTER ROSEN COLLECTION

CHINESE IMPERIAL JADE SCREEN OF THE CH'IEN-LUNG PERIOD (1736–95 A.D.)

This Chinese imperial screen is composed of a gilt teakwood frame of eight folds set with spinach-green jade panels, carved on one side with landscape designs and on the other with flowers. The photograph was taken with a light arranged behind the screen to bring out the translucent quality of the jade





BY COURTESY OF (1) THE DIRECTOR OF THE IMPERIAL HOUSEHOLD MUSEUM, JAPAN, (2) (SHIMBI SHOIN, LTD) FROM "THE MASTERPIECES SELECTED FROM THE FINE ARTS OF THE FAR EAST"

A CHINESE AND A JAPANESE SCREEN IN THE T'ANG STYLE

1. Chinese screen of the eighth century painted with a precept in 48 ideographs, each character written both in the "seal" and in the "running" style. The panels, which are joined with cords, are coloured alternately red and green, with designs of clouds and other conventionalized forms in white. From the Imperial Collection in the Shosoin, Nara, Japan

2. Japanese landscape screen of the 11th century, probably after a T'ang original, depicts the visitation of a noble and his servants to a hermit's house set in a landscape of trees, hills and water. The over refinement of the drawings is characteristic of the "Japanese picture" style of the Fujiwara period (900–1189). From the Buddhist monastery of Toji at Kyoto

side landscapes, birds, animals and even withered trees and rocks, all of which ordinarily were treated in monochrome with China ink. Unfortunately there exists no example of the typical art of the Sung as applied on screens, nor are there any screens dating from the subsequent Yüan and Ming dynasties, in both of which it is recorded that painted and inscribed screens were produced. It is possible, however, that some of the paintings coming from these periods, now mounted as single hangings, were once panels of folding screens.

The Ashikaga Period.—Again turning to Japan, one can see an echo of the Chinese art of these three dynasties in paintings by Japanese artists of the Ashikaga period (1337–1573). Sōtan, Nōami, Sesshū, Masanobu and Motonobu are outstanding figures who painted in ink on screens after the Chinese idealists. A screen by Sōtan (Plate IV., fig. 1), who died in 1464, may be taken as a typical specimen of this style. The vigour of the brush, the subtle quality of the ink, the well-carried-out atmospheric perspective—all tell of the master hand which portrays the spirit of majestic nature. This screen is one of a pair which together show landscapes of the four seasons treated as one composition and consequently forming one composite whole. Beside the "Twelve Monthly Observances" and "Landscapes of the Four Seasons," such themes as "Flowers of the Four Seasons," "Farmers of the Four Seasons," "Lives of the 24 Paragons of Filial Piety," the "Eight Taoist Immortals," etc., frequently occur as single designs. The Idealistic school of painting was carried through the next period, the Momoyama (1574–1602), by artists of the Kano, the Unkoku and the Soga schools. In the screen (Plate IV., fig. 2) by Tōhaku (1539–1610) we see a remarkable monochrome; the varied shades of China ink being so used as to suggest the presence of colours, yet with no disturbing element of pigments and no sense of monotony.

A new type of screen introduced some time in the 14th century from Korea contributed much toward revolutionizing the general scheme of composition. Heretofore, a folding screen had consisted of a group of separate panels, each with brocaded borders, tied together by means of cords passing through holes pierced at the vertical edges of the panels (Plate III., fig. 1). In the Korean type the leaves were joined by paper hinges which were built into the body of the screen before the silk or paper for painting was pasted, a brocade border extending over the composite whole (*see* Plate IV.). Whereas in the former style the continuance of the design was interfered with by the frame and the brocade borders of each panel, in the latter style the tightly joined leaves made one surface for painting a picture.

Screens characteristic of the Momoyama period, the inherent love of the Japanese for simplicity notwithstanding, are more decorative in type, with backgrounds of gold leaf upon which appear bold designs in solid pigments on a massive scale. Eitoku (1545–90), who was the chief exponent of the style, is said to have supplied 100 pairs of screens for the Momoyama palace of the Taikō. He painted in two styles, ink and polychrome; the polychrome screens are very effective; for example, one of a pair in which are shown foreigners bringing tribute to the Chinese emperor, Tai-tsung, of the T'ang dynasty; the subject—"Barbarians Presenting Tribute"—being symbolic of the peace and prosperity of the country. The popular pictorial motives on screens at this time were "The Dragon and the Tiger," "Lions," "Old Pine Trees" (respectively symbolizing the conflict between spirit and matter, nobility and power, longevity and fidelity).

The Tokugawa Period.—In Japan during the Tokugawa period (1603–1868), a new movement in decorative painting was developed by Sōtatsu (1576–1643) who preserved the vigorous and broad brush-work practised by the masters in monochrome, but in place of ink used pigments on a gold ground. Even as he adopted the coloring of the old Yamato-é, so he took many themes from old sources, such as the romances of Genji and Isé, the wars of the Hogen and Heiji Eras, the wind and thunder gods. He was also a genius in the impressionistic treatment of flowers and waterscapes on screens. Following Sōtatsu's style, Kōrin (1658–1716) further enlarged upon decorativeness by introducing more brilliant colours and more daring composition. In the twofold screen (fig. 6) depicting violent waves is apparent this artist's largeness of conception and power of technique. In the Tokugawa days, artists in all schools—the Kano, the Tosa, the Genre, the Literary, the Realistic—exerted their artistic efforts on screens. In principle, the pictorial scheme for screens by these painters of varied styles had changed little from that of the preceding Ashikaga and Momoyama periods and it is still continued to-day. A bold design is treated in dissymmetry, yet is well balanced and effective; at the same time it bears a certain moral, historical, legendary or auspicious significance. The subjects treated were many and varied, including those which have already been referred to and also such themes as the "Eight Views of Hsiao Hsing," the "Ten Snow-Incidents," the "A-fang Pleasance," the "Four Gray-beards of the Shan Mountain," the "Seven Sages of the Bamboo Grove," the "Four Accomplishments," "Floating Fans," "Phoenixes," etc. Generally Japanese screens are six-fold, about 6 ft. in height and 12 ft. in width when stretched, and they are usually executed in pairs. Among the smaller type we may count "pillow" screens with brightly coloured pictures, which are placed about beds, and low, two-fold screens with simple decoration, or none at all, which are used in connection with the tea-ceremony (*q.v.*).

The Ch'ing Dynasty.—During the Ch'ing dynasty (1644–1911) in China, painting on screens was practised, as indicated by the presence of occasional examples dating from the last few centuries. But it is in screens of applied art that the period excels. It has already been said that the application of the minor arts to screens began in ancient China. The best known among such screens of recent centuries are the so-called "Coromandel screens" which are made of wooden panels finished with a coat of lacquer, through which designs—landscapes, figures, flowers, auspicious emblems, etc.—are incised and filled with various thick, opaque water-colours; a technique known from the Ming dynasty. A large portion, however, of the existing specimens are of the 17th to 19th centuries (Plate I., fig. 1). "Coromandel" has no bearing upon their provenance, but indicates that these screens of Chinese origin were shipped to European countries from the coast of Coromandel. Other screens in the category of lacquer are those with lacquered panels (sometimes coated with white oil paint) decorated in gold lacquer; and those of red carved lacquer. Screens of carved teakwood construction set with jade and porcelain plaques, or panelled with silks, tapestries or embroideries, are occasionally seen. (*See* Plate II.). (*See* also INTERIOR DECORATION, ORIENTAL; JAPANESE PAINTING AND PRINTS; CHINESE PAINTING; FLOWER ARRANGING; BATIK.)

Furniture.—As an article of furniture, the screen is an ornamental frame, usually of wood, but sometimes of metal, for protection from observation, draught or the heat of a fire. Screens are made of all shapes and sizes, and may consist of leather, paper or textile materials fastened to the framework; they may have several leaves or only one—thus a fourfold screen has four leaves. Fire screens are usually small, with a single leaf—indeed in the Georgian period of English furniture they often took the form of a circular, oval, heart-shaped or oblong piece of framed embroidery fixed to a wooden pole or upright, upon which they could be raised or lowered. This variety, which was called a pole-screen, was more effective as an ornament than as a protection. The hand-screen was light and portable, as the name implies. At the present time fire-screens are often of glass set in metal frames. The larger type of screen, with several leaves, is of uncertain origin, but probably first came into use towards the end of the 16th century. The earlier examples were of stamped or painted Spanish leather or of some rich stuff such as tapestry; at a later date lacquer was extensively used. They were tall enough to conceal the person sitting behind them, and were frequently exceedingly handsome and stately. (K. T.)

SCREW, a cylindrical or conical piece of wood or metal having a helical groove running round it. The surface thus formed constitutes an external screw, while a similar groove cut round the interior of a cylindrical hole, as in a nut, constitutes an internal screw. The ridge between successive turns of the groove is the "thread," and the distance between successive turns of the thread

is the "pitch." For screw as a mechanical power *see* MECHANICS; for the screw used to propel steamships *see* SHIPBUILDING.

Standardization of Screws.—All screws made to-day are copies of pre-existing or master screws, which are made in numerous forms. These are so standardized that a thread cut to a given standard in England fits its fellow thread cut to the same standard in America, Germany or elsewhere. The first attempt at securing uniformity in screw threads was made by Sir Joseph Whitworth about 1841. In the course of about twenty years the Whitworth system generally displaced the previous heterogeneous designs of threads, by the existence of which engineers' repairs had been rendered most inconvenient and costly, almost every establishment having its own "standard" set of screwing tackle.

When the Whitworth threads were accepted in England, Germany and the United States, it appeared as though they were established for ever in an impregnable position, as a unification evolved from chaos. Moreover, Great Britain at that time occupied a position of pre-eminence in manufacturing engineering, which was favourable to the establishment of an English system. But two things were wanting to permanence—the facts that the Whitworth threads were not based on the metric system, and that the United States was destined to come into rivalry with Great Britain. Metric systems became standardized on the continent of Europe and the Sellers thread in America overshadowed the Whitworth, though it is impossible to doubt that the Sellers like the Whitworth must in time be swallowed up by some one metric system.

The threads now recognized as standard are included in about eight great systems, out of about sixty that have been advocated and systematized. Their elements are shown by the diagram, fig. 1; but tables of dimensions are omitted, since they would demand too much space.

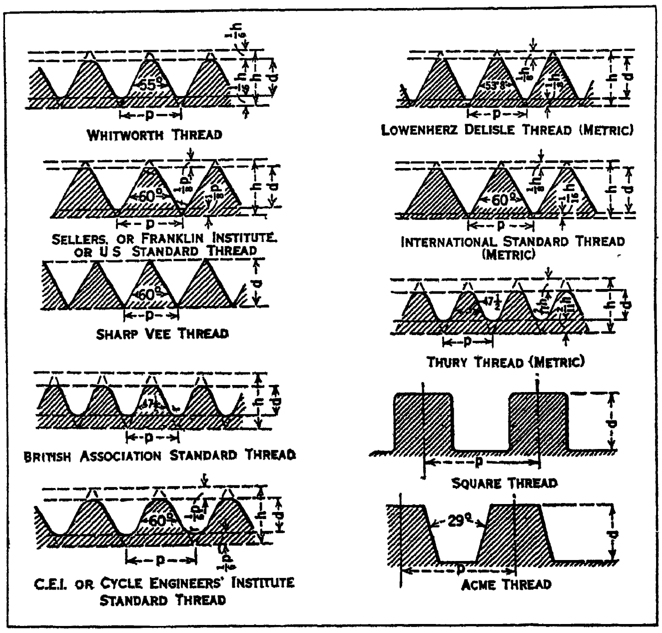


FIG. 1.—SECTIONS OF PRINCIPAL SCREW THREADS

METHODS OF CUTTING SCREWS

There are four methods employed for the cutting of screw threads: one by means of a single-edged tool held in the saddle of the screw-cutting lathe, and traversed horizontally only, the cylinder which is to receive the thread revolving the while; another by means of short master screws, hobs or leaders, controlling chasers or comb tools; the third by means of screw taps and dies, either the work or the tool being absolutely still. The fourth is by means of a milling cutter presented to the work in a special screw-milling machine, both the work and the cutter revolving.

In the Lathe.—The problem of screw-cutting in the lathe in the simplest form resolves itself into the relative number of revolutions of the lathe spindle and of the lead screw (fig. 2). If the two rotate at the same speed, the thread cut on the spindle axis will be equal in pitch to that of the lead screw. If the spindle revolves more slowly than the lead screw, a thread coarser than that in the latter will result; if it revolves more rapidly, one of finer pitch will be produced. The spindle is the first factor, being the *driver*, and the lead screw is *driven* therefrom through the change wheels—the variables—which determine the number of revolutions of the latter whether the same, or slower, or faster than the spindle.

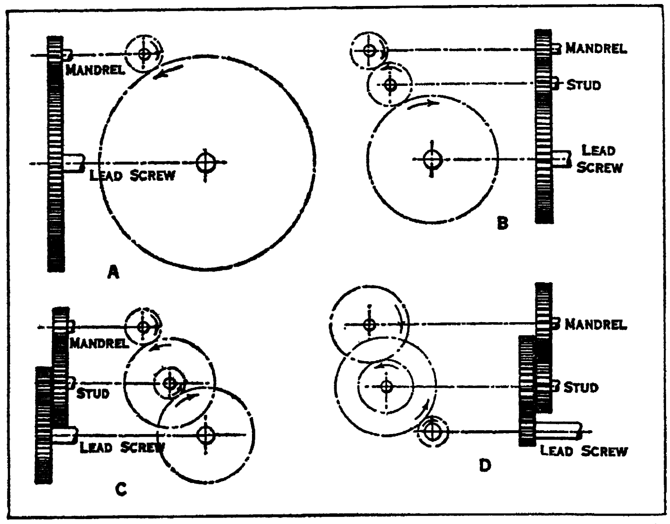


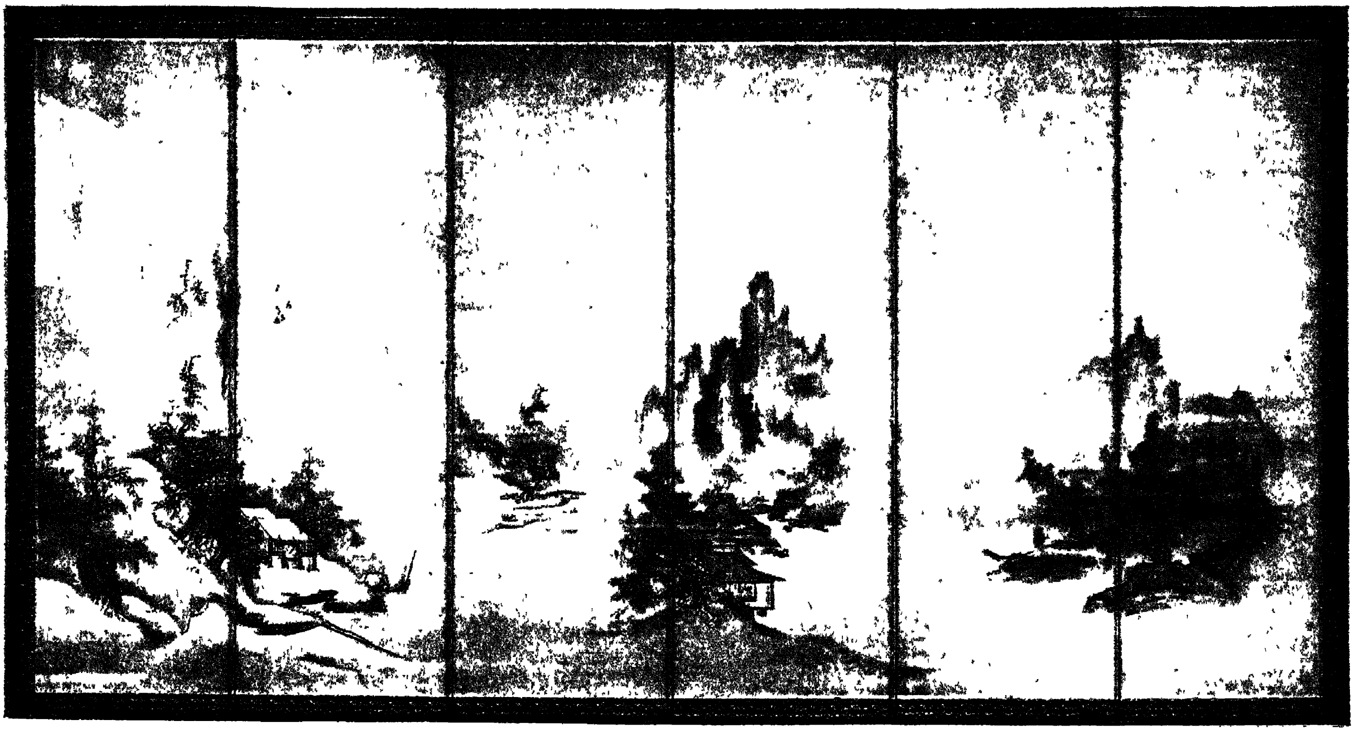
FIG. 2.—(A) SIMPLE TRAIN WHICH ROTATES LEAD SCREW IN OPPOSITE DIRECTION TO MANDREL, AND MAKES SLIDE-REST FEED AWAY FROM HEADSTOCK; (B) SIMPLE TRAIN WITH INTERMEDIATE WHEEL ON STUD, WHICH ROTATES LEAD SCREW IN SAME DIRECTION AS MANDREL; (C) TYPICAL COMPOUND TRAIN ARRANGED FOR CUTTING A SCREW FINER THAN THAT OF LEAD SCREW; (D) FOR SCREW COARSER THAN THAT OF LEAD SCREW

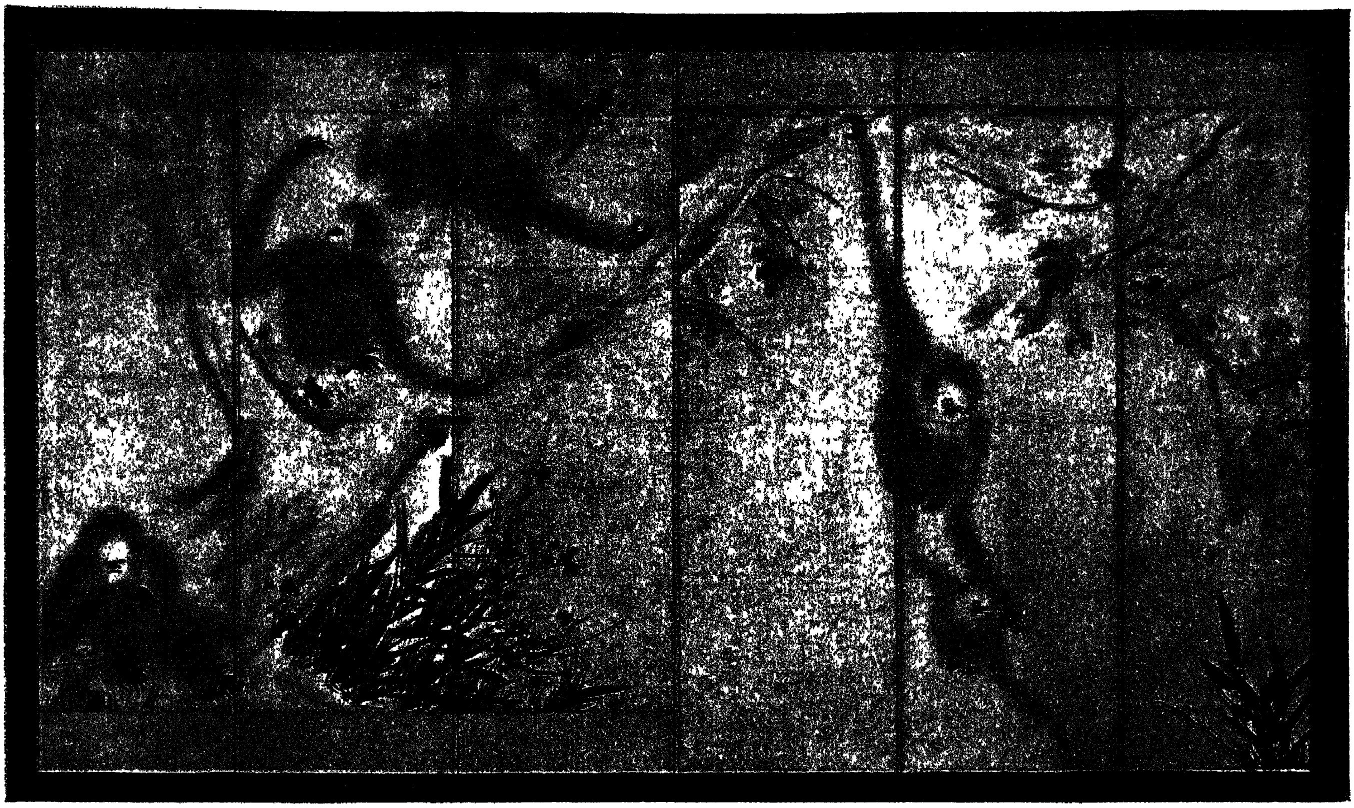
Screw-cutting in all its details is an extensive subject, including the cutting of what are termed odd or unequal pitches, that is, those which involve fractions, the catching of threads for successive traverses of the tool, the cutting of multiple threads and of right- and left-hand threads, which involve much practical detail.

The principle of screw-cutting may be stated briefly thus: the pitch of the guide screw is to that of the screw to be cut as the number of teeth on the mandrel or (headstock) wheel is to the number of teeth on the lead screw wheel. It is therefore simply a question of ratio. Hence for cutting threads finer than those of the lead screw, the guide screw must rotate more slowly than the lathe mandrel; and for cutting threads coarser than those of the guide screw, the lead screw must rotate faster than the lathe mandrel (fig. 2, C and D). When the ratios are ascertained, these facts indicate when the larger or the smaller wheels must be placed as drivers, or be driven. "Simple trains" are those which contain only one pair of change wheels; "compound trains" have two, three, four or more pairs (fig. 2), and are necessary when the ratio between the guide screw and the screw to be cut exceeds about six to one.

A device which has become very popular under the name of Hendey-Norton gears comprises a nest of change wheels, mounted and keyed on the end of the lead screw. A stud wheel is made to engage through an intermediate wheel with any one of the change gears, on the simple movement of a lever, giving different ratios for screw-cutting. These again are doubled or trebled by altering the ratios of other gears connected therewith, so that for each position of engagement of the stud wheel, two, or in some cases three, pitches can be cut. This avoids the waste of time involved in setting up fresh wheels on the swing-plate as often as a screw of different pitch has to be cut.

Another step in the direction of economy depends on the removal of all screw-cutting, except those screws which are of several feet in length, from the ordinary lathe to the special chasing and screwing machines. When there was no other method available except that of common dies operated by hand or carried in a screwing machine, there was good reason why a true cutting





BY COURTESY OF THE MUSEUM OF FINE ARTS, BOSTON

TWO JAPANESE SCREENS

Above: Landscape, by Oguri Sōtan (1398–1464), painted in monochrome, with gold wash, on paper. It is one of a pair of six-fold Japanese screens in the Fenollosa-Weld collection

Below: Spider-monkeys, by Hasegawa Tōhaku (died 1610), painted in monochrome on paper. It is one of a pair of six-fold Japanese screens in the Bigelow collection

tool should be operated in the lathe through change wheels. But the reason no longer exists, since for the single cutting tool of the lathe the two or three cutters of the chasing and screwing machines (figs. 3 and 4) are substituted, and the hollow mandrel embodied in the latter permits of screws being cut and parted from the solid bars of several feet in length.

The second method of cutting screws is that by means of hobs or leaders, and either comb or single-edged tools. That is, a

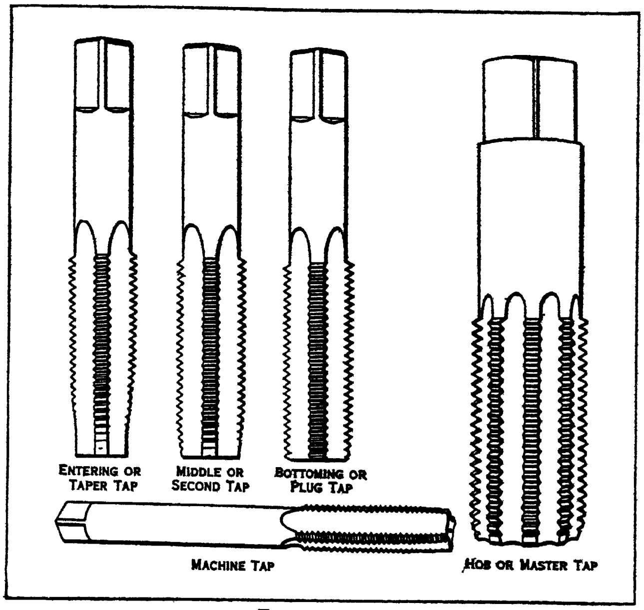


FIG. 3.—TAPS

short standard screw is mounted somewhere on the lathe, at the rear, or in front, and a nut partly embracing this becomes a guide to a bar which is attached to the tool slide directly. These are termed chasing lathes. Their value lies in the cutting of screws of but a few inches in length, of which large numbers are required, a familiar example being the screwed stays for the fire-boxes of steam boilers, hundreds of which are used in a single boiler.

By Taps and Dies.—The third method embodies the use of taps and dies in their numerous designs. The simpler forms used are those operated by hand at the bench, from which all the machine taps and dies have been elaborated. The tap is the solid screwed cylindrical tool which cuts an internal thread (fig. 3); the die is the hollow tool which cuts a thread on the outside of a cylinder (fig. 4).

In all taps and dies the problem is to cut a screw, of which the

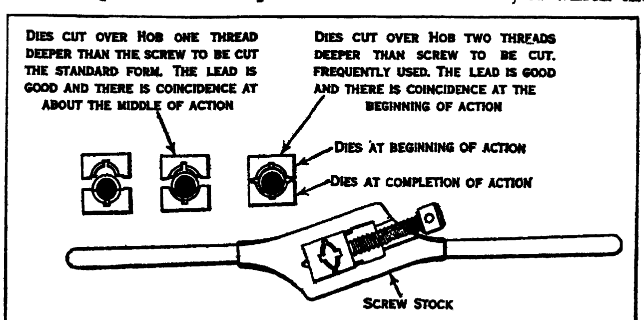


FIG. 4.—DIES

angle of thread changes from point to root, with tools whose angle must remain constant. In taps there is no choice of angle, since they must be the exact counterparts of the tapped threads when finished. But in dies a compromise is made by cutting them with hobs, or master taps, one thread larger than the thread to be cut by the dies. Briefly, the practical effect is that the dies are only counterparts of the thread to be cut at about the middle part of their action.

Dies are held in stocks. In the common die stocks one adjustable die is moved forward with a screw, which forms one of the handles of the stock, or a separate tightening screw is used at right angles with the handles, or the tightening screw is set diagonally in relation to the handle. Sir Joseph Whitworth's well known "guide" screw stock (fig. 5) is a typical example of the embodiment of the principle just stated, the dies being cut over a hob two depths of thread larger than the screw; one, a broad die, is used for guidance only, and two narrow dies do all the cutting.

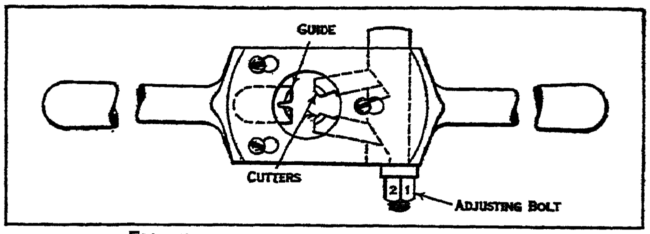


FIG. 5.—WHITWORTH GUIDE-SCREW STOCK

The guide-screw stock derives its name from the fact that it embodies a guide *a* distinct from the cutters *b,b,* the guide doing very little actual cutting; it is one of the best tools for screw-cutting outside the lathe, but some of the American types of dies give very accurate results, especially when they are combined with a guide placed in advance of the dies, to keep them truly parallel on the work.

Machine Work.—Hand tapping and screwing has long been confined to occasional pieces of work done by the fitter at the bench, the erecter and repairer. Screws and tapped holes required in quantities are done on machines which include numerous types, at a rate of production which would seem incredible were it not so common. For cutting common screws of no very great length the lathe has long been superseded by the various screwing machines. The earlier forms were provided with clutch mechanism for running the solid dies back off the thread, in imitation of the action of the hands, and the dies could not cut a complete thread at one traverse, two or three traverses being necessary in the production of a full thread. In the modern screwing machines (fig. 3) the cutters are closed and released by cam mechanism, and all threads except those of large diameter are cut at a single traverse. Common bolts and nuts are cut in machines of this kind, machine taps, which are longer than hand operated taps, being employed in the same machines.

But the smaller screws made in large quantities, and screws which have to be cut on pieces of work on which other operations, as turning, boring, facing, knurling, have to be performed, are made in the numerous capstan or turret lathes, the dies or taps being held in the turrets. In most cases, however, the dies are held in a chuck which is inserted in one of the holes in the turret and which

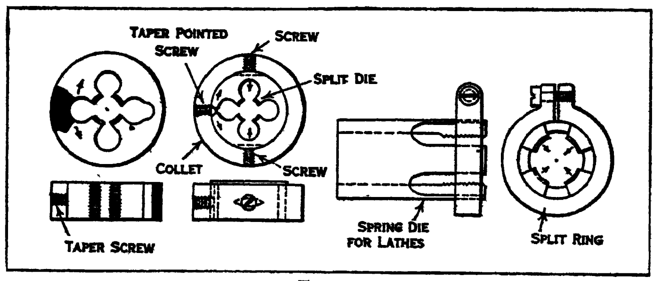


FIG. 6

is better for the cutting of the finer screws. More valuable than any other single improvement is the automatic opening of many dies used in turret lathes, by which the running back of the die over the work is avoided. They are so beautifully contrived that contact with a stop, the position of which can be regulated, arrests the cutting action and causes the dies to fly open away from the screw, so that the turret can be slid away instantly, while the dies close in readiness for the next screw.

Sizing Taps are used for the finishing of threads which are required to be finished so uniformly as to be interchangeable one with the other. These are ordinary plug or second taps, generally short in length, and as they remove but a mere trifle of material

they retain their size for a very long time. The case of sizing taps is more difficult than that of dies, because a die can be readily compressed to an extent sufficient to compensate for wear, but a tap has to be expanded.

Screw Milling and Thread Grinding.—Screw milling, the latest development in screw-cutting, involves the use of a special machine, something like the lathe in outline, the piece of work to be threaded being rotated in the axis of the machine. The cutter is carried in a head, with swivelling arrangements, to provide for variations in screw angles, and is rotated at speeds suitable for the metal or alloy being cut. The necessary traverse is imparted either to the work or to the cutter, according to the design of machine, by lead screw and change gears. This method is employed to a considerable extent, chiefly for cutting coarsely threaded screws and worms. The great advantage which the revolving cutter possesses over the single-edged tool is its rapidity of action, by which threads may be produced more quickly than in the lathe.

Much of the precision finishing of screws is now performed with the aid of grinding wheels, which will operate on hardened screws as well as on unhardened. Some of this work is done in small precision lathes, while there are worm-thread grinders for accurately finishing the flanks of the threads of large screws or worms.

TESTING SCREWS

The screws cut in engineers' shops are sufficiently true for all practical purposes. But the fact remains that no guide screw yet made is true, and no true screw can be made apart from the use of devices which are unknown in the machine shop. The microscope is brought into requisition for testing standard screws, but commercial screws simply have to pass the test of gauges. The microscope class of measuring machine makes use of cross-hairs, adjusted to various portions of the screw, and a micrometer apparatus for fine reading of differences. At the National Physical laboratory, Teddington, England, there are fine machines for testing pitch errors by the system of magnification of the movement of a style brought into contact with the threads of the screw undergoing examination. The magnification is 750 in one case. The results of errors in any screw sent for test are shown on a chart.

An accurate mode of testing effective screw diameters is by means of what is termed the "three-wire" method. Three hard steel wires lapped to a high state of accuracy are laid in the grooves of a screw, two on one side and one on the other, and measurement is taken over the lot with a micrometer calliper, or in a measuring machine.

Screw thread gauges are considered in the article TOOL, but a new kind of testing has arisen, which does not come under the head of a tool, since it depends on optical methods. Briefly, a magnified image of the screw thread, as much as fifty times larger, is thrown on a screen by a lantern. The screw rests in a cradle in front of the lens, and any number of screws can be tried in succession. First a master screw or gauge is put in and its shadow projected on to a tolerance chart on the screen some distance. When the cradle has been adjusted so that this master screw appears correctly on the chart, the screws to be tried will reveal, by their position on the chart, whether they are too large or too small, or of inaccurate pitch. Short framed lines indicate the boundaries of a good thread while a faulty shadow is seen to be undersize. Errors of pitch are revealed by the shadow standing too far to one side.

The problem of producing a true screw has occupied investigators since the days of Henry Maudslay (1771–1831). The great difficulty is that of attaining accurate pitch, so that the distances between all the threads shall be uniform, and consequently that a nut on the screw shall move equably during the rotation. The importance of this point is felt in the dividing engines of various classes employed for ruling, and in measuring machines used for testing standards of length.

There are a number of methods of correcting the errors in screws; the principal one is that of retarding or accelerating the traverse motion of the screw-cutting tool by means of a compensating lever bearing on a compensating bar, which is formed after observations have been made on the degree of accuracy of the leading screw used to propel the tool carriage. The original errors in the leading screw are therefore eliminated as far as possible. The inspection of the screw is done by means of the microscope working in conjunction with a line measure fastened down parallel with the axis of the screw, so that the coincidence or otherwise of the screw pitches with the subdivisions of the measure may be compared. (J. G. Ho.)

SCREWDRIVER, the tool which drives screws, must be made of good steel and suitably tempered so that it will not snap off through being too hard, or twist or bend through being too soft. The chief interest in this connection in manufacturing processes and repairs attaches to the mechanically operated screw-drivers which vastly speed up the rate of removing or inserting screws. Some are driven by a flexible shaft actuated from a cord and pulley, the shaft being manoeuvred about anyhow to suit the situation of the screws. Or a pneumatic or electric drill is fitted with the blade, and held in the hands anywhere required. Some small articles demanding the use of numerous screws are placed under a fixed screw-driving machine, the spindle of which carries the driver blade, pressed down by a lever. In wood working, screw-driving machines are largely used in mass production.

For hand use only the *ratchet* and the spiral types are very convenient. The former enables the grip to be maintained on the handle the whole of the time, while the screw is turned in either direction, leaving one hand free. The latter sends the screw home or runs it out on giving a straight push to the handle. Some drivers combine both actions for selection as desired.

SCREW-PINE, the popular name for plants of the genus *Pandanus,* which are shrubs or trees of peculiar habit, having a main stem and a few branches at the ends of which is a tuft of long, stiff, narrow leaves closely arranged in three strongly twisted lines. The stem forms stout roots some distance above the ground; they grow obliquely downwards to the soil, and owing to the decay of the lower part of the stem the plant is often supported merely by these strong prop-like roots. The ripe fruits are borne in often very large spherical or cylindrical heads, which are often extremely hard. The genus is the principal one of the family Pandanaceae, a small family of monocotyledons, which is widely distributed through the tropics of the Old World, especially in the islands of the Malay archipelago and of the Indian and Pacific oceans.

SCREW-PROPELLER: *see* SHIPBUILDING.

SCRIABIN, ALEXANDER NICHOLAEVICH (1871–1915), Russian composer, was born at Moscow on Christmas Day 1871 (O.S.). His father was a lawyer; his mother, a good pianist and pupil of Leschetizsky, died when he was one year old. His schooling was received in the Moscow Cadet Corps, but he never showed any liking for the military career for which he was intended, and at 18 entered the Moscow Conservatoire of Music where he was a pupil of Safonov and Taneev. On leaving the conservatoire Scriabin was greatly helped by the patriotic music publisher Belaiev, who brought out his earlier works and arranged a European piano recital tour for him. At 20 he returned to Moscow and joined the conservatoire staff. Later he again travelled, this time for six years, visiting the United States amongst other countries. He then settled in Brussels for some time, and in 1910 returned to Moscow. In 1914 Scriabin visited England, giving two piano recitals, playing his own concerto and appearing as pianist in his *Prometheus.* He was then suffering from a tumour of the lip, from which, soon after his return, he died, April 14, 1915.

As a composer, Scriabin represents what may be called the classical-romantic school carried forward to its most advanced point. The form of his sonata and symphony movements he derives from Mozart, through Beethoven; however bewildering these may at first sound, they will be found, on further hearing, to be laid out on essentially the Mozart-Beethoven lines. In his pianistic idiom and general pianistic qualities of style, Scriabin derives largely from Chopin, of whose work he was a great admirer. All this then indicates a conservative side to his com-

position, but he was more radical in his harmonies, and it was, probably, largely the novelty of these that retarded appreciation of his later works. It is said that Scriabin gradually evolved a synthetic scale of upper partials or "mystic" chord of superposed 4ths. (C,D,E,F#,A,B♭, or as a chord, C,F#,B♭,E,A,D). One's actual impression, however, of his harmony is of an almost ceaseless chromaticism and of an almost unbroken use of the dominant chord with the flat 7th, 9th, 13th, sharpened 4th, and most frequent of all, the sharpened 5th (or flattened 6th). It is seldom one recognizes his chord of superposed 4ths as such, excepting at times the characteristic two perfect 4ths at the top. In his later work he makes still further harmonic excursions, notably with sharp 7ths or flat 2nds. The hint of this new harmonic scheme may be seen in the earliest compositions, and its development was fairly regular and consistent, until it came to dominate his later output. In his later works he discards entirely the old key signatures. In his orchestration Scriabin calls for a large force, and uses it very freely: his scores are exceedingly contrapuntal in texture, the various instruments moving very independently and weaving together their respective themes: muted brass plays a large part in his orchestral colour scheme. In the first symphony a chorus is used in the finale; the *Poem of Fire* also uses a chorus, but in an orchestral way, no words being supplied. For the last-named work the composer also wrote an optional part for a "Tastiera per luce," or keyboard of light, the intention being that varying colours should play upon a screen as the work was being performed. The composer was greatly interested in theories as to a correspondence between the musical scale and the scale of colours. In his great *Mystery* (left unfinished at his death) music, dance, speech, perfume and colour were to be combined; this work was to be rather a work of ritual than of art, and was to express its author's idealistic mysticism through the medium of 2,000 participants.

It is usual to look upon Scriabin's musical work as largely the expression of theosophical views, and undoubtedly much of his inspiration was drawn from the works of Blavatsky and others. He was not, however, a close reader or a careful thinker. Seizing the main idea of a book or a creed, he would neglect the details, and then his imagination would quickly develop a huge scheme of thought having little relation to what he had read. The titles of many of his works and of their separate parts, and the marks of expression affixed to particular passages, indicate plainly the existence of a spiritual "programme." The emancipation of the human soul through ceaseless striving, and its achievement of self-expression, may be said, very roughly, to represent the general sense of the spiritual basis of Scriabin's musical works.

The works of Scriabin have been variously classed into periods. A logical classification is into four periods as follows: 1st period, with a strong Chopin influence; the dividing line between this and the 2nd period runs through the first symphony, and the 2nd period shows some Wagner and Liszt influences; the dividing line between this and the 3rd period runs through the fifth sonata, and a 4th period begins with the *Poem of Fire*.

Among Scriabin's principal works are the following. For orchestra: *Reverie*, op. 24; first symphony, op. 26; second symphony, op. 29; third symphony (or *Divine Poem*), op. 43; fourth symphony (or *Poem of Ecstasy*), op. 54; *Prometheus* (or *"Poem of Fire"*), op. 60. For piano: ten sonatas, together with a very large number of preludes, études, impromptus, mazurkas, poems, etc., including the great *Vers la Flamme* poem and the much-discussed last work, the Five Preludes (op. 74). For piano and orchestra: Concerto, op. 20. No songs or chamber music are included in Scriabin's output. (P. A. S.)

SCRIBE, AUGUSTIN EUGÈNE (1791–1861), French dramatist, was born in Paris on Dec. 24, 1791. His first piece, *Le Prétendu sans le savoir,* was produced without his name at the Variétés in 1810, and was a failure. Numerous other plays, written in collaboration with various authors, followed; but Scribe achieved no distinct success till 1815, when *Une Nuit de la garde nationale,* written in collaboration with Delestre-Poirson, made him famous. Thenceforward his fertility was unceasing and its results prodigious. He wrote every kind of drama—vaudevilles, comedies, tragedies, opera-libretti. To the Gymnase theatre alone he is said to have furnished a hundred and fifty pieces before 1830. This extraordinary fecundity is explained by the systematic methods of collaboration which he established. He had a number of co-workers, one of whom supplied the story, another the dialogue, a third the jokes and so on. He is said in some cases to have sent sums of money for "copyright in ideas" to men who were unaware that he had taken suggestions from their work. Among his collaborators were Jean Henri Dupin (1787–1887), Germain Delavigne, Delestre-Poirson, Mélesville (A. H. J. Duveyrier), Marc-Antoine Desaugiers, Xavier Saintine and Gabriel Legouvé. His début in serious comedy was made at the Théâtre Français in 1822 with *Valérie,* the first of many successful pieces of the same kind. His industry was untiring and his knowledge both of the mechanism of the stage and of the tastes of the audience was wonderful. He was for fifty years the best exponent of the ideas of the French middle classes. The best-known of Scribe's pieces after his first successful one are *Une Chaîne* (1842); *Le Verre d'eau* (1842); *Adrienne Lecouvreur* (1849), in conjunction with Legouvé; *Bertrand et Raton, ou l'art de conspirer;* and the libretti of many of the most famous operas of the middle of the century, especially those of Auber and Meyerbeer. The books of *La Muette de Portici, Fra Diavolo, Robert le Diable,* and of *Les Huguenots* are wholly or in part by him. Scribe died in Paris on Feb. 20, 1861.

His *Oeuvres complètes* appeared in seventy-six volumes in 1874–85. *See* Legouvé, *Eugène Scribe* (1874); and N. C. Arvin, *E. Scribe and the French Theatre, 1815–60* (Cambridge, Mass., 1924).

SCRIBES, a famous Jewish group frequently mentioned together with the Pharisees (*q.v.*), in the Gospels. Their rise is connected in the closest possible manner with the study of the *Torah* (Law). This study and understanding of the *Torah* was highly complex in character; it followed, therefore, that the existence of a distinct body of experts on the subject became a necessity. Thus there arose the scribes, with whom *Torah*-study was a matter of professional occupation. Originally this occupation belonged to the priesthood, for the priests were at first, both the guardians and teachers of the Law. Ezra himself was both priest and *Sopher* ("scribe"). But by degrees the study of the law was pursued by others besides the priests—for the *Law* was meant equally for layman and priest, and the one had as much interest in it as the other—so that there arose an independent class of *Torah*-students, who in time supplanted the priests as teachers of the people, and became the recognized official exponents of the law. At the same time, this did not necessarily exclude scribes from being priests for, on the testimony of Philo, we know that in the synagogues priests often undertook the duty of reading the law and expounding it to the people, a duty which belonged specifically to the scribes; so that there is no reason to believe that scribes were never priests. In the first instance, scribes occupied themselves exclusively with study; they were not allowed to pursue any other calling, lest their thoughts should be withdrawn from *Torah*-study; *see* Ecclus. xxxviii. 24: "The wisdom of a learned man cometh by opportunity of leisure: and he that hath little business shall become wise . . ." But in later days it became absolute duty for them to have some other calling besides, in order to earn a livelihood, the reason being that all labour for the law had to be gratuitous. For the most part the scribes belonged to the Pharisaic party; but as the one qualification for being a scribe consisted in being "learned in the Law" there must have been scribes in the Sadducean party as well, indeed this is implied in the New Testament (*see* Mark ii. 16, Luke v. 30, Acts xxiii. 9). As the scribes were occupied with the administration of the law as well as with its study, they were also called "Lawyers" (Matt. xxii. 35, Luke vii. 30, x. 25, xi. 45, 46), or "teachers of the Law" (Luke v. 17, Acts v. 34); "Lawyer" and "Scribe" are synonymous, for which reason they are never mentioned together in the New Testament. But as administrators of the law it followed, in a natural course, that the scribes should also be among those who saw to its being carried out; so that they also had the power of sitting as judges, and therefore also of passing sentence upon those who were guilty of breaking the

law. Hence scribes were among those who composed the great Sanhedrin at Jerusalem, and as they were the ones whose special study of the law made them experts, it cannot be doubted that their influence in this supreme court must have been considerable.

The difference between the scribes and the pharisees was briefly this—the scribes handed down the traditional, *i.e.*, the Oral Law as well as the Written Law, and explained it; the pharisees carried out in actual practice what was prescribed. This, of course, does not mean to say that the scribes did not also strictly observe the legal enactments; but that their special duties constituted them a class distinct from the pharisees is clear from the way in which they are differentiated in the New Testament, for there we read of the "Scribes of the Pharisees" (Mark ii. 16, Acts xxiii. 9), and of "the Pharisees and their scribes" (Luke v. 30), showing clearly that the scribes were distinct from the Pharisees. *See* G. F. Moore, *Judaism.* (G. H. B.)

SCRIPPS, EDWARD WYLLIS (1854–1926), American newspaper publisher, was born at Rushville (Ill.) June 18, 1854. He was brought up on a farm in Winchester county and in 1872 joined the staff of the Detroit *Tribune,* then owned by his brother James. Fire destroyed this paper in 1875 and the same year J. E. Scripps founded the Detroit *Evening News,* with E. W. Scripps as city editor. Three years later the latter founded the Cleveland *Penny Press,* which under his direction achieved immediate success. He gradually acquired other journals in Ohio and elsewhere, which later became known as the Scripps-Howard group.

In 1896 he, in conjunction with Milton A. McRae, formed the Scripps-McRae Press Association for the purpose of providing his papers with cable news. He also, in 1901, organized the Newspaper Enterprise Association, with the object of supplying features to local papers. In 1908 the Scripps-McRae association was merged with the publishers' press association and the Pacific coast press association, under the name of the United Press Association, Mr. Scripps holding a controlling interest. In 1917 his health broke down under the strain of war work and in 1920 he retired from business activity. In this same year he founded and endowed *Science Service,* a news bureau for the dissemination of scientific facts. In 1924 he transferred control of his various interests to his son Robert P. Scripps. He died on board his yacht in Monrovia bay, Liberia, West Africa, on March 12, 1926.

SCROFULA or **STRUMA,** the general names formerly given to the disease now termed tuberculosis (*q.v.*)—"scrofulous," "strumous" and "tuberculous" being nearly interchangeable. The particular characters associated with "scrofula" have, therefore, varied at different periods when the real nature of the disease was misunderstood; but essentially what was meant was tuberculosis of the bones and lymphatic glands, with its attendant symptoms, and it is in this sense that the word survives. The old English popular name was "king's evil," so called from the belief that the sovereign's touch could effect a cure. This superstition can be traced back to the time of Edward the Confessor in England, and to a much earlier period in France. Samuel Johnson was touched by Queen Anne in 1712, and the same prerogative of royalty was exercised by Prince Charles Edward in 1745.

SCROGGS, SIR WILLIAM (*c.* 1623–1683), lord chief justice of England, was the son of a butcher of sufficient means to give his son a university education. Scroggs went to Oriel college, and later to Pembroke college, Oxford. There is some evidence that he fought on the royalist side during the Civil War. He was called to the bar in 1653, was appointed a judge of the common pleas in 1676, and two years later was promoted to be lord chief justice. As lord chief justice Scroggs presided at the trial of the persons denounced by Titus Oates for complicity in the "popish plot," and he treated these prisoners with characteristic violence and brutality, overwhelming them with indecent sarcasm and abuse while on their trial, and taunting them with savage mockery when sentencing them to death. He may at first have been a sincere believer in the existence of a plot; at all events he did nothing to test the credibility of such perjured witnesses as Oates, Bedloe, and Dangerfield. At the trial in Feb. 1679 of the prisoners accused of the murder of Sir Edmund Godfrey he gave a characteristic exhibition of his methods, including a tirade against the Roman Catholic religion. But Oates' next move, accusing the queen's physician, Wakeman, seemed to be going too far, and in the succeeding trials Scroggs impugned the testimony of Bedloe and Oates, thereby incurring great unpopularity in the country. Oates and Bedloe now arraigned him (1680) before the privy council for misconduct of the Wakeman case, but he was acquitted. The same year he discharged the grand jury to save the duke of York from trial as a popish recusant. In Jan. 1681 he was impeached; dissolution saved him, but he was removed from the bench. He died on Oct. 25, 1683.

Scroggs was perhaps the worst of the judges who disgraced the English bench at a period when it had sunk to the lowest degradation; and although his infamy is less notorious than that of Jeffreys, his character exhibited fewer redeeming features. Scroggs was the author of a work on the *Practice of Courts-Leet and Courts-Baron* (London, 1701), and he edited reports of the State trials over which he presided. He was the subject of many contemporary satires.

See W. Cobbett, *Complete Collection of State Trials* (vols. i.–x. of *State Trials,* 33 vols., London, 1809); Roger North, *Life of Lord Guilford, etc.,* edit. by A. Jessopp (3 vols., London, 1890), and *Examen* (London, 1740); Narcissus Luttrell, *A Brief Relation of State Affairs, 1678–1714* (6 vols., Oxford, 1857); Anthony à Wood, *Athenae Oxonienses,* edited by P. Bliss (4 vols., London, 1813–20); *Correspondence of the Family of Hatton,* edit. by E. M. Thompson (2 vols., Camden Soc. 22, 23, London, 1878); Lord Campbell, *Lives of the Chief Justices of England* (3 vols., London, 1849–57); Edward Foss, *The Judges of England* (9 vols., London, 1848–64); Sir J. F. Stephen, *History of the Criminal Law of England* (3 vols., London, 1883); Henry B. Irving, *Life of Judge Jeffreys* (London, 1898).

SCROPE (skrōōp), an old English family of Norman origin. Sir William le Scrope, of Bolton, in Wensleydale, Yorkshire, had two sons, HENRY (d. 1336) and GEOFFREY (d. 1340), both of whom were in succession chief justice of the king's bench and prominent supporters of the court in the reign of Edward II. Henry was father of RICHARD LE SCROPE, 1st Baron Scrope of Bolton (*c.* 1327–1403), chancellor of England, an active adherent of John of Gaunt. Having been knight of the shire of Yorkshire in the parliament of 1364, he was summoned to the upper house as a baron by writ in 1371, when he was made treasurer and keeper of the great seal. In 1378 Lord Scrope became chancellor; he attempted to curb the extravagance of Richard II., and was dismissed in 1382.

His eldest son WILLIAM (*c.* 1350–1399) was created earl of Wiltshire in 1397 by Richard II., and he bought the sovereignty of the Isle of Man from the earl of Salisbury. In 1398 he became treasurer of England. His execution at Bristol was one of the first acts of Henry IV., and the irregular sentence of an improvised court was confirmed by that monarch's first parliament. Wiltshire's father, Lord Scrope, and his other sons were not included in the attainder, but received full pardon from Henry. Scrope, who was the builder of Bolton Castle, his principal residence, died in 1403. He was succeeded in the barony by his second son, Roger, whose descendants held it till 1630. On the death of EMMANUEL SCROPE, 11th baron (1584–1630), who was created earl of Sunderland in 1627, the earldom became extinct.

SIR GEOFFREY LE SCROPE (d. 1340), chief justice of the king's bench as mentioned above, uncle of the first Baron Scrope of Bolton, had a son Henry (1315–1391), who in 1350 was summoned to parliament by writ as Baron Scrope, the designation "of Masham" being added in the time of his grandson to distinguish the title from that held by the elder branch. HENRY LE SCROPE, 3rd Baron Scrope of Masham (*c.* 1376–1415), was a favourite of Henry V., by whom he was made treasurer in 1410 and employed on diplomatic missions abroad. But in 1415 he was concerned in a conspiracy to dethrone Henry and was executed at Southampton, when his title was forfeited. It was, however, restored to his brother John in 1455; and it fell into abeyance on the death, in 1517, of Geoffrey, 11th Baron Scrope of Masham, without male heirs.

See Sir N. H. Nicolas, *The Scrope and Grosvenor Controversy* (2 vols., London, 1832), containing much detailed information about the various branches of the Scrope family; J. H. Wylie, *History of England*

under Henry IV. (4 vols., London, 1884–98); Edward Foss, *The Judges of England* (9 vols., London, 1848–64); G. P. Scrope, *History of the Manor and Ancient Barony of Castle Combe, Wilts* (London, 1852); G. E. C., *Complete Peerage,* vol. vii. (London, 1896).

SCROPHULARIACEAE, in botany, a family of seed plants belonging to the sympetalous section of Dicotyledons and a member of the series Tubiflorae. It is a cosmopolitan order containing about 200 genera with about 2,600 species; the majority occur in temperate regions, the numbers diminishing rapidly towards the tropics and colder regions. About 30% of the species are annual herbs, such as eyebright (*Euphrasia officinalis*), cow-wheat (*Melampyrum*), and species of *Veronica;* more than 60% are biennial or generally perennial herbs and undershrubs, such as species of *Veronica,* mullein (*Verbascum*), foxglove (*Digitalis purpurea*), etc., while shrubs and trees are rare; *Paulownia,* a native of the mountains of Japan, a tree with large leaves and handsome panicles of violet flowers, is grown in European gardens.

The stem is sometimes prostrate and creeping, as in ivy-leaved toad-flax (*Linaria Cymbalaria*) and some of the native British Veronicas, but generally erect as in foxglove, figwort, mullein, etc.; a few are climbers as *Rhodochiton* and *Maurandia.* The South African genera *Hyobanche* and *Harveya* are parasites almost devoid of chlorophyll with scale-like leaves; and many genera are semiparasitic, having green leaves, but attaching themselves by root-suckers to roots of grass, etc., from which they derive part of their nourishment; such are *Euphrasia, Rhinanthus, Pedicularis,* etc. A few genera are aquatic, e.g., *Ambulia* (Old World Tropics), and have much divided submerged leaves and entire aerial leaves. The flowers are solitary in the leaf-axils, as in *Mimulus,* species of *Linaria,* etc., or form spikes or racemes which are terminal as in foxglove, species of *Veronica,* etc., or axillary, as in *Veronica* (*Chamaedrys* section). The flowers are hermaphrodite, hypogynous and zygomorphic in the median plane, being often more or less two-lipped, and having five sepals joined below and persisting in the fruiting stage, five petals uniting to form a corolla of various shape, generally four stamens, the fifth (posterior) being suppressed or represented by a rudiment, while the anterior pair are longer than the posterior, and two generally equal carpels in the median plane forming a two-celled ovary containing numerous anatropous ovules on a thick axile placenta, and bearing a simple or bilobed style.

When a terminal flower is present it becomes regular as in toad-flax, where radial symmetry is produced by development of a spur to each petal—such flowers are termed peloric; all the flowers in a spike are sometimes peloric. In *Euphrasia* and many species of *Veronica* the posterior sepal is suppressed. The form of the corolla shows great variety, depending on the length and breadth of the tube—which in *Veronica* is almost obsolete, while in foxglove it is large and almost bell-shaped—and the development of the limbs, which are spreading in *Veronica,* small and almost erect in figwort, or form a pair of closed lips as in *Linaria* and *Antirrhinum.* In *Verbascum* the five segments are almost equal, forming a nearly regular corolla; the approach to regularity in the corolla in *Verbascum* is associated with the presence of five fertile stamens, but the three posterior are generally larger than the two anterior. In *Veronica, Calceolaria* and other genera only two stamens are present. Honey is secreted by a disk surrounding the base of the ovary or by special nectaries below it. *Verbascum* and *Veronica* with a short-tubed corolla represent an open type of flower with more exposed nectar; in foxglove the honey is at the base of the long tube, and a bee crawling to reach it will rub with its back the anthers or stigmas which are placed on the upper side of the bell. The closed flowers of *Linaria* and *Antirrhinum* can be visited only by insects strong enough to separate the lips.

The fruit is generally a capsule surrounded at the base, or sometimes as in yellow-rattle (*Rhinanthus*) enveloped in the persistent calyx; it opens by two or four valves, or, as in *Antirrhinum,* by pores. Occasionally it is a berry. In *Linaria Cymbalaria* the fruit becomes buried by the stalks bending downwards when ripe.

The family is divided into tribes by characters derived from the number of fertile stamens present and the form of the corolla. It is well represented in Britain by 13 genera, viz., *Verbascum* (mullein), *Linaria* (toad-flax), *Antirrhinum* (snapdragon), *Scrophularia* (figwort), *Limosella, Sibthorpia, Digitalis* (foxglove), *Veronica* (speedwell), *Bartsia, Euphrasia* (eyebright), *Rhinanthus* (yellow-rattle), *Pedicularis* (louse-wort) and *Melampyrum* (cow-wheat). The best known representatives in North America are *Verbascum* (mullein), *Pentstemon* (beard-tongue), *Mimulus* (monkey-flower), *Veronica* (speedwell), *Gerardia, Castilleja* (painted cup), and *Pedicularis* (louse-wort). Common in cultivation are European species of *Antirrhinum* (snapdragon), *Digitalis* (foxglove), and *Linaria* (toad-flax). Several genera are well known in gardens; such are *Calceolaria, Collinsia, Pentstemon* and *Mimulus* (musk).

SCRUB-BIRD, the name applied to species of an Australian genus of birds and especially to *Atrichornis clamosa.* This bird is brown above, each feather barred with a darker shade; the throat and belly are reddish-white and there is a black patch on the throat; the flanks are brown. It inhabits the thickest "scrub" and the males are noisy and imitative. A second species, *A. rufescens,* from New South Wales, is brown all over. They form the family *Atrichornithidae* of the perching birds (Passeres).

SCRUTIN DE LISTE, a system of election of national representatives by which the electors of a department vote for all the deputies to be elected in that department, comparable to the "general ticket" in the United States (Fr. *scrutin,* voting by ballot, and *liste,* a list). It is distinguished from the *scrutin d'arrondissement,* under which the electors in each arrondissement vote only for the deputy to be elected in it. *See* REPRESENTATION.

SCRUTINY, careful examination or enquiry. The word is specifically applied in the early Church to the examination of the catechumens or those under instruction in the faith. They were taught the creed and the Lord's Prayer, examined therein and exorcized prior to baptism. Scrutiny also indicates a method of electing a pope in the Roman Catholic Church, in contradistinction to two other methods, acclamation and accession. (*See* CONCLAVE.) In the law of elections, scrutiny is the careful examination of votes cast after the unsuccessful candidate has lodged a petition claiming the seat, and alleging that he has the majority of legal votes.

SCUDÉRY, GEORGES DE (1601–1667), French writer, was born at Havre, on Aug. 22, 1601. He first served in the army but conceived a fancy for literature before he was thirty, and during the whole of the middle of the century he was one of the most characteristic figures of Paris. He gained the favour of Richelieu by his opposition to Corneille. He wrote a letter to the Academy criticizing the *Cid,* and his play, *L'Amour tyrannique* (1640), was patronized by the cardinal in opposition to Corneille. He was appointed governor of the fortress of Notre-Dame de la Garde, near Marseilles in 1643, and in 1650 he was elected to the Academy. During the troubles of the Fronde he was exiled to Normandy, where he made his fortune by a rich marriage. He was an industrious dramatist, but *L'Amour tyrannique* is practically the only piece among his numerous tragicomedies and pastorals that has escaped oblivion. His other most famous work was the epic of *Alaric* (1655). He lent his name to his sister's first romances, but did little beyond correcting the proofs. He died at Paris on May 14, 1667. Scudéry's swash-buckler affectations have been rather exaggerated by literary gossip and tradition. Although possibly not quite sane, he had some poetical power, a fervent love of literature, a high sense of honour and of friendship.

SCUDÉRY, MADELEINE DE (1607–1701), French novelist, sister of Georges de Scudéry (*q.v.*), established herself in Paris with her brother. She was at once admitted to the Rambouillet coterie, afterwards established a *salon* of her own under the title of the *Société du samedi,* and for the last half of the 17th century, under the pseudonym of "Sapho" or her own name, was acknowledged as the first blue-stocking of France and of the world. She formed with Pellisson a close friendship only terminated by his death in 1693. Her lengthy novels, such as *Artamène, ou le Grand Cyrus* (10 vols. 1648–1653), *Clélie* (10 vols. 1654–1661), *Ibrahim, ou l'illustre Bassa* (4 vols. 1661), *Almahide, ou l'esclave reine* (8 vols. 1661–1663) were the delight of all Europe,

including persons of the wit and sense of Madame de Sévigné. With classical or Oriental personages for nominal heroes and heroines, the whole language and action are taken from the fashionable ideas of the time, and the personages can be identified either really or colourably with Mademoiselle de Scudéry's contemporaries. In *Clélie,* Herminius represents Paul Pellisson; Scaurus and Lyriane were Paul Scarron and his wife (afterwards Mme. de Maintenon); and in the description of Sapho in vol. x. of *Le Grand Cyrus* the author paints herself. It is in *Clélie* that the famous Carte de Tendre appeared, a description of an Arcadia, where the river of Inclination waters the villages of Billet Doux, Petits Soins and so forth. The interminable length of the stories is made out by endless conversations and, as far as incidents go, chiefly by successive abductions of the heroines, conceived and related in the most decorous spirit, for Mademoiselle de Scudéry is nothing if not decorous.

In that early day of the novel prolixity did not repel. "Sapho" had really studied mankind in her contemporaries and knew how to analyse and describe their characters with fidelity and point. Moreover her novels had the interest always attaching to the *roman à clef.* She was a real mistress of dialogue. She had a distinct vocation as a pedagogue, and is compared by Sainte-Beuve to Mme. de Genlis. She could moralize—a favourite employment of the time—with sense and propriety. Though she was incapable of the exquisite prose of Mme. de Sévigné and some others of her contemporaries, her purely literary merits were considerable. Madeleine survived her brother more than thirty years, and in her later days published numerous volumes of conversations, to a great extent extracted from her novels, thus forming a kind of anthology of her work. She outlived her vogue to some extent, but retained a circle of friends to whom she was always the "incomparable Sapho." She died on June 2, 1701.

Her *Life and Correspondence* were published at Paris by MM. Rathery and Boutron in 1873. An amusing sketch of her is to be found in vol. iv. of Sainte-Beuve's *Causeries du lundi.* Georges de Scudéry is sketched by Théophile Gautier in his *Grotesques. See* also V. Cousin, *La Société française au XVIIe siècle,* vol. ii.

SCULL, a light oar with blade more concave than the ordinary racing oar and with shorter helm, thus allowing the user to hold one in each hand. *See* ROWING; BOAT.

SCULPTURE, the art of representing observed or imagined objects in solid materials and in three dimensions. The field of sculpture is so vast that it cannot be conveniently covered in a single article. It has therefore been divided into a number of parts incorporated under various subjects.

For the technique of sculpture, *see* SCULPTURE TECHNIQUE: *Modelling; Casting and Finishing; Terra-Cotta; Stone Carving; Wood Carving; Plaster Casting. See* also GEM; NUMISMATICS; IVORY CARVING; WOOD CARVING; STONE CARVING; SILVERSMITHS' AND GOLDSMITHS' WORK. For additional history of Sculpture, *see* EGYPT: *Art and Archaeology;* GREEK ART; ROMAN ART; BYZANTINE ART; RENAISSANCE ART; GOTHIC ART. There are also independent articles, such as CHINESE SCULPTURE and JAPANESE SCULPTURE, as well as sections under INDIAN AND SINHALESE ART AND ARCHAEOLOGY; TIBETAN ART; MEXICO; NEGRO, etc. Following this general treatise, the various uses of sculpture are given in special articles under SCULPTURE: *Monumental; Garden; Portrait; Architectural; Decorative.*

For the work of individual sculptors the following names may be referred to: PHEIDIAS, PRAXITELES, DONATELLO, MICHELANGELO, BERNINI, GOUJON, CANOVA, RODIN.

HISTORY

Undoubtedly the beginnings of sculpture may be explained by that spontaneous delight which all men find in the imitation of natural objects. Sculpture would seem to be almost inevitably conceived as a realistic art, since it offers us, not appearances, like painting, but actual forms reproduced from nature and placed, like nature's forms, in space. Yet the power of sculpture to embody also an abstract beauty, like music or architecture, seems to have been felt at a very early date. The use of sculpture for the decoration of objects, such as the bone handles of weapons, in which imitated natural forms had to be fitted to the contours of geometric forms, may have led to the discovery of that arranged beauty that arises from a rhythmic disposition of line and mass. Purely representative sculpture, cut into the wall of a cave or carved from a tree-trunk, assumed immediately a corresponding tendency towards the creation of abstract harmonies. Composition, which implies a conscious selection and arrangement of observed objects and demands an adjustment of nature to fit an assigned space, became a necessary part of artistic effort. That idealization of nature, which selects from her seeming chaos laws which are in harmony with his own needs and desires, prompted the artist to insist upon those laws in his descriptive art, which was thus diverted from its original intent—the literal rendering of natural form. Throughout its history, sculpture has thus offered two kinds of beauty: the sensuous beauty of imitated natural forms and the imagined or religious beauty of natural forms made harmonious with man's spiritual needs.

EGYPT

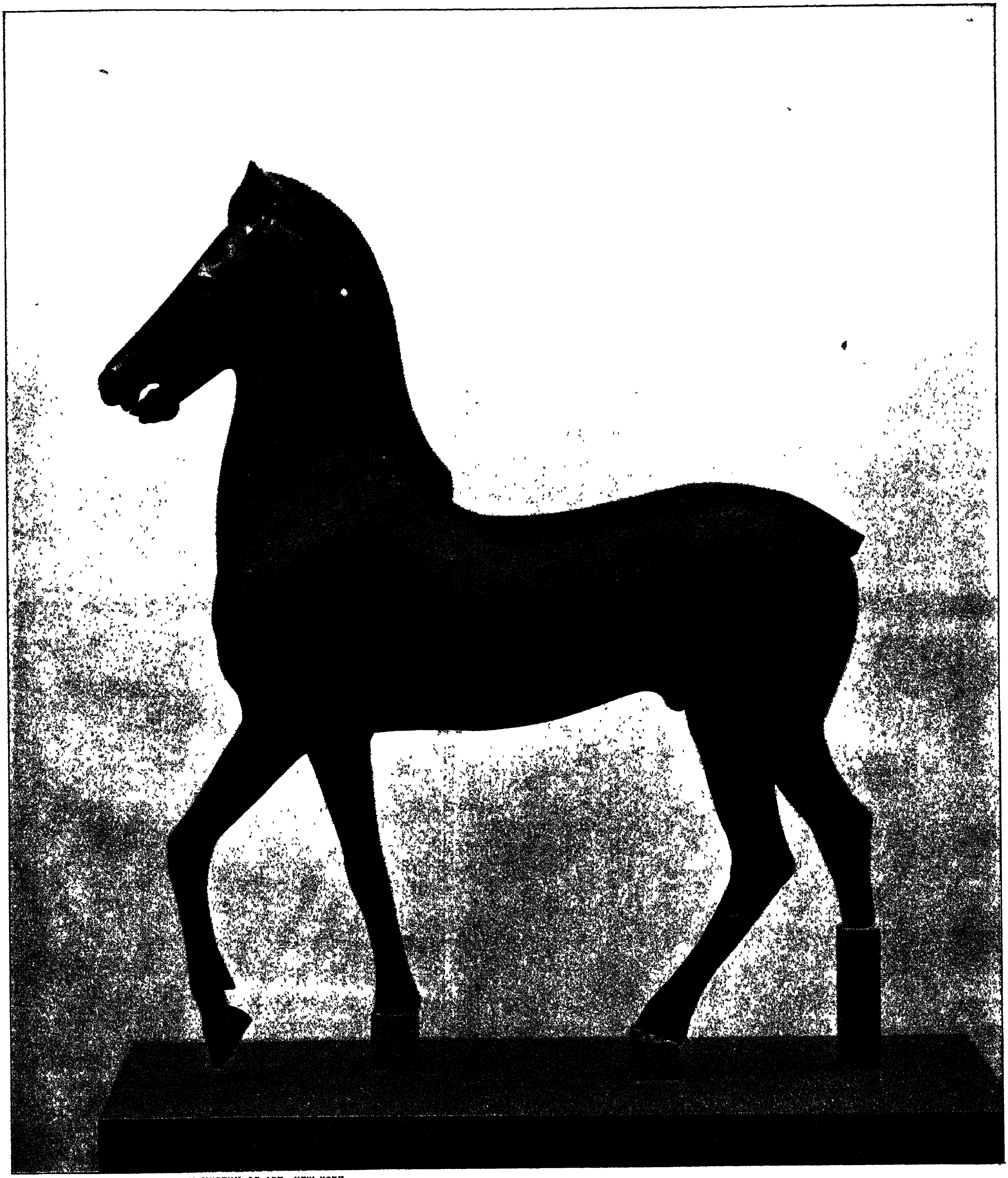
This dual rôle of sculpture is illustrated in the art of Egypt. In the decorative sculpture of Egypt, natural forms, or forms derived from nature, are oftentimes perfectly adjusted, through elimination or arrangement of parts, to the shape and material, the structure and function of furniture, weapons, fabrics, and architecture. The world of chiselled forms which peoples the tombs of the Nile valley, although ritualistic and useful in its purpose and hidden for ever from the eyes of men, shows a persistent search for harmony in arrangement and for the idealization of nature. The power of these abstractions is most evident in the great seated statues of the Pharaohs, which are neither decorations nor illustrations, but monuments. The compact and definite forms, the economy of detail, the great scale and the emphasis upon the inner structure of the body, endow these heroic figures with the architectonic grandeur of abstract forms; and the characterization of the figure, ignoring physical peculiarities to insist upon spiritual realities—upon the dignity, reserve, and power of sovereignty—informs them with the majesty they were intended to celebrate.

Egyptian sculpture illustrates also the way in which the reproduction of nature is limited, in sculpture, by artistic or social conventions. Sculpture, in spite of its objectivity is necessarily a conventional art, limited in range by the need for equilibrium and by the nature of its materials. Conventions, arising in primitive times from inadequacy of technique, or invented by some artist as an expedient for the realization in stone of that pattern which he perceives in nature, are continually being crystallized into precedents or even into social or religious laws. From the repetition of conventions there arise traditions which interpose themselves between the individual artist and nature. The monotony of the sculpture of Egypt, which for forty centuries observes the same iron convention, is perhaps its most amazing characteristic; yet there is no sculptor, except the first sculptor, who has not felt to some extent the generalizing influence of tradition. Of all the arts, sculpture is, excepting only architecture, the most traditional.

GREECE

The idealization of nature and of man, which was an essential part of the Hellenic religion, encouraged the Greek sculptor to escape from the conventions of Egypt, and to discover, in nature, a nobler pattern for the human body. In Greece, religion, far from despising nature, gave her sanction to that passion for nature, to that persistent and penetrating search for the secrets of nature's beauty, which the greatest Hellenic sculpture expresses. From the investigation of appearances the Greek sculptor proceeded to the investigation of the laws of structure and of form, to the architecture of the human body. A simplification of planes, a lucid relationship among the masses and contours, a harmonious direction of line and shadow, are the result of this analysis. The serene beauty of the 5th century gods arises directly from the imposition of these qualities upon forms that are also sensuously beautiful.

In the 4th century, when an interest in individual beauty sup-



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK

GREEK BRONZE, BELIEVED TO BE OF ATTIC OR SOUTH ITALIAN ORIGIN

The statuette, 15 13/16 inches in height and 14¼ in length, is believed to have been made about 470 B.C. Although there is uncertainty about the identity of the artist, the beauty and grace of the conception of the design point to the possible workmanship of Calamis, a well-known Athenian sculptor. Indeed, there is considerable basis for the conjecture that this statuette is a part of a miniature model of the charioteer group which Calamis was commissioned to execute by the Syracusan tyrant Deimonides. The tail, parts of the legs and one ear, and the eyes, which may have been inlaid, are missing. It is cast solid, weighing 25½ pounds

planted the religious exaltation of the Age of Pericles, these metaphysical qualities are less evident in sculpture. The gods lose their heroic detachment, their moral calm, as the artist develops a more descriptive technique. The planes which bound their bodies become less rigid and less definite as the artist searches out the nuances of light and shadow that pass over them. The action of inward forces becomes hidden under a clothing of soft and tremulous flesh.

After Alexander Greek sculpture departs still farther from the rigorous "architecture" of the 5th century gods. Life is reproduced with greater and greater actuality. Detail is elaborated; movement, expressed in the effort of muscles or the sweep of draperies, and emotion, often violent and exaggerated, is insisted upon. Allegory and narrative rather than form become the preoccupations of the sculptor. The Greek artist, who had discovered in the human body a pattern of divinity, ends as a story-teller in whose art this pattern persists only as a system of elegant eliminations, a canon of correct proportions.

THE ROMAN EMPIRE

Rome, after the 1st century B.C., became the chief patron of the realistic sculpture of Greece. The production of copies and imitations for the Roman market amounted almost to an industry in Antioch, Alexandria, and in certain cities in Asia Minor. Precedent and convention necessarily take the place of nature and architecture under these conditions as the determining element in the art of sculpture. The spirit of the Orient was increasingly felt, dissolving the Greek forms under an opulence of ornamental motives; and when, in the 2nd and 3rd centuries, Christianity and monasticism robbed the sculptor of the patronage of the temples, the human body gradually ceased to play its ennobling part in his art. The Hellenic types remained. The narratives of the Old and New Testament, the martyrdoms of the Saints, are illustrated by a rearrangement of Alexandrine groups. Hermes, the Ram-bearer, becomes the Good Shepherd; the *genre* fisherman becomes Christ, the Fisher of Men. But these are reduced in scale, oftentimes little more than the decorative detail of wall-panel or sarcophagus, and charged with a ritualistic meaning which obscures nature and renders her unnecessary.

In Rome itself a parallel transformation took place, although the Greek tradition found there a more virile continuation than in the East. The imagination of Rome, like that of the East, was captured by the realism of the art of the Age of Alexander rather than by the architectonic beauty of Athenian art, but in her commemorative monuments, such as the Arch of Titus and the Column of Trajan, the episodic style of Alexandria is given a wider range and a more vigorous technique than is found elsewhere. Sculpture, on these structures, is a purely pictorial art. Intent on an illusionist treatment of nature and of events the sculptor seldom permits the monumental harmonies to invade his work. In Rome, the rendering of foliated ornament attained a perfect balance between nature and convention not excelled except in the Renaissance decoration of the 15th century; the art of realistic portraiture reached a technical perfection; and at times, as in the Ara Pacis Augustae, the Hellenistic precedents of dignity and grace in the rendering of draperies and of flesh are exquisitely revived. But in Rome, as in the East, the form-giving rôle of sculpture is gradually forgotten.

ROMANESQUE SCULPTURE

It was not until the 11th century that sculpture became once more a monumental art. In the Romanesque monasteries, which covered Western Europe, sculpture, being made once more subordinate to architecture in the decoration of cloister and abbey doorway, began a fresh development which carried it from archaic beginnings to a superb culmination in the sculptural ensembles of the 13th century cathedrals.

The basis for this new sculpture was the Christian iconography of the East and of Rome, derived as we have seen from a somewhat distant Hellenic tradition. The Romanesque sculptor had to learn anew the technique of his craft but he had for his model the forms of an art already sophisticated and even decadent. The theocratic spirit of the age turned him from the observation of natural or human beauty. Preoccupied with spirit and not with form, he could not evolve his Christ, like the Hellenic Apollo, from a naked athlete. The Christian sculptor began with symbols —symbols made sacrosanct by authority and usage. His reliefs, cut in the tympana of abbey portals or moulded on the panels of bronze doors, repeat the types, the proportions, even the stylistic treatment—the low relief, the concentric folds and clinging drapery, the colour and gold—of a Byzantine miniature or ivory-carving.

But ivory carvings and miniatures cannot be fitted, without some modifications, into an architectural scheme. To do that a rearrangement of their figures, a redistribution of shadow and emphasis, and an enlargement of scale are necessary. Figures placed in the semi-circular tympanum of a doorway demand a balanced composition in which a central figure is made dominant and all the lines and shadows made to bend in harmony with the wide arch over them. Figures chiselled on a lintel demand a regular and rectilinear arrangement, free from deep shadow and bent line; figures placed on the splays of doorways must stand rigidly upright and be free of gesture or a too marked individuality; and figures cut into a capital must follow, in a symmetrical, flower-like arrangement, the warped surfaces which are transitional between shaft and arch. In this way the Byzantine forms, already abstract, suffered in the hands of the monastic builders a further abstraction; they are transformed into architecture.

GOTHIC SCULPTURE

The monastic carvings formed the basis from which the communes of northern France developed the superb sculptural art of the 13th, 14th, and 15th centuries. The great cathedrals demanded sculpture in order that the abstract and mechanical rhythms of their architecture might be informed with some measure of life and of sensual beauty. No doubt some of this sculpture, like that of the monasteries, was doctrinal, or even didactic in origin. Symbolism, an "algebra of art," was certainly an important source of inspiration wherever the Church controlled the design. But these were not the primary impulses from which Gothic art sprung. Those impulses lay very deep in the emotional life of the time. Gothic sculpture, like Gothic architecture, is the concrete expression of that great wave of joyousness and health, of spiritual unity and heroic exaltation that was born with the rise of the great communes. It is an art, not of dogma, but of a natural and human society. It expresses, in its great period, the collective soul of a Europe that for a moment found in an exalted faith an escape from tyranny and despair.

13th Century.—The remarkable characteristic of 13th century sculpture is its recovery of the plastic sense. Romanesque sculpture, essentially an art of relief and of ornament, remained, in the monasteries, almost wholly decorative and symbolic in character; but the patronage that created Gothic art—that of the communes of northern France—desired almost from the beginning a sculpture of three dimensions. At Chartres, at Bourges, and at the Abbey of St. Denis we find as early as the third quarter of the 12th century, figures cut in the round, true statues, which announce unmistakably their character as stone monuments. Rigid in contour and with the forms revealed by definite clear planes, surrounded by light and space, the Gothic figures of the 13th century possess in a remarkable degree a quality of beauty that is unmistakably glyptic.

Even more remarkable is the humanization of this sculpture. When the solid architecture of the first cathedrals had imposed simplicity and breadth, concreteness and balance, upon the Romanesque forms, the free spirit of the communes re-endowed them with natural beauty. In the great portals of the 13th century cathedrals, a stone population, imprisoned still in vast architectural frames, takes on gradually the aspect of reality, as the sculptor turns from symbolic pictures to nature. The bodily semblances of men and women emerge from the shaft-like forms that stand along the doorways; they assume attitudes of life, turning the head, raising an arm, planting the feet firmly upon the ground. Their angular planes soften into effects of warmth and

energy; their draperies lose their geometric stiffness to hang in graceful folds that reveal the action of the bodies beneath; and their faces, still ideal and generalized, assume a physiognomy and expressiveness that interpret character and mind. An equilibrium between architecture and nature is once more established. As in the pediments of the Parthenon and the Temple of the Olympian Zeus, an enframement of noble architecture imposes order and a mystic beauty upon an ensemble of forms which are at once symbolic and human.

This new art had to be developed step by step from experimental beginnings. It grows from archaism to scientific mastery, in a manner which curiously parallels the development of Greek sculpture. The earliest statues, like those from Corbeil (now at St. Denis) or in the Porte Royale of Chartres, seem to have been cut from columns—as though the sculptor had merely revealed, by the removal of an outside covering, the living forms imprisoned within the shaft. Rigid and compact in form, these statues have the "frontality" of primitive Greece. Their angular immobile bodies are wrapped in thin draperies whose parallel folds are delicately incised. The gestures are stiff and awkward. The faces, with prominent eyes, have the curious ironic smile of archaic art. Like the draped figures erected on the Acropolis in the 6th century, the "kings and queens" of Chartres charm us with a naïve and natural technique, quite free from the austere conventionality of Romanesque carvings. Ranged in their architectural enframement, they possess also a tense and mystic dignity—like apparitions, existing in a world of dreams.

Less than one hundred years separate these archaic beginnings from the superb culmination of Gothic sculpture in the portals of Reims and Amiens. The rapid construction of the great cathedrals was paralleled by the development of a sculpture that was amazingly profuse and vigorous. The Greek miracle was repeated; the French sculptor in two generations reconquered all that Rome and Byzantium had lost. The innumerable figures of saints and prophets that fill the doorways of the cathedrals are studied from nature and not from Byzantine iconography. Endowed with humanity and with life, these figures are nevertheless treated with a breadth and simplicity altogether consonant with the nobility of their architectural enframement. The draperies, modelled in such a way as to reveal the form and action of the body, are at once gracious and solemn; the gestures and attitudes, while wholly unconstrained and expressive, are yet free from any violence or agitation that might disturb the repose of the geometric design; and the faces, although living and individual, have almost invariably that grave passivity that is most suitable to an architectural environment. The solemn company of saints or prophets stand, as they might stand in Heaven, on either side of the figure of Christ, or of His Mother, who is surrounded by a choir of angelic figures, ranged in the orders of the vault. In the tympanum a rich embroidery of reliefs explains in pictorial imagery some story—the Redemption, the Resurrection—full of symbolic meaning. The whole is a transcendent vision, half history, half prophecy, revealing the completeness and order and grandeur of that universe which the mediaeval theologian, himself an artist, had envisaged.

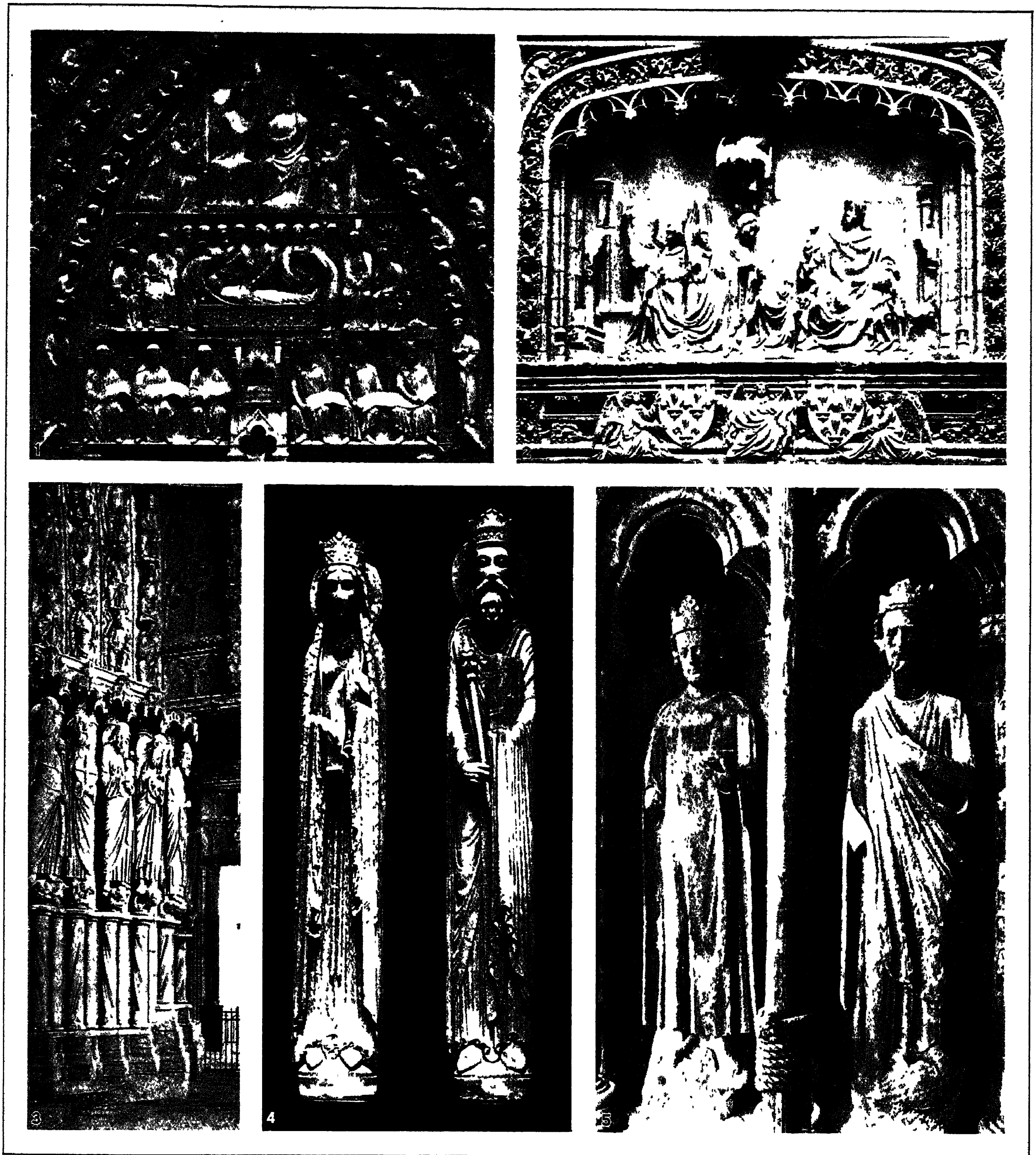
The notable qualities of these great ensembles are the perfect union of sculpture and architecture—of nature and mathematics—and the dependence of each part upon the character of the whole. The beauty of nature enters here only to be subdued to the spiritual harmonies which control the design.

The figures of the martyrs in the south transept portal of Chartres (*c.* 1220) are excellent examples of early 13th century figure sculptures. The bodies, enveloped in compact masses of drapery which prevent the slightest articulation of leg or torso, are cut from cylinders of stone. The feet are planted firmly on corbels sculptured with a symbol of martyrdom; the arms cling closely to the bodies; the erect heads bend only in the slightest degree to the right or left. The draperies are thinly incised and hang in studied parallel folds. What gives these figures beauty and spiritual power is the idealization of their faces and the part which they take in the vast ensemble about them. One feels in the transept portals of Chartres the unmistakable presence of a spiritual authority.

The figures of St. Theodore and St. George (*c.* 1240), also in the south portal of Chartres, illustrate the rapid technical advance that took place in the second quarter of the 13th century. These figures have little of the rigidity of the martyr figures standing beside them. The weight of the body, which bends a little to one side, is thrown upon one foot, and the forms of the legs and shoulders are indicated beneath the draperies which fall in more natural and much deeper folds. The elegance and dignity of these figures is paralleled in those of the right portal of the west façade of Amiens: *La Porte Mère-Dieu,* the first great doorway that is wholly Gothic in character. The natural ease of the postures and the grace of the draperies, especially in the figures of the women, endow these figures with charm without robbing them of their hieratic dignity. The central and left doorways at Notre-Dame, Paris, and the portals of Laon Cathedral, although much restored, are also fine examples of Gothic sculpture of the first half of the XIII. century; but undoubtedly the greatest achievement of this period is the central doorway of Amiens. This majestic portal, which has for its central figure the radiant *Beau Dieu* flanked by the ranged forms of the Disciples, most perfectly achieves the Gothic ideal: a celestial vision that brings within the compass of a single architectural design one of the noblest ensembles of form ever conceived by man.

The great portals of Reims contain many examples of early 13th century sculptures—the *Abraham,* for example, and the *St. John the Baptist* on the right doorway of the western façade; but the greater number of the figures, as well as the sumptuous character of the whole, are more characteristic of the last half of the century. After 1260, the architecture of the doorways holds the statues which people them less firmly in its embrace. The curves of the bodies increase; their contours and planes become less regular and less definite; the draperies, shot with deep shadows, assume a picturesqueness that tends to destroy their plastic unity. The faces are less generalized. A sweet humanity softens the religious austerity of saints and angels. Sometimes, as in the central doorway of the west façade, they turn towards each other to enact some simple drama, and sometimes—as in the *St. Elizabeth*—we discover a modelling that seems obviously imitated from some Hellenic example. Greece is never far distant from these 13th century figures. The Greek spirit, or a spirit akin to the Greek, pervades them even when there is no suggestion of Greek technique. Standing at the threshold of the 14th century, when realism is beginning her successful conquest of architecture, the figures of Reims have that tense and somewhat nervous beauty that seems to foretell the profound change that is taking place in Christian thought.

14th Century.—The perfect balance between mathematics and nature lasted only a moment. By the first quarter of the 14th century, when the cathedral-building impulse was dying, when the making of shrines, of tombs, of ecclesiastic furniture drew the sculptor from his work in the great portals, the architectural quality had already lost its dominance in his modelled forms. The figures in the jambs of the doorways begin to sway, to bend, to make gestures no longer confined within the architectural frame. No longer generalized in type, they become individuals, rendered oftentimes with an actuality of detail and of expression that approaches portraiture. Their draperies, falling in naturalistic folds, are arranged ingeniously for effects of chiaroscuro and of pattern in which the structural line is progressively ignored. The groups in the tympani, the seriated figures in the orders of the arches and along the lintels abandon their simplicity for a luxury of detail and for pictorial truthfulness. Their number is multiplied; accessories, details, settings are elaborated; and the narrative, rather than the symbolic meaning, is insisted upon. The foliated forms of flower and leaf spring from the cathedral stones; birds, animals, landscapes appear; contemporary costume and contemporary personalities are depicted. From the observed universe about him the sculptor creates a new iconography in which types of living people replace the types which tradition had established and in which there are substituted, for the doctrinal scenes of monastic art, scenes such as the Coronation, the Entombment, the



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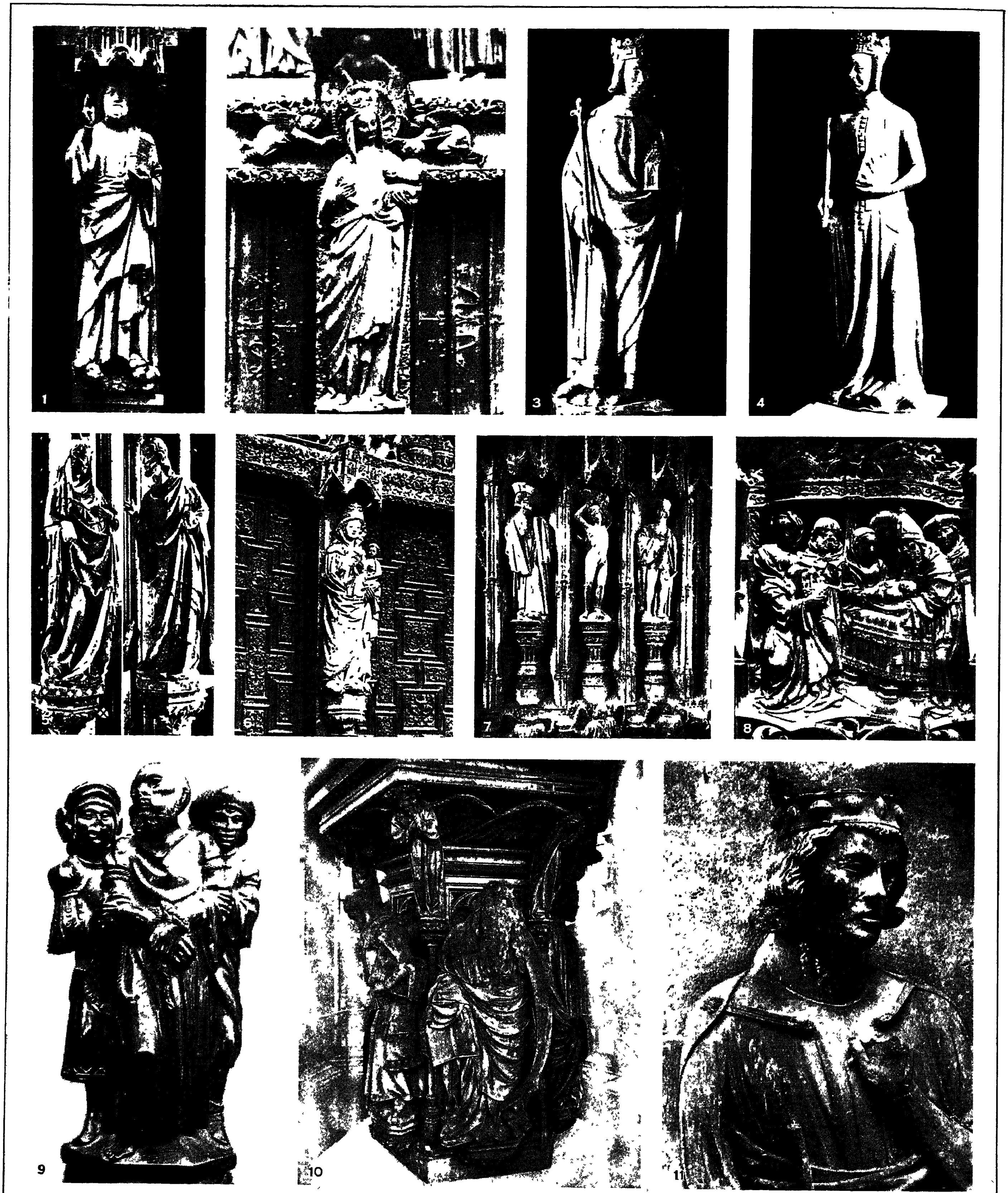
GOTHIC ARCHITECTURAL SCULPTURE

1. Tympanum above the left portal of the façade of Notre Dame, representing the entombment of Christ and coronation of the Virgin, 13th century
2. Bas relief from the Château de la Ferté-Milon, 14th century
3. Right side of the central door, North Porch, Chartres cathedral, France. The figures, admirable examples of 13th century northern France Gothic, represent Isaiah, Jeremiah, Simeon with the Child Jesus in his arms, John the Baptist, and Peter
4. Statue of King Solomon and the Queen of Sheba, formerly at Corbeil, now at St. Denis
5. Statues of Edwy (Eadwig) and Edward the Martyr, kings of England, on the front of Wells Cathedral, part of a group of ten kings and princes in an exterior decoration scheme of statuary comprising 180 figures, many life size, executed in polychromed stone. First half of the 13th century

SCULPTURE



GOTHIC SCULPTURE

1. Statue of Christ (*Beau Dieu*) on central portal of Amiens cathedral, 13th century. 2. *La Vièrge Dorée* on south transept portal of Amiens cathedral. 3. Charles V. of France, 14th century, portrait statue. In the Louvre. 4. Jeanne de Bourbon (d. 1378) at St. Denis. 5. Mary and Christ. German. 6. *Nuestra Señora la Blanca* on the portal of the south transept of Leon cathedral, 14th century. 7. St. Sebastian, in the Chapel of Henry VII. (built 1502–20) in Westminster Abbey. 8. One of 400 carvings on the choir stalls of Amiens cathedral, 1508–19. 9. Wood carving, Amiens cathedral. 10. "Moses' Well," pedestal by Claus Sluter and Claus de Werver, 15th century. 11. St. Louis, Reims cathedral

Scenes of the Passion, which are expressive of human suffering and of human aspirations.

The sculpture of the 13th century was international in character, all Europe having turned to France for inspiration and guidance. The fine sculptures of the cathedrals at Bamberg and of Strasbourg, for example, are the work of men who must have been intimately familiar with the sculptures of Reims and Chartres. The famous tympanum of the Hospital of St. John, in Bruges, is a direct imitation of French work. The figures on the towers of Wells (*c.* 1230) although displaying a tenderness that is unmistakably English in character were at least in part inspired by the Porte Royale of Chartres. At Burgos, the superb transept portals are probably the actual work of French artists, and the beautiful portal of the south transept of Leon Cathedral, although having many details that are Spanish—such as the *Neustra Senora la Blanca*—is essentially a reproduction of the north portal of Chartres.

In the 14th century, when the vitality of France was lessened by the Hundred Years' War, and when the growth of realism had led to a more studied observation of contemporaneous life, local schools became gradually more independent. Of these, the schools of Germany appear to have been the most vigorous. The architectural line disappears at an early period in Germany. Free and even sinuous attitudes, lively and expressive faces, and draperies which are richly and even extravagantly modelled are characteristic of her 14th century sculptures, produced in great abundance and charged oftentimes with a compelling vitality. The pillar-statues in the choir of Cologne Cathedral (1322–1330) are good examples of this art, too strongly individualized for architectural effectiveness but with an intensity of life that is analogous in feeling to the Baroque. The ornate west portal of the Minster of Thann and the corresponding portal of the historic church of St. Lorenz in Nuremberg (both about 1350) show the mastery of the German sculptor in the use of realistic anecdote to produce a sumptuous ornamentation.

Flanders and, towards the end of the century, Burgundy were centres of realistic art scarcely less important than Germany. The naturalism common to all Europe at this time was especially suited to the temper of Flanders. A national art developed rapidly there from the French base and before the end of the century the making of sculptures had become almost an industry in Tournai, in Bruges, and in Courtrai. A colloquial art, deriving its subject-matter from the life of the court, the merchant-class, and the mystery play, Flemish sculptures, soon attained a vast popularity throughout northern Europe. No longer associated with architecture and no longer intent on the expression of spiritual or even intellectual concepts the sculptor rapidly abandoned the simple and monumental harmonies of the 13th century. These qualities no doubt appeared to him as limitations in technique. His own skill was oftentimes amazing, a representational virtuosity which delights us with its sympathetic rendering of contemporary life. The mediaeval world, like ancient Egypt, lives before us in his innumerable carvings in which the scenes of sacred history take place in the familiar settings of a Flemish market-place or church and are enacted by bourgeois figures that embody the physiognomy, the costume, the manners and the postures of their day.

Effigies and the ornamentation of tombs, the vast retablos that fill the spaces behind the altars, the sanctuary enclosures and chapel screens, and the choir stalls, with canopy, arm-rests and misericordia, are the objects most congenial to this pictorial art. These furnished inexhaustible fields for the incomparable skill of the 14th century carver, who filled the cathedrals with sumptuous furniture in which his storied art is mingled with a vast intricacy of ornamental forms—of carved canopy and interlaced tracery, of cusped panel and flowered pinnacle. For this work, stone soon ceased to be the desirable medium. Bronze, for sepulchral images and for fonts, was used extensively in Flanders, especially in the *Ateliers* of Dinant. Terra-cotta was also extensively used, but wood was by far the most popular material. Easily worked into the narrative panels and groups—greatly reduced in scale from the monumental work of the earlier century—and easily transported, wood lent itself also to the elaborate enframements, the gilded and coloured ornament, which had now become the fashion.

In the middle of the 14th century this Flemish art invaded France whose taste already shared the tendency of Flanders towards realism and decorative elaboration. The serene radiance of the 13th century had disappeared, to be replaced by a gracious and ingenious beauty that is less exalted and less self-contained. An elegance of line, especially in the flowing draperies, a gentle sentiment in the expression of the features, and an amusing dexterity in the rendering of accessories distinguish these French figures which by the middle of the 14th century had renounced altogether their architectural stiffness. The devotional statues of the Virgin and Child, made in large numbers at this time, illustrate most clearly this transformed art. These elegant and tender figures, whose bending forms are clothed with graceful simple draperies, are often informed with a sweet and appealing humanity. The many portrait statues of the period, such as those of Charles V. and Jeanne de Bourbon, in the Louvre, share these winning qualities. But in the numerous anecdotal scenes, which embellish the sepulchres, the choir stalls and the retablos we see more obviously the influence of Flanders.

A colony of Flemish sculptors had settled in Paris towards the end of the 13th century. Their numbers and influence increased rapidly. The vast population of little carved figures, of *genre* scenes and narrative panels, the wealth of intricate ornament, the sumptuous colour and gilding that were created with increasing opulence of form in the French cathedrals were due, in part at least, to this Flemish influence which continued into the 15th century.

This Franco-Flemish art found its way into England. The thirty angels in the Angel Choir of Lincoln Cathedral are touched with French coquetry and Flemish pictorialism; and the apostles in the upper tiers of the Exeter façade are clearly of Flemish descent. In wood carving England rivalled every continental school; her choir-stalls, such as those at Chester, Ely and Gloucester are not equalled for technical excellence and realistic animation except perhaps in the stalls of Amiens and Toledo. Realism, and an extraordinary delight in technical virtuosity, were common to all of northern Europe, and although Flanders was the centre of this art, the schools of England, France and Germany maintained always an independent tradition. Spain, which also yielded to the taste for episode and decorative embroidery formed a wide field for Flemish and French craftsmen, who carved the vast screens around the cathedral *coro* with a luxury of reliefs that are at once homely and sumptuous.

15th Century.—In the first part of the 15th century, except in Burgundy, every trace of monumental form disappeared before the universal triumph of Flemish realism. Carved landscape and architecture and even perspective are introduced into the wealth of episodic scenes that fill the retablos, the tombs and the choir stalls and appear in increasing quantity on the panels of secular furniture as well. A pure pictorialism overcomes everywhere what was left of the plastic sense. The groups of figures, accurately reproduced from life, are arranged in pictorial compositions which are pervaded by an emotionalism, a violence of gesture, a distortion of features wholly inconsistent with plastic beauty. The postures and types of everyday life are untouched by idealism or even by sentiment in this commercial art which achieves at its best only an illustrative interest and decorative beauty. Wood is the almost universal material. A finish of high colour and gold gave to its intricate surfaces a sumptuousness that is sometimes oriental in quality.

In Burgundy this excessive realism was tempered by a certain dignity, a breadth of handling and at times distinction of treatment. The pomp and wealth of the court of Dijon, which after the Hundred Years' War eclipsed momentarily that of Paris, demanded an art less bourgeois than that of the commercial towns to the north. Burgundian art, essentially a continuation of the nobler French tradition, yields in many ways to the objectivity of Flanders and still more to the boldness and weight of Germany. In this art realistic attitudes, realistic physiognomies and draperies, are given an emotional power, lacking in most

realistic sculptures, by reason of their solid proportions, the vigorous handling of mass, the scale of and weight of their materials, and by breadth of treatment. A great amplitude of drapery, simple in mass and outline, with broad and deep folds oftentimes gives to the Burgundian figures an almost monumental dignity. The *Pedestal* built in the Carthusian monastery of Champmol, near Dijon, by Claus Sluter and Claus de Werve is a characteristic example of this solid art.

In France, where much good work was produced in spite of the military calamities, the Flemish style continued to be tempered by a Gallic restraint and charm. French draperies are more fluid and graceful, French groupings less agitated, faces more tender and serene. The relief over the door of the chapel at Amboise, for example, although having all the Flemish accessories of landscape and picture, is yet ennobled by a tender sentiment and a certain dignity of posture and of composition. The *Coronation of the Virgin*, at the chateau of Ferté-Milon, is another lovely example of late French sculpture, more simple and more sincerely felt than its contemporaries in Antwerp.

The Loire valley, a region most secure from the ravages of the English war, was the region in which the French spirit was most persistent. Towards the end of the century this spirit reasserts itself in other parts of France. For a moment, in that period known as the Détente, it is exhibited in sculptures that have a breadth and simplicity not realized in sculpture since the beginning of the 14th century. At this time the realistic figures of tombs and ecclesiastical furniture, although still in contemporary costume, assume a tranquillity of pose and treatment that lends great dignity to their sensuous and pictorial beauty. The Détente did not at any time approach the 13th century, for its forms are at no time truly sculptural or truly monumental, but it did create many appealing and poetic figures. Of these the *Vierge d'Olivet* by Michele Colombe (in the Louvre) and the statues from the *Tomb of Francis II. of Brittany* in Nantes Cathedral are superb examples.

Germany was prolific in sculpture during the 15th century. Grace and tenderness are less frequent in her art, in which an exaggeration of movement and of emotion becomes more and more pronounced. The love of pictorialism, of agitated complex draperies, and of dramatic attitudes that distinguishes the late Gothic of Germany have often led to a comparison with the Baroque to which it is certainly akin. An intensity of spiritual experience oftentimes underlies the nervous and formless panels, filled with tumultuous draperies and agonized faces.

Germany developed a great variety of local schools. Of these, the School of Nuremberg is the more dramatic and robust in style, that of Würzburg more lyric, and that of Swabia more infused with thought. In Bavaria, where stone was used as often as wood, a greater restraint tempers the realism of the time.

German sculptors found their way into Spain in the 15th century and worked there side by side with their Flemish colleagues. The huge wooden retablos of the Spanish cathedrals, covered with sculptural relief and rich polychrome carvings, offered splendid fields for their art, which was not, of course, unmodified by the Spanish taste for sumptuous ornament or the Moorish tradition of intricate patterning and perfect finish. The great retable at Toledo Cathedral is an example, as are also the choir-stalls of León; these are perhaps the most splendid ensembles of carved ornament in Europe.

Under this magnificent embroidery architecture was forgotten. Sculpture no longer existed as a monumental art. Gothic sculpture had completed the cycle that Hellenic sculpture had followed; her sculptors end, like those of Greece, as story-tellers and ornamentalists.

RENAISSANCE SCULPTURE

In Italy in the 15th century the growth of the scientific spirit, expressing itself in research and experiment, led to a renewed interest in classic sculpture. This sculpture, which was that of Latium rather than of Greece, revealed itself at first as little more than a new and more perfect realism than had been achieved by the Gothic carver. It offered besides a system of chiselled ornaments which comprised new and exquisite motives for the embellishment of architecture. Especially in the modelling of the nude figure and in the design and rendering of draperies the ancient statues embody a technique which seemed to the Italian sculptor the perfection of representational art. The Pisan sculptors, Nicolo d'Apulia and Giovanni Pisano, were among the first to restore to the figures of Christ and His Mother, and to scenes from the Bible, the proportions, attitudes, and accessories of the figures on Roman sarcophagi, and their example was widely imitated throughout Italy.

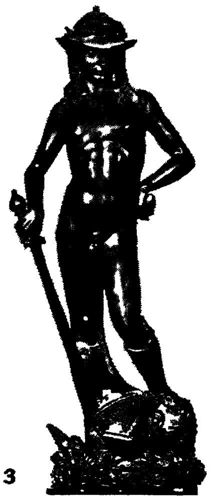
As men turned with growing enthusiasm to the study of the ancient civilizations a broader appreciation of antique sculpture followed. Beyond its exquisite imitation of nature, artists perceived the idealization, or interpretation, of nature. The Italian sculptor awoke to the breadth and dignity, the monumental beauty, which his own decorative and narrative art had lost. Antique art, which had revealed to him the beauty of the human body, revealed also the beauty of structural law, of the geometry of mass and shadow, and taught him to seize those subtle relationships in the world of form which architecture abstractly expresses.

The concise monumental style of Giotto—a painter with a sculptor's mind—first exhibited this broader aspect of classic art. Lorenzo Ghiberti (1378–1455) expresses in his nudes, in his gracious draperies, in the restraint and dignity of his pictorial reliefs, some understanding of the new ideal. Donatello (1385–1466) illustrates to us all the stages by which the antique revealed itself. The uncompromising realism of his first work, his delight in *genre* types, in the rendering of muscles, harsh features, and textures, is gradually penetrated by the ennobling influence of the antique. Roman motives such as dancing children and the nude, enter his art together with that ideal and generalized beauty and the monumental harmonies that Rome teaches him. Human beauty and human dignity become the themes of this art. Thought, rather than sentiment, is the quality that shines through it. His bronze *David*, in the Bargello, Florence; his *Judith*, also in Florence; and his *Gattamalata*, in Verona, are superb examples of that balance which he achieved between actual and abstract harmonies.

Antonio Pollaiuolo (1432–1498) and Andrea del Verrochio (1435–1488) were realists whose energetic work shows much less the influence of the classics. The *Herakles and Antaeus*, in the Bargello, Florence, by Pollaiuolo, shows this artist's interest in movement and in anatomy, and the fine *Colleoni Monument*, in Venice, by Verrochio is a superb embodiment of energy and power. Luca della Robbia (1399–1482) and Andrea della Robbia (1435–1525) were decorators whose lovely ornament and devotional sentiment are often touched with antique serenity. Mina da Fiesole (1431–1484) and Desiderio da Settignano (1428–1464) were also decorators to whose gracious styles the classic motives were most congenial.

All of these were Florentines, but the new movement in sculpture was not confined to Florence. The Venetian sculptor Antonio Rizzo (died 1499), although essentially mediaeval, exemplifies in his nudes and his draperies a growing understanding of the classic spirit. In Venice also the Lombardi (Pietro and his sons Antonio and Tullio) developed an exquisite style of Renaissance ornament, which was, in technique at least, equalled by the work of Giovanni Antonio Amadeo (1447–1522) and his assistants at the Certosa of Pavia. The greatest sculptor, outside of Florence, was Jacopo della Quercia (1373–1438), a master of the nude, whose fine reliefs, set about the portals of San Petronio, in Bologna, anticipate in their energy the later figures of Michelangelo.

Michelangelo was without doubt the greatest sculptor of the Renaissance. His work, which was traditional and yet individual, derives its form and its technique from the classic and yet is full of an intensity of feeling that belong only to himself and to his own day. His heroic nudes express profoundly the pathos and futility of man's life; yet, while they speak a philosophic language, they embody also a physical beauty that is even more eloquent. The *Captive*, in the Louvre, most perfectly realizes these qualities, but they are present also in the marvellous figures



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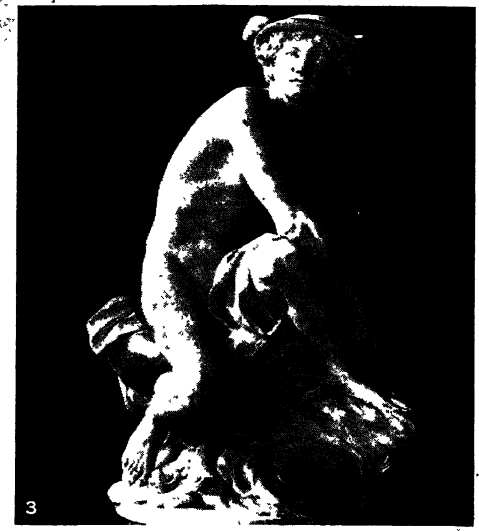
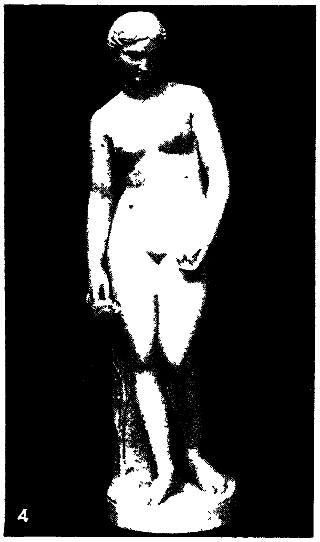
SCULPTURE IN ITALY AND FRANCE FROM THE 13TH TO THE 14TH CENTURY

1. "Madonna and Child," the earliest known work of Giovanni Pisano (1250–1320), a forerunner of the Gothic in Italy. In the Campo Santo, Pisa
2. "Creation of Eve" by Jacopo della Quercia (1371–1438), Italian; on the door of the Baptistry, Bologna
3. "David" by Donatello, Italian sculptor (1386–1466); the first nude statue of the Renaissance, executed in bronze about 1430 during the artist's classic period
4. "Herakles and Antaeus," a bronze statuette by Antonia Pollaiuolo (1432–98), Italian realist. In the Bargello, Florence
5. "Seated Moses" by Michelangelo (1475–1564); designed between 1513 and 1516 for the mausoleum of Pope Julius; now in the church of S. Pietro in Vincoli, Rome
6. "David" modeled in bronze in 1476 by Andrea del Verrocchio (1435–88), Italian realist
7. "Meeting of Saints Francis and Dominic," an enamelled terra cotta lunette by Andrea della Robbia, nephew and pupil of Luca della Robbia, the first artist in Italy to apply the art of glazing terra cotta to monumental sculpture. Executed between 1490 and 1495 in the loggia of the Hospital of S. Paolo, Florence
8. "Apollo," one of four statues by Jacobo Sansovino (1486–1570) surmounting the arches of the Loggetta dei Cavalieri, Venice
9. "Diana and the Stag," a fountain designed by Jean Goujon (*c.* 1520–*c.* 1566) for the château d'Anet. Now in the Louvre

SCULPTURE



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RENAISSANCE AND MODERN SCULPTURE IN EUROPE AND AMERICA

1. "Rape of the Sabines" by Giambologna (1529–1608), Italian. In the Loggia dei Lanzi, Florence. 2. "Milo" by Pierre Puget (1622–94), French. In the Louvre. 3. "Mercury" (putting on his sandals) by Jean Baptiste Pigalle (1714–85), French. In the Louvre. 4. "Clytie" by William Henry Rinehart (1825–74), American. 5. "Night with her children Sleep and Death," a bas-relief in marble by Bertel Thorwaldsen (1770–1844), Danish. 6. "California" by Hiram Powers (1805–73), American. 7. "Perseus with the head of Medusa" by Antonio Canova (1757–1822), Italian. In the Vatican. 8. "Nymph and Satyr" by Clodion (1736–1814), French. 9. "Jeanne d'Arc" by François Rude (1784–1855), French. In the Louvre

of the *Medici Tombs,* Florence, and in the *Seated Moses,* which was to have been a part of a colossal mausoleum for Julius II. His *David,* Florence, is sensationally realistic and his *Pietà,* in St. Peter's, Rome, anticipates in its superb pictorialism, its amazing and dramatic technique, and its tender sentiment the greatest characteristics of the baroque sculpture of the following century.

Among the later renaissance sculptors Jacobo Sansovino (1486–1570) is notable for the technical excellence and classic grace of his figure sculpture in the Loggetta of Venice; Benvenuto Cellini (1500–1571) for his excellent decorative work and especially for the *Perseus,* in the Loggia dei Lanzi, Florence; and Giovanni Bologna (1524–1608) for his colossal fountains and the amazing dexterity which he often shows in the presentment of the human figure.

Outside of Italy, the Renaissance was most at home in France. Not only the subject-matter of classic sculpture, but also that Hellenic feeling for grace which informs also the best work of the Italian school, became thoroughly a part of the French tradition. In France the Renaissance is not, as in England, an alien mode. Jean Goujon (1510?–1566?) was a master of draperies and of the decorative rendering of the feminine form, not surpassed in the world. In his *decorations* for Pierre Lescot, Louvre, Paris, he has combined the most exquisite sensuous loveliness with classic restraint and dignity. Germain Pilon (1535–1590) though more realistic than Goujon attains at times a greater monumentality.

In Germany, where the religious wars prevented the extensive growth of sculpture, the new spirit met with more resistance. Renaissance ideas are fused with the Gothic in the decorative work of Peter Vischer of Nuremberg (1460–1529) and of his son Peter Vischer the Younger (1487–1528). England employed a few Italian artists; the Tomb of Henry VII. in the Chapel of Henry VII., Westminster Abbey, by Pietro Torrigiano (1472–1528), is one of numerous examples which were to prove a mine of ornamental motives to later decorators. Spain developed a more vigorous Renaissance tradition, sending her artists to Italy to study under the greatest masters. Of these Bartolomé Ordónez and Alonso Berruguete, both pupils of Michelangelo, are the most celebrated.

THE BAROQUE

A return to naturalism and to a dramatic pictorialism are the characteristics of the Baroque art that, after the 16th century, supplanted the classicism of the High Renaissance. The proportions which the classic canon had established for the human body retain their authority in the Baroque, but the calm and generalized features, the rigid, statue-like poses, give way to a physiognomy that is individualized and emotionally expressive, to attitudes that embody dramatic and often passionate movement. The draperies that clothe these classic forms no longer hang in graceful quiet lines, but, with deep and voluptuous folds, with broken profiles and abrupt shadows, they share, in a tumultuous movement, the agitation of the bodies they cover. These human forms are arranged in pictorial groups which enact some drama of ecstasy or cruel suffering among the modelled forms of trees and rocks, of architecture and curtained canopy, of floating billowy clouds and golden rays of sculptured light. Movement, not repose, and emotion, fervid and unrestrained, like that of the *Laocoön,* are the ideals of this somewhat theatrical art in which light and shade and colour, rather than form and proportion, are the principal actors.

Michelangelo was the first Renaissance sculptor to inform the classic types with superhuman energy and emotional intensity, and in the later work of Giovanni Bologna—such as the *Rape of the Sabine Woman* in the Loggia dei Lanzi, Florence—we find that delight in the contortion of form, and that astonishing virtuosity of modelling, which are to be among the striking characteristics of Baroque sculpture. But the great figure of the Baroque was Giovanni Lorenzo Bernini (1598–1680). A technician unexcelled in the history of sculpture, with an imaginative power second only to that of Donatello and Michelangelo, he, almost single-handed, created that grandiose and dramatic form which sculpture was to retain almost to the time of Napoleon. He is at his best in his great altars and magnificent tombs, but not less characteristic are his portrait busts—such as the *Louis XIV.,* at Versailles—in which an accurate and sympathetic characterization of features is combined with a theatrical opulence of costume and periwig. His youthful *Apollo and Daphne,* in the Villa Borghese, Rome, shows his power as an illustrator; the *David,* also in the Villa Borghese, is an example of his ability to infuse his figures with an intense and concentrated energy; and his *Ecstasy of St. Theresa,* in S. Maria della Vittoria, Rome, is among the most poignant picturizations of that "passionate mysticism" which characterized the Catholicism of his day.

Algardi, Cavallini, Borromini and Andrea Pozzo are among the successful Baroque sculptors who followed Bernini in Italy, finding in the facility of stucco a congenial medium for the exploitation of his style. But the political and economic weakness of Italy in the 18th century greatly limited the opportunities of her artists, and it is chiefly in the courts of Versailles and of Vienna that Baroque art, so consonant to the imperial spirit and to that of the Catholic reaction, received its greatest patronage. The Italian excesses in pictorialism and in emotional expression were tempered in France by the persistence of the classic tradition, while in Germany, where the late Gothic opulence of natural form had never felt the frigid touch of classicism, and in Vienna, where the Turkish invader had brought the fantasy of the Orient to the gates of Vienna, the baroque assumed a gaiety and exuberance beyond that of its native Italy. In Spain, a profound and active piety endowed many baroque sculptures with an intensity of devotional feeling which, although realistically rendered, recalls the ecstatic paintings of El Greco.

Guillaume Coustou I. (1677–1746) is a characteristic exponent of the Baroque in France. His *Louis XIV. Crossing the Rhine,* at Versailles (begun by his brother Nicholas Coustou) bestows on the Italian love of picture and allegory a graciousness that is wholly French. Pierre Puget (1620–1694), a pupil of Bernini, renders the effort of muscles and the whirl of draperies with a technical skill nearly equal to his master; his *Milo of Croton* in the Louvre is characteristic. Jean Baptiste Pigalle (1714–1785), in his *Mercury* in the Kaiser Friedrich Museum, Berlin, and in other works, illustrates that politeness of theme and that grace of treatment with which France endows the Baroque. Claude Michel, called Clodion (1738–1814), carries these tendencies to an extreme, combining them with a natural and sensual technique of rendering; his *Nymph and Satyr* in the Metropolitan Museum, New York, displays to great advantage the animation and charm of his best work. Jean Antoine Houdon (1741–1828) presages in his *Diana,* in the Hermitage at Leningrad, the return to the classic which is to mark the end of the 18th century. His portraits—of which the *Washington,* in the Capitol at Richmond and the *Voltaire* in the Comédie Français, Paris, are good examples—are unexcelled in their noble and sympathetic realism.

Andreas Schlüter (1664–1714), in his numerous tombs and in the *Expiring Warriors* of the Arsenal of Berlin, displays the vigorous and realistic Baroque of Germany, and Johann Bernhard Fischer von Erlach (1656–1723), in his *Trinity Column* in the Grabenstrasse, Vienna, illustrates its exuberance and joyousness. George Raphael Donner (1693–1741), the greatest Germanic sculptor of the 18th century, anticipates in his *Fountain of the New Market,* Vienna, the reaction towards classicism that brings the century to a close.

In England, the *Tomb of the Elder Pitt,* Westminster Abbey, by John Bacon (1740–1799); in Holland the opulent *Pulpit* in Brussels Cathedral, by Hendrik Verbruggen (1655–1724); and in Spain the *Virgin of the Immaculate Conception* by Juan Martinez Montañes (1570–1649) are characteristic examples of the national Baroque schools.

THE 19TH CENTURY

About the end of the 18th century an antiquarian enthusiasm, common to all European countries, created a reaction towards the classic in architecture, painting and sculpture. A widespread interest in aesthetic theory—a phase of that social and intellectual

ferment that preceded the Revolution—prompted the wide acceptance of an aesthetic system in which the ancient masterpieces, revealed anew by the discoveries and writings of archaeologists, are held up as the perfect models for modern imitation. When, at the beginning of the 19th century, the triumph of Napoleon, putting an end to the monarchial order which had sustained the Baroque tradition, gave the arts a patronage whose taste had been formed, not in court or in church, but in the pages of theorists and the galleries of museums, literary and academic influences became dominant in art. The static and generalized Greek statues, as revealed in a world of Latin copies, once more appear in the arts of painting and sculpture: life and movement, picture and emotion, portraiture and costume disappear before the Roman conqueror whose austere taste tolerates neither sentiment or story, neither religion or nature.

The new art, to which the name Neo-Classicism is given, differs from that of the Renaissance in its more complete and intransigent imitation of classic statues. The Renaissance artists, excepting a few of the minor masters of the 16th century, never created statues which directly reproduce in subject, pose, proportion, and surface treatment the models of antiquity. To them the antique was an inexhaustible source of inspiration, a mine of technical precedents, not a mould into which their own free and individual life was to be compressed. The antique was a language in whose musical cadences they expressed their own thoughts. To the Neo-Classic artist the antique was a system, a discipline, an inflexible and impersonal canon imposed upon him by authority.

Antonio Canova (1757–1822), an Italian, was the great master of the Neo-Classic. His *Perseus*, in the Vatican, reproduces directly the Apollo Belvedere; his *Venus Italica*, in the Pitti Gallery, Florence, is the Venus di Medicis of the Uffizi. In his portraits—such as the *Pauline Buonaparte* of the Villa Borghese, Rome—he gives to his contemporaries the simplified forms, the tranquil poses, the generalized features of Roman statues, and stripping them of their clothing, he gives to their bodies the sensuous charm of Praxitelian muscles. But he does not always escape the Baroque influence as his famous *Cupid and Psyche*, in the Louvre, shows; and there are many of his works, such as the *Hebe*, in the National Gallery of Berlin, in which nature and an almost Gallic feeling for elegance and warmth put to rout his academic principles. He was a greater man than his theories; to his fine taste and generous character, no less than to the temper of his time, he owed his immense popularity.

Bertel Thorwaldsen (1770–1844), a Dane who lived in Rome, whose coldly archaeological work had a tremendous vogue throughout the 19th century; Johann Heinrich Danneker (1758–1841), born in Stuttgart, who sometimes softened his correct style with touches of Baroque tenderness; and Johann Gottfried Schadow (1764–1850), who returns more than once to nature for inspiration, are the important figures among the Neo-Classicists. The *Adonis*, by Thorwaldsen, in the Glyptothek in Munich; the *Ariadne*, by Danneker, in Frankfort; and the *Princesses Louise and Friederike*, by Schadow, in the Royal Palace of Berlin, are examples of their work. The Neo-Classic is represented in England by such sculptures as the *Earl of Mansfield Monument*, by John Flaxman, in Westminster Abbey, and in America by the *California* of Hiram Powers (1805–1873) in the Metropolitan Museum, and by the *Clytie* of William H. Rinehart (1825–1874) in the Peabody Institute, Baltimore.

The history of sculpture after the first quarter of the 19th century is a record of the effort of sculptors to escape the arid tyranny of Neo-Classicism. The romantic spirit, which took possession of literature, painting, and architecture, did not prevail in sculpture until, near the end of the century, Rodin led a final and successful assault against the academic entrenchments. The definite inherited subject-matter of sculpture proved less tractable to the excessive individualism, itself a facet of romanticism, which invaded the other arts. In the meantime, sculptors tried, not without success, to widen the range of classic sculpture by endowing it with movement, subjectivity, decorative charm, costume, and, at times, with truth. The era is one of experiment and research; we are no doubt too near to it to appraise it judiciously or to interpret adequately its deeper significance.

François Rude (1784–1855), in his thrilling *Marseillaise*, on the Arc de Triomphe, Paris, illustrates the way in which romance sometimes took possession of the classic figures, compelling them to attitudes of passionate movement. His *Neapolitan Fisher Boy* in the Louvre, a *genre* subject, and his *Marshal Ney*, who waves his drawn sword above the flowers of the Place de l'Observatoire, Paris, are other examples in which classic beauty, clothed in modern costume, assumes a modern posture. David d'Angers (1788–1856), whose skill and mastery of classic form is well exemplified by the fine *Philopoemen*, in the Louvre, brought "local color" into classic art in his costumed figures of his contemporaries. Antoine Louis Barye (1796–1875), the most original and virile sculptor of his time, escaped altogether the classic forms by devoting himself to animal sculpture, giving to the forms of tigers, elephants and bears an intensity of life and a conciseness and breadth that recalls Egyptian examples. Jean Baptiste Carpeaux (1827–1875) attempted to develop the Neo-Classic in the direction of the Baroque; he re-established in his *Dance*, on the façade of the Opera House, Paris, a sensitive, gracious and rhythmic pictorialism that resembles the work of Clodion.

In Germany, Daniel Christian Rauch (1777–1857), a pupil of Schadow, carried on, with touches of naturalism, the Neo-Classic tradition; his *Joseph Maximilien*, in Vienna, is a characteristic work. Reinhold Begas (1831–1911), a master of the feminine nude, found, like Carpeaux, inspiration in the Baroque; and the Baroque, in its lighter and joyous mood, was also exquisitely interpreted by Viktor Tilgner (1844–1896), whose *Monument to Mozart*, Vienna, has caught delightfully the spirit of the master that it commemorates. Adolf Hildebrandt (1847–), who is one of the great masters of our time, returns to the classic nude, freeing it both from movement and from subjectivity. In his *Masculine Nude*, in the National Gallery of Berlin, he has recaptured admirably the simplicity and repose of the Greeks without enslaving himself to their conventions.

In Italy Neo-Classicism had but a feeble life after Canova, giving way after a brief period to that literal and sugary style from which Italy has been only recently redeemed by the impressionism of Medardo Rosso and his school. In England, Alfred Stevens (1817–1875) escaped almost altogether the Neo-Classic influence; his *Caryatides* are the work of a virile and original artist whose genius, unhappily, found but few opportunities for its expression. Hamo Thornycroft (1850–) ennobles his classic nudes with lovely and natural sentiment.

In the United States, John Quincy Adams Ward (1830–1910) was the first important sculptor to temper the classic tradition with some effort towards national feeling. His style is dry and sometimes uninspired, but always robust and unaffected. Augustus Saint-Gaudens (1848–1907) attained in his best work a charming equilibrium between poetic grace and an austere idealism. His *Monument to the Wife of Henry Adams*, in Washington and his *Lincoln*, in Lincoln Park, Chicago, nobly continue the classic tradition of France. Daniel Chester French (1850–) is a superb technician who endows American themes with nobility and power. His *Death Staying the Hand of the Sculptor*, in Forest Hills Cemetery, Boston, is one of the loveliest pictorial reliefs of our time.

CONTEMPORARY SCULPTURE

Auguste Rodin (1840–1917) was the first sculptor to challenge successfully the classic authority. Taking nature, not tradition, for his guide he created a purely naturalistic sculpture, almost wholly free from architectonic form. Not structure, nor abstract harmonies of mass, are emphasized in his work, but rather the natural loveliness of flesh, in the rendering of which he recalls Praxiteles and the Hellenistic masters. This realism he used as a medium for narrative and for the expression of sentiment. His sculptures are a series of pictures in which characterization and action, ideas and romance, not form, are the things insisted upon. To attain these, he eventually sacrificed even his realism, developing an impressionistic style which permits a distortion of nature





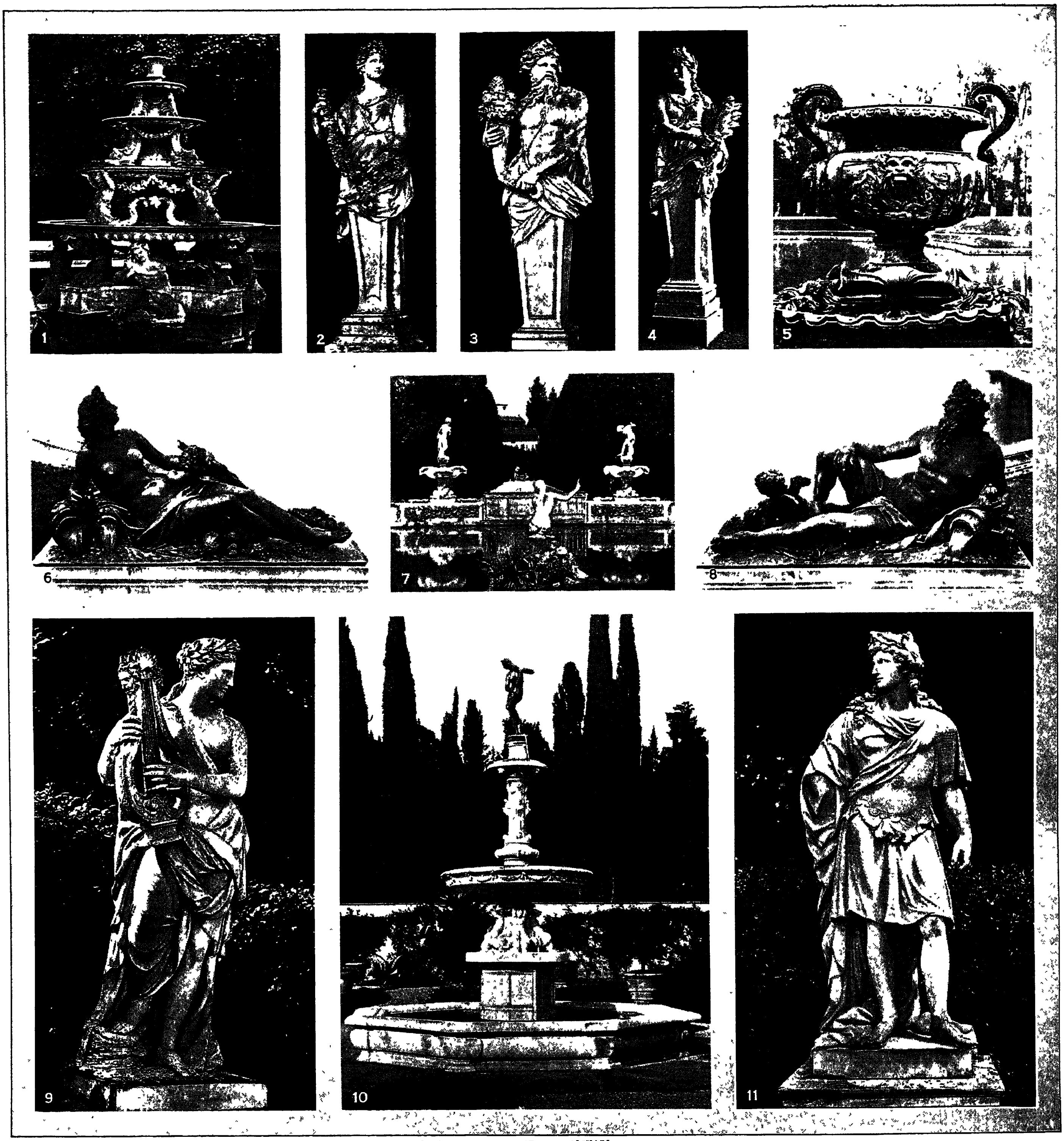




BY COURTESY OF (4, 6) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (5) THE PHILLIPS MEMORIAL GALLERY, (8) LIBRAIRIE DE FRANCE; PHOTOGRAPHS, (1, 2) GIRAUDON, (7) CARL KLEIN, (9) EWING GALLOWAY

SCULPTURE OF THE 19TH AND 20TH CENTURIES

1. "Ugolino and his Sons" by Jean Baptiste Carpeaux (1827–75). Formerly in the Jardin des Tuileries, now in the Louvre
2. "The Kiss," a marble group by Auguste Rodin (1840–1917) representing Paolo Malatesta and Francesca da Rimini. First exhibited 1898
3. "The Hewer" by George Grey Barnard (1863–)
4. "Lion and Snake" by Antoine Louis Barye (1796–1875). Now in the Metropolitan Museum of Art
5. "Madonna of Alsace" by Emile Antoine Bourdelle (1861–)
6. "The Millmore Memorial," also known as "Death and the Sculptor," by Daniel Chester French (1850–)
7. Portrait of Mme. Warroquier by Charles Despiau (1874–)
8. "Baigneuse Acoudée" by Aristide Maillol (1861–)
9. Puritan Statue by Augustus St. Gaudens (1840–1907) representing Deacon Samuel Chapin, one of the founders of Springfield, Massachusetts



PHOTOGRAPHS, (1-6, 8, 9, 11) COLLECTION ARCHIVES PHOTOGRAPHIQUES; PHOTOGRAPHS, (7, 10) ALINARI

RENAISSANCE GARDEN SCULPTURE AT VERSAILLES AND FLORENCE

1. Fountain of the Pyramids executed in lead by François Girardon (1630–1715) from drawings by Claude Perrault (1613–88). In the Parterre du Nord, Gardens of Versailles
2. Springtime by Simon Mazière (1649– ?). In the Gardens of Versailles
3. The river Achelous by Simon Mazière. In the Gardens of Versailles
4. Ceres by J. B. Poultier (1653–1719), one of a row of marble statues near the entrance to the Lawn in the Gardens of Versailles
5. One of the 22 leaden vases forming part of the Fountain of Neptune, a great semi-circular fountain in the Gardens at Versailles, begun by André Le Notre (1613–1700), and Jules Hardouin Mansart (1645–1708), architects of the park, and completed in 1740
6. The River Dordogne by Charles Antoine Coysevox (1640–1720), cast in bronze by the Keller brothers (1635–1700 and 1638–1702), one of eight statues representing the principal rivers of France. In the Gardens of Versailles
7. Fountain by Alfredo Paragi in the Boboli Garden, Florence, a park laid out by Tribolo in 1550 for Cosimo I.
8. The Garonne river by Charles Antoine Coysevox, cast in bronze by the Keller brothers. In the Gardens of Versailles
9. The Lyric Poem, marble statue by Jean Baptiste Tubi (1635 or 1630–1700) (with C. A. Coysevox). In the Gardens of Versailles
10. Fountain of Venus by Giovanni Bologna (1524–1608) in the Royal villa of Petraja, Florence
11. The Heroic Poem, marble statue by Jean Drouilly (1641–98). In the Parterre du Nord of the Gardens of Versailles

and an elimination for the sake of emphasis far in excess of that permitted by the classic canon.

The Kiss, in the Musée Rodin, Paris, is a characteristic work, illustrating not only the natural proportions and treatment of the body which Rodin substituted for the classic canon, but also the sensuality and formlessness, the romantic and subjective quality, of Rodin's art. The *Victor Hugo* in the garden of the Palais Royal, the *Thinker,* in the front of the Pantheon, Paris, are also among his best works.

The influence of Rodin was paramount in the art of sculpture until after the period of the World War and remains perhaps the most important element in contemporary work. Everywhere it has sanctioned a popular realism, encouraged a subjective and individualistic development, and tended to destroy not only the authority of tradition but to prevent the growth of any new continuity in sculptural development.

Max Klinger (1857–1890) is an example of the extreme individualist in sculpture. A literary and even mystic interpretation is required by his pictorial and formless works, among which the *Beethoven* of the Leipzig Museum is perhaps the best known. Constantin Meunier (1831–1905), a Belgian sculptor, is more directly influenced by the pictorial romanticism of Millet; his realism, his admirable technique, his impressionism, are informed with democratic sentiment. Medardo Rosso (b. 1866) an Italian, and Paul Troubetskoi, a Russian (b. 1866), are among other important members of the pictorial and emotional school of Rodin. George Grey Barnard (b. 1863) belongs also to this school. An artist of great originality and force, he is like Rodin in his realism, in his love of symbolic and moral values in form, and in his impressionistic technique. He is, like Rodin, not untouched by Baroque tendencies. His *Great God Pan,* on the campus of Columbia University and his *Hewer* in the Brooklyn Art Institute, are among the fine achievements of American sculpture. Other American artists who deserve a more extended notice than is here possible are: Paul Bartlett (b. 1865), Gutzon Borglum (b. 1867), Charles Grafly (b. 1862), Paul Manship (b. 1885), James E. Fraser (b. 1876), Edward McCartan (b. 1878), Mahonri Young (b. 1877), Leo Lentelli (b. 1879), and Malvina Hoffman.

Before the death of Rodin a reaction against his art had commenced. The realistic and interpretive art of the great romanticist had ignored those architectonic qualities that had ennobled sculpture in its greatest periods. To recapture these qualities without again subjecting sculpture to the deadening influence of formulae —to free sculpture from symbol and picture and restore it as a form-giving art—has become, in our time, the aim of an increasing number of artists.

Among these, Aristide Maillol (b. 1861), Antoine Bourdelle (b. 1861), Joseph Bernard (b. 1870), and Charles Despiau (b. 1874), are most prominent. All were pupils of Rodin, and retain in their work much of Rodin's worship of nature and vigour of technique; but, unlike Rodin, they do not use natural forms as a medium for emotion or thought. Nature, rather, is the basis from which they build up a design of plastic and harmonious forms. Bourdelle has the greatest range of imagination and achieves in his best work a superb vitality combined with an impressive solidity and breadth of treatment: his *Herakles,* in the Luxembourg, is as charged with arrested energy as the bow he bends and yet is designed with the most studied care for balance of masses and for plastic rhythm. Maillol, who has had the greatest influence of any sculptor since Rodin, arranges figures of great natural loveliness into compositions that attain the serenity of Hellenic art: in his *Monument to Cézanne,* for example, which contrasts strangely with Bourdelle's *Herakles,* being wholly without strain or effort, nature and design reach an almost perfect equilibrium. Despiau excels in portraiture, producing busts that have an arranged and exquisite naturalism. Bernard, whose work embodies most directly the essential characteristics of modern art, is at his best in such decorative works as the *Femme et Enfant Dansant,* in the Luxembourg, in which forms derived from life are simplified and woven into a rhythmic pattern.

Frank Dobson, Gaudier-Brzeska, and Eric Gill are the most notable exponents of modern sculpture in England. Dobson's work, like Maillol's, is usually severely architectural and most satisfying in the formal values it achieves. Gaudier, who was killed in the World War, was a sensitive and original artist of the highest endowments. Gill is less brilliant, but a splendid technician. In Germany, George Kolbe's work exhibits a most interesting and promising synthesis of movement and formal harmonies; and in Spain, Mateo Hernandez (b. 1897) creates from the carefully-observed forms of animals, translated into diorite, living designs that attain a simple and elegant formalism. The Balkan sculptor, Ivan Mestrovic (b. 1883) is perhaps the most virile and original sculptor outside of France and is one of the few contemporary artists wholly free from French influence; his sculptures, full of racial rather than personal significance, have a feeling for materials and for architecture like that revealed in archaic Greek sculpture.

In recent years the reaction from Rodin's representational art has gone so far as to create a sculpture in which descriptive modelling is almost entirely eliminated. In order to attain an intense aesthetic expressiveness, the simplification of mass and the elimination of detail are carried so far that sculpture tends to become almost wholly an art of abstractions. Conceived forms and arrangements, which have always been the chief pre-occupation of sculptors, are held to be independent of observed forms and arrangements. That emotional energy that is inherent in sculptured masses is, it is thought, obscured and often defeated by symbolic or descriptive attributes or by an emphasis upon reproduced organic forms. Alexander Archipenko, Constantin Brancusi, Ernst Barlach, Moïse Kegan, Ossip Zadkine, Wilhelm Lehnbruck, Henri Laurens, Modigliani, Joseph Czaki, and John Mowbray-Clarke are among the many sculptors whose experiments in this new field have resulted in works of great interest and charm. Jacob Epstein (b. 1880), one of the most talented and vigorous sculptors of our day, has, apparently, abandoned his experiments in abstract design for a romantic and realistic art more akin to that of Rodin.

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(For cross-references to other related subjects, *see* introduction to this article.) (J. Hud.)

GARDEN SCULPTURE

Strictly speaking garden sculpture is not in a class by itself. Very often we may find in a garden a figure taken from the ruins of some old Gothic cathedral which makes a perfect piece of garden sculpture, or again we may see a fragment of a Greek statue or even an old Chinese idol which when given just the right setting seems to be a necessary part of the garden in which they are placed. Not all sculpture, however, is suitable for a garden decoration even though it be very fine sculpture from the point of view of composition or modelling or the expression of an idea or an emotion. Therefore, it would be well to consider here the things which make a piece of sculpture take its proper place in a garden or park.

One of the first requisites of a successful garden decoration is that it be something that will make a pleasing spot and be part

of the ensemble. It may be an old well-head or a great stone or terra-cotta vase which will serve the purpose best; it may be a great jet of water shooting straight up from a pool or simple basin; it may be a statue in stone, lead or bronze. Regardless of what it is, in order to take its proper place in a garden it must have just the right scale and colour.

This question of colour is a very important one. Quite often a fine statue in bronze placed against a background of thick dark foliage is completely lost and counts for nothing as a decoration, whereas a statue in stone on just the right scale, though it may be crudely executed, will be much more successful as a decoration because it counts as a spot of colour where the dark bronze was lost as a silhouette against the trees or shrubbery. Where bronze is used it should be shown silhouetted against the sky or against a garden wall or terrace where the dark bronze will be in contrast to the lighter background, for even though the bronze be light in colour when first placed out of doors it will soon lose its original patina, and gradually grow darker in colour. It is practically impossible to give to bronze an artificial patina which will not change colour when exposed to the elements. (*See* BRONZE: *Corrosion and Restoration.*) Marble or stone, on the other hand, when placed out of doors will most often take on a beautiful mellow tone which is in perfect harmony with the landscape and at the same time make a perfect silhouette against the green. (*See* STONE CARVING.)

When placed in the open, lead will also take on a very pleasing colour, a soft warm grey which always makes an agreeable spot. Lead is especially suited to fountain figures, and very often when seen in the moonlight it takes on a beautiful silvery tint, an effect which can be obtained by the use of no other material.

There are, of course, various forms of landscape gardening, each requiring a different treatment with regard to its sculptural decoration, but they divide themselves into two general classifications. First, there is the large formal garden or park with its long straight paths, its carefully planned vistas and beautifully kept lawns; then, there is the small informal garden with its nicely arranged flower-beds and its small intimate nooks. One thinks of the park in Versailles or of some of the beautiful old gardens of Italy which were designed as settings for the villas of aristocracy in the time of the Renaissance as fine examples of the large formal garden. At Versailles there is a profusion of sculpture all taking its proper place in the surrounding landscape and though the work was done by several different men there is no lack of harmony in design or execution and each figure is simply a part of a beautifully planned ensemble. Where they placed rows of statues against a heavy mass of foliage bordering some broad grassy avenue they always used stone; when they placed statues out in the open where they were silhouetted against the sky or against the water of some great pool they used bronze or lead, with the result that the sculpture always counts as a spot of colour and adds greatly to the beauty of the ensemble. One may feel that a piece of sculpture which is to be placed in the open should be rugged in treatment and massive in design. This may be true in regard to sculpture to be placed in a large open square or plaza of some big city, or of a monument or a group for some great building, but a single figure or group for a garden must have a certain refinement of detail and elegance of design such as nature has given to the flowers and trees, and all the things with which to make the garden a thing of beauty.

One may again feel that a piece of sculpture should be more or less of a solid mass free from holes which pierce the composition. This may be true of certain kinds of sculpture, but in garden sculpture where the single figure or group in stone is silhouetted against the dark green of the trees it is sometimes well to have carefully designed holes which will give to the group a certain lightness and freedom which is in keeping with the design of the trees where the branches sometimes part and allow a glimpse of the sky beyond.

While the small informal garden requires a different type of sculpture from that of the large formal garden the same principles of scale and colour should be applied here as in the larger gardens. If the setting calls for a statue, say, 3 ft. high, it does not necessarily mean that any statue 3 ft. high, however charming, will suit the place. A statuette which may look well indoors is clearly lost when placed outdoors because its mass and details are out of scale with the things of nature which surround it.

While the subject matter of garden sculpture is not perhaps of first importance one nevertheless feels that there are certain subjects more suited to the garden than others. One is inclined to think of the mythical woodland creatures and of subjects that are joyous and which have to do with life in the open. However, whether the statue be a small chubby child or a goddess done in a fine architectural style it must first of all be a thing which takes its place in the garden and is in harmony with the trees and flowers which are its neighbours.

Thus it is that many garden decorations though crudely executed make pleasing spots when seen from a distance and are therefore in a way successful, but the really successful garden decoration is the one which makes a good spot when seen from a distance and which at the same time is designed and executed in such a manner as will repay anyone who comes near enough to inspect it as a work of art. (*See* also LANDSCAPE ARCHITECTURE; SCULPTURE TECHNIQUE.) (E. McC.)

PORTRAIT SCULPTURE

Good portrait sculpture has remained essentially the same throughout the ages. Only its trappings and its ornamentation have undergone changes, just as conventions of dress have changed periodically, characterizing a particular epoch. Thus we may recognize an Egyptian portrait bust by the indication of its wearing apparel or its mode of arranging the hair, while excessive attention to personal adornment indulged in the late 18th and in the 19th centuries leaves its stamp also upon the portraiture of that period.

In essentials, however,—in the fundamental construction of the human head,—the fine portraiture of these remotely associated periods remains the same. You see on the city streets to-day types that coincide exactly, except for the non-essentials of dress, with the types richly revealed in the best portraiture of the Egyptians and of the Romans. This fact leads back to the very foundations of portrait sculpture and of human construction. Everyone knows, for example, that the nose is in the centre of the face and that, accepted as the centre, it can give the alignment of the other features. Yet many portrait busts neglect this simple first principle, and, in consequence, destroy the normal perfect balance of the head.

GEOMETRIC BASIS

The fundamental law of head construction is, in consequence, as much a truism as a law in geometry and must be accepted without reservation by the portraitist. If it were actually reduced to mathematical principles it could be indicated by a line drawn down through the centre of the head from the apex of the skull to a point marking the centre of the mass attaching the neck to the body. This imaginary line might be described as the "flow" of the mass (*A–B*, fig. 1).

In order to complete the geometry of portrait bust construction a straight line may be drawn at right angles to the general line of the "flow" running from the eye to the back of the skull and centring eyes and nose (*D–C*, fig. 1).

Structure and Likeness.—Once this framework of fundamental construction has been produced the matter of obtaining a likeness is comparatively simple, and the features with their individualizing characteristics are at once seen to be ornaments on the general flow of the head construction just as buttons or embroidery are ornaments on the coat or dress.

The sculptor who has spent years studying the human head knows well that good portraiture is concerned with the individuality of the simple head construction as indicated by the "flow" of the mass rather than by the meticulous copying of the features. He knows from studying the work of his fellows that there are two types of portrait sculpture, one type preoccupied with features, and the other with the fundamentals of construction. There is a unity in the bone structure which he perceives is not built brick

PHOTOGRAPHS, (1, 2, 3) MATTIE EDWARDS HEWITT

EXAMPLES OF GARDEN SCULPTURE

1. Torso by Elie Nadelman, on the estate of Ralph Pulitzer at Manhasset, Long Island
2. "Diana" by Edward McCartan, in the garden of the H. W. Crofts' estate in Greenwich, Connecticut
3. A marble figure by John Gregory, in an inner court of the home of S. R. Guggenheim, Pt. Washington, Long Island. The base is decorated with acanthus leaves
4. "Woman With a Child" by Paul Manship, on the estate of C. M. Schwab at Loretto, Pennsylvania
5. "Sonata" by Mario Korbel, in the garden of George G. Booth at Detroit, Michigan
6. A fountain by Paul Manship

on brick as is a man-made work of architecture and which if grasped in its entirety lends a semblance of life; a quality of convincing sureness which cannot otherwise be obtained.

It is quite possible to achieve a likeness without adhering to fundamentals, but as the years pass and the subject dies the portrait bust must rest on its merits as a work of art and not as a likeness. The Romans who posed for some of the finest examples of ancient portraiture have long since passed from the land of the living. No one living to-day has an interest, sentimental or otherwise, in the tilt of the ancient's nose or the dear and familiar lifting of the ancient's eyebrow. The personal element in portraiture is stripped from consideration by the impersonal passage of time, and the work is left to stand or fall on its value as a piece of head construction. It is not at all improbable that some of the ancient portraits preserved to-day as the finest relics of antiquity in the museums of the world won less acclaim in their own era than other works more effective as likenesses than as art.

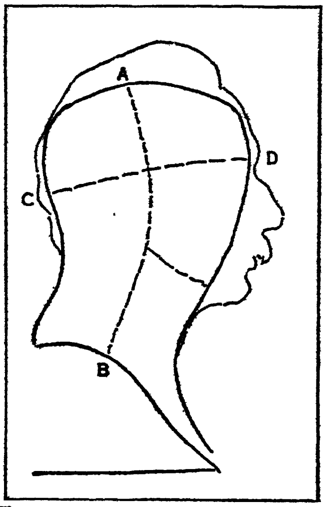

FIG. 1.—DIAGRAM SHOWING FROM A TO B THE PLANE OF THE STRUCTURAL MASS OF THE HEAD; FROM D TO C A SECOND LINE PASSING AT RIGHT ANGLES, CENTRING EYES AND NOSE WITH BACK OF SKULL

GOOD PORTRAITURE UNIVERSAL, NOT RACIAL

Granting the fundamental principle upon which the human head is built it follows naturally that good portraiture is universal and not racial. Because a portrait is primitive African or Egyptian or Chinese does not mean that it is any better as a portrait than a bust produced in Rome, Paris or New York. Racial differences occur from the frontal bone to the chin (Pl. I., figs. 3 and 8) and do not affect the real mass structure of the head.

By the same reasoning it would be a thankless task to establish the superiority of any one period of portrait sculpture over another. The factor of time is unimportant. A portrait that was good in the days before Christ is good to-day and takes its place with the best portraiture produced by the succeeding ages down to the present time.

The fundamental construction of a head, while of paramount importance in its valuation, is less striking to the layman than external characteristics. It is difficult, for example, to appreciate the structural kinship between a highly conventionalized portrait bust of an Egyptian king and a work emphasizing the individuality of a less exalted personage. Yet the difference between the highly individualized and the highly conventionalized portrait may lie solely in the treatment of externals.

Externals Establish the Period.—It is the outer convention rather than the inner structure that brands a portrait bust as the work of some particular period. The mode of life, the customs and manners and environment of the age invariably affect the outer appearance of the individual. Sometimes the mode of dress or the coiffure establishes what might be considered a symbol of the time, and this symbol or convention finds echo in the work of the portrait sculptor (Pl. I., figs. 1 and 7).

A study of Cambodian heads (Pl. I., fig. 7) or those produced in Egypt (Pl. I., fig. 2) and in Rome (Pl. I., fig. 4) shows the influence of the current mode on the work of art. The Cambodian portraitist in particular followed a definite symbolism in the rendering of the hair, while the popular coif of other lands is repeated with more or less conventional emphasis in the fashioning of the portrait bust.

Thus, although the individual was an individual in ancient lands quite as much as in the Europe and America of to-day, certain characteristics of dress stamp him with the life of a definite period.

Conventionalization and Realism in Portraiture.—It is interesting to note that many periods of art production showed equal interest in conventionalization and in realism. The modern tendency to reduce all forms to their simplest essentials is no new thing. It merely serves to emphasize and accept the principle of fundamental construction, and to publish to the world that details are merely details and have very little to do with the basic character of a work of art. Conventionalization of human forms (Pl. X., fig. 3) and simplification with the resultant absence of personal characterizing details (Pl. I., fig. 5) may be found in portrait sculpture from earliest times to the present era.

In Egypt, as well as in China, India and Cambodia, the conventionalization of forms was particularly favoured. Many of the fine renderings of kings and queens (Pl. I., fig. 1) are so highly conventionalized that the personal characteristics are lost or obscured. If one may judge by the mass of portraiture that has come down to us the high dignitaries of the religious and governmental life were placed on a plane above human characterization and were considered more as symbols of the church and State than as individuals. Yet, paralleling the conventional in portraiture there was a wealth of individual representations indulged usually in subjects of lesser rank, but presenting a definite individual character with all the eccentricities, all the imperfections of the ordinary man (Pl. I., figs. 2, 3 and 9).

Realism in the development of the portrait bust began almost with the first known portrait and marched triumphantly through the centuries, cropping out in unexpected places even in the great cathedrals of the middle ages where, carved on choir stools or as incidental architectural decoration, there are hundreds of little portrait busts characterizing the artisan or the ecclesiast or even the aristocrat of the time. Occurring as they did in an epoch devoted not to portrait sculpture but to architecture they serve to demonstrate the tremendous urge of the human race toward the perpetuation of the individual.

There is a slight shade of difference in viewpoint between conventionalizing and idealizing the human head. In conventionalizing the sculptor chooses the characteristics of subject and period and reduces them to decorative forms and symbols. Thus we find the hair of the African or the coiffure of the Cambodian expressed not realistically but by means of conventionalized decoration (Pl. I., figs. 7 and 8).

It remained for Rome, however, to lay final stress upon the individual as an individual. The long succession of portraits that issued from that city in the centuries of its world dominion show clearly the swing of the art pendulum from idealization and conventionalization to the frank acceptance of human imperfections. Sculptors delighted in these imperfections, these marks of personality, and expressed them with a realistic force that is as powerful to-day as it was in the long ago. Realism so held the portraitist in its grip that he often forgot the dress of a man and centred his attention upon the fundamental characterization of his subject as a timeless individual. The finest of these heads are, in consequence, forever modern as they reveal the human being stripped of period identification (Pl. I., fig. 4).

The Decline of Portrait Sculpture.—For many years after the Roman era portrait sculpture declined with the other arts, appearing only incidentally through the middle ages, and not returning to prominence much before the 18th century when, as in the past, it mirrored in its externals the modes of the elaborate elegance, following through almost two centuries an over-ornate career, yet, under its outer trappings, producing some fine examples of sculptural portraiture.

The 20th century is witnessing a return to the general simplicity found in the portraiture of the ancients.

DIFFERENCES IN VIEWPOINT AND MODELLING

A study of portrait heads produced throughout the ages reveals a rich variety of viewpoints and of modelling. Everyone is familiar with the unanimated face. You see it sitting opposite you in the public conveyance. Its expression has settled to that of hopeless, inactive monotony. For purposes of characterization it might be termed a "street-car face." This aspect of portraiture may have

a variety of underlying causes. The sculptor may be frankly bored with the subject. He may lack understanding of the subject and be unwilling to exert himself sufficiently to establish mutual sympathy. He may be faced with a personality that refuses to give that sympathy. Or, through lack of experience and inability to handle his medium, he may neglect the life-giving structural essentials.

In his effort to achieve simplicity a sculptor often gives the big essentials of head construction but so covers them with a general modelling that the richness of surface is lost. This type of portraiture reminds one of a figure neatly enveloped in a veil, or generalized by the use of tights. It is the antithesis of rich form sculpture in which detail is held in perfect scale to and is supported by the mass (Pl. XII., fig. 2).

At the other pole is the portrait head that achieves likeness and individuality by thinness of form, as if the artist were working with a drawn line upon the clay, emphasizing detail rather than construction, a type of work implying a pen and ink mental approach and readily defined as "pen and ink sculpture" (Pl. I., fig. 6).

The exaggeration of individual characteristics with extreme emphasis upon striking details supplies another classification under the head of caricature (*q.v.*).

PRODUCING A LIVING PORTRAIT

To produce a portrait bust that gives the impression of life the sculptor must have behind him a wealth of experience. He must know that a man does not laugh with his mouth or his eyes alone but with his entire head, and that when he smiles there is a concerted movement of all the features (Pl. XII., fig. 1).

Every subject has a definite life flavour that reveals itself in some individual characteristic or series of characteristics. The successful portrait head discovers these characteristics. Needless to say, the sculptor who has personal knowledge of his subject can produce a more living bust. But he is seldom called upon to execute a portrait of an intimate friend. The portrait commission concerns itself almost exclusively with the perfect stranger, and when faced with such a sitter the sculptor must draw largely upon his knowledge of human nature and his ability to read facial characteristics in the light of the subject's environment and profession. What he does and is contributes largely to the basis for character analysis.

When the sculptor gropes unsuccessfully for this revelatory contact he produces the unanimated street-car face, visualizing the man on the model stand as impersonally and monotonously as he would the man beside him in a tram. The features are there; the likeness may be there also, but the personality, the life-giving quality of understanding between subject and artist, is absent.

Sculptor and Sitter.—In many respects a portrait head created from memory may have more life than one executed after many sittings. Sitters vary greatly in what they give of themselves. Some are sympathetic and establish at once a bond of sympathy with the sculptor, thus enhancing his creative power. Others sit through hours without a spark of understanding. It is often true that more can be gained by talking to a subject during rest periods and by studying the reaction of the man when he is unconscious of a pose than when he sits through the long hours on the stand. After a time the expression of any face sets, and there is danger of reproducing a deadened countenance.

One of the most difficult tasks that a portrait sculptor is called upon to face is the commission to make the head of someone no longer living. Many busts of historical personages are created solely from contemporary prints, photographs or portraits, the character of the data varying according to the period in which the individual lived. Seldom is there adequate material from which to work. If the portrait desired is that of some notable who lived many years ago the artist may wield a freer hand and use his own knowledge of the human head and his conception of the man's character without being forced to meet the criticisms and suggestions of relatives or friends whose impressions of the individual may be vivid but conflicting (Pl. X., fig. 1). The one hope of success lies in the sculptor's knowledge of construction and in the wealth of his experience as a portraitist, and with this knowledge and experience he must portray that intangible quality known as character. It is no task for the novice.

Studying Colour in Portraiture.—The experienced portraitist understands many subtleties of construction that are missed altogether by the literal copyist. He appreciates, for example, the structural differences between the blonde and the brunette. He knows that dark hair and light hair fall in different masses and that even when dark hair whitens with age it still preserves the mass quality of its original colour (Pl. XII., fig. 3). Thus hair of different colours is essentially different in form.

Black hair falls in heavier masses and gives a solid effect. Where it separates and one lock appears distinct from another the separation is sharp and produces a strong shadow. Blonde hair, on the other hand, has very few solid masses. It is fluffy and light in effect and does not possess either the solidity or the sheen of dark hair (Pl. XI., fig. 4). The difference between blonde and brunette indicates at once the need for a corresponding difference in the modelling of each type. Forms that are definite and that produce definite shadows give a brunette colouring while blonde colouring is obtained through a negation of the shadows and by the modelling of subtle, less well defined forms.

How Colour Impression Is Produced.—The portrait bust of the past few centuries has relied for colour quality almost entirely upon gradation of shadow produced by modelled form. Dark skin, light skin; dark eyes, light eyes; dark hair, light hair,—such colour differences are translated in terms of light and shade.

This sculptural interpretation of pigments was aided by the ancients through actual colour application as seen in many a portrait discovered on Egyptian soil (Pl. I., fig. 2). Chinese portrait heads were also coloured, while a similar tradition reappeared in the ecclesiastical heads of the middle ages. It was possible for the Egyptian portraitist to paint on the bust the elaborate necklaces and jewel arrangements that give a clue to the mode of dress and of life. Crowns and head-dresses, first expressed in terms of form, were then painted in designs and colours characteristic of the period (Pl. I., fig. 1).

When the actual application of colour fell into disuse it became necessary for the portraitist to indicate pigments and design solely through the modelling of form. Folds of the toga might appear in Roman portraiture, while the coiffure of the lady of antiquity, changing with the style of each succeeding era, writes its chapter in the conventions of the portrait head.

The Influence of Externals on Portraiture.—The elaborate over-decoration of the 18th century and the heavier decorative trend of the 19th found echo in the accessories of dress used by the portrait sculptor in his effort to establish the individual in point of time as well as in point of character (Pl. X., fig. 1).

Externals thus leave their stamp upon the portrait bust as it marches through the ages, but externals have never made the portrait a finer work of art. It stands or falls by virtue of its construction, its modelling and the artist's own knowledge of human nature.

THE CHOICE OF MATERIAL

The modelling of a portrait head and the choice of size, whether life-size or over, is largely conditioned by choice of the material in which the head is to be cut or cast.

Wood, stone, metal and terra cotta provide a range of choice for the portrait sculptor, and each of these materials has its own technique. In Egypt stone was a favourite material, and the great simplicity of many an Egyptian portrait head may be due to the fact that the sculptor chose porphyry as his material for expression. Porphyry presents its own problems in the matter of carving. It is very hard, and necessitates the simplifying of surface treatment and the reduction of forms to their basic essentials. In Greece and Rome, on the other hand, where marble was so largely used, the sculptor had more opportunity to display his skill in the handling of intricate surfaces with greater attention to detail.

The control of the material over the modelling and even over the general conception of the work undertaken may be readily understood if a porphyry head of the Egyptians, with its simple

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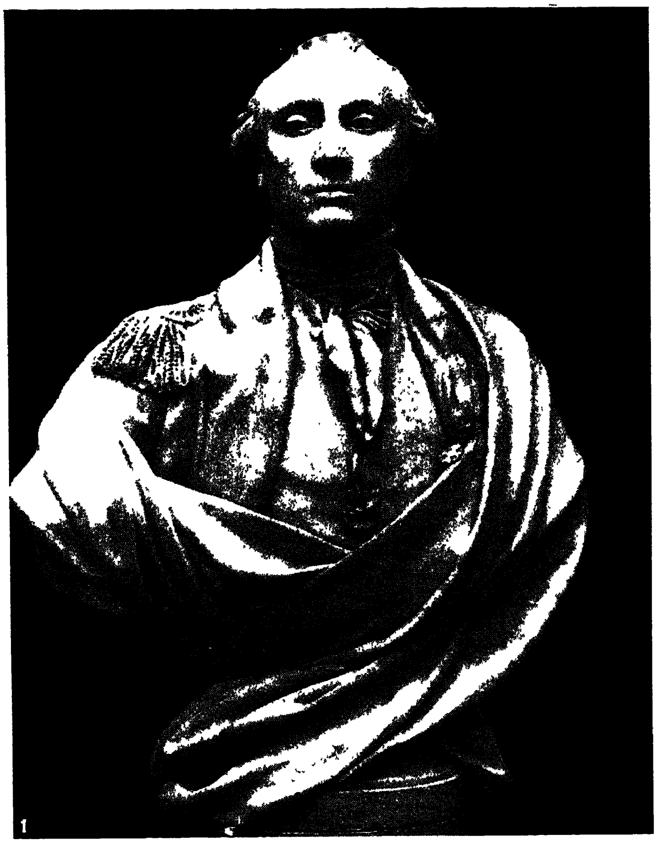
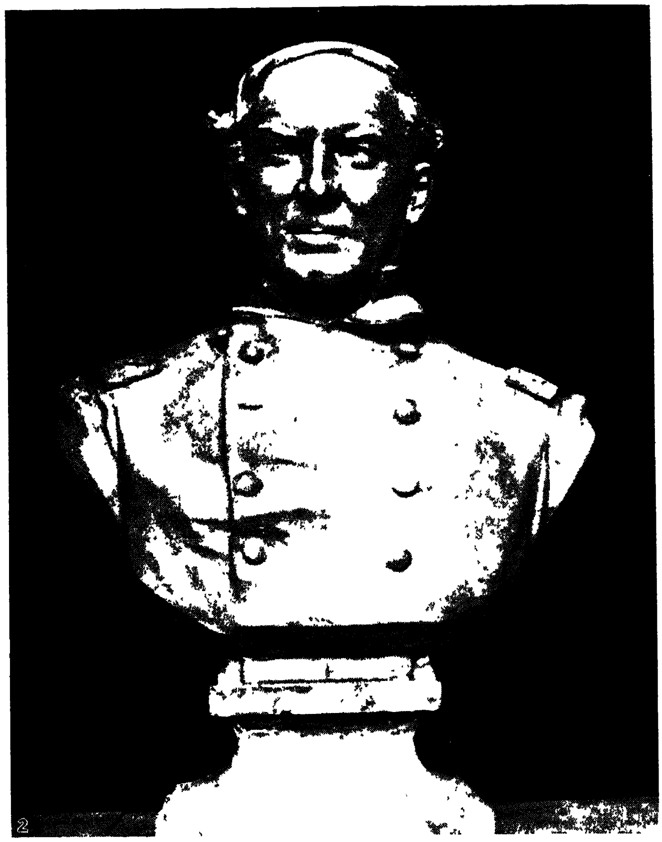
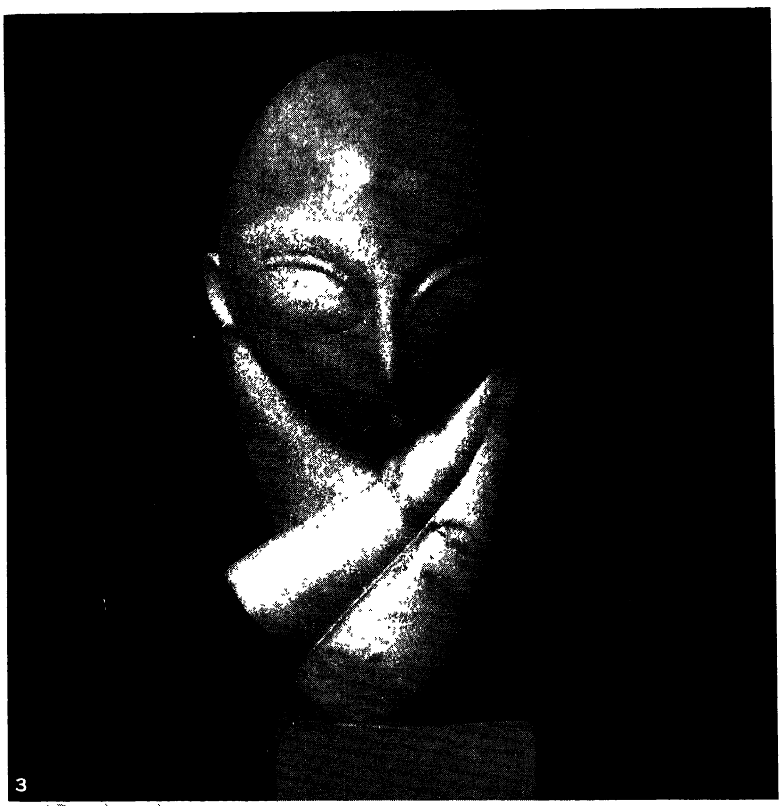
EARLY PORTRAITURE FROM VARIOUS PARTS OF THE WORLD

1. Portrait of Queen Nefertiti, an example of painted sculpture in Egypt about 1370 B.C. 2. Painted limestone head of an Egyptian official showing realistic treatment about 2750 B.C. 3. Portrait called "The Green Head," an example of simplified form, Egypt about 600 B.C. 4. Roman portrait, showing form and construction treated in a way that emphasizes the man as an individual. 5. Stone head of a Bodhisattva, late 6th or 7th century A.D. showing characteristic conventionalized treatment. 6. Roman terra cotta head; an example of details drawn or etched on the modeling. 7. Cambodian head, showing conventionalization, especially in the treatment of the coiffure. 8. Bronze conventionalized heads from Benin, West Africa. 9. Gypsum mask, an example of realism in Egyptian art about 1370 B.C.

SCULPTURE







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REALISM AND CONVENTIONALIZATION IN RECENT PORTRAITURE

1. Portrait of Lafayette by Jean Antoine Houdon (1741–1828)
2. Portrait of Admiral Farragut by Charles Grafly (1862–1929)
3. Portrait of Madam Pogany by Constantin Brancusi (1876–   )

forms, is placed side by side with a Gothic group of the middle ages, carved from Caen stone or from some other soft stone material. No such flowering of detail and intricate design in sculpture would have been possible had the carvers of the middle ages and the Renaissance been confined to the use of a hard, unyielding stone.

The hard stone thus lends itself to conventionalization, urging the sculptor on to express form more or less symbolically, while the soft stone allows him to indulge his fancy for absolute realism and for intricate ornamentation.

The Effect of Material on Size.—The sculptor who wishes his portrait bust to assume life-size proportions must, again, understand the material in which the head is to appear. If the portrait is to be cast in bronze it must be modelled slightly larger than life. Bronze shrinks $\frac{3}{16}$ in. equally in length, breadth and thickness, to the foot, and the heavier the bronze employed the greater the shrinkage.

Terra cotta, or dried clay, shrinks 1 in. to the foot, and does not shrink equally unless the model is so constructed that the shrinkage shall be equal. When the sculptor does not understand the terra cotta material the parts shrink unequally and the original model is either distorted, cracked, or both. Distortion of terra cotta pieces that have come down to us from antiquity may often be attributed to this cause.

In dealing with the portrait head carved in wood the sculptor must appreciate that a solid block of wood checks or cracks. Many African and Chinese portrait carvings show serious cracks. This tendency, however, can be controlled if the wood is built up by dove-tailing or glueing together smaller blocks to produce the required volume, or by boring and excavating the interior of the large solid block.

The Material May Aid Characterization.—It is not impossible that, in studying the character of the individual the sculptor discovers forms or traits that may be best expressed in some one particular material, thus utilizing the material as a direct agent in the characterization.

The artist who feels for his material understands that it requires a technique in keeping with its nature, and does not attempt to force upon it some alien treatment. For example, the beauty of wood lies in the fact that it is wood, and the sculptor who uses it as a carving basis should treat it as wood and not give it a surface peculiar to the nature of marble. If, on the other hand, he desires for characterization the surface of wood as a base, he should not choose marble.

PORTRAYING STATURE IN THE PORTRAIT HEAD

The portrait sculptor must indicate in the head alone the characteristics of his sitter. He is, therefore, faced with another interesting and difficult problem. How can he impart through the head the movement and form of the body? How can size, weight and stature be indicated in the bust?

Incidental decoration can do little to achieve this goal. The stature of an individual is a very basic thing and conditions all parts of the body from the head to the feet. In fashioning a portrait statue it is a simple matter to indicate size and weight. In the portrait head, however, such characteristics can be suggested in the setting or base. A portrait head, for example, must end somewhere and when ended must be mounted upon a block or base.

The Treatment of the Base.—The sculptor who studies the stature of his subject completes his portrait bust with a general form indicating the bulk of the sitter. If he happens to be a tall, thin person, the artist creates a tall, thin base (Pl. XII., fig. 1). If he be a short, heavy-set man, the base is wide and broad (Pl. XII., fig. 3). Any such setting goes back to a fundamental appreciation for form sensed by the ancients, and almost entirely forgotten in the over-ornate art of the 18th and 19th centuries.

GOOD PORTRAITURE TIMELESS

To-day, therefore, the sculptor stands as he stood thousands of years ago, face to face with the same problems of natural form that conditioned the portraiture of Egypt and of Rome. He has passed through centuries of experimentation during which his art became incrusted with extraneous and often meaningless details. Busts of this nature belong so exclusively to a certain period in the world's development that they give the impression of being out of date. They provide a gauge for the study of their own contemporary modes of dress, and because they are so localized they appear less modern than portraits executed thousands of years before by the sculptors of antiquity.

Many a fine portrait head created in Egypt or in Rome and produced purely as a study in structural forms and resulting life is ageless and periodless in its adherence to the universal principles of the sculptor's art. Conventions of dress, conventions of execution have come and gone, but the art of the portrait bust, in its fundamental aspect, has changed not one whit from the first efforts of a master hand to reproduce its kind.

(C. AND D. G.)

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MONUMENTAL SCULPTURE

By monumental sculpture is meant that sculpture which is intended to perpetuate the memory of a person or an event. Included in this definition are all types of memorials in which sculpture is the important part, even though architecture or mosaic or some other art may play an important part in the composition; but it is not intended to include that sculpture which forms merely a decorative accessory in a building such as the sculptures in temple pediments, in the portals of a cathedral, or on the piers of a triumphal arch even though these adorn a memorial structure. Sculpture of that type will be defined as architectural sculpture or as decorative sculpture. (*See* other sections of this article.) In the definition of monumental sculpture we include all public memorials that are sculptural in quality and intended to commemorate historic, literary or scientific events such as military victories, the signing of treaties, the discovery of new lands, or a mechanical invention; all memorials to persons—to statesmen, soldiers, poets, martyrs; all sculptural monuments intended to decorate a city; and all funerary sculptures, whether built within the walls of a cathedral or in the open air.

Monumental sculpture, to serve its purpose as memorial, must be permanent, and must clearly express the character of the person or event that it is meant to honour. Enduring materials, such as bronze or granite, so arranged as to be in perfect equilibrium and so modelled as to minimize the possibility of fractures would seem to be essential to this art; and it would seem obvious that these modelled forms should be those of men and women and should recall, either by direct representation, by association or by the more subtle emotions which may be evoked by arrangements of mass and line, the qualities or the significance of the thing commemorated. Heroic scale and simplicity, because they lend both dignity and permanence, are the most frequent attributes of monumental sculpture, and that idealization of forms and of attitudes which leads to the elimination of all that is ephemeral or mean is an almost universal characteristic. More than any other form of plastic art, monumental sculpture strives to express those qualities of structural truth, of harmony in mass and movement, which good architecture also embodies. A realistic or pictorial treatment, although often used for the decoration of memorials, is apt to be less effective for monuments which are intended to illustrate, not accidental or trivial aspects of nature but rather those heroic qualities of the human spirit that attest its enduring greatness. A romantic or symbolic treatment which depends upon knowledge or upon understanding for its appreciation and a purely decorative style which offers only sensual delight, are also unsatis-

fying in a memorial. That monumental sculpture is best that imposes upon natural human forms the architectural logic of mass and structure.

The desire to leave some record of his sojourn on earth seems to have been instinctive with man from the beginning, and no doubt this instinct is closely associated with his desire to represent the human form in stone or wood. From the earliest ages man seized upon the hardest and most enduring materials in which to carve representations of his own form. With the development of the first civilization, in Egypt, Chaldea, Mexico, these instincts found expression in a wide range of monumental sculptures.

Ancient Civilizations.—We shall omit a detailed description of the monumental sculpture of Egypt, Mesopotamia, Greece and Rome, since this is described elsewhere. (*See* EGYPT: *Archaeology and Art;* GREEK ART; ROMAN ART.) Both the Egyptians and the archaic Greek peoples set up in the precincts of their temples sculptured memorials which are concise and solid in character. After the end of the 6th century these monuments shared the growing naturalism of all Hellenic art: the memorial set up in Athens to "Harmodius and Aristogiton" (514 B.C.—copy in Naples) is an example. An equilibrium between naturalism and idealism is characteristic of the finest Greek memorials, such as the "Victory of Samothrace," set up in 306 B.C. to celebrate a naval victory. In the later phases of Greek sculpture, realism, to which are added dramatic and narrative qualities, becomes dominant, as the "Dedication of Attales I." (241–179 B.C.) at Pergamum, commemorating a victory over the Gauls, attests.

In Rome, memorial sculpture is almost always an accessory of architecture; but it is, nevertheless, almost wholly pictorial in character. The vigorous and realistic frieze which envelops in a superb spiral the column of Trajan (a war memorial set up in A.D. 113) is an example, as are also the fine reliefs of the arch of Titus (A.D. 71), set up to celebrate the capture of Jerusalem. The sculpture of the "Ara Pacis Augustae" (13 B.C.), one of the few monuments set up to commemorate a peace, are more idealized, as is also the contemporary "Augustus of the Prima Porta," one of the finest achievements of Roman monumental art.

The Middle Ages.—No sculptors understood more profoundly the principles and technique of monumental sculpture than the sculptors of the middle ages, particularly those of the 13th century in France, but since their greatest achievements were the sculptural ensembles of the cathedral portals, it will be more convenient to discuss their work at another place. (*See* section on *Architectural Sculpture;* also GOTHIC: *Art.*) We shall speak here only of a phase of their art less dependent on architecture: the execution of sepulchral effigies and tombs.

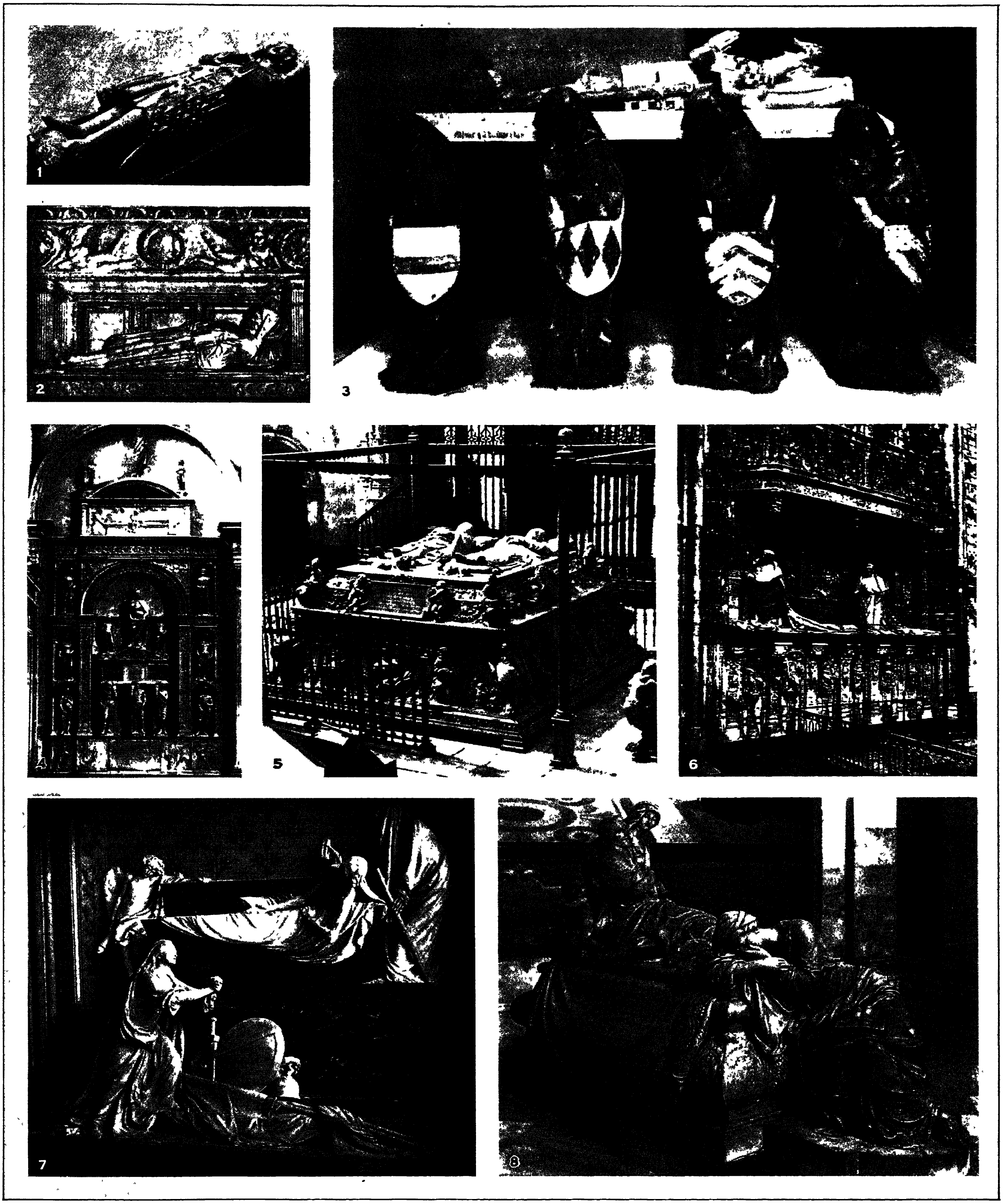
From the beginning the Christian Church marked the graves of her apostles and her martyrs with a stone or bronze memorial. The character of these did not at first differ from other contemporary memorials except by the occasional use of Christian symbols. The vast number of sarcophagi in Rome, executed for the most part after the reign of Constantine, illustrate the development of this Hellenistic art, in which classic forms and drapery, not without dignity and grace, are united intricately with the conventional decorative motives of orientalized Antioch or the *genre* detail of Alexandria. After the 5th century they share the technical decadence of Rome.

The revival of the arts under Justinian—and later under Charlemagne—found a wide expression in intimate sculpture such as ivory carvings and architectural ornament, but left few examples of monumental art. The bronze Easter column, set up it is said by St. Bernard, in the cathedral at Hildesheim is little more than a piece of constructed ornament. It was not until the 10th and 11th centuries, when the sculptor was called upon to decorate the new monastic buildings, that the monumental spirit was once more revived. Developed in the abbey doorways, where the sculptor had to learn anew the technique of stone carving and of rendering the human figure, this spirit gradually entered once more the sepulchral art of Germany and France. It is felt first perhaps in that form of tomb in which a sculptured figure of the deceased is cut or moulded on top of a sarcophagus or on the sepulchral slab let into the floor of abbey or cloister. Although these figures continued for a long time to be only flat reliefs scratched into the flat surface of the stone they are idealized and simple forms. When, after the 11th century, they begin to be carved in bolder relief and finally in the round, the figure is still conceived, as in the incised reliefs, in a standing posture, but laid on his back. The form is rigid, the head erect, and the draperies, unaffected by the change in position, drop in stiff, thinly cut folds from shoulder to feet. Germany was the centre for the production of these grave reliefs, which show a progressive development in technique. The relief grows higher and higher, the figure and the features gain steadily in idealism and in dignity, and the draperies show an increasing beauty of pattern and line. The series of effigies at Ovedlinburg, representing the abbesses of that monastery, illustrate this evolution.

The sepulchral effigies of the 13th century share those ideal and simple qualities which are manifest in the cathedral doorways, but the preoccupation of the sculptor with architecture prevented a wide or sustained development in this field. That development had to await the 14th century when the decoration of the architectural structure of the cathedrals seemed gradually less important than their embellishment with furniture, with retables and chapel screens, and with tombs wherein an individual patron, rather than a community, might be commemorated. This new patronage, which removed the sculpture from the geometric lines of the building, accelerated the growth of naturalism which can be traced more continuously in the tomb figures than in any other field. The body, laid at full length on the stone slab, begins to lose its rigidity. Its forms are clearly defined below the drapery which flows over it in an increasing complexity of fold. The features attain first a realism that approaches portraiture and then, as the influence of St. Francis permeates religion, they take on an emotional or sentimental quality. Accessories, symbols, details of costume and heraldry are rendered with greater and greater elaboration.

The tombs in the Abbey of St. Denis, near Paris (1264) built by St. Louis for his ancestors and his sons are characteristic examples of 13th century tombs. In these the figure is modelled not in relief but in the round. Each figure, represented as in early manhood, and rendered as a standing figure laid upon the ground, is graciously idealized. Each has a simple architectural framework, low in relief, and each is placed on a base embellished with pictorial reliefs. The expression is calm and benign and the draperies straight and simple with long clearly incised lines. The tombs for Rollo and William Longue-Epée, in the cathedral of Rouen (*c.* 1270), the bronze figures of Geoffrey d'Eu, in the cathedral at Amiens, are other interesting examples of these austere effigies.

Characteristic of the 14th century is the tomb of Charles V., at St. Denis by André Beauneveu; where the advancing realism of the century expresses itself in accurate portraiture and in more flowing and natural draperies. The figure is portrayed in the stiffness of death, and about him are grouped representations of his relatives in the costumes and attitudes of mourners. The fine tombs of the popes at Avignon—one of which is elaborated with a canopy—and the effigy of Robert d'Artois at St. Denis, clad in full armour with a lance in his hand, are other examples which illustrate the growing interest in actuality. In the 15th century, when this principle reached its widest acceptance, Flanders and Germany became the most important centres for sepulchral art. At Tournai there was developed the type of tomb in which the figure of the deceased, no longer dead and recumbent, kneels before the Virgin or some religious object; and these tombs, the production of which amounted to an industry, were exported to all parts of England, France and Germany, and widely imitated. The "Monument to Isabella de Bourbon" in the cathedral at Antwerp (*c.* 1465) and the "Tomb of Louis de Male, at Lille" (1455), both of which are of bronze, are characteristic examples of this Flemish art in which the elaboration of detail and the representation of action and of personality are clearly the preoccupation of the sculptor. Burgundy, which after the beginning of the Hundred Years' War became the sculptural centre of Europe, produced a funerary art not less realistic than that of Flanders. The famous Tomb of Philip the Bold (completed 1411) is an elaborate example of this art, in which the recumbent figure of the king is placed on a



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SCULPTURE ON TOMBS

1. Tomb of Robert d'Artois in St. Denis Cathedral, France
2. Tomb of Cristoforo Felici, in the church of S. Francesco, Siena
3. Tomb of Philippe Pot now in the Louvre
4. Tomb of the Doge, Pietro Mocenigo, in the church of SS. Giovanni e Paolo, Venice
5. Tomb of Ferdinand and Isabella at Granada, Spain
6. Tomb of Cardinal d'Amboise in Rouen Cathedral
7. Tomb of Comte d'Harcourt in the Cathedral of Notre Dame, Paris
8. Tomb of Richelieu by Bouchardon in the Sorbonne, Paris

high pedestal elaborately decorated with traceries and with the modelled forms of draped mourners. The effigy is clothed in ample and flowing robes and at his head are the kneeling forms of two angels. German tombs, after the 13th century, are notable for their profusion of accessory and for the occasional introduction of narrative and action into the sculptured figures. Escutcheons are developed in Germany into elaborate decorations and early in the 15th century the baldachino or canopy makes its appearance here as in Italy. Ornate canopies are also common in 15th century England as are also the multiplication of angels, heraldry and symbolic ornament, and the realistic trend is so far developed as to lead to examples wherein the base of the tomb is left open to reveal the corpse within.

The custom of placing the tomb in a niche in the wall received wide acceptance in Spain and in Italy in the 15th century. In Spain these niches, framed in wide arches, received a lavish embellishment in which Moorish ornament frequently appears: the "Tomb of the Two Knights" in the church of S. Esteban at Cuellar and the "Monument to Archbishop Lope de Fontecha" in the cathedral at Burgos are examples. In the elaborate "Tomb of Juan de Padilla," by Gil de Siloé, now in the museum at Burgos, the effigy kneels before a relief of the Pietá against a background of delicate tracery. In Italy the influence of the antique and the example of Nicola d'Apulia is shown in the substitution of a sarcophagus, covered with figure carvings, for the northern tomb-base. The effigy, lying on this sarcophagus, is revealed by angels who pull aside sculptured curtains. In the more sumptuous examples a great baldachino, or marble canopy, supported by four piers, surmounts the tomb and is covered with a wealth of Gothic ornament. The three "Tombs of the Scaliger Family" (1350–74), in Verona, where the canopy is surmounted by a bronze equestrian statue, and the "Tomb of Mary of Hungary" (1325), in Naples, are examples of these canopied monuments.

The Renaissance.—The tombs of 15th century Italy are among the most perfect examples of that exquisite fusion of decorative architecture and classic sculpture which characterized this century. Although oftentimes greatly increased in size as compared to their Gothic prototypes, and most profuse in detail, they seldom attain a truly monumental character; they are, rather, accumulations of ornament, schematically arranged in a great niche set in the wall of a church. The vast Gothic churches of the Franciscans and Dominicans—S. Annunziata in Verona, S. Croce in Florence, SS. Giovanni e Paolo in Venice, for example—are lined with these tombs—the work of the Lombard ornamentalist—that contrast strangely with their laconic architecture.

A characteristic design for these tombs is that of an enframement of marble architectural forms—of arabesqued pilasters delicately wrought, with moulded and carved archivolts, entablatures and bases—enriched with statues placed in niches or in a pediment, and surrounding a sarcophagus upon which rests the effigy of the deceased. All parts of this enframement are exquisitely carved.

The "Tomb of Pietro Mocenigo" (*c.* 1462), by Pietro Lombardi in the church of SS. Giovanni e Paolo, Venice, is a superb example of this sepulchral art. The doge, in his robes of State, stands upright upon the sarcophagus, which is borne on the shoulders of three soldiers clad in classic armour. The "Tomb of Christolphe Felici" (1486) by Ambrose Lorenzetti, in Siena; the "Tomb of Leonardo Bruni" (1444) by Bernardo Rossellino, in S. Croce, Florence; the "Tomb of Carlo Marsuppini" (1455) by Desiderio da Settignano, also in S. Croce are other examples of this art that attains at its best a perfection of technique never surpassed.

In the 16th century, the Italian tombs lose this exquisite ornament. A more sober and studied style, in which scale, dignity and classic correctness are the ideals sought for, appears. The new feeling is foreshadowed in the almost perfect "Tomb of Ilaria del Carretto" (1405) by Jacopo della Quercia, in the cathedral at Lucca. The 16th century master of tomb design is Andrea Sansovino, whose "Tomb of Ascanio Maria Sforza," in the church of S. Maria del Popolo, Rome, takes the form and dignity of a Roman triumphal arch. The "Tombs of the Medici" (1523–34), in San Lorenzo, Florence, and the "Design for the Tomb of Julius II.," only partly executed, both of which are by Michelangelo, are the greatest examples of the mature and powerful art of this century. (*See* MICHELANGELO.)

The monumental sculpture of renaissance Italy was not, however, confined to tombs. Donatello revived the equestrian statue in his "Statue of Gattamalata" (1443–53) in Padua, bringing monumental sculpture into the open air and giving it once more a civic, rather than a religious significance. The "Statue of Colleoni" (1465) by Verrocchio, in Venice and the "Designs for a Statue to Francesco Sforza" (1506–10) by Leonardo da Vinci, followed. Michelangelo set his heroic figure of the nude David (1501) in front of the Palazzo Vecchio of Florence, while Niccolo Tribolo, also a Florentine, created the precedents in fountain design which were to be developed into the monumental fountains of the next century.

In France the renaissance created many decorated tombs of the greatest beauty among which the "Tomb of Cardinal Amboise" (1525) in Rouen cathedral, the "Tomb of Francis II. of Brittany" (1507) by Michel Colombe, in the cathedral of Nantes, and the "Tomb of Francis I." (1525) at St. Denis, by Pierre Bontemps, are perhaps the most celebrated. Jean Goujon, the greatest of French sculptors, has given us an example of his vital and gracious style in the "Fountain of the Nymphs," Paris; and Germain Pilon, whose work exemplifies the noblest classic tradition, achieves in his "Effigy of René Birague," in the Louvre, a most perfect balance between a sympathetic naturalism and monumental restraint.

The splendid "Tombs at Brou" (1505–26) near Bourg, built for Margaret of Austria, by Konrad Meit of Worms, are characteristic of the somewhat ornate renaissance of Germany, where the Thirty Years' War greatly limited the production of monuments. In Spain an army of Flemish and Italian ornamentalists, attracted by the prosperity which followed the discovery of America, embellished with sumptuous tombs the newly-built Gothic cathedrals, and founded with their Spanish pupils a school of decorative art which lasted well into the 16th century. "The Tombs of the Catholic Kings, Isabella and Ferdinand" (1517) by Dominico Fancelli of Florence, and "Doña Juana la Loca y Don Felipe el Hermoso" (1520) by Bartolomé Ordóñez, both of which are in the splendid Capilla Real of Granada cathedral, are two of the finest sepulchres of Europe. Other examples are the "Tomb of the Infante Don Juan" (1512) in the church of Santo Tomas, Avila; "The Tomb of Bishop Gonzalo de Terma" (*c.* 1525) by Diego de Silve, in Burgos cathedral; and recessed "Tomb of Enrique II. and Catherine of Lancaster" (1534) by Alanso de Covarrubias, in Toledo cathedral.

The Baroque.—No field was more congenial to the spirit of baroque art than sculpture carried out on a conspicuous scale. The baroque was a large style, delighting in impressiveness of heroic mass and deep shadow even when, in its effort to achieve a dramatic effect, it ignored not only structure and the laws of equilibrium but also that repose and dignity which in most ages have been considered the first essentials in monumental art.

The tombs of Bernini are magnificent dramas in which symbolic figures, clothed in sweeping draperies, with rhetorical gesture and expressive features, share in some emotional experience, theatrically depicted. An example of this virile art is the "Tomb of Alexander VII.," in St. Peter's, Rome. The pontiff, set in a great apse, kneels on a high pedestal about which Charity, Truth, Justice and Wisdom weep disconsolately while Death, a skeleton, raises the great draperies of polychrome and gold that veil a darkened doorway. The "Fountain of the Triton," in the Piazza Barberini, Rome, from which all clarity of profile or of shadow, all definiteness of plane, are removed, is also characteristic of Bernini's style, widely imitated throughout Italy.

The baroque monuments of France, less agitated and more gracious than those of Italy, are illustrated by the "Tomb of Richelieu," by François Girardon, in the Church of the Sorbonne, Paris. The dying cardinal, lying on his sarcophagus, is upheld by Religion and mourned by Science. The three figures, united by the lines of skilfully arranged draperies, are informed by a solemn and touching sentiment. The famous "Tomb of the Comte de Saxe," by Jean Baptiste Pigalle, equally allegorical, embodies in a

more theatrical composition, less sentiment and more symbolism. About the erect, dignified figure of the general, Death, France, Hercules, Eros and the Lion of England enact a spirited drama that overflows the architectural boundaries assigned to it.

The "Monument to the Great Elector," by Andreas Schlüter, a realistic and robust equestrian statue, is representative of the German baroque, as is also the periwigged "Apotheosis of Prince Eugene," by Balthasar Permoser in the Barok museum of Vienna. The baroque in Germany attained at times astonishing vitality and elaboration of form; the Trinity column, in Vienna, is an example. In England the baroque spirit is less understood. Of the many baroque monuments in Westminster Abbey, the best one, the "Tomb of Lady Nightingale" is by the Anglicized Frenchman, François Roubillac. Characteristic of the more fervid devotional sentiment of Spain is the "Pietà," by Gregorio Hernandez.

The 19th Century.—The 19th century witnessed an almost feverish activity in the building of sculptured monuments. A new type of memorial, that of a statue placed in a public place, replaces the intramural sepulchre, as the devotional and intellectual spirit of the baroque centuries gives way to the more national and sentimental feeling of the Victorian age. The neo-classic purity and coldness which dominates the first phases of 19th century art is slowly modified by realism and romance. France remains to the end of the century the centre of sculptural art.

"The Tomb of Clement XIV.," by Canova, in the church of SS. Apostoli, Rome, is a good illustration of early 19th century classicism. The composition is that of Bernini—the draped figure of the pontiff seated on his sarcophagus and mourned by Charity and Peace—but the dramatic action is replaced by a dreamy mournfulness, which is made impersonal by the generalized features, by classic draperies, and by the definite geometry of the architectural forms. The "Tomb of Nelson," by John Flaxman, in St. Paul's, London, while remotely derived from Pigalle, shares the dignity and classic restraint of Canova, which now become characteristic of all sepulchral art. The "Tomb of Queen Louise," in Charlottenburg, by Christian Rauch, is one of the loveliest of these neo-classic tombs.

The equestrian statue of Joseph II., in Vienna, by Franz Zanner, depicting the Austrian kaiser in the armour of a Roman general, illustrated the return to classic prototypes in street memorials. The "Cities of France," seated around the Place de la Concorde, in Paris; the graceful "Victories" which guard the tomb of Napoleon at the Invalides; the "Wounded Lion," at Lucerne, by Thorwaldsen; and the "Statue of General Washington," by Greenough, at Washington, in which the father of his country, half-naked, takes the pose and expression of Zeus, are other examples of neo-classic taste in monuments.

The nationalization of classic types, which was attempted by Thorwaldsen in his later works, illustrates that desire for national expression which the patriotism of the 19th century demanded. David d'Angers, called upon to create in the streets of French cities many representations of famous Frenchmen, not only gave these a contemporary costume but also gestures and expressions in harmony with their characters and activities. His "Corneille" at Rouen, "General Drouot," at Nancy, and "Thomas Jefferson," at Washington, are examples. François Rude shared this effort to nationalize French sculpture, as his "Marshal Ney," in Paris, demonstrates. Rauch, in his famous equestrian "Frederick the Great," in Berlin, not only renders realistically the costume and features of the king, but surrounds the pedestal with the portraits of his contemporaries. In America, John Quincy Adams Ward, in such monuments as the "Washington," in front of the sub-treasury in New York, succeeds admirably in adding a touch of national feeling to figures essentially classic.

The search for nationalism led inevitably to the revival of national styles. Carpeaux, in his spirited "Fountain of the Four Races," in the Luxembourg gardens, recaptures the pictorial warmth of French baroque masters; Jules Dalou, in his "Triumph of the Republic" and his "Silenus Monument" carries these tendencies still farther. Henri Chapu recalls in his "Tomb of Regnault," École des Beaux-Arts, Paris, the exquisite grace of Goujon, and the "Tomb of General Lamoricière," in Nantes, by Paul Dubois, illustrates also this tendency to turn to the national renaissance—a tendency equally noticeable in Germany and in Italy. In America this movement found expression in such admirable monuments as General Sherman in New York, by Augustus Saint-Gaudens.

Contemporary Monuments.—The period since 1875 has been prolific in commemorative art. This has been due, in part at least, to the development of realism and to the romantic and pictorial, and therefore popular, character which sculpture assumed towards the end of the 19th century. The growing tendency towards naturalism in monumental art, exemplified by the work of Rude, Carpeaux and Bayre, culminated in Rodin, whose "Monument to the Burghers of Calais" is the negation of classic form. The realism of this monument, which recalls that of the 15th century Gothic and its narrative and emotional power, have made it the prototype of a world of memorials both in Europe and in America. "The Monument to Victor Hugo" is less literal and achieves something of the strength of Michelangelo. The impressionistic technique and the "popular mysticism" which this monument exemplifies have also been widely imitated. Bartholomé in his fine "Monument to the Dead," in the Cemetery of Père Lachaise, Paris, embodies not only his freedom from the Hellenic rule, but also the realism, and the mysticism, the pictorial treatment, which Rodin had made popular. The monuments which continue the tradition are innumerable: the "Fountain of Time," in Chicago, by Lorado Taft; the "Burden of Life," in Harrisburg, Penn., by George Grey Barnard; and the lovely "Bacchanale," by Malvina Hoffman, are American examples. (*See* also EFFIGIES, MONUMENTAL; MONUMENT; TOMB; SCULPTURE TECHNIQUE.)

(J. HUD.)

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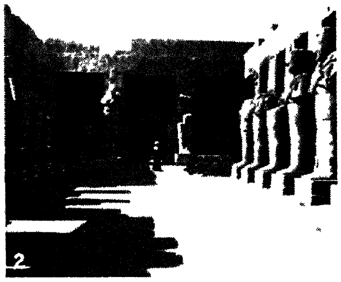
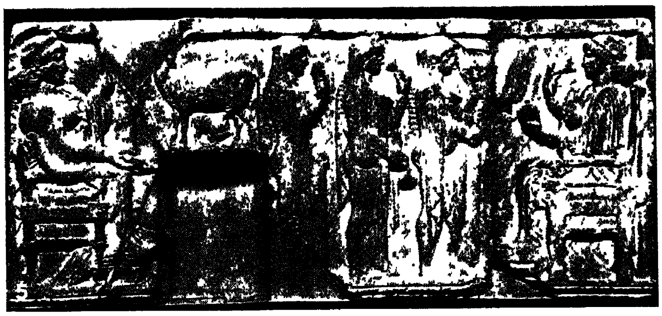
ARCHITECTURAL SCULPTURE

Architectural sculpture originated not only from the fact that something ornate was desired, but because practically all sculpture in the beginning had a symbolic meaning. Images of gods were wrought with their symbols, or the story of some great man's life was done in pictorial fashion, in bas-relief; and, as temples were built to enshrine these great deities, lesser symbols were gradually introduced to surround and protect the focal point. Man, with his instinct to invent and design, used these sculptures to enhance architecture with beautiful shapes and spacing.

Egyptian.—An interesting example of symbolic sculpture, known from the earliest periods to the present time, although its meaning seems to be lost, is the Gryphon, representing the elements. The wings, fins, blazing eyes, feet and body of the lion symbolize air, water, fire and earth. This was very often placed on the corners of the temples. Some of the finest pieces of Egyptian sculpture representing the deities were Ra, Isis, Osiris and, of course, the Sphinx. This is sculpture, architecture and symbolism knit together in a highly artistic and decorative manner. All these Egyptian works were powerful, massive and beautifully fitted to architecture, and to the great scheme laid out by the architects of that period. Their scale plan was enormous. Scale is one of the most important elements that an artist has to deal with, and this does not mean only the scale of proportion of one thing to another; the immensity of scale gives the onlooker a feeling of awe as well as beauty, whereas the small scale may simply appeal to his sense of beauty. The Egyptians felt how important it was to make their works of art in enormous scale. The Pyramids and the Sphinx carry what the designer wished to convey even after thousands of years. The Egyptian artists left probably the most impressive and awe-inspiring monuments yet erected in the world. The shape of the Pyramid at a small scale,





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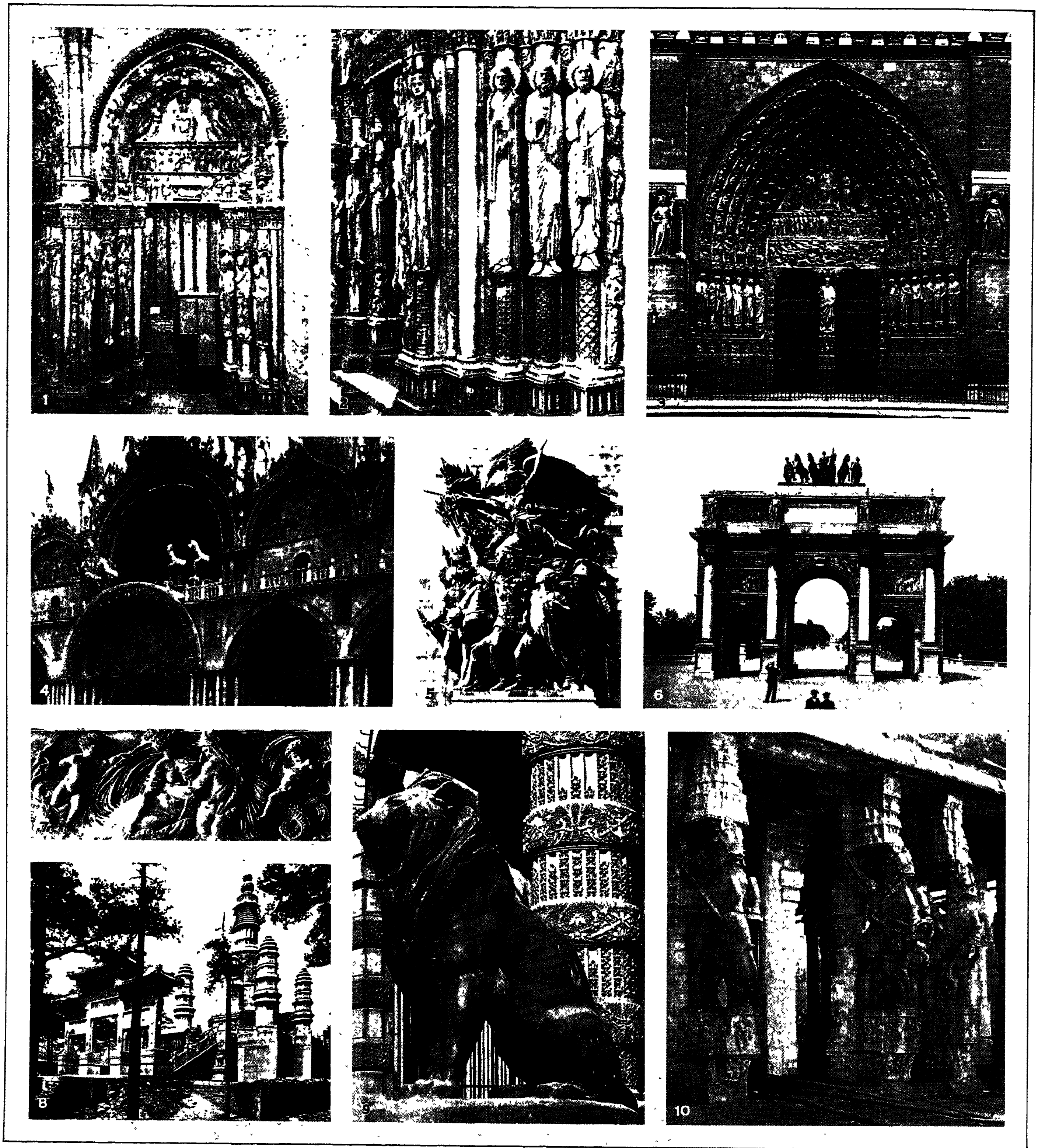
ANCIENT ARCHITECTURAL SCULPTURE

1. Relief panels on the birth house of Isis at Dendera, Egypt, depicting Isis feeding her son Horus, the father Osiris, and Ra, the highest God offering a gift
2. Massive carving in the Mortuary Hall of Rameses II., at Karnak, Egypt
3. Carvings adorning the wall of the Temple of Hathor at Abu Simbel, Egypt, as they appear when viewed from the Nile
4. Relief from the palace at Ashur Nasir, 9th century, B.C., Assyria
5. Relief from Harpy tomb in Xanthos, predecessor of many other Lycian tombs of the 4th and 5th century
6. Complete frieze of the Theatre of Dionysus at Athens, Greece
7. Relief from the frieze of the Parthenon, Athens, Greece
8. Portals of a 13th century cathedral in Italy
9. Detail of the Arch of Titus at Rome. The relief shows a seven branched candlestick from the Temple at Jerusalem

SCULPTURE



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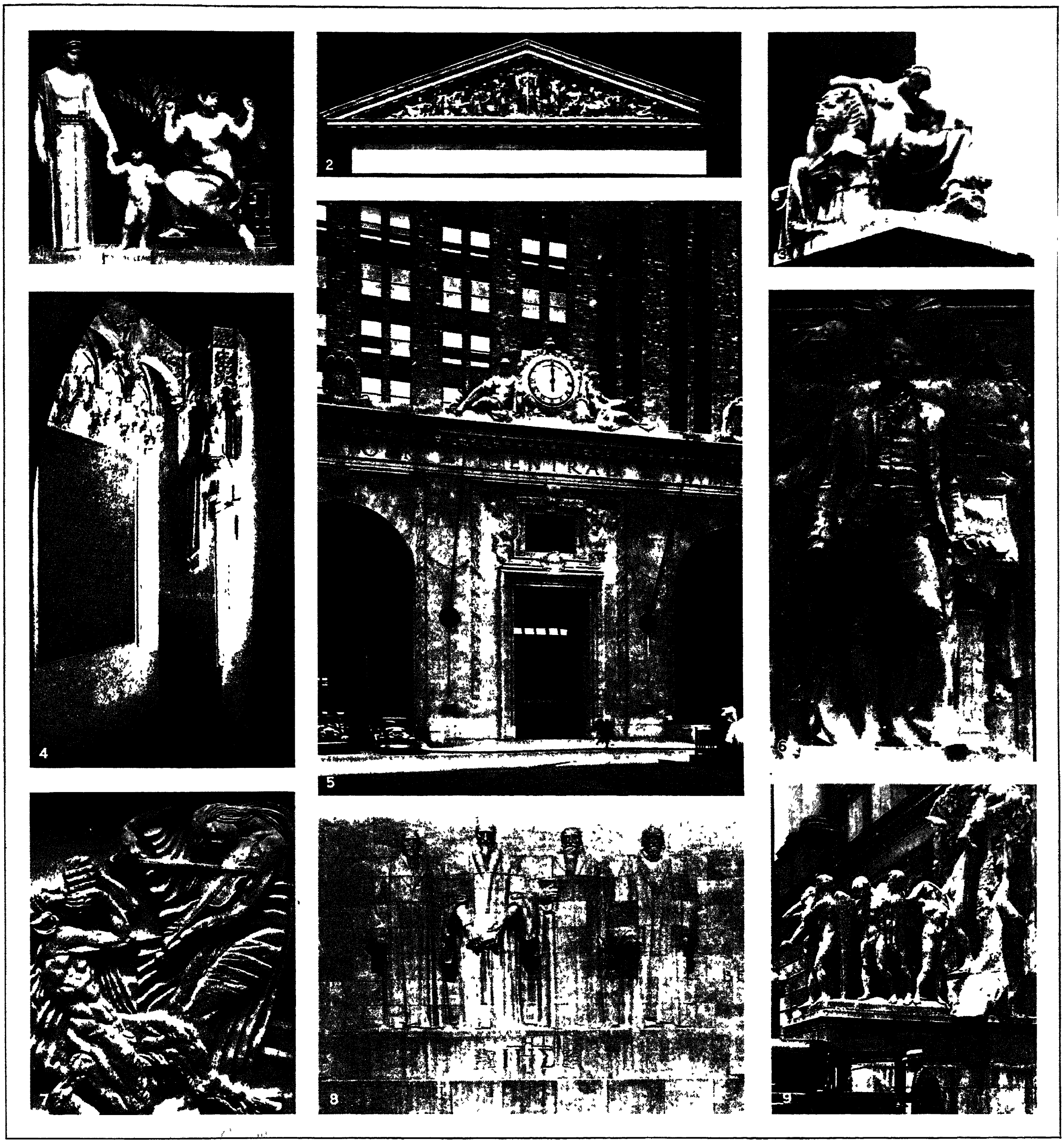
ARCHITECTURAL SCULPTURE OF EUROPE AND THE ORIENT

1. The Porte Royale, or central doorway of the Cathedral of Chartres, adorned with statues of royal saints, 12th century. 2. Kings of Judah, a group of 16 figures on the gallery above the Porte Royale, Cathedral of Chartres. 3. Middle portal of the façade of Notre Dame Cathedral, Paris. With the exception of the modern figure of Christ on the central pillar, the sculpturing (partly restored by Viollet-le-Duc) is early Gothic. 4. Detail of the façade of the Basilica of St. Mark, Venice, showing the famous bronze horses modelled by a Greek artist of the 3rd century. The façade, which is divided into two tiers of 5 arches each is pillared with marble and inlaid with scenes in mosaic. 5. The "Marseillaise" by Jean François Rude (1784–1855), on the east façade of the Arc de Triomphe de L'Etoile, Paris. 6. The Arc de Triomphe du Carrousel, Paris, erected (1806–07) by Pierre F. Fontaine (1762–1853) and Charles Percier (1764–1838) in commemoration of Napoleon's victories of 1805. Forty-eight feet in height, it is a reduced copy of the arch of Severus at Rome. 7. Panel by Jean Goujon (*c.* 1520–*c.* 1566) from the Fountain of Innocents, erected by Pierre Lescot (*d.* 1578) in 1550. In the Louvre. 8. View of the Huang Ssu (Yellow Temple), Buddhist monastery in Peking, China, showing the Pan Ch'an Lama Memorial built by Chien Lung in the 18th century. Designed on Thibetan lines, its marble sides are elaborately sculptured and it is surmounted by a cupola of gilded bronze. 9. Lion by Antoine L. Barye (1796–1875) in the Tuileries gardens. 10. Equestrian statue of the four princes in the great temple of Sri Rangam (built 11th–16th century A.D.) near Trichinopoly, South India



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EXAMPLES OF ARCHITECTURAL SCULPTURE

1. Group in glazed terra cotta by Carl Paul Jennewein (1890–) for the pediment of The Philadelphia Museum of Art. This is part of an unusual exterior decoration scheme in polychrome in the manner of the ancient Greeks, conforming with the classic design of the building
2. Model of pediment by Adolph Alexander Weinman (1870–) for senate wing of Wisconsin State capital, 1912
3. Statue in front of the Custom House of New York city. Executed by Daniel Chester French (1850–)
4. Memorial to the Dead in the American Cathedral at Paris, France, Mahonri Mackintosh Young (1872–), sculptor. Bertram Grosvenor Goodhue (1869–1924), architect
5. Ornamental clock for the Grand Central building in New York city. By Edward McCartan (1878–)
6. Statue of George Washington by Alexander Sterling Calder (1870–) on Washington's Arch at Washington Square, New York city
7. "Music" by Emile Antoine Bourdelle (1861–) for the Théâtre des Champs Elysées, Paris, France
8. Central group representing Farel, Calvin, Bèze and Knox, designed by Henri Bouchard (1875–) and Paul Maximillian Landowsky (1875–), for the Reformation Monument at Geneva, Switzerland. Laverrière, Monod and Taillens, architects
9. "The Burden of Life and Labour" by George Gray Barnard (1863–). On the capitol at Harrisburg, Pennsylvania

say, 4 or 5 ft. high, has no element to make it impressive or particularly beautiful, but executed in the size of the Cheops, it is wonderful. Another example of the importance of scale is the Washington Monument, very striking in its present proportion, but which at small scale would not be impressive or particularly beautiful. The same thing may be said of a small hill that is the exact shape of a mountain; the mountain is impressive but the hill is insignificant.

The Egyptians made small sandstone models with the idea of carving the full size in granite, and these models were studied with that point in mind. Thoughts of carving were controlled by materials, and it is not usually realized what an important part material and tools play in the making of a national art. All primitive peoples have had very poor facilities for the making of things artistic, and this has left a decided stamp, usually of strength, simplicity and beauty, not alone in sculpture and architecture, but in rugs, vases and utensils. Egypt's great carvings are, as a rule, in granite or porphyry, the hardest of materials, which made it next to impossible to cut depths or to model suavely with the tools at their command; the result was the solid mass and beautiful architectural form that the stone more or less held after being roughly shaped. The difference is readily noted between the Egyptian and Greek carvings of capitals over the columns, the simplicity of the Egyptian and the growing complicated Greek orders from the Doric to the Corinthian. The natural idea in the beginning was to follow the known order of Egypt, but the material, being easy to manage, led to new forms of less simplicity and a corresponding elegance, which, however, lost in power and fundamental beauty.

An advantage that the Greeks and Egyptians had over the northern sculptors was in the fact that they could work constantly outdoors in loggias and patios. Michelangelo made the Medici tombs in the Loggia dei Lanzi, an ideal place to study the effect of light and shade, with the direct outdoor light falling on the figures. The light in that particular spot can best be studied where there is now placed the group called "The Rape of the Sabine Women."

Archaic Greek.—The Archaic Greek period was most fascinating and delightful; it had a certain wonderful grace, primitive and grotesque. It was playful, light in vein, and beautifully adapted to architecture; it seemed to fill a required space with a flowing richness of design incomparable, as in the Olympian pediments, for instance, although the modelling in itself does not approach that of the Parthenon groups, 500 years later. In the Olympian pediment, the massing of the volume of sculpture was placed beautifully over the capitals, allowing the darks to follow the shadows between the columns. The figures were interwoven in such a manner that there was a constant flow of light from one mass to the other, not a perfectly flat light, but a gradual tapering effect of light and shadow making a wonderful play of colour through the design. This moving effect followed from the end of the pediment straight up to the centre from both sides where figures standing erect stopped the movement, and gave a perpendicular feeling from the centre of the pediment through the centre of the façade. This same effect was carried out in the Parthenon, according to the drawings of Carrey, with a like result.

Greek.—From the Archaic there was a gradual development into the period which we know as the greatest in Greek art; at Athens, with its Parthenon and Erechtheum, many other wonderful works were being built. The Erechtheum is one of the choice bits of architecture of the world, with its superb caryatids, figures possibly the most closely allied to architecture of all the Greek period. Another superb decoration used on Greek buildings, which is now a criterion, is the acroteria (*q.v.*), which gradually developed into a most beautiful form. It is founded on a plant basis, with the use of a growing character which has a beautiful sense of proportion, subtracting all realism and creating a motif that is one of the greatest inventions of all sculptural decorations.

Three of the most wonderful pieces of sculpture used in connection with architecture that have ever been produced are the so-called "Ilissos," "The Fates" and "Theseus." The "Ilissos" is undoubtedly the greatest piece of modelling that has ever been produced by man. It may not have carried architecturally as well from a distance as some of the groups in the Olympian pediment, but one can hardly question the high standard of taste of that period and it was very likely perfect from all standpoints. The figures known as "The Fates" with their wonderful draperies are marvellous, beautifully designed and yet solid and monumental, and surely make a superb shape in the spaces for which they were designed. The two connected figures of the three "Fates" are infinitely superior in workmanship to and more beautiful than the detached third figure. It seems that only here and there one sees the touch on this figure of the master hand that did the other two. The group of two is so marvellously massed in plane and volume, and yet so perfectly drawn and designed that the layman might look at the group without realizing its geometric shape. It is made with three broad planes, practically flat, with the carving extending in and out in a very slight degree. Michelangelo has used this same method, cutting a block into triangular shapes, making a group of figures by drawing them on the three surfaces of the plane and carving into those surfaces, but leaving parts of the figure (draperies, etc.), to touch the surfaces in all the planes. This is particularly noticeable in his group, "Descent from the Cross." All great sculpture seems to have this feeling of volume, mass and geometric shape. It would seem that "Ilissos," "Theseus" and "The Fates" were the work of one man, but it is difficult to believe that they were done by Phidias, the several works known to be done by Phidias having a much more rigid character. There is a replica of a sketch which is called "Athene of the Parthenon," and was evidently a working model. This is tremendously robust and powerful in volume, but lacks that wonderful beauty which the previously mentioned figures have to the last degree. The sculpture of the Parthenon pediments varied greatly and must have been the work of numbers of artists.

From that period on, sculpture gradually became less virile and less fitted to architectural settings. Evidently the sculptors felt that they wished more realism and even went so far as to show textures in draperies, an unknown thing until this period. The Romans obtained Greek sculptors and required them to make copies of some of the finest of the Greek works of art. Many discoveries of such figures are still being made in Italy—a fortunate thing for the art of the world.

Italian.—Except for portraits, Roman sculpture was less interesting in every way than the Greek, and there was a lessening interest in architectural sculpture, which again came to the front with the Italian Renaissance period; and here again we have examples of some of the greatest pieces of sculpture known to the world. Such names as Della Robbia, Donatello, Michelangelo, Verrocchio are among the greatest, and the work they produced is close to the high-water mark. At this period, two of the greatest equestrian statues were made, the Colleoni and the Gattamelata. It is extraordinary to relate that undoubtedly these two characters would have been entirely forgotten to the world if Donatello and Verrocchio had not made them live for ever in enduring works of art. The statues, "Night and Day" and "Morning and Evening," on the tombs of the Medici by Michelangelo are among the greatest pieces of sculpture existing.

Gothic.—In all of the periods mentioned, sculpture followed the prevailing type of architecture: the long and low, or horizontal; the Egyptian, Greek or Renaissance type. A direct contrast to this style of architecture is found in that of the Gothic period, which, instead of following the line of the earth, reached into the heavens, and with the architecture the sculpture followed. Gothic sculpture is particularly attenuated and extended, the necks, body and legs of the figures being thin and long, but when viewed from the ground at a height of 50 or 60 ft., the figures seem to reassemble themselves and appear in perfect proportion. Apparently the figures were modelled by men who understood how they would look at a height, or possibly modelled in place, or at least tried in the position in which they were to be seen. In no other period has sculpture played a more important part than in Gothic architecture. It was used to embellish and colour, to give light and shadow to doorways and spires, and, in fact, the most

powerful effects of broken shadows were brought out by sculpture. Figures, animals and gargoyles were used as symbols as well as decorations in the Gothic scheme as they were in the Egyptian or Greek religions. A strange motif was the gargoyle, grotesque, with a sense of humour and a realism in spite of the fact that it is perfectly architectural in ensemble.

As an example of fine description of Gothic architecture, the following is quoted from Victor Hugo on the Cathedral of Notre Dame:

> Its front showed in succession and together: three ogive carved-in great doors; the embroidered and lace-worked ribbon-band of its twenty-eight niches for the statues of kings of Israel and Judah; an immense rose window flanked by two side-windows, as a priest is by his deacon and subdeacon; the high, frail gallery of trefoil arcades carrying a heavy platform on its slender colonnades; and finally, the two black, massive towers with their sloping roof-sheds. All these were the harmonious parts of a magnificent whole, piled up one above the other in five gigantic storeys, broadening out before the eye without confusing it with all their countless details of statuary, sculpture and carving, all powerfully "drawn in" to help along the quest of grandeur of the whole building. It was a vast symphony in stone, so to say, the colossal work of one man and one people, a complete composite whole like the "Iliad," whose sister it is. The prodigious product of a union of all the forces of an age, on whose every stone we see stand out in a hundred ways, the fancy of the workman disciplined by the genius of the artist. In a word, it is a human creation as strong and as fruitful as the divine creation from which it seems to have borrowed its double nature; variety and eternity. And what has been said of the whole church, of the Cathedral of Notre Dame, applies to all these Christian churches of the Middle Ages. All is contained in this, developed out of itself, logical and well-proportioned. If you measure the giant's big toe, you have measured the giant!

French.—Apart from French Gothic, we have a wonderful period of sculpture in France related to architecture. For a time there was a decided tendency to keep the sculpture from being at all realistic, resulting in a type that was very wooden in character. It was actually more architecture than sculpture, and there is always a moment when architecture and sculpture clearly meet. Sometimes they overlap; architecture becomes sculpture and sculpture becomes architecture, as in the case of the work of some of our present day modernists. "The Dance," for instance, on the façade of the Grand Opera House in Paris tends toward the realistic, yet it has perfect balance. The other groups on the façade are stiff and wooden in comparison. There is a story to the effect that when "The Dance," by Carpeaux, was put up, it was so hated that acids and ink were thrown over the marble. Discoloration can be seen to the present day.

The two types of sculpture are manifest in the Arc de Triomphe. The marvelous group of "The Marseillaise," by Rude, is very realistic in its movement and modelling, superb and courageous in its design, but it still holds its place in its architectural balance with such perfection that the other groups seem rigid, and so much like architecture itself that the fine, relieving note is lost. Yet, at the time these works were set in place, the less beautiful groups were admired as much as, if not more than, the Rude group. Now, there is no question in the minds of the artists and laymen which group of the Arc de Triomphe is the greatest.

The Louvre has its succession of fine pieces of architectural sculpture, among them some lions by Barye, and a beautiful pediment group by Carpeaux called "Flora." The bridges over the Seine in a later period come in for their share of architectural sculpture, but few of them have the solidity and power of the Rude and Carpeaux groups. They seem to be rather of the explosive type of sculpture, with broken silhouettes and flaring lines which weaken the groups to such an extent that they seem meagre and poor—particularly those of the Pont Alexander III. and also the groups on the Grand Palais near the north end of that famous bridge.

Rodin, one of the greatest French artists, was a superb modeller, with once in a while a sense of power and volume that tended toward making sculpture particularly architectural, but he was more often lacking in the sense of sculpture fitted to architecture. His "Gates of Hell" are famous mostly for the beautiful bits of modelling and design rather than from a sense of their fitness to architecture. It may be said of Rodin that he constantly demands that sculpture shall express moods and conditions which more properly belong to other arts.

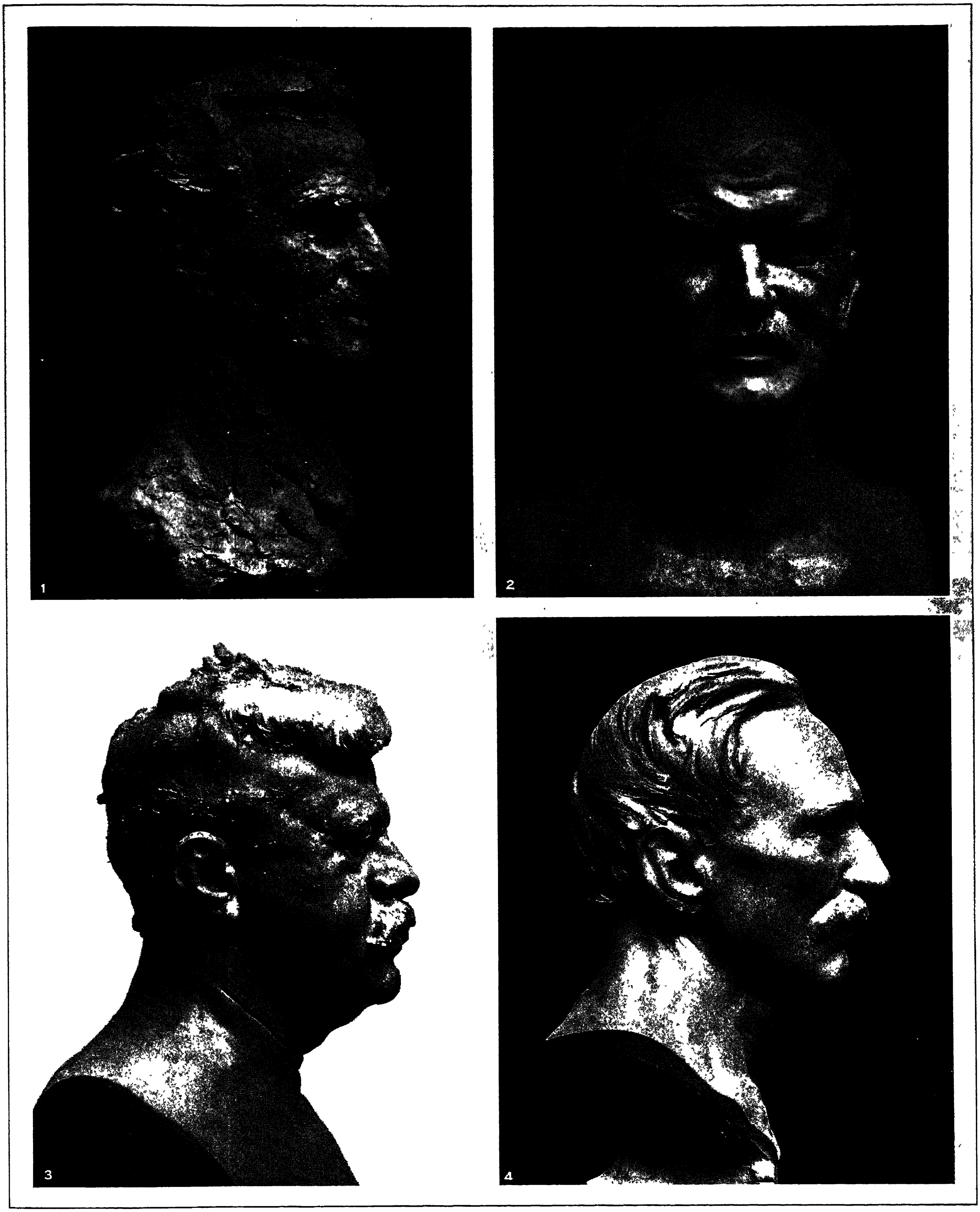
Modern Tendencies.—At the present time a type of sculpture is being used which more nearly forms a unit with architecture than anything that has been done for a long period. In America St. Gaudens had a fine sense of the relationship of sculpture to architecture. He was really a sculptor of monuments before anything else. His Adams memorial in Rock Creek cemetery, Washington, was fitted to architecture, although as a matter of fact it may be said that the architecture is fitted to the sculpture; as a whole it is a perfect combination. In front of the Custom House in New York city there are four fine groups by Daniel C. French. One called "Africa" is original and unusually architectural in its form, and is a high mark in sculpture.

It is interesting to note the changes in types of architecture. This has many causes, such as utilitarianism, climate, religion and geography. In New York it may be attributed to the fact that spaces are small and elevators are used so extensively. The buildings are carried into the air rather than along the ground, and the results have been a new type of sculpture. Other examples are the Nebraska State Capitol, the Kansas City war memorial, and nearly all city buildings. The sculpture seems to grow from the architecture into realistic forms of living things, either plant or animal, tending toward the modernistic types. Bas-relief is being used as much as it was used by the Egyptians. This keeps sculpture and architecture on the same plane, but it thereby loses in richness and a difference of plane which was sought after by architects and sculptors of the past. Even the figures which are supposed to represent sculpture in the round are flattened in parts, with the torso, arms and heads growing into the full round. Other evidences that architecture is meeting sculpture and that sculpture is growing into architecture is shown in the fact that architecture is becoming more fluid and sculpture more rigid. This may lead to something that has never been done before, but more likely this sameness of treatment will be detrimental to both architecture and sculpture.

With the possibilities that concrete brings to architecture and sculpture, there is only the hope that good taste will prevail to such an extent as to prevent art from succumbing to the ease with which this material can be used, making a period approximate to the one after the invention of the jig-saw, when all façades and front porches were made of ginger-bread design, owing to the facility with which the work could be accomplished. This tendency to merge architecture and sculpture presents the likelihood of missing something fine in not adhering to what Shakespeare speaks of as "excellent differences."

Composition is subtle and almost incomprehensible, but there are in all great sculptural pieces certain vital requirements. The first is volume, including shape; the second is the intricate lacing of the parts in rhythm; and the third and most vital is perfect feeling, or the co-ordination of the body into a whole. The brain can think one thought at a time; that thought makes the body one rhythmic gesture under the same central thought control. This follows through groups of people, as shown by the fact that the controlling person in a party is the moving power of all others; otherwise the individuals that compose a group of people are not perfectly harmonious. In an equestrian statue the horse must be dominated and controlled by the spirit of the rider. The great difference between the Colleoni and the Gattamelata is that the rider of the one is filled with verve and energy, which is reflected in the horse, whereas the rider in the other is philosophic, quiet and dignified, qualities also depicted in the horse that he rides. Any one of these vital points left out of the composition would mean that the work was not a masterpiece.

There is no end to the variety of conceptions if these themes are adhered to. What has been done in sculpture, as well as the other arts, is merely a scratch on the surface; those who say that everything has been done cannot visualize the untold possibilities of sculpture in its relationship to architecture. (*See* other sections of this article, such as *Decorative Sculpture; Monumental Sculpture:* also articles under SCULPTURE TECHNIQUE.) (J. E. FR.)



HEADS BY CHARLES GRAFLY ILLUSTRATING SUBTLETIES OF CONSTRUCTION AND COLOUR

1. Sketch showing how a smile affects the construction of all features. 2. Portrait which gives an impression of the size of the man by the careful treatment of the neck and shoulders. 3. Portrait showing treatment of fluffy blond hair. 4. Portrait showing treatment of dark hair turned gray

DECORATIVE SCULPTURE

Under the general heading of decorative sculpture is included all sculpture made primarily as decoration or part of an architectural scheme, or which is so designed as to fit into an architectural setting, or which, though not designed for any particular place, is yet so considered in its form relationships and harmonies of line and mass, that it becomes an abstraction in form of the object or subject represented. Thus it may be a work created in the artist's studio of the expression of some sculptural idea or emotion alone. It may be a large or a small work, a "Perseus Decapitating the Gorgona" by Cellini, a "Narcissus from Pompeii," or a small sculptured work from the Orient. It is rather a question, in the broadest sense, of the consideration of the subject of decorative sculpture, that it is the treatment of the form of the subject represented, the formalization or conventionalization of natural forms, rather than a strict reproduction of the forms of nature themselves that renders sculpture decorative. Thus it follows that all good sculpture is in a certain sense decorative, or at least has a large percentage of this decorative element in its conception. This discussion, therefore, does not involve so much a classification of a certain kind of sculpture as it does an element which should be present in all good sculpture. The sculpture of the Egyptian monument depicting gods, men and beasts is always fundamentally decorative. Each line and form is conceived in its relationship to those about it and to the architecture on the surface of which it is placed. It becomes at a distance a pattern taking its place in detail on the mass of the architecture, yet it may be emotional and dramatic in its intent, depending upon the imagination and the vigour of the sense of visualization of the artist. So, too, with the architectural sculpture of the Greeks. The pedimental groups and the frieze of the Parthenon are so beautifully proportioned to the architectural setting as to become an essential part of the architecture itself, and withal, a nobly expressed idea of high emotional quality, combining a spiritualized representation of natural forms such as has hardly been known in art. Gothic art (*q.v.*) is always decorative, whether it is of carved stone panels, tympana or figures of a 13th century cathedral, or the delicately chiselled bronze or ivory statuette. With Chinese sculpture (*q.v.*) it is practically the same and the carvings of primitive people are a formalized and therefore decorative representation of the chosen subject-matter.

Sculpture Arrangements.—A work of art always looks best when it is properly shown in the correct setting and when isolated and set off by appropriate surroundings. Our modern museums recognize this fact and their curators carefully study the lighting conditions, the texture and general quality of the background, as well as the association of one art object with another. So it is with a small bronze figure done by a sculptor of the Renaissance, not necessarily designed with a definite setting in mind, and though the sculptor did not know exactly what background was going to set it off, still he did so clearly have before him the general type of table, furniture or pedestal of the style of the period on which his sculpture was to be placed, that he could not well go astray. So a painter of that period painted a portrait or a subject piece for a patron without knowing the exact wall or place in which it was to go, yet he was careful to design the frame to surround it and make it in harmony with the picture. The sculptor designed the base or pedestal of his marble or bronze statue or statuette. The painter and the sculptor were generally architects as well, and the artists of this time began their training in what may be termed the applied arts. Thus the great artist was the flowering of natural genius which was to begin with natural craftsmanship and which had been trained in the application or association of art.

Sculpture was rarely created during the Gothic age except for a definite purpose or place and it was only with the period of Italian classical revival of the 15th century that began the flair of what is called "art for art's sake." Princes became collectors of art objects and it was not long before they began ordering painted or sculptured representations of mythological or other subjects and to build galleries to hold their collections. Even after this influence of the collector-connoisseur had been felt, decorative sculpture flourished in Europe through the baroque period and into the 18th century, where it found beautiful expression, especially as applied to garden sculpture, of which that at Versailles in France and of the Villa D'Este and at Frascati in Italy are examples. The decorative tendency continued on during the classical revival of Napoleonic times, but after that comes a period which lasted down to the 20th century, during which nature was copied in a photographic manner rather than formalized and interpreted, and the decorative sense in sculpture was to become almost completely lost.

Schools of Art.—In our own time comes a reaction against the naturalistic school and the beginning of a new classical revival, the Viennese secessionist movement being one of the leaders in this direction, and in Scandinavia, Germany and more recently in France, it is of vital moment. In this connection it would be well to mention the Decorative Arts Exposition held at Paris in 1925 where French decorative sculpture was magnificently shown, and where it revealed the many interesting tendencies and accomplishments in this field. Most other countries were represented by splendid achievements as well. This classical revivalist effort has not been especially coherent as it has lacked the direct traditional tendencies of the former periods of this nature because of the conditions of modern life which surround it and also because of the various other revolutionary tendencies toward which modern art is diverging. Cubism and post-impressionism (*q.v.*) have left their strong influence, and the fact that until recently and since the middle of the 19th century sculpture has been conceived and carried out as the interpretation in stone or bronze of a clay model rather than in the final material itself. Only now is coming the reaction against this tendency and there is an important school of sculptors who are working directly in the final materials of their art.

One of the factors at work in the world of modern art is the wide-spread appreciation of primitive art. Negroid sculpture, Polynesian woodcarving or Alaskan carvings in wood and slate have taken their place beside the ancient art of Egypt, China, India and elsewhere and have created definite impressions on certain schools of modern sculpture. These impressions are the result of the great publicity given lately to the interesting discoveries of what has heretofore been inaccessible. Naturally, in the handicraft of all primitive peoples the decorative element is strong. (*See* ART: *Principles of Art.*) Conservative art museums are devoting space to the exposition of these early decorative objects to a degree formerly unknown. Art dealers are exploiting it and critics are devoting much consideration to its qualities. A multitude of books devoted to the illustration of the objects has appeared within the last few years and the appreciation of primitive art has in some circles seemed to supersede that of the more highly developed classical kind.

There is a tendency toward a certain chaotic condition in some schools of modern art due to many causes, of which may be mentioned the lack of well defined rules of limitation, which bring about a mood of endless personal experimentation. Though sometimes interesting and promising of great things to come, and, in the hands of an artist of great talent, much sought after and appreciated, yet, because of their remoteness to tradition or because of their peculiar qualities, it is difficult to place these creations advantageously and make them fit into settings of modern life and appear in terms of what has heretofore been considered beautiful. For after all, and in the long run, art exists and will survive because it is beautiful, and when the contrary is the case the movement which brought it about will change or be short lived. Other tendencies of this lack of relatedness are caused to an extent by the fact that art is not as essentially a part of the life of to-day as it was in former times. It is a thing apart and not integral to our social order. Machine-made objects take the place of hand-made ones and the development of handicraft is not on the increase. Quantity production and standardization are a bugbear to the man who loves the beautiful artisan-created object. The variety and somewhat accidental qualities of hand-made work have a charm that the machine-made ones cannot reproduce, and a decorative work, though of original beauty of design and of

value as a unique piece, becomes undesirable when reproduced mechanically by the thousands—the Venus de Milo loses her charm as a cigarette advertisement.

Modern Tendencies.—Architecture, termed the parent of the arts, is beginning to arrive at a crystallization of certain well defined styles, more especially in America where restriction laws have dictated many of the new forms, and where the great height of the buildings has made it possible to use ornamentation in a new form. Self-imposed rules are coming into being and decorative sculpture is beginning to feel the influence toward an elimination of unnecessary detail and a reduction to pure line and form.

Other influences are being felt in modern art and sculpture in particular, as in the appreciation of the fleet lines brought into being by the swift moving automobile and the aeroplane lines of speed. It is the reflection of the spirit of our day in the language of the day, and it is ever changing and always fundamentally optimistic.

To sum up, let us say that the elements which are most essential to decorative sculpture are composition involving a pleasing distribution of masses, inherent beauty of line and form, and in which the open spaces between forms are as carefully considered for justness of shape as the forms themselves, and a rhythmic feeling between all associated parts from all points of view. These qualifications are age-old and have been appreciated by men from generation to generation.

Great sculpture is inherently decorative and in a truly great statue the inspirational or imaginative force that impels the artist to create and to give actuality of life to his work is that quality which arrests our imagination and makes us feel the spirit that is contained forever within the form of the marble. It is then that marble holds a throbbing soul and inner force. Afterwards the cold eye of appreciation is turned to the surface of the statue and knows the qualities which go to make up its superficial beauty and harmony, knows why the hand wants to touch it—for one of the primary appeals of sculpture is to the sense of touch and therein is one quality which painting has not as it appeals only to the eye. We conclude that in great sculpture the emotional and inner life quality comes first, then follows the sensuous feeling for form with its outward expression of harmony and decorative rhythms, which is always of secondary importance in the work of art.

MATERIALS

Terra-Cotta.—The sculptor of to-day works with materials very similar to those that have always been used. Terra-cotta or baked clay in one form or another is perhaps one of the earliest substances which man has attempted for artistic expression. Primitive races have made use of small clay figures. In Egypt and Greece, in India and China, the earliest civilizations have known this art and many beautifully modelled figures, glazed or unglazed, have come down to us through the centuries. The early Greeks executed sepulchral figures and sarcophagi in terra-cotta, of which the one in the British Museum is a fine example, and even heroic statues and groups, such as the group in the Villa Pope Julius in Rome from Veii, of Hercules, Apollo, and Hermes. Of these only the figure of Apollo is intact but there are fragments of the others. Terra-cotta or pottery was used in a masterful way by the sculptors of the T'ang and Sung dynasties in China. From Della Robbia all the way down through the ages to that flowering of masterpieces in this art of the 18th century many different styles and schools have brought it to a beautiful perfection. In primitive America the sculptured art of the Aztecs, the Mayas and the Incas was in a large part terra-cotta. (*See* SCULPTURE TECHNIQUE: *Terra-Cotta.*)

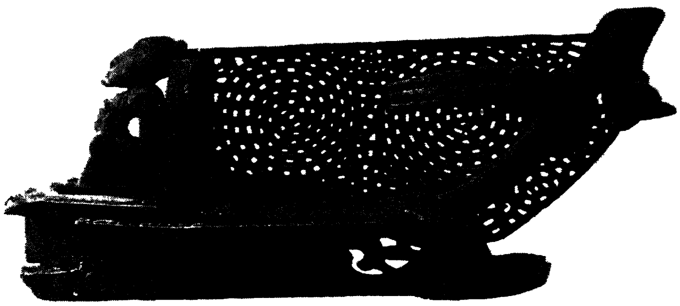
Why is it that this substance has persisted throughout the ages and what are its advantages? First of all, it is easily modelled and sculptors who are practising their art of difficult and tedious technique have been anxious to make use of a material which lends facility to their work. Another great advantage which terra-cotta has is that after being baked it becomes, with proper handling, one of the most durable of substances, not subject to erosion or corrosion. Finally, it undoubtedly appeals because of its possibilities in colour. The use of various toned clays and the possibility of the decorative effect arrived at by coating it with a brilliant or soft-toned glaze in a great variety of colours has appealed to many sculptors who feel the limitations of their art as practised in other materials in regard to colour. (*See* POTTERIES AND PORCELAINS.)

Bronze.—Bronze (*q.v.*) is a material which, though not used quite as early as the clays, came into the hands of man thousands of years ago. The Egyptians used bronze in making statues. It was also a favourite material of the Minoan civilization and the Chinese were masters of it in the third millennium B.C. As a material it has advantages similar to those of terra-cotta for the sculptor can make his original model in clay, in the same method as that used for the making of terra-cotta, and the process of casting is very little more difficult than that of firing terra-cotta. Moreover, bronze lends itself to easy and approximately perfect reproductions of the original model so that a number of copies can be made from the original. But perhaps the greatest advantage to the sculptor in the use of bronze lies in its tensile strength which lends itself to certain forms of expression quite impossible in stone, terra-cotta or any other non-metallic material. For instance a running figure may be so modelled as to touch the base with only the toes of one foot. Equestrian statues or figures of deer or other animals with slender legs can be beautifully treated in bronze and are strong and sustaining. An excellent example of this typical treatment may be seen in the statue of "Mercury" by Giovanni di Bologna or in a Quadriga group where the horses' reins and the finest of detail are executed in bronze. In addition to the advantages of this tensile strength are the advantages of finish permitting of the finest detail and considerable range of colour from pale brilliant gold or silver-like tones through the various greens, browns and even reds of the patinas which are natural to this substance.

Stone.—Marble and stones have often been thought of as the natural materials in which sculptors work, perhaps because of the fact that so many great masterpieces have been executed in them. (*See* SCULPTURE TECHNIQUE: *Stone Carving.*) Stone sculpture, though difficult in execution, has the quality of permanence which appeals in itself, and in addition it readily associates with architecture which makes such a considerable use of the same material. To the trained sculptor it is possible to make much more beautiful forms from a resisting material than from a soft one. The very resistance makes it necessary for the artist to have a more complete and well defined mental picture of that which he is executing. Soft material lends itself to the changing of volume but not to the perfection of vital form itself. It is undoubtedly this quality of hardness in jade which has led the Chinese to carve so many beautiful objects from it, and the Egyptians did their most beautiful work in the hard basalt and granite. These materials all have a fundamental structure which impose upon the artist considerations of compactness of mass and unity of form which in the final conception impress with their qualities of beauty.

Marble or stone also exists in many beautiful colours and represents better than any other substance the quality of human flesh. Its surface texture and its translucency as well as its colour make it the natural material in which to execute portraits of women or children where bronze because of its heavy colour would be inappropriate. It is especially too the material for garden groups or figures where it is desirable that the statuary stand out in contrast to a setting of verdure. (*See* section on GARDEN SCULPTURE.)

Wood and Ivory.—Due to the vulnerability of wood and ivory to climatic changes these materials can be successfully employed as a rule in comparatively small and compact arrangements, yet generally in Europe and in India and China, as well as with the primitive peoples, beautiful sculpture has been created in both materials. Of course, though those materials are easier to carve, the grain imposes another difficulty with which the sculptor must contend and it is in the turning of this grain to the purpose of the design and its execution that the artist must think. These substances lend themselves to polychromatic effects and to the application of gilding to their surfaces. (*See* SCULPTURE TECHNIQUE: *Ivory Carving and Woodcarving.*)



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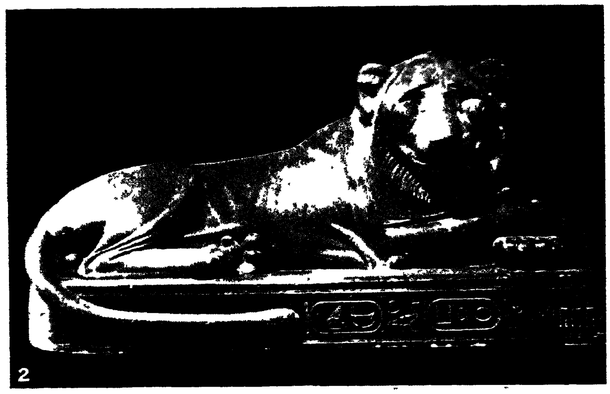

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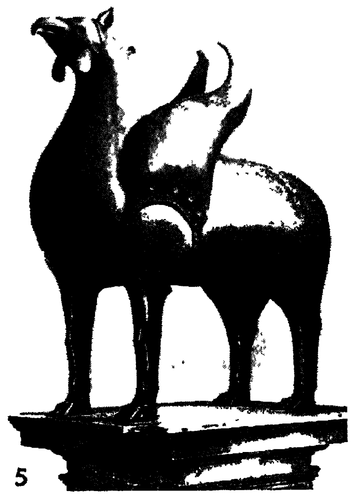

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EXAMPLES OF EARLY DECORATIVE SCULPTURE

1. Carved prow of a Maori canoe
2. Egyptian lion, 4th century, now in the Vatican Museum, Rome
3. Grotesque aquamanile (water ewer) of bronze representing St. George and the Dragon, 13th century, England
4. Copper figure of Siva (post-Vedic god of Hindu Mythology), 18–19th century, South Indian
5. Bronze griffin, Campo Santo, Pisa, Italy
6. Crozier of carved ivory, French, 14th century
7. Saint Nicaise and the angel called "The Smile of Reims," two of more than 500 statues that form part of the decorative sculpture in the 13th century cathedral of Notre Dame at Reims. The statues are shown in restored condition after having been damaged during the World War
8. "The Descent From the Cross," a group in the Louvre, Paris
9. Ivory statuette "Virgin and Child," Gothic, end of 13th century

PHOTOGRAPHS, ALINARI

ITALIAN SCULPTURE, FROM THE 14TH TO THE 19TH CENTURY

1. St. John the Baptist by Donatello (1386?–1466). In the Museo Nazionale, Florence
2. Bronze fountain figure of boy holding a dolphin, by Andrea Verrocchio (1435–88). In the Palazzo Vecchio, Florence
3. Statue of Victory by Michelangelo (1475–1564). In the Palazzo Vecchio, Florence
4. Mercury by Giovanni Bologna (1524–1608). In the Museo Nazionale, Florence
5. Pauline Bonaparte by Antonio Canova (1757–1822). In the Museo della Villa Borghese, Rome
6. Perseus with the head of Medusa, by Benvenuto Cellini (1500–71). In the Loggia dei Lanzi, Florence

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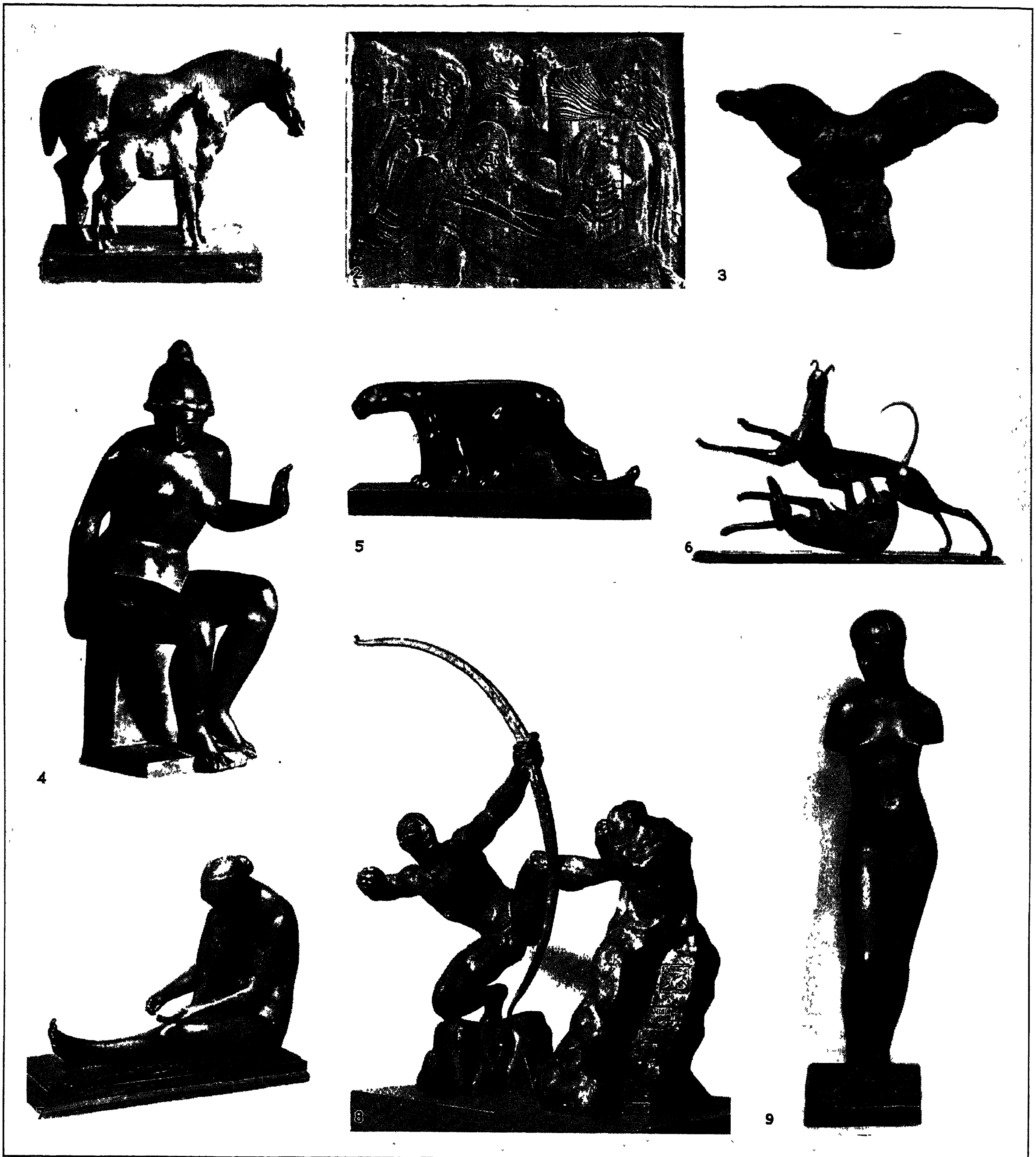
TYPES OF DECORATIVE SCULPTURE

1. "Baigneuse," an example of decorative sculpture by Falconet (1716–91), French. In the Louvre. 2. "Diana," by Houdon (1741–1828), French. Now in the Louvre. 3. "Nymph and Satyr," a group by E. McCartan (1879–), American. 4. "Dawn," a bronze statue by Arthur Lee (1881–), American. 5. "Dancer and Gazelles" by Paul Manship (1885–), American. In Cleveland Museum. 6. "Athlete Struggling With Python" by Lord Leighton (1830–96), English. In Tate Galleries. 7. "Mounted Amazon" by Franz von Stuck (1863–1925), German. In Metropolitan Museum of Art



BY COURTESY OF (1, 7, 8) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (3) THE AMERICAN SWEDISH NEWS EXCHANGE, INC., (4) THE WEYHE GALLERY, PHOTOGRAPHS, (2) ALFRED BOSSOM, (5) BONNEY, (9) CARL KLEIN

DECORATIVE SCULPTURE OF THE 20TH CENTURY

1. "Mare and Foal," bronze statuette group by Herbert Haseltine, English animal sculptor
2. "Deposition," wood relief by Ivan Mestrović (1883–). Yugoslavic
3. "Horse" by Carl Milles (1875–). Swedish
4. "Danae," bronze figure by Aristide Maillol (1861–). French
5. "Black Panther," by Mateo Hernandez (1888–), Spanish animal sculptor
6. "Hounds," by Wilhelm Hunt Diederich (1884–). American
7. "Woman at Her Toilet," bronze statue by Jane Poupelet. French
8. "Heracles Drawing His Bow Against the Stymphalian Birds," a group in bronze gilt by Emile Antoine Bourdelle (1861–). French
9. "Diana," bronze statuette (24 in. high) by Charles Despiau (1874–).

Polychromy in Sculpture.—One of the important elements in arriving at decorative effects in sculpture is the application of colour to its surface. In ancient times sculpture was generally polychromed. The savage people of practically all countries have liked to apply colour to statues of their deities, to the carvings used in connection with their religious rites, and to the masks worn in their ceremonials as well as to their architecture in general. The polychromy was usually in the nature of opaque earth colours, the principal tones used depending upon the country where found and the substances available, but with red and black dominating and white, yellow and green or blue used. The colour was applied in flat tones with usually no attempt at mixing or blending, and the quality of the vivacity of the idol or mask or other object was heightened by its use and the decorative effects of the ensemble intensified.

In Egypt, colour was generally applied to sculpture, and in particular was a feature of relief work. It was rather the colour effect that dominated in the picture than the shadow of delineation of the carving. In fact, one is inclined to consider the relief rather as a painting in which the drawing was made permanent by the carved and rounded outline. Here, too, unmodulated colours were used and often patterns and ornamentation were picked out with the brush rather than carved with the chisel. The sculptors of Greece followed the tradition of Egyptian polychromy and until Hellenistic times used colour in their statuary. Ornamentations in architecture were also painted but it was in the great chryselephantine statues by Phidias that the art of the use of coloured matter in sculpture reached its greatest expression. Here flesh parts were executed in ivory while an intarsia of gold and silver and ebony made up together with other materials the rest of the statue or group. It is master craftsmanship in the hands of genius of artistic expression. Early Greek bronze statuary was oftentimes gilded and silver was inlaid in the ornamentation of a robe or a fillet around the head of a statue. The eyes were generally done in colour of inlaid materials, giving an expression of great liveliness. With Hellenistic times in Greece and the increased tendency towards naturalism in sculpture, painting gave way and the Romans made less use of polychromy than the Greeks, although many statues have come down to us composed of different coloured marbles. The Gothic sculptors liked to paint their statues and the interiors of churches of that period were generally rich in colour. This tendency towards painting of statuary was maintained until the time of the Renaissance. But after the finding of excavated marbles from ancient times in Rome, which were usually without colour, and the general popularizing of collecting of antiques, sculptors gave up the practice which had formerly been usual. Chinese sculpture has always been characterized by its use of colour. One is sometimes inclined to think that they preferred to a greater extent the use of colour on their statuary than on their paintings themselves.

With the general influence on the moderns of the primitives in art it remains to be seen how and what will be the reaction. Indications are that interesting use will be made of the lessons learned and the ways indicated. And hand in hand with the most ancient of methods come those of the most modern. Chrome steel, nickel and aluminium are metals, the use of which has considerable decorative value. New methods of applying glazes and paints are in use in the industries of to-day and new paints and enamels influence our artists. New materials are being frequently invented which find beautiful use in the automobile industry, in the making of radio apparatus, and in many fixtures and objects of utilitarian purpose. Those serving the use of artistry and in the hands of the new school of craftsmen sculptors, it is to be hoped, will give to the coming age a brilliant addition to the use of polychromy and coloured materials in our art. (P. MAN.)

SCULPTURE TECHNIQUE. The following articles treat upon all the various mechanical techniques involved in the art of sculpture including Wood-Carving, Stone Carving, Ivory Carving, Terra Cotta. Further material will be found under the separate articles on BRONZE AND BRASS ORNAMENTAL WORK, LEAD IN ART, IVORY CARVING, WOOD-CARVING, TERRA COTTA, as well as the shorter articles on REPOUSSÉ, ENGRAVING, etc.

The theory of technique is treated under the general article TECHNIQUE IN ART and under the other individual articles preceding this section: Garden, Portrait, Monumental, Architectural and Decorative Sculpture; and it is necessary for the student to consult these articles as the techniques vary somewhat according to the application of the sculptor's work.

Further study of technique may be pursued in the articles or sections of articles on Greek Art, Chinese Sculpture, Japanese Sculpture, Indian Art and Archaeology, etc., as many of these articles, though written from an archaeological viewpoint, do nevertheless treat upon the techniques involved in the practice of these ancient arts.

WOOD-CARVING

Wood-carving consists entirely in a sort of elimination of parts obscuring the desired image. Although the mechanical process is simple, the training required by the carver before he can put it into practice is by no means simple. Firstly, the carver must have a clear idea of what he is about to carve; its shape and form have to be studied before he makes a cut. He must have long practised the use of his various tools; he must know how to conquer the very serious difficulty which the grain of the wood presents in every inch of his work. Many years of laborious practice at last enable him to master all these problems. Of course there are many cases in which such skill and knowledge are neither to be found nor expected, as for instance in the case of primitive work, where a kind of child-like naïveté compensates for the lack of skill. The more sophisticated carver is not content to stop at this stage; he experiments with new forms, invents new tools, and slowly builds up a coherent manner of work which embodies both knowledge of form and skill in the use of his tools. From beginner to master, from generation to generation, this goes on, and so shapes itself into a dignified art—an art which demands a keen love of beautiful form and a constant pleasure in the use of the creative faculties.

Acquiring Technique.—Two kinds of knowledge therefore are essential to the wood-carver. A knowledge of form and a knowledge of and skill with his tools. The beginner must learn to cut before he invents anything for himself. The grain of all kinds of wood runs in a fairly straight direction, but the cuts made by the tools go in every possible direction. This difficulty has to be cunningly mastered by subtle movements of the tools; it takes at least two years of constant practice before one has thoroughly mastered the art of "cutting."

When a carver begins to learn the use of beautiful forms those forms are to him never the precise counterpart of nature's forms. He has been long enough at his craft to have learned that purely natural shapes and forms are inexpressible in wood, and that his only chance of making his subject readable is to adopt the traditional "convention" in his treatment, wherein he must simplify all his forms, arrange them in agreeable groups and make the very most of the strong contrast between light and shade of which his subject may admit.

Up to this stage the carver has been learning what may be called the technicalities of his craft, and perhaps exercising his mind in getting a useful knowledge of form. In this respect there is probably no difference between the education of a mediaeval and a modern carver, but here the modern carver is often expected to remain satisfied, and to go on carving, not what he would himself like to do, but what he is told to do by others. An architect, "builder," or some patron of art may give him a "design" to follow—none of them, probably, knowing anything about the use of carving tools. A handicap like this puts a full stop to the progress of the craftsman; he ceases to think of his craft in any other way than as a source of livelihood, and thus the innate talent of our wood-carvers is lost. This was not so in the case of the mediaeval carvers. There can be no doubt that there was someone to guide the work going on in the shop. This would be in all probability the master carver who controlled but did not fetter. This will be clearly seen by a reference to the illustrations, showing work of 14th and 15th century carvings. Such work could not have been done by fettered hands. Here fancy is seen to play within well kept bounds—the best treatment for a given position

has been decided by actual experience, be it under a *miserere* seat, on a stall division, or the orderly arrangement of a rood screen. This delightful playfulness of fancy has disappeared from our workshops, and instead of invention, spontaneous and living, we get miles of some stupid kind of "ornament" generally copied mechanically. It would be rash to look for an early change for the better in this respect, but there are some signs of improvement.

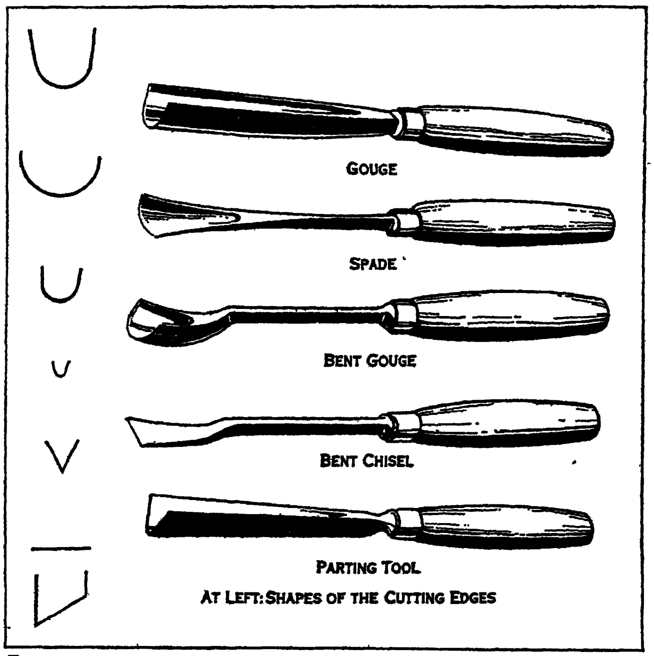


FIG. 1.—A FEW OF THE MORE COMMON SHAPES OF CARVERS' TOOLS WHICH ARE MADE IN MANY SIZES AND SWEEPS OF EDGES

Many architects are now trusting their carvers with more liberal freedom in the execution of their instructions, a movement which must have a good effect on all the workmen in the shop, where, as a rule, the manual dexterity of the carvers is in every way equal to that of their ancient predecessors, but where they seldom find much encouragement for their inventive faculties.

The Wood-carver's Tools.—The tools most commonly in use consist for the most part of chisels and gouges. They vary in size and shape. The gouges may run from $\frac{1}{16}$ in. to over an inch in width and have a variety of "sweeps" or curve of cutting edge: the chisels likewise are of different widths, and they are in three or four different forms, "straight," "bent" and "corner" (*see* fig. 1). The number of tools which may be used by a carver varies of course in accordance with the work he is doing; sometimes he will use half-a-dozen, sometimes more, these being a selection from his whole set which, in itself, may amount to several hundred. When the tools are in use, they are laid beside the carver with their cutting edges towards him in order that he may quickly pick up the one he wants.

These tools have to be kept very sharp and this requires great skill and care on the part of the carver. Blunt or mis-shapen tools cannot be used with effect. The stones he uses for this purpose are of various kinds. Some use "Turkey," some "Washita," but there are many more, including artificial stones such as Carborundum. For the inside of gouges "slips" of these stones are used shaped to the curves required, and for fine or very small tools a slip of "Arcansas" is used, a thin slip of very close texture. As a rule, soft wood like pine, requires a sharper tool than the hard woods like oak. Therefore tools used for this kind of wood are sharpened with a more acute edge. Both sides of a carver's tools are rubbed to a bevel, that which rests on the wood being the longest bevel. The inside only receives enough rubbing to produce a clean cutting edge. Some other tools are shown in fig. 2. The mallet is used for the heavier kind of work, where forcible blows are wanted, but mostly, for the lighter use of his tools, the carver uses the palm of his hand as a mallet when such is required. The bench screw is passed through the top of the bench and screwed into the lower side of the wood, which can thus be turned about on the bench; the use of the cramp is obvious, but there is a larger one known as a "bench holdfast" for thick wood which cannot be cramped to the bench. A carver's bench must be of very firm construction to remain steady under blows and sideway pressure. It is generally about 3 ft. 2 in. high and of a length and width suitable to the space he has at command: it should have the light in front of it, never over it. The benches in a carver's shop are often of considerable length as much room is required for long pieces of wood.

Woods Used in Carving.—The woods in common use are oak, yellow pine, and limewood, but many others are used in a less degree such as mahogany, walnut, chestnut, and for small articles box, pearwood and cherrywood. Teak is sometimes carved but it does not compare well with oak. The choicest kind of oak for the carver is English oak, as its texture is hard and close and its colour is beautiful. Next to this comes the Austrian oak which cuts freely but is not so close in its grain. The American variety is not so good for the carver's purpose; it is caney in texture and unpleasant in colour. Chestnut is not much used for carving but it might have a wider acceptance because it is very like oak and cuts well under the tool. This, of course, is the "Spanish" or "sweet" chestnut, variety. Mahogany likewise is not much used, except for very inferior work, where it is always French-polished. Mahogany, though, may be very useful wood if properly treated; if it is left unpolished, or simply waxed, it in time takes on a very beautiful colour but passes through stages of unpleasantness before that arrives. It is a good wood for figure carving which is intended for painting and decorating. For furniture or other work which comes close to the eye there is no better wood than Italian walnut; the most delicate carving may be done upon it. The "American" walnut and "French" walnut are much used for smaller work, but are not very amenable to the more delicate touches of the carver. Limewood is mostly used for figure work which is intended for decoration, although sometimes left in its natural state, as in the work of Grinling Gibbons.

Methods.—Having drawn the outline of the work in hand upon the wood the carver proceeds to make a groove all round this outline with a gouge of small size called a "fluter." Then he takes up a fairly large gouge of quickish curve and with it digs out all the wood between the standing parts until he approaches the depth he

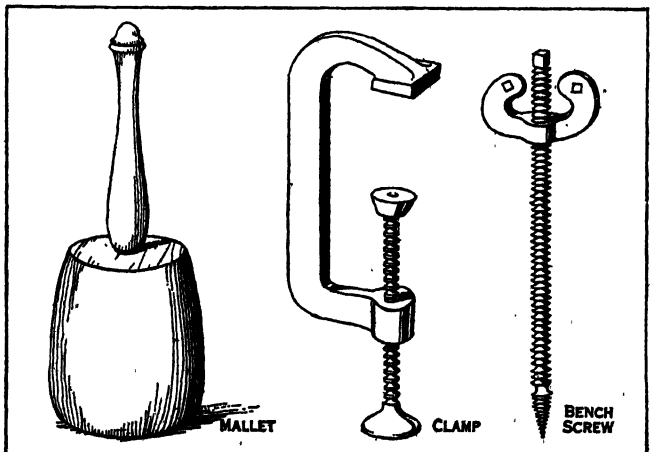


FIG. 2.—WOODEN MALLET, USED ONLY FOR HEAVY WORK; CLAMP AND BENCH SCREW USED TO HOLD WORK FIRMLY ON BENCH

requires. Then with a gouge of flatter curve he cuts down the sides of the projecting parts until they are nearly upright. His next movement is towards a more complete realization of his design. He begins to indicate the positions of veins, lower parts to their respective planes, and in general tries to put in the first stage of any detail such as the articulation of a leaf, berries, tendrils, etc., but all in a tentative way, leaving sufficient wood around every part to allow of little amendments as the work develops. This process, up to the point he has reached, is called "bosting in," that is, getting his work into a rough state of readiness for the "finishing." This is considered the most important part of

PHOTOGRAPHS, (1, 2) ALINARI, (3, 4) EYRE AND SPOTTISWOODE, LTD.

ANCIENT AND MODERN STONE CARVING

1. Slave by Michelangelo from the tomb of Julius II.
2. Head of "Evening" by Michelangelo from the tomb of Lorenzo de'Medici
3. Low relief of horsemen from frieze of the Parthenon
4. The Three Fates from the east pediment of the Parthenon
5. Sculptor finishing work on a marble

the work of a carver. The work, when it has been through this process of "bosting in," should be so suggestive of the final stage that it is not difficult for a skilful carver to realize completely all that is meant by the more or less rough details in it. The "finishing" is the clearing up of details by completing the contours, levelling the ground, making mitred corners, and should, if properly done, include securing a pleasant texture which may display the quality of the wood.

The foregoing applies to work in moderate relief. Low relief carving or very high relief requires a somewhat different treatment. Low relief requires in the carver a very high level of knowledge in the matter of drawing, because it depends so much upon the way in which its leading lines are disposed. Not less important is the management of the surface contours, and as in low relief not one of them can be even approximately true to the real form of the object represented, it follows that the contours must be delicately graduated so as to suggest roundness where it does not exist (at least to the same extent). All this means in the carver good draughtsmanship, and a very keen sense of form. In low relief, therefore, there is very little to do in the way of "bosting in." It is mostly sharp cutting and drawing with the tools.

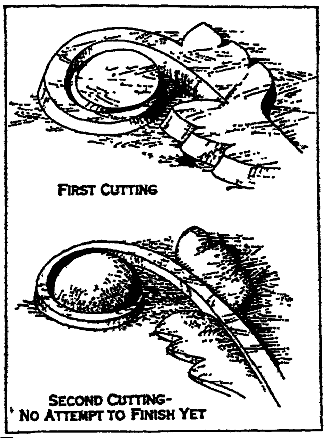


FIG. 3.—STEPS IN CARVING A DESIGN: ABOVE, DESIGN OUTLINED AND WOOD AROUND IT CUT AWAY; BELOW, MODELLING STARTED

High relief carving, or carving in the round, demands much knowledge of form on the carver's part. Let us suppose that he is carving a head; he must know to a nicety and by heart the exact proportions, the position of each feature and he must find these details by a process of clearance which is very confusing. Figure carving in a modern shop is often done as a divided labour: that is to say, one man makes a model and another man carves it. This is done by means of an instrument called a "pointer" which is so made that a measurement can be taken on any part of a modelled surface and transferred to the wood in exactly the same relation to a registered mark on each. By this means little points are made all over the surfaces which have previously been "blocked out," that is, carved down to within a quarter of an inch of the true surface. When some hundreds of these points have been made the whole surface is carved true between them. Such mechanical workmanship cannot have the most interesting results, but it saves time and eliminates the chances of failure and so is much in favour.

A word or two may be said here as to figure-carving in general. There can be little doubt that when figures were being carved for the decoration of churches in ancient days they were carved with the full intention of completing them by covering them with paint and gold. That this was so, many examples testify and often where the painting has disappeared traces of such still remain. So many met with this misfortune that it gradually became the custom for carvers to copy them as they saw them, that is, without decoration, so that in modern times figures have seldom been decorated in the old way. The result is that they are not often seen in such a good light that their lines or features can be properly distinguished. Wood always has a way of hiding itself if the lighting is not very strong, but the moment it is covered with gold and paint it reappears in all its details even in a dark recess. Nearly all the carved woodwork of ancient times was decorated with paint and gold, that is, of course, in all cases where it was safe from rubbing. Stalls or other church fittings which were liable to rubbing were never painted.

Modern Decline.—The outlook, from a wood-carver's point of view, cannot be said to be very encouraging at the present time. Ever since the beginning of the 19th century, the output from the carver's shop has steadily declined. It has ceased to be used on household furniture, and for domestic architecture such decoration is no longer required. Shops, railway stations, restaurants and some public buildings still make use of wood-carving, but of no artistic merit. The church seems to be the only sanctuary of the art, and there a better kind of carving may be seen, though never on the scale of importance which it once had. No doubt the cause of the decline is to be found in the increasing use of machinery and the enormous advance in the cost of labour. It is difficult to see in the face of these formidable facts what can be done to preserve the craft. It is not an art that can stand by itself; detached pieces of wood-carving, however good, are no more than toys. The danger in making such a use of wood-carving lies in the fact that it is under no restraint; there is no necessity for discipline, and such unlimited freedom leads mostly to a mere seeking after novelty, both as to motive and execution.

(G. JA.)

STONE CARVING

To a sculptor, in the true sense of the word (*sculpere*, to carve), a knowledge of the nature of marble is essential, for in marble he visualizes his finished work. However, it often happens that he is ignorant through lack of previous training of the very corner stone of his education as a sculptor, and has to entrust the execution of his work to men, who, though skilled in the art of carving, may not possess the artistic fire of the creator. There is a distinction in the words *sculptor* and *carver*. Michelangelo was a *sculptor*, because he wrested his creations from the stone with his own hands; the artisan, who copies in stone from the model given him by the artist, is a *carver*, who, often, may not have any knowledge of art, and works to the best of his mechanical ability, upon the work entrusted to his skill.

Marble, because of its texture and consistency, as well as its workable qualities, is the stone best suited to the needs of the sculptor, and for the sake of his art he should be taught early the nature of it, and the way of using it. It is as essential as the academic studies of geometry, perspective, anatomy and form (for Nature herself created it for her glory).

How to Begin a Statue.—In preparation of the finished masterpiece a model of the work on a small scale is essential, either in wax or in plaster. From excavations, years ago, it seems that even the ancient Egyptians made models in plaster, for when a room was unearthed, which seemed to be the studio of an Egyptian sculptor, many sketches in plaster were found in a good state of preservation, as well as casts from life of faces, etc., and all the necessary instruments for the pursuit of his art.

The Etruscans, too, knew and made models in plaster, as well as the Greeks, and certainly, the Tuscan artists of a later day. The model itself, however, is nothing but a sketch, an idea, which must later complete itself under the chisel, upon the marble.

After a little familiarity with the subject it is possible, by means of a few points and measurements, to give form to a marble statue; with the help of a small sketch a life size statue may be executed, or one even larger than life, by beginning with the gradual indication of the lines and principal reliefs. For this indication it will be necessary to use pointed tools. Then with the aid of compasses, measurements are made between the small model and the marble block, to make sure that the finished work will be done in accurate proportion. The statue to be executed is then blocked out in form, always with the help of the pointed tool, taking care to make the indications parsimoniously, though fearlessly. When the pointing is satisfactory, with just regard for reliefs and accurate values, a dented chisel is used, care being taken that the work is done always with due regard for the whole, and avoiding isolating the more fragile details when they are not closely linked with the principal form. This first work on the stone must be maintained at only one value, and care must be taken that no deep cavities are made, which might prevent the making of possible slight changes. When the statue has reached this state, the main plan of the finished work being clearly mapped out, it is placed upon a turning table that is at once manageable and very solidly constructed, so that the blows of the hammer will not cause any oscillations. Approaching the block with

greater precision, the sculptor next begins the main work, starting with the head of the statue. Unlike modelling in clay, wherein from the small one proceeds to the larger and main object, in sculpture one starts with the whole and gradually arrives at the achieved statue as the artist had planned it. For this reason it is necessary upon beginning to work on the model with hammer and dented chisel, to approach with caution and precision toward the release of the final forms. Geometrical working, upon the principles of right angles and squares, has ever been the method of the great masters.

When the head of the statue presents a just value with the whole, and is well allied with the neck, the sculptor proceeds upon the torso and arms, without losing sight of the general plan and construction. Indeed, the whole is ever borne in mind, and no given part is ever dwelt upon at the expense of another. Thus an equal tone is maintained, and harmony achieved in every form and value.

This method seems to have been the one adopted by Michelangelo, Donatello, Jacopo della Quercia, and the brothers Pisano before them, who have left sound traces of their labour.

The Greeks.—Nothing definite has come down to us of the system employed by the Greeks, but all their works show beyond a doubt that they were primarily master carvers on stone. Of course, even they had to make use of sketches in plaster to embody the original form of their creations, but Parian and Pentelic marble, of which the most famous museums are full, was the medium of their divine art, and never was the medium better employed and immortalized. The work of the Greeks was the product of the *bottega.* Every artist's studio was a school; academies with definite programmes did not exist. At a tender age the future sculptor exercised himself in working upon stone and marble, and this was the first step in his art. Then he drew and modelled under the supervision of the master, who, with paternal love guided the hand of the student and developed his intelligence. From the simple plane to the minutest decorations the students advanced. Often they worked hand in hand with the master upon his statue, and thus they developed into artists —carvers and sculptors.

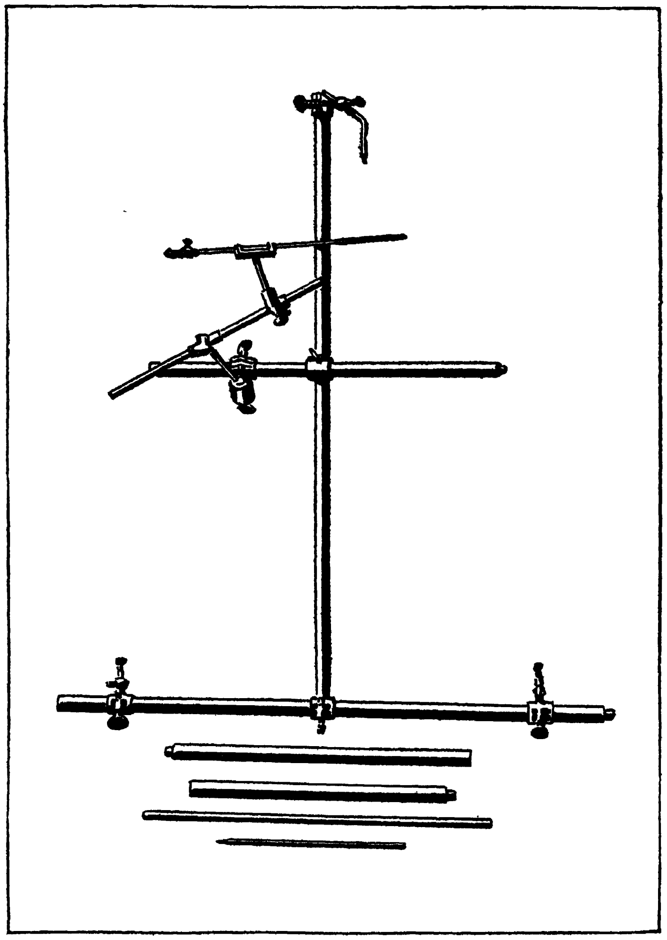
In this fashion were created the masterworks of the past. The Parthenon, in which sculpture and architecture are united in one glorious harmony, is the expression of the highest art. Pheidias, the sculptor, worked hand in hand with Ictinus, the architect, and under them a legion of master carvers wrought on the Parian marble reliefs, statues and groups that are a glory to this day. Take, for example, the great relief that covered the wall of the inner portico; it was the chisel of the carver that glorified it. The artist, indeed, contributed in the conception of the work with sketches and designs in charcoal upon the marble; but, working on relief and background, it was the carver that left his impress upon it. A study of the friezes in the Parthenon shows, by its unequal quality, that the carving was executed by various hands: some groups present all the perfection of the Pheidian hand; others, though still of a high order and holding their own with dignity, are lacking, however, in the precision noted elsewhere. Nevertheless, a small fragment of any Parthenon frieze would be enough to build the reputation of an artist.

Michelangelo.—It is well known how Michelangelo created his *David.* Already the immense block of marble that he used for his statue had suffered sacrilege by the tools of another sculptor. To Michelangelo was granted to create therefrom a miracle of sculpture. The marble was placed upon a pedestal, a house was erected about it, and the artist gave himself up to his task. A sketch was made, smaller by one-tenth, finished in all the minutest anatomical details. From this, with the help of scans and measurements, with carving and reliefs, Michelangelo wrested out of the stone his immortal work, made possible only by the daring of his youth and the supreme mastery he had over his material.

Upon observing the works of Michelangelo it often seems as though the rough and varying form of the raw block of marble as it came from the quarry gave to him the conception of the figure and group. This is more apparent in the four statues of the *Slaves* which were brought to light not many years ago. In two of them in particular are still to be seen the planes and cavities as they were wrought by nature in the marble quarry.

There is also the *Madonna de'Medici,* created in Michelangelo's maturity and which seems to have attained the apex of an artist's and carver's potentiality, both in the largeness of conception and the compactness of form, insuring solidity. No particular of the work is isolated; harmony is maintained throughout. Yet even in this group is to be found the suggestion of the mountain. The principal line has still the imprint of the natural plane, and religiously Michelangelo seems to have maintained it, even though he made it serve the purposes of his group: it is the line that descends from the right shoulder of the Madonna to the sole. It is also to be observed how well allied he kept the foot of the Child in its firmness and strength, making every detail serve toward the ultimate harmony of the finished statue. Only through thorough cognizance of his substance and a mastery of his tools was it possible to the artist to achieve his perfection.

Modern Methods of Carving.—With new times and new civilization have come other methods and ideas in all things, as well as in the method of carving. Under present conditions any young sculptor could become a proficient carver if he devoted a little of his daily time to this art. The problem of his existence would



POINTING MACHINE FOR TRANSFERRING POINTS FROM THE WORKING MODEL TO BLOCK OF STONE

be solved, for if it is too difficult for a young beginner to find in himself statues and monuments to be erected, he can easily manage to gain both experience and a livelihood by learning how to carve marble.

With the help of a pointing machine the present mechanical system of carving is easy to learn and free of responsibility because it is mathematically exact. Let us imagine that a statue is to be carved; the marble block is acquired and brought to the studio, then upon the model is applied a cross with three points, one of which is in the shape of a hook to support the

armature of the cross. The three points are of iron or brass, needle-shaped, which will find a place to receive them, also of metal, in the model or plaster mould. Upon the cross there is a movable armature, easy to manipulate, and revolving to the desire of the carver. At the extremity of the instrument there is a needle, the point of which will be approached to the model. At first, that is, for the primary blocking, the needle will not be made to touch the model, but will be limited to approach within an inch of it. The cross will then be placed upon the marble, and the needle will be guided until it touches the point already marked. For the primary roughing out, given a statue six feet in height, a point every six inches should prove sufficient; for the rest, the good sense and accurate eye of the manipulator will be needed. When the statue has thus been dealt with in attaining its first form, the pointing is done anew. Even this second time it is advisable not to go to the final points; for the beginner it is better to make an approach of approximately one-third of an inch, leaving the rest for the final pointing. (It is also advisable for beginners not to employ too many points or measures, but rather to content themselves with placing these indications upon the highest reliefs, marking each with the maximum of neatness and assurance, each point being given its own proper plane, before designating with the metal needle the final point.)

The tools used are chisels, plain and dented, and points of various sizes. They must always be clean and sharp; clean, too, must be the statue, in whatever stage of work. The marble must be cut in good, clear light, that the forms may always be well defined. The carver then examines his work from different aspects and by various lights, seeing to it that the surface of the statue is free of little undulations, and that the plane is clean, almost smooth, so that it may attain positiveness.

Later, that the true beauty and colour of the marble may be brought to light, the statue is washed with sand and rubbed with burlap or any cloth of rough texture. If a higher polish is desired, the marble is rubbed with either natural or artificial pumice stone for a long time, clear, clean water always being used. The marble is then washed with oxalic acid which has been reduced to the consistency of table salt, applied with a damp cloth to the surface, and rubbed vigorously. Care must be taken that no quantity of the acid remain upon the statue, for it is injurious to marble.

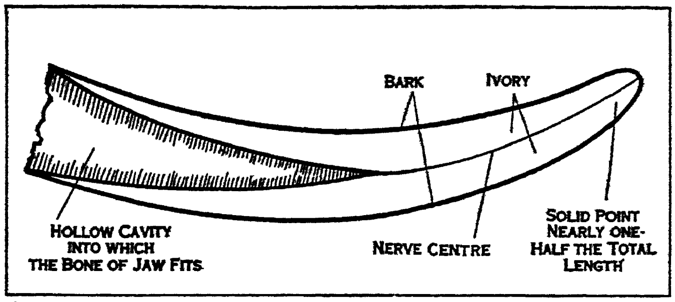
(There is, of course, the danger of refining to a fault, until the stone loses the qualities of its own peculiar nature and seems soft and weak to the eye.)

Bernini was among the first to finish his statues with the maximum of precision and care as to detail. Afterwards Canova, taking advantage of all progress and improvements made in the art of sculpture, was assiduous in giving his work such a quality of refinement that his carvers often went to extremes. Under them the qualities of the past masters were not taken into consideration, so that in the meticulous refinement that resulted from their labour the marble often had the semblance of majolica.

That which is best in sculpture never makes one forget the origin of the art, from *carving* on stone, as the Egyptians carved it, and the Greeks, and the masters of the Renaissance. The most important equipment of a young sculptor should be a knowledge and a love of the mother stone, which immortalizes the artist's greatest dreams. (*See* also SCULPTURE, and other sections of this article.) (A. P.)

IVORY CARVING

The Material.—In approaching the subject of ivory carving it is necessary first to consider the material in so far as it concerns the carver. Ivory, strictly speaking, is the tusk of the elephant: the tusk being the upper incisor tooth. For practical purposes the term must be allowed to include morse or walrus ivory, hippopotamus ivory and even certain kinds of bone and horn. The best ivory comes from tropical Africa. Asiatic ivory is whiter, more opaque and somewhat softer. The tusk is hollow at the end where it joins on to the jaw-bone; the walls gradually become thicker until, at about half the length, the tusk becomes solid; from here to the tip runs a nerve centre which shows in the cross section as a black spot; the tusk is covered with a rough bark of a hard pithy nature, brown on the outside and greenish white within; the thickness of the bark varies with the size of the tusk from $\frac{1}{16}$ in.–$\frac{1}{4}$ in. or so. The whole of the bark must be removed in carving. Seen in cross section the tusk shows a number of minute intersecting tubes radiating from the centre outwards, giving rather the appearance of engine turning on the back of a



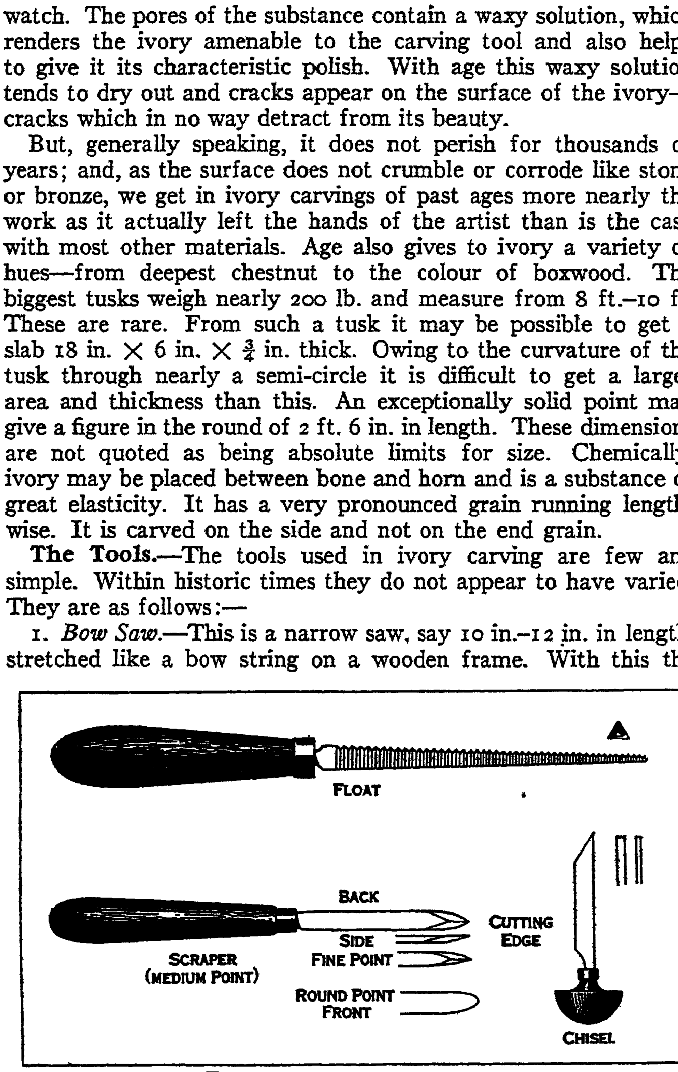
SECTIONAL VIEW OF TUSK; CURVATURE INCREASES WITH LENGTH OF TUSK

watch. The pores of the substance contain a waxy solution, which renders the ivory amenable to the carving tool and also helps to give it its characteristic polish. With age this waxy solution tends to dry out and cracks appear on the surface of the ivory—cracks which in no way detract from its beauty.

But, generally speaking, it does not perish for thousands of years; and, as the surface does not crumble or corrode like stone or bronze, we get in ivory carvings of past ages more nearly the work as it actually left the hands of the artist than is the case with most other materials. Age also gives to ivory a variety of hues—from deepest chestnut to the colour of boxwood. The biggest tusks weigh nearly 200 lb. and measure from 8 ft.–10 ft. These are rare. From such a tusk it may be possible to get a slab 18 in. × 6 in. × $\frac{3}{4}$ in. thick. Owing to the curvature of the tusk through nearly a semi-circle it is difficult to get a larger area and thickness than this. An exceptionally solid point may give a figure in the round of 2 ft. 6 in. in length. These dimensions are not quoted as being absolute limits for size. Chemically, ivory may be placed between bone and horn and is a substance of great elasticity. It has a very pronounced grain running lengthwise. It is carved on the side and not on the end grain.

The Tools.—The tools used in ivory carving are few and simple. Within historic times they do not appear to have varied. They are as follows:—

1. *Bow Saw.*—This is a narrow saw, say 10 in.–12 in. in length, stretched like a bow string on a wooden frame. With this the



TOOLS USED IN IVORY CARVING

tusk may be sawn into lengths or slabs. [*Note:* When available a small-toothed circular machine saw is much quicker, more accurate and less wasteful than the bow saw for the preliminary cutting of ivory.]

2. *Float.*—(*See* Illustration.) This is a triangular tapering tool in a wooden handle. Two of the three faces are cut across into small ridges throughout their length. By holding the handle in the right hand and forcing one of the ridged faces outwards and obliquely over the surface of the ivory, shreds of the substance

may be pared off.

3. *Gouge and Mallet.*—Small gouges, up to about ½ in., tempered as for wood-carving, may be used with a mallet. The carving should always be with the grain and the mallet must not be used with violence. Great care and some experience are necessary as the ivory will break or flake some little distance ahead of the tool.

4. *Rasp* and *File.*—Fine rasps and medium files will be found useful at many points of ivory carving.

5. *Chisel.*—(*See* Illustration p. 221.) After the roughing out has been done, this small tool comes into use. The ball handle is held firmly in the centre of the palm; the blade is held near the point between the thumb and forefinger. Considerable force must be exerted in each cut, pressure being given with the wrist and forearm.

6. *Scraper.*—(*See* Illustration p. 221.) This is the most distinctive tool used in ivory carving. It resembles a wood-carving chisel ground to a point, fine or round as required, with the front face kept flat and the rear face bevelled off into a cutting edge. It is held like a pen in the right hand: the finger tips being about 1 in.–½ in. from the point. Using the thumb of the left hand to give a steadying pressure at the point, the tool is pushed with a short flicking movement over the surface of the ivory, removing the substance in shavings. Fine pointed scrapers can be used for engraving the most delicate lines. Nearly all ivory carving is finished with the scraper.

Polishing the Carving is most effectively carried out by gently applying fine pumice powder with a soft damp cloth. In small interstices, where the finger cannot reach, a piece of wood, such as a match-stick, may be used with the damp powder. Whiting or a white tooth-powder may also be used for a final polish, if this is required.

Methods of Holding.—When carving in the round, ivory is best held in a wooden vice, or between pieces of wood, cork or thick felt inserted into the jaws of an iron vice. Ivory must never be held directly between the jaws of a metal vice, as this will cause a deep bruise. Larger pieces can often be held conveniently in the left hand at certain stages of the carving. Slabs of ivory on which a relief is to be carved should be fixed to a piece of wood of suitable size, 1 in.–¾ in. thick, by means of beeswax. The melted beeswax should be poured on to the centre of the piece of wood, the ivory pressed on to the molten wax. The wax should be in such quantity that a small amount exudes on all sides when the ivory is pressed down. When set, this superfluous wax should be scraped away before the carving is commenced, or it will get on to the hands and tools. When it is necessary to draw upon ivory, as for a relief, an ordinary lead pencil should be used. The pencil lines can be fixed by painting over the whole surface with white spirit varnish. This quickly dries into a hard transparent skin, impervious to moisture, which in no way interferes with the process of the carving. (A. Du.)

TERRA COTTA

Material.—Clay is decomposed felspathic and silicious rock (*see* Clays), varying in composition and colour according to its location. Pure clay or Kaolin, as the Chinese named it, is a residual, non-plastic, white-burning clay, not usable in its natural state but essential in the composition of porcelain and china bodies. In contrast, the impure sedimentary clays, of which all earthenware and most terra cotta sculpture are made, are plastic and in their natural state contain all the requisites for modelling (plasticity, porosity, vitrification). If these are lacking, the clay can be modified to obtain these essentials. Buff and red-burning clays in their green (or raw) state are grey, black, tan and red, but when burned these change to a light flesh colour which ranges to a deep chocolate brown, the tones modified according to the proportions of iron carried and also by the temperature reached in the firing.

A good modelling clay must have: (1) plasticity, with the ability of holding its form both while being worked and during the firing; (2) porosity, or sufficient looseness or openness in the clay particles to enable the moisture to escape in drying without shrinking too much or cracking; (3) vitrification, or the proper resistance to heat, so that it does not warp and crack in the firing or shrink excessively. The open, rather sandy clays are the more desirable.

Uses.—Sculptors have worked in terra cotta since the beginning of history, using it for the modelling of small figures, for the making of moulds and for pressing in the moulds, as well as for architectural details, friezes, tiles, roofing and façades. The amount of terra cotta objects produced is naturally governed by the workable material of the country. In Egypt and Italy it was used extensively because of the scarcity of marble and stone.

METHOD

Preparation.—A suitable clay having been located, it must be mined and cleaned of all foreign substances (stone, twigs, etc.) by washing, blunging, sieving, and then separating from the water. In modern efficient equipment the separating is done by means of a compressor which absorbs the water and leaves the clay in compact workable squares, which in turn are placed in a damp box and kept moist for use by the sculptor when needed. In primitive plants one method is to make a trough of hollow tile; into this trough the liquid clay, or slip, is poured and, because of the porous quality of the tile, the water is absorbed and evaporated, leaving the clay which can be rolled up and stored away.

Construction.—Now it is ready for the sculptor. One method of constructing a figure is to build it up on an armature, with either plasticine or clay. If clay is used, it must be kept wet either by spraying water on the figure from time to time as the work advances, or by keeping damp cloths around most of the surface, and by covering it entirely and keeping it in a damp box when not being worked. If the original is not to be cast, but to be fired directly, no armature can remain in the statue because of the twisting and burning of the wire in the fire. Usually small statuettes are made solid; but for larger figures and groups it is best to build them hollow, keeping the thickness of the clay walls as even as possible. In this method the clay requires definite preparation. It must be thoroughly wedged, which means that the clay is cut in two on a taut wire and vigorously thrown down, one piece on top of the other, to expel the air. This is done repeatedly until the clay is even in texture and uniform in moisture. If a clay is too hard, water can be poured on the clay and then the clay cut and beaten again as before. It is wise to start with approximately as much clay as the size of the figure to be constructed, working as long as possible until it begins to sag on account of the moisture. While working up to this point care should be taken when adding new clay to work it thoroughly into the old clay, making sure that no air has been allowed to enter and that the added clay is securely blended to the old. When the sculptor has worked as long as the clay will permit, the statue is allowed to dry and stiffen just enough to hold its shape, and then the sculptor will proceed as before. When the figure is ultimately accomplished, and the fine details are being developed, it is helpful to spray the figure occasionally with a very fine spray of water.

Should a mould be made, the clay is not allowed to dry but is kept in what is known as leather-hard condition, firm and hard but still moist. From this the mould is cast, and if the piece is not too intricate and has no undercuts, the original may be saved. The clay, shrinking slightly as it drys, separates itself from the plaster mould. In order to cast a difficult mould, one with small passages and many pieces, the clay must be poured. Clay in a dry state, powdered and sprinkled into water and then stirred vigorously or blunged, makes what is known as slip (a liquid clay). Slip needs to be fairly thick to prevent too great shrinkage in the drying. The mould should be dry before the pouring, and the slip free from air bubbles. Pouring the slip very slowly over the mouth of one pitcher on to the mouth of another will break the bubbles. To make the mould ready for pouring, it should be tied together securely and wedges placed between the plaster and the cord to tighten the hold. Then the slip is poured in until the mould is full and shaken gently to raise any bubbles. The slip will adhere to the dry mould, the moisture soaking into the plaster, and as the amount soaks down, more slip is poured in to fill the mould again to the top. This process is repeated until the thickness of the wall can

BY COURTESY OF (3, 5, 6) THE METROPOLITAN MUSEUM OF ART, NEW YORK, COPR. H. BONNAIRE

SCULPTURE AND SCULPTURE PREPARATION

1. Opened mould for the horse's head in fig. 2
2. Illustrating the four stages of development from mould to finished product, left to right: (1) rough casting by pressing, (2) retouched, (3) once fired, (4) finished glazed head
3. Head of Balzac, by Rodin
4. Latest type of electric kiln at Greenwich House pottery. Used for firing terra cotta sculpture
5. "The Caryatid" by Rodin
6. "Ephèbe" by Louis Aimé
7. Portrait statuette by Paul Manship
8. Pediment for Philadelphia Museum of Art, executed by Carl Paul Jennewein

BY COURTESY OF THE ETTL STUDIOS

THE CONSTRUCTION OF A LARGE ARMATURE

1. Completed armature ready for clay
2. Artist's small model from which the large armature was made by a system of points
3. Detail of the left hind leg. The end of each wire which projects from the wood indicates the position of a point taken from the small model and so governs the thickness of the clay
4. Putting the horse's head of the armature in place
5. Plaster cast of the finished full sized statue

be seen by scraping across the mouth of the mould with a flat knife, and, if sufficient, the mould is then inverted on two or three small blocks or tiles and allowed to drain. When it begins to pull away from the mould, or is firm enough to stand by itself, it is safe to untie and separate the mould. It is stood on a flat level table, and the sculptor then begins to work over the surface, cutting away the seams which always show where the sections of the mould come together, and refinishing and retouching. The statue is then allowed to dry slowly and is ready for the fire.

Another method, which, if possible to use, is quicker, is to saturate the mould and then, after wedging the clay thoroughly, to roll it out with a rolling pin on a flat, dry, unpainted surface until the clay is an even thickness and not hard. The clay is then placed on each half of the mould and with a damp sponge gently patted into all of the irregularities of the mould and the edges are trimmed with a thin pointed knife. Then the two halves of the mould are tied together, and the sculptor works the clay back and forth across the seam inside the mould vigorously, adding small bits of clay where it is uneven. This is very important, because if the joining is not sufficient the clay will crack in the firing. The cast can be taken from the mould almost immediately, and the mould is ready to use again. With the heavier clay the shrinkage is less than with the slip. The retouching is the same in both methods.

The colour of the clay can be modified by blending a light clay with a red clay or by completing the objects in one clay and then by giving them a wash, or *engobe,* of slip of the desired colour.

Firing.—Kilns vary in their size, construction, and manipulation and have been built to burn coal, wood, oil or gas. There are updraft, downdraft, and muffle kilns, and round, square, and oblong kilns, made of brick, stone, and sheet iron. The latest development is the electric kiln. In stacking a kiln, the unglazed ware will not stick together and the pieces can consequently be allowed to touch. Figures set in the kiln for firing should be placed on spurs, or small pieces of fire brick, which raise them slightly and allow the heat to circulate all around the figures. When the fire is started it is raised gradually to allow the moisture to escape slowly so as to prevent cracking; for although a piece may have been drying for a year, it still contains from 18 to 20% of moisture.

Terra-cotta can be fired in any type of kiln, different clays demanding different temperatures. To fire heads, sketches, statuettes, animals, etc., the average clay fired to 1,800° F is sufficient. The higher the fire the denser the body, the darker the colour. For unglazed architectural decoration and for garden sculpture, the body needs to be well fired, as it will be exposed to the weather. Science has progressed in registering heat from the sight gauge to the Seger Pyrometric Cones, and finally to the automatic heat-recording pyrometer.

When the kiln has cooled, the ware is unpacked and, if the sculptor is interested in colour by glaze, he weighs out his glaze formula, grinds the glaze and applies it to the statue as a liquid, painting it on and allowing it to dry. Then it is reset in the kiln, great care being taken to prevent the statues from touching, and refired, the temperature being determined by the type of the glaze.

There is a growing interest among modern sculptors to work in clay, some carrying their work to the height of exquisite finish and others dashing off spirited sketches which in this medium express spontaneity as they can in no other material.

Among the American sculptors, Herbert Adams, Paul Manship, Victor Salvatore, Gleb Derujinski, Paul Jennewein, Bessie Potter Vonnoh, Alfio Faggi, John Gregory, Elsa Horn Voss, Janet Scudder, Beniamino Bufana, Carl Walters, and A. A. Weiman are the chief workers. They use various methods of finish. Adams and Manship treat the terra cotta individually with a wax and oil paint finish. Salvatore and Derujinski leave their work in the biscuit, while Jennewein, Gregory, Weiman, and Voss carry their sculpture to a glazed finish. The sculptors show great contrast, Jennewein and Gregory designing strong and decorative architectural details, pediments, friezes, etc., while Voss portrays animals with great charm. Rodin, Despiau, and Maillol are the outstanding figures in modern French terra cotta, and Wackerle in modern German.

The possibilities of glaze sculpture are just being investigated. The Della Robbias used it extensively, but their colour and type of glaze never varied and did not lend itself to very sensitive modelling. The modern sculptor who is interested in colour is working to make a glaze which has quality and yet is thin enough not to hide the details of the modelling. For architectural details, however, the thick brilliant glazes are suitable. (*See* TERRA COTTA, which includes bibliography; also SCULPTURE.) (M. R.)

MODELLING, PRACTICE

Modelling, as treated in this article, is that preliminary stage of a work of sculpture which involves its actual creation in a soft material and its subsequent casting or reproduction in a more permanent material. No consideration is to be given to that attribute of a piece of sculpture which is spoken of in criticism as "good or bad" modelling. The latter attribute is dependent upon those qualities which the sculptor has put into his work, such as the conception of mass, surface, texture and detail. (*See* following section, MODELLING, THEORY.)

Materials.—Formerly, sculptors often carved their works direct from the stone or wood, but the advantages of being able to take off or add on, to twist and change until such time as the work has assumed the desired form has appealed so strongly to the modern sculptor that modeling is almost universally used and the acceptance of the possibility of these changes help to bring modern sculpture to perfection just as the changes in the manuscript help to bring the writing of a book into better form. Michelangelo and other old masters often carved directly in stone, but only an artist of great vision and much training dare commence work upon a valuable piece of marble, and though work so executed may possibly gain in spontaneity it is sure at all times to lack in that thoughtful consideration which a more tractable material permits.

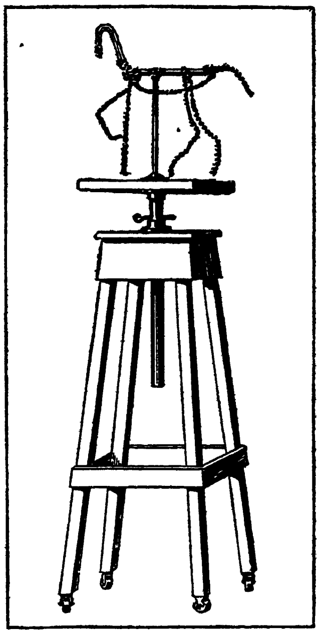
When the processes in modelling were first practised clay was used, but this material has faults in that it is difficult to keep at just the right degree of moisture, and when too dry it must be frequently sprayed with water or covered with moist rags. Wax, which came into use later, is also difficult to handle and very fragile. Thus a comparatively new substance, which is called plasticine and which is really a clay-like material of an oily composition that dries much more slowly, has come into general use, eliminating many of the sculptor's difficulties.

Conception.—The sculptor often makes a number of preliminary sketches in plasticine of the work of art he is contemplating, and as a rule he makes these sketches small enough to avoid the necessity of supports or armatures. Sometimes these sketches are made over an extended period of time and changed again and again until the general idea has "crystallized" in the artist's mind, and he has established just about what arrangement of his work is going to be best. It is often necessary to make a larger and more detailed sketch, including final corrections so that the whole may be kept in mind as his work proceeds. This preliminary work is necessary because of the fact that sculpture often involves so extended a period of time in its creation that certain considerations are likely to be lost sight of as the work proceeds.

Armatures.—On the basis of the final sketch and upon the sculptor's determination as to the size in which the modelling is to be carried out, a suitable armature or support must be constructed. For instance, assuming that the sculptor intends to model a standing figure 30 inches high, a square, iron rod, with three branches at the bottom for support, and bent at a point about 18 inches from the base to meet at a right angle the small of the back of the standing figure, is screwed to a board which is used as a base. The fixed centre of the human body is the small of the back, or the centre between the pelvis bone, and it is important that the armature at this point be so arranged that any change in the position of the arms, legs or torso will not interfere with the fundamental balance of the figure. This bent portion of the iron rod at the small of the back should be, in the example adopted, about 6 inches in length with a 2-inch upward bend at the end. Lead wire, or pipe, of ⅛" diameter should

be used, one section for each leg, one extended up to the top of the head and two more attached properly for the arms, and these lead extensions are attached to the iron support and bent in accordance with the movement of the sketch from which the sculptor is working.

Sufficient plasticine must next be applied to the armature and the work of modelling should proceed until it arrives at an approximation of the original sketch at which time a living model should be obtained and posed as nearly as possible like the sketch. From the model measurements can be taken and corrections made to bring the work closer to life and actuality. Sculptors sometimes take liberty with modelling and this is the artist's license if any advantage of general effect is obtained, but though it is not entirely essential to follow the anatomy of the model or models exactly, it is certainly very necessary that the sculptor be well versed in this part of his work and equipped with the knowledge which makes it possible for him to change the forms to advantage. It is wise to follow the model closely in the control of mass as a whole, but many of the details may be changed so that the planes and profiles are better related and more pleasing.


MODELLING STAND AND ARMATURE

When the artist feels that he has accomplished to the best of his ability the work before him, he must next consider the process of putting it into plaster, as no casting in bronze or cutting from the stone can be made from the clay model. It is advisable to have a professional moulder do this work, as even the mixing of the plaster is a skilful process and the location and arrangement of the mould sutures takes a great deal of practice. (*See* section, this article, *Plaster Casting.*)

Relief.—The sculptor, if he would be successful in modelling high or low relief, should have a mastery of modelling in the round as he is attempting in relief to give a three-dimensional effect and this involves the same understanding of mass, composition, planes and profiles as in the round. The most important question to be considered is that of the relationship of the highest points to the lowest in the background, and this must be carefully thought about and established. The background does not, however, have to be perfectly flat but may follow the general movement of the figures upon it, being deeper in some places than in others, in order to soften certain passages and aid the relief in its various planes.

Enlargement.—For enlarging to life size or greater, the modern sculptor makes use of a so-called enlarging machine of which there are several types, all based, however, upon the principle of the pantograph. For the large figure the armature is erected similar in principle to that for the small work, but is usually constructed of wood, lath and plaster so as to bring the bulk of the armature closer to the surface and in this way not necessitate the use of such great masses of clay, and thus avoid the possibility of parts falling off by their own weight and lack of proper support. For some large works plaster may be used as a modelling medium, thus avoiding the extra work and expense of the final casting.

After the figure has been so treated and carefully "pointed up," it must be gone over again carefully by the sculptor to make any minor changes which appear to be necessary when the figure is perceived in larger scale and which were not so obvious in the smaller model. Thus the modern sculptor not only makes use of all the above mediums for the betterment of his work, but also keeps the result carefully under his supervision so that it is in perfect keeping with his personality and the spontaneity of his conception. (*See* discussion of other related subjects in this article.) (L. LEN.)

MODELLING, THEORY

As sculpture is the art of form, modelling is that part of the art of sculpture concerned with the treatment and manipulation of the surface of form; also, in a secondary meaning of the word, the building up and shaping of a work of sculpture in a plastic material preparatory to casting in plaster of Paris, bronze or terra cotta, or cutting in wood or stone.

With the Greeks one of the tests of a work of sculpture lay in the animation, vibration and life of its surfaces. This is due to the modelling and in this special sense modelling may be called the art of the surface of form.

Modelling as a method of building sculpture dates from the time when men hunted the wild horse, the hairy mammoth, the reindeer and the bison in western Europe. There is proof of this to be seen to-day in the caves of France and Spain in the group of bison and the torso of a woman found there. The originals of the Greek terra cottas were undoubtedly first modelled in clay, followed by a mould from which many copies could be reproduced. The earliest bronzes were either modelled solid in wax, as was done in the half life-size figure of Gudea from Sumeria, 13th century, B.C., now in the Louvre, and the earliest Egyptian and Greek bronzes, or over a core, composed of materials similar to those used in this for casting in bronze, thereby allowing the metal to be made very thin and the statue hollow.

Modelling, considered as the art of surfaces as distinguished from the building up of a statue or other piece of sculpture, is well illustrated by the works of Michelangelo and Rodin. Michelangelo's bronzes have perished, but his works in marble show almost perfectly this special quality of modelling, as the art of surfaces; they rely, almost wholly, for their effect, power and charm on what has been done with their surfaces. The Greeks, instead of relying primarily on the surfaces, which were only part of their conception of sculpture, paid particular attention to the development of clear profiles and significant silhouettes. As a result of this practice, Greek sculpture always appears to good advantage in the open air, while Michelangelo's, with the possible exception of the "David," is confused when placed out of doors. Basing his theory and practice of sculpture on the development of beautiful surfaces and significant modelling, he paid little attention, comparatively, to the clearness of the silhouettes. As seen from a distance, his silhouettes are rather obscure, his statues more or less shapeless. To get the maximum enjoyment out of Michelangelo's masterpieces, the observer should be near enough to see and feel the projections and depressions—the convex and concave surfaces. (*See* MICHELANGELO.)

In the case of Rodin, these qualities of modelling are developed to excess, with the consequent neglect of qualities just as vital. No group of his is as fine as the figures composing it, and no figure is as good as the individual parts. We have only to recall such figures as have been placed in the squares and gardens of Paris to be aware of the difference in the effect of the same figures when seen in a museum, where all the advancing and receding planes, with their projections and depressions, become a source of keen enjoyment and result in a surface of great richness. Thus it was that Rodin instinctively created so many fragments, justifying his use of sensual and highly modelled planes against areas deliberately left rough and unfinished. A Rodin is best when it is small enough to be handled and the surface felt with the fingers, thereby getting the utmost possible enjoyment out of it. This conception of sculpture leads naturally to the "morceau" (the part or detail) and is the result of too much occupation with modelling. It is also one of the causes of the modern cult of the fragment.

In the actual manipulation of the materials used in modelling, many methods are employed, resulting in various textures of the surface. Some sculptors apply the clay, plasticine or wax in small, round pellets, called in French "modelé à la boulette." This method has been very popular since the middle of the 19th

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STAGES IN THE PROGRESS OF MODELLING A PORTRAIT BUST IN CLAY

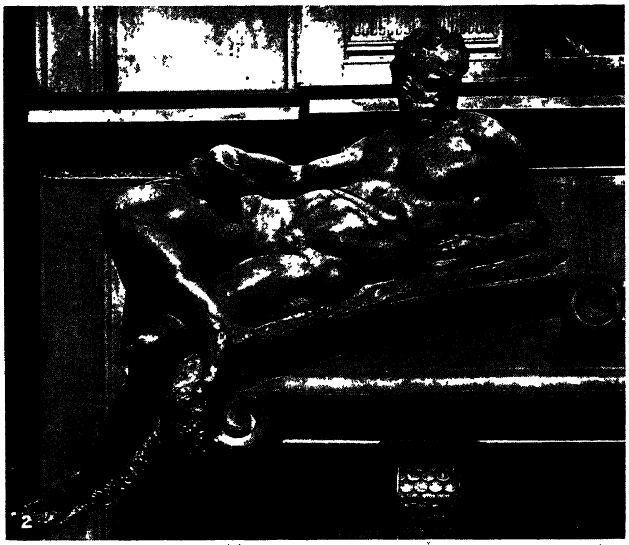
1–3. Blocking out head with the clay. A moist mass of clay about the size of the figure to be constructed is built up on an armature, and the head and shoulders blocked out

4–6. Head roughed out with the clay. Upon completing the geometric construction of the head the sculptor begins the individual details, working from full view, profile and three-quarters view

7–9. Getting the action. With the external likeness established, the sculptor now attempts to give movement to the portrait bust—a characteristic pose or expression that will interpret the personality of the model and make the clay figure a living portrait

SCULPTURE TECHNIQUE


1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SCULPTURE FROM THE 16TH TO THE 19TH CENTURY

1. "Perseus holding the head of Medusa" by Benvenuto Cellini (1500–71). In the Loggia dei Lanzi, Florence
2. "Evening" by Michelangelo (1475–1564), one of two emblematic reclining figures on the sarcophagus of Lorenzo de' Medici; built 1523–34 in the church of San Lorenzo, Florence
3. "Dancing," designed by Jean Baptiste Carpeaux (1827–75) for the façade of the Paris Opera House
4. "Stone Age" by Emmanuel Frémiet (1824–1910), French
5. "Lapitha and the Centaur" by Antoine Louis Barye (1796–1875), the leading sculptor of animal life in the French school
6. Sabine Houdon in 1788 at the age of 10 months, by Jean Antoine Houdon (1741–1828), French
7. "The Bronze Age" by Auguste Rodin (1840–1917), first exhibited in the Salon of 1880 when it took a 3rd class medal
8. "Man with pincers" by Constantin Meunier (1831–1905), Belgian
9. "Grief" (also known as "Death" and "The Peace of God") by Augustus Saint-Gaudens (1840–1907), American

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CONTEMPORARY SCULPTURE

1. "Torso" by Aristide Maillol (1861–), French
2. "Head of a Girl" by Jacob Epstein (1880–), American
3. Bronze Indian Equestrian statue by Ivan Mestrović (1883–), Yugoslavic. In Grant Park, Chicago
4. "Apollo and the Muse" a bas-relief by Leo Lentelli (1879–), American. On the façade of Steinway building, New York city
5. "Pan" by George Grey Barnard (1863–), American
6. Portrait of John F. Braun by Charles Grafly (1862–1929), American
7. "Philomela" by John Gregory (1879–), American
8. "Comedy and Tragedy (Hamlet and the Fool)," Shakespeare Memorial, by Alexander Stirling Calder (1870–), American

century. It allows a gradual building up of the form, producing a surface that is granular and vibrating in the light, and somewhat like the effect of an Impressionistic painting. (*See* PAINTING; IMPRESSIONISM.) It developed at about the same time as the Impressionist school, and must be looked upon as an outgrowth of ideas current at that time. Other sculptors apply the clay in great hunks and masses, working it slowly into shape by putting on and cutting off until the desired form and surface are achieved. For tools, some sculptors rely almost wholly upon the hands and fingers, especially the thumb, while others use tools of different shapes and of various materials, such as wire, wood, sheets of steel, etc. (*see* section above, MODELLING, PRACTICE). With such a variety of tools, the sculptor is capable of producing surfaces varying from one as smooth as glass to one as rough and corrugated as concrete. As a general rule, sculpture of the earlier periods, and even down to the middle of the 19th century, has a smooth surface, while work done since that time runs the whole gamut from the highest polish to extreme roughness, according to the character of the subject.

From about 1850 many apparently new qualities were introduced into sculpture besides the "modelé à la boulette." Some were qualities derived from the study of ancient works and the effect of time and weather on the materials used in their construction. Other qualities grew out of the general expansion of the fields of science, art and literature. At that time all things seemed possible. There was a spirit of exploration and adventure abroad as well as an interest in the past. Men turned their minds eagerly to the past to discover many forgotten beauties. Greece and the Renaissance were no longer the whole of antiquity. Dissatisfied with the art of the academies and the failure of anything resembling a genuine tradition, men turned hopefully for aid to the whole field of the past, in all times and places, instead of the strictly limited fields they were taught to venerate; they sought for aid and inspiration in the Gothic, the Romanesque, in India, China and Archaic Greece, which, until then, were unknown or forgotten. A general expansion followed. It was realized by some that there were principles and laws underlying the practice and theory of the arts wherever and whenever found. The German sculptor, Adolf Hildebrand (*q.v.*), attempted to formulate and state a number of these fundamental laws in his book *The Problem of Form in Painting and Sculpture*. It has had a great and beneficent effect on the understanding of the arts of painting and of sculpture. Alongside of this attempt to understand and use the principles found in the arts of the past there grew up a desire to imitate. Sculptors and painters strove to work in the spirit and manner of different periods. They tried to give the accidental and picturesque effects of time and weather on bronze, stone, and wood to new work. They attempted to become reconstructors as well as restorers.

Those eager spirits who looked to the future attempted to use the results of science and observation in creating a new art. The outstanding scientific contribution was in the realm of optics; the most fruitful of results was Prof. Rood's book on the colours of the spectrum as applied to the art of Painting. It was this book which determined the course of development of the Impressionistic school led by Claude Monet. In its preoccupation with light it had a great influence on certain sculptors. They were no longer content to get effects of colour in their work by the age-old methods, but tried to achieve effects of light and colour by methods more appropriate to painting. The Italian Rossi carried this to extreme, as did Rodin. They tried to obtain colour not only by depressions and projections and the use of ornament, but attempted, by their modelling, to get the effects of light as it not only revealed but obscured the actual form. Hollows were deepened to obtain strong dark effects, and filled up to create surfaces which would reflect the greatest amount of light. Details were accentuated and suppressed for the general effects of luminosity. There are things by Rodin and by Rossi which approach nearer to the paintings of Carrière than to any sculpture of the past.

Sculpture became sketchy and impressionistic for the first time. Such works often had great charm. Effects were attempted in sculpture which had never been thought possible before. But the movement passed; it was an interesting but rather futile experiment. One of the results of the study of the arts of the past has been a renewed interest in the theory and practice of working directly in the material in which the work is to be completed. A cult has grown up of the "taille direct"; it has been elevated into a slogan of almost hieratic import. It has become so important in the minds of some of the practitioners that they would never think of working otherwise. It has become not only necessary that every stroke of the chisel be delivered by the sculptor himself, but has even gone so far that no model can be used except the living model. The block of stone or piece of wood must be attacked direct. Whole figures are cut out of the hardest and most obdurate materials without a preliminary study in plastic form being made. It is insisted that all the great works of the past were so made. Along with this has grown the belief that all work should be cut in place. It is maintained that the unity of the architecture and sculpture in the great monuments was so obtained. Much is to be said for this theory and practice. It results in a much more intimate contact between the artist and his work and, what is of much more importance, in a greater respect for the material in which the work is done. There is less of a tendency toward attempting to do in stone or wood those things which are perfectly possible and proper in bronze. Generally, a greater sense of mass is achieved, or perhaps, not so much achieved as retained. There is more of the feeling of the block in the finished work. With the Egyptians, their practice of cutting their work out of the hardest of stones (granite, basalt and diorite) with primitive tools undoubtedly determined the style of their sculpture. If the sculptor has to cut incisions in a material almost as hard as the tools he is working with, he will cut them no deeper than is necessary, and he will cut no more material than is essential to the finished statue. That some pieces were cut directly in the stone without preliminary studies and models is hardly borne out by historic facts. Too many sculptors' models in chalkstone and other easily worked materials have survived from Egypt. We seem to have no authentic plastic models of the archaic or classic age of Greece. On the other hand, consider the pediment figures and the frieze from the Parthenon; it is inconceivable that they were cut "in situ" without very complete preliminary models. The frieze was perhaps worked from a finished drawing, but even that is very doubtful, as a study of the relief indicates. It is interesting to note that the pediment figures were not cut in place but were carved and finished on the ground and then hoisted into position. As proof of this, one need only glance at the backs of the figures which went against the wall of the buildings. It is assumed by some archaeologists that the Greeks followed, generally, the practice of carving their statues directly out of the stone block; the reason given was that they knew so well their "canon" and what was to be done that they just went ahead. In the case of men doing "school pieces," this was undoubtedly so; but the creation of an original work was a totally different matter and it is just as likely that the architects of the Parthenon, Ictinus and Callicrates, went ahead without plans for their great building, as to think that Phidias carved the frieze without knowing beforehand what he was doing. The frieze, by the way, shows distinctly the carving of a number of different workmen.

During the Romanesque and Gothic periods, it seems, with the information we have on this subject, that a similar procedure was practised. Minor works are left to the master stone-carvers, but the large groups and statues are too complete, too "right in place," to have been left to the whim of the stone-carver.

During the Renaissance, where we find so many masterpieces, with complete harmony between architecture and sculpture (notably in the tombs by Mino da Fiesole, Desiderio da Settignano, Donatello and the Della Robbias), the work was generally in the hands of a sculptor. In Michelangelo we have the individualist who had difficulty in working with assistants; he found it easier to do the work himself than to put up with the slowness and irritation of helpers. He carved his figures himself directly in the marble, and we see with what results. No statue

of his, not even the "David," is completely finished. The top of the "David's" head is not finished. This lack of completeness grew out of a number of different causes, namely, his impetuosity, his impatience, and his practice of attacking the block of marble without sufficient preparation. He is recorded to have said that one should make a full-sized model first, but his own temperament forbade it in his own case. As a compensation for the fragmentary and incomplete state of his works in sculpture, we have the most wonderful and expressive marble-carving in the world. Nowhere is there such surging life, nowhere is the actual stone so transformed. His chisel cuts the marble with the creative power of a brush stroke of Rembrandt. Under his hand marble becomes truly living stone.

The modern cult of the "taille direct" shows none of this transforming power. Only too often it is used as a questionable merit to cover up incompetence, the thought being, "I cut it directly in this hard stone; therefore it must be good." The differences in modelling between carved and modelled surfaces is not as great as is generally assumed. Of course, stone should remain stone, granite should remain granite, and wood should remain wood. Certain things perfectly feasible in bronze when translated into stone or marble become objectionable because of the nature of the materials. Such things as the statues of Siva, found so often in Hindu art, with the encircling halo of flame, become atrocities when carved in stone. This grows out of the very nature of the materials themselves. Bronze, being a very tough material with great tensile strength, may be pierced full of holes provided the unity is maintained in the design; stone, having a low tensile strength, demands a treatment more in the mass.

The surfaces of stone, marble and granite, as well as wood, may be treated to show the mark of the cutting chisel or carried to the highest degree of polish. The polished surface makes a very different appeal to the eye and also to the sense of touch. Marbles, granites, and the hardiest stones, such as basalt and diorite, change colour as well when polished. The degree of smoothness or polish should always be determined by the effect desired.

It will be well to remember that bronze is always a cast material and though it has very special qualities of its own, of hardness, colour and reflecting powers, it has always been cast molten and fluid into a mould from a model. The better the casting the less work necessary on the finished statue. Details are often chased on the bronze but generally they exist in the original model and are only sharpened in the bronze. (M. Y.)

THEORY

So widely separated have become those, in this modern generation who write on art, from the artists themselves, that criticism is generally completely ignored by the latter save when they receive gratifying though really unimportant praise, and it is almost an unheard of thing for an artist to change his style because of critical suggestion. Therefore it has been thought advisable, in the planning of this Fourteenth Edition of the *Encyclopædia Britannica,* to resort to the artists themselves for the articles covering the practice of every art and to supplement this first-hand information by a few brief treatises which help to bind it together and unify its deductions.

This article, therefore, like the one on TECHNIQUE IN ART and others on DRAWING and DESIGN, is written primarily for the purpose of correlating the artist's theories, and will be of use to the student, as well as for the purpose of establishing a type of criticism making possible judgment not only of the results of an artist's labours but also of his various plans and methods of arriving at them.

The metaphysical and historical aspects of the problem are represented in this edition by the articles on FINE ARTS and on AESTHETICS. A study of the various articles written by artists in every field of the graphic and plastic arts of both fine and applied classifications stresses a contrasting view: that the artist is an analytical and reasoning being like the scientist, and that the main concern in his work is what we describe by the general term "technique." He is inspired at times just as in truth is the scientist, but, like the scientist, he must also apply himself to analytical thinking and hard labour. It is with these aspects that the present article is concerned.

Material.—One of the most important interests to the artist is that of the materials or substances with which he works and the methods whereby they can be most effectively treated. Their relative strengths are spoken of in the preceding sections on Sculpture Technique: *Modelling,* their colour against foliage or sky is treated in *Garden Sculpture,* and so from many different viewpoints it is the sculptor's concern that he be well-equipped with an experimental knowledge of textures and qualities, physical as well as aesthetic, qualities which cannot often be described in words, they are so delicate and intangible, but can only be shown in actual work; characteristics which are as true and yet as difficult to describe as the shading of a curve. If he is working in stone he must know whether it is granular, stratified, or crystalline; he must know the properties in the same manner of wood, ivory and other substances, and there is no possible way for him to find these out other than by trying them, experimenting with them, discovering their properties, just as might a scientist in his laboratory, but properties of course quite different from those which interest the scientist. In the example of Mestrović's work shown on Plate X. is well demonstrated this sculptor's masterful handling of wood, but the figure "Rhythm" by Arthur Lee (Plate IX.) shows an even greater knowledge of the quality of the material, which in this case is marble.

Not only must the texture and grain be kept in mind: in the modelling of a head the sculptor finds that the outstanding features such as the nose and ears cannot be left so thin, if the figure is to be cut in marble, as they would be, if it were to be cast in bronze, or they will appear too translucent, for marble is not so opaque as bronze.

It will be interesting for the reader to look at the other plates in the sculpture section as well as those on CHINESE SCULPTURE, INDIAN SCULPTURE under INDIAN AND SINHALESE ART AND ARCHAEOLOGY, and GREEK ART, judging which best express the material in which they are wrought and which are weak in this qualification. Thus the first step in critical judgment may be arrived at.

Finish.—The finish of the surface is a matter of great importance; it should be appropriate to the material, and at the same time to the subject portrayed. It must, moreover, be such that it creates a surface not harmful to the modelling. Many Renaissance bronzes lose all quality of their modelling because of the confusing highlights caused by their too-highly polished finish.

It is offensive to see a beautiful piece of marble capable of sustaining a fine polish, upon which have been left careless chisel marks. This indicates that the artist was either too lazy or too hurried, or perhaps too interested in creating a style of his own. On the other hand an over-polished finish upon a material which is too rough and crude to sustain it is also lacking in good taste. How is the artist to know just how deeply his carving should go; just what degree of detail to use; and what texture of surface is best suited to his work? Only through a long study of the works of others both contemporary and ancient and through many experiments of his own; and the critic judging a piece of sculpture should always think of this element as well as that of the material and judge as to whether or not the sculptor has been successful in this work.

Detail and Design.—The addition of decorative detail to a figure is a question which has been much discussed and it is well enough for the purist to point to the Greeks and Michelangelo and say: "There stands a beautiful form needing no decoration," but he certainly can never disprove the beauty, largely due to the ornamental treatment of drapery, hair, and other details existing in the best of the Gothic, Chinese and East Indian sculpture. It is true that form must grow from within, but form is only seen on the surface. A surface decoration may be quite separate and distinct in detail from the underlying form; its design and texture may have little to do with that other more powerful element, but it must never conceal the life within. Think of the beauty of the swell, only faintly suggested, of a rounded breast, or of a firmly curved thigh as revealed under

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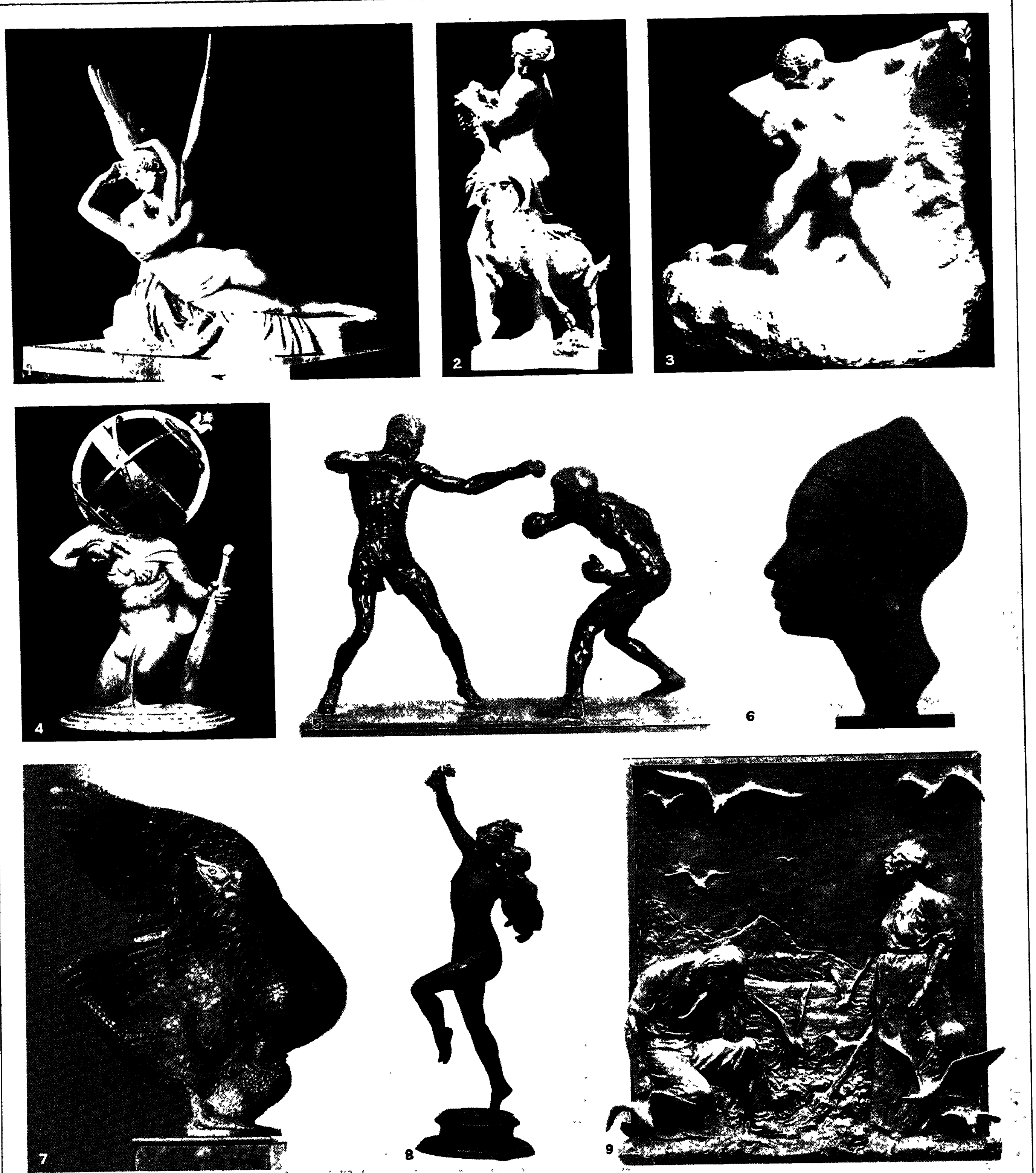
SCULPTURE EXAMPLES ILLUSTRATING MODELLING THEORY

1. Statuette of Aphrodite Anadyomene coming up from the waves; smooth, fine lifelike modelling. Probably after a type of the 4th century
2. Fragment of group in the original unfinished clay after drying. An interesting treatment in clay which would have to be somewhat changed if executed in bronze or stone. By Rodin (1840–1917)
3. "Esclave," in the Galleria dell' Accademia, Florence. Unfinished statue in marble illustrates Michelangelo's method of working directly in the marble without completed preliminary study
4. Bronze figure of "Adam" (the creation of man) by Rodin. Shows modelling of surfaces, without work on plaster or bronze
5. Statue of "Day" from the Medici Tombs. An example of Michelangelo's work done directly in marble. Note the life with which this master imbued his work
6. Bronze "Head of Beethoven," by Emile Antoine Bourdelle, 20th century; somewhat too plastic for bronze but powerfully modelled. French
7. "Jules Dalon," a portrait bust by Rodin in bronze. Example of modelling in clay, appropriate to bronze, but could only be obtained in the former medium
8. "Torso di un Fauno," late Greek fragment in marble, showing rich full modelling of forms akin to that of Michelangelo and Rubens



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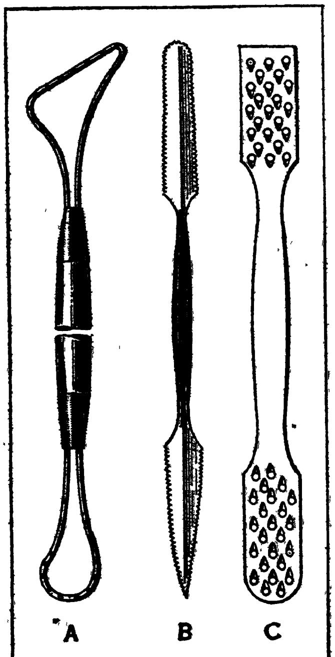
EXAMPLES OF SCULPTURE TECHNIQUE

1. "Amour et Psyche" by Canova (1757–1822), Italian. The group in marble was cut by a marble carver from the completed clay model. In the Louvre. 2. "Girl with Goat" by E. McCartan (1878–), American. Finished plaster for bronze statuette. The nicely finished treatment of the girl is in contrast to the sharp, rough treatment of the goat. 3. "L'Éternel Printemps," a marble statuette by Auguste Rodin (1840–1917), French. Rodin's voluptuous modelling of flesh is shown to advantage against the unfinished surfaces. In the Metropolitan Museum of Art. 4. "Hercules Sustaining the Universe," a sundial by Paul Manship (1885–), American. Example of decorative sculpture depending for its effectiveness upon its architectural sense and conventionalized treatment of detail. In the garden of C. M. Schwab, Loretto, Pa. 5. "Two Bantams" by Mahonri Young (1877–), American. This bronze group illustrates unity of composition by linear design. 6. "Head of Negress from Guadeloupe" by Dora Gordine, English. Shows method of modelling *à la boulette*. Exhibited in the Leicester Galleries, London. 7. "Goose" by Sirio Japanari. Example of ornate surface achieved by stressing the pattern of feathers. 8. "Bacchante" by Frederick MacMonnies (1863–), American; showing effective use of clear and unusual silhouette. In Metropolitan Museum of Art, New York. 9. Panel from "The Sea Gull Monument" by Mahonri Young. Bronze in Salt Lake City. Relief treated pictorially. Different surfaces are used to express sense of space

the draperies of surface decoration of many Greek and Chinese figures. Are they not more enchanting in a way than the more obvious beauties of the nude?

But the sculptor must not approach his problem thinking only of design, whether it be the design of surface or of structure, for his work will then lack life as did some of the Gothic, and may appear self-conscious and strained. It is better to "find" design in one's natural surroundings than to attempt to "construct" it. The observant artist often thrills with a sense of surprise and discovery at the sight of a quite accidentally occurring design which nature weaves into the tapestry of her days and nights. It may come when least expected and from the most unlikely source. It is not inspiration but the lucky chance of a certain combination of light and action and mood which must be grasped and noted at once before it is lost forever. By being always on the alert, the artist can keep himself ready instantly to take note of it. Through the accumulation of his notes he can always be equipped with a stock of designs which may be brought into his work. Korin, that great Japanese screen painter, executed in a perfectly naturalistic and direct way each fragment of nature which impressed him with its expressive design, and so the sculptor may see in the grace of a poised head, the crouch of a cat, or the shrug of a greyhound, a design which needs no enhancement; in the ruffs of fur, the ripples of muscle, the rhythm of ribs, the curling of hair, or the wrinkles of age, he can find a thousand sincere decorations infinitely better than anything he can imagine. He may find them in the folds of clothing, and even a short pleated skirt is a motive in surface decoration which the Egyptians would have employed in making a beautifully successful design.

Expression of Tool.—In sculpture the actual mark of the tool (*see* TECHNIQUE IN ART) is not so beautiful in itself, nor so sensitive a reflection of the mood and character of the artist as it is in painting. This is undoubtedly because the medium of the sculptor is a more difficult one to handle, but nevertheless the sculptor must consider this question and he must be very careful, if for instance, he is working in clay or plasticine, that his final bronze does not express the soft plastic appearance which he has imparted to the original substance, upon which he has left the casual marks of his tools or even his fingers. One cannot leave a deep thumb impression on bronze, and there is no excuse for leaving it on the clay image from which the bronze is to be cast, for this gives a false impression of the qualities of the final material in which the work of art is to be seen.



MODELLING TOOLS: (A) WIRE TOOL FOR MODELLING AND CUTTING CLAY; (B & C) TOOLS FOR PLASTER WORK

Some sculptors not only show great skill in the proper expression of their tools and the impression they make on the medium, but form a personal technique suitable to the subjects they are portraying. Thus Mestrović has developed a technique peculiarly personal and peculiarly suitable to the wood in which he often works; and Rodin not only employed a personal, appropriate and vital method of treating the smoother surfaces of his figures but also, as a gesture effective in its qualities of contrast, left rough tool marks on the surrounding stone (*cf.* Plate I., fig. 2).

The sculptor must, however, be very careful that this personal use of tools does not become an affectation. It should be natural, human and appropriate to the medium and should be chosen only because it is suitable to what the sculptor wishes to express. Modern critics would do well to point out the frequent insincere use of what might be termed personal textures of tool marks which are employed by some sculptors as a trade-mark.

Modelling.—Structural and rhythmical modelling that is true in its portrayal of the artist's theme and which conveys some of the original emotional thrill of beauty which gave to the artist the creative urge is attained only after the artist mastered and balanced his whole array of technical forces. This is well shown by Arthur Lee's figure, "Rhythm." It is this perfect conception upheld by a perfect technique which puts the breath of life into his work and even the master cannot be always sure of grasping it. But one thing is certain and that is that this life must be drawn from the great tumult of life with which nature surrounds us. Perhaps one model will not suffice for the sculptor; he may have to resort to two or three and perhaps even they are not sufficient, so that he will find himself forced to create details which he remembers from still other models, but it is certain that in the expression of this quality of vital force the artist is but the translator of an epic inscribed by the master of all master craftsmen. The "modernistic" rhythms which emanate from the finite mind of a single artist are trite and dead as compared with those which millions of years have developed in the evolution of animal and man.

Choice of Subject.—It seems strange that in these days of keen athletic youth, great action and intense living, many sculptors are still content with the portrayal of well-rounded and rather phlegmatic female figures usually reminiscent of days long past, in form, in position and in name. This is probably due to the sculptor's training in the classics and to the attitude fostered by the adoption of the term "fine arts" (*see* TECHNIQUE IN ART), but on every hand slender, beautifully athletic forms are walking, running, skating, skiing, swimming, and dancing;—doing a thousand things with a clean-cut action and beauty never attained even in the days of Greece, and closer to the modern sculptor and his public. Some sculptors have adopted this viewpoint and the alert living figures of boxers by Mahonri Young (*see* Plate VIII., fig. 5) are an example showing the tremendous possibilities, for these two figures are bound together by that intangible, though very real cord of antagonism in a primitive contest, in a way which has hardly been better portrayed. Even though the sculptor may not adopt the facts of modern existence in his work it is still possible for him to portray the spirit of this, even though the name of his subject be hundreds of years old. Edward McCartan has grasped this spirit in his figure, the "Diana with the Greyhound" (*see* SCULPTURE, Plate VIII., fig. 2), and it is not difficult to imagine this girl buoyantly walking down some familiar road and shortening the leash on her dog as she crosses at the street corner. In such manner did Michelangelo and Cellini express the spirit of the Renaissance. Even better did the Greeks record all that was beautiful in their daily lives.

But a sculptor must be careful to choose a subject which he understands and loves. His is perhaps the most enduring craft and many are the miscreations that live too long. Often without more than a few hours of thought he will start a work which will take him years to complete and which may exist for centuries. Thus sculpture must have a fundamental meaning and the artist should think of it as existing not only for his contemporaries but for generations to come. For this reason he must deal with those qualities which all men comprehend. By this it is not suggested that a meaning which is involved or literary can be employed. Such meanings are not sufficiently universal, and the contemplation which is necessary before the sculptor begins work should consist of preliminary observation, the assembling of notes made at previous times, and those trial sketches recording things which he may forget in the heat of his actual work. It is said that famous painters of the Far East often merge themselves in contemplation of the silk upon which they are going to develop a work of art, and that they do not permit themselves to make even the lightest line suggestive of the composition, for the reason that the first touch of brush to silk to a certain degree commits them, and masses, rhythms and lines can be more easily moved in the imagination before this first lightest touch has begun the crystallization of what they wish to do. Many great sculptors have weakened their work by not devoting an amount of time in considera-

tion proportionate to that expended in the actual labour. This was especially true of Michelangelo who in the great vigour of his mind sometimes created beings that seemed to wish to reach outside the block of stone. (*See* SCULPTURE TECHNIQUE: *Modeling, Theory.*)

Characterization.—After having selected the subject and model it is necessary to choose certain characteristics and to eliminate those extraneous details which do not form an inherent and component part of its being. This is the artist's privilege, nay, it is almost the heart of his work, and selection must be thought out carefully. Many modern artists are carrying this privilege so far that their work eliminates all possibility for those blending chords of characteristics that develop in a fine portrait sculpture as rightly as in organ music. Thus the "Portrait of Mme. Pogany" by Brancusi (*see* SCULPTURE PORTRAIT, Plate X., fig. 3) when compared with the other two portraits on the page, that of "Lafayette" by Houdon and that of "Admiral Farragut" by Charles Grafly, seems childlike in its simplicity. The work of the true portrait sculptor as seen in the other two, shows all the complications of the characters portrayed, but reduces them to a meaningful whole. It is difficult to understand why in these days of diversity of interest and complications of existence some artists should choose to show less in their work than did many of the more primitive peoples. Compare the Brancusi head (Plate X., fig. 3 of SCULPTURE) with Plate IX. One must agree that this simplified characterisation can hardly be more than an affectation, for the result does not gain in the distinction of design, which is demonstrated in the negro head of Plate IX., fig. 8, of SCULPTURE, and to which Brancusi's work is distinctly inferior in the portrayal of character. Thus character portrayal and accent are not caricature, nor are they the assumed attitude of a theorist.

Association With Surroundings.—Sculptors have found it necessary to specialize in certain fields, because they have found it necessary to study not only the problems of their work in itself but those which are involved in adapting it to its intended surroundings. In the foregoing articles certain broad truths have been pointed out, but the reader must realize that these are only samples of the problems which must be solved, for not only must the sculptor who is making portraits be a student of craniology, physiognomy and anthropometry, but he who is working for the enhancement of the beauty of a building must be properly equipped with a knowledge of periods of architecture and decorative styles, their reason for being and their influences. Each division in this field of art has its problems of application, whether it be portrait, architectural, garden, monumental or any other branch of sculpture, and whether it be large or small, bronze or stone, designed to be shown indoors or out-of-doors, on an eminence or level with the eyes.

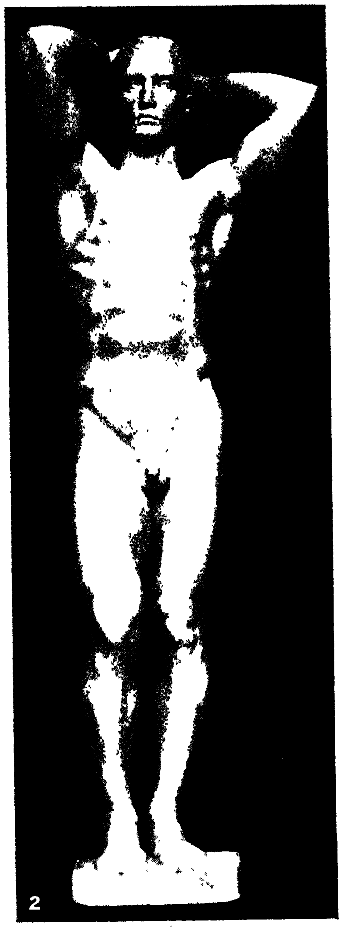
Psychological Balance.—Sculptors, of all artists, feel the necessity for a proper balance, because of the enduring quality of their art, while painters are often the first to take up the enthusiasms of the day, and to drop them. In recent years there has been a great wave of interest in the subjective; man searches his inner being with interest in an endeavour to find that which he has not been able to find outside himself. Perhaps this tendency is due to the declining power of religion and it has been suggested that men are no longer moved as were those of the Middle Ages in the worship of a god and now search for a god within themselves. In art there has been a revolt against the strongly objective viewpoint of the academist, for realism was carried in the 19th century to its ultimate climax. The impressionists were not concerned with reality but were interested only in their impression of things, in catching the fleeting moment, and thus their work grew swifter and swifter in the hope that they could catch quickly passing glimpses of light and colour. Sculptors only distantly followed this movement. However, after the impressionists, various groups of distortionists who were sculptors as well as painters, carved and twisted reality until all semblance of meaning was lost and no one could guess with what model the artist had begun his work. In defense of all this, artists said that they were "expressing themselves," an argument which though not complimentary to their reason was nevertheless unanswerable, for who could tell what another saw or did not see?

This reaction against the too objective viewpoint of the 19th century is a healthy one and was necessary in the development of the evolution of art, but there is nowadays among artists a growing understanding that a readjustment will be necessary and of all artists the sculptors appreciate best the necessity of balance between the objective and the subjective, the factual and the imaginative, that which can be observed in the artist's world, and that which the inner being of the artist imposes upon it.

The primitive artist first makes as good a copy as he can of the object he is attempting to portray and then feeling a lack in its static quality resorts to various devices to indicate its movement. In doing so he combines what he actually sees, the objective, with what he feels, the subjective; and every artist does the same, for nothing in nature is quite good enough to satisfy the artist; he must improve on it a little. Nothing in nature exactly fits with the spirit of his mood and thought, and therefore he must mould it the better to suit his expression. It is this subjective quality which, along with his technique, creates what we call the artist's style, for in it we see something of the man himself; we see the object which he is portraying through his eyes, coloured by his emotions, illuminated by his dreams and enriched by his knowledge. But this style should never be consciously imposed upon the theme in such a way as to obscure it, for the artist's true endeavour is to make it possible for his fellowmen to see more clearly and with more feeling than they could without him. In order to accomplish his purpose he may make a round breast rounder to point out its roundness, or in like manner accent or suppress any quality of light or shade, strength or weakness, vigour or impassivity, any emotion, any association, or any other reaction which he may choose to employ, if the power of his work upon his fellowmen can thereby be increased, so that it enlightens and instructs them in the experience of the beautiful, and broadens their understanding. The grotesque of the Renaissance may be as great art as the placid figures of an Amida Buddha, for art, like science, is not concerned with right and wrong, good and bad. Its urge is to broaden and explain, to impart feelings which could never be expressed in words, and which may never have been felt or expressed in just that individual way before. Thus it makes us understand almost as though we ourselves had experienced all that the artist has.

The sculptor who would express heroism in a monument or pathos in a tomb, the delighted glee of a child, or the tenderness of a mother, or a blending of all these things and thousands of others must take the soul of his work from the observations of these actual elements in the faces and bodily movements of those about him. If he wishes to make his work understandable and moving he cannot impose upon it so much of his own secret personal language that it can only be understood, if he himself stands by explaining to all men who observe, down through the ages.

People mistrust emotions they do not readily understand and many of our serious plastic artists because of this personal clouding of the observations which they have made, are actually burlesquing the very emotions, an understanding of which they are so earnestly pleading for. In the tense moment of a great drama an actor can become reasonably extravagant in his gestures, for his audience, having been carried through all of the facts which the dramatist has provided, is with him. They know why he feels as he does and their sympathy leads them to be moved by acting which, if not explained, would seem ridiculous. All that another actor need do to rouse the laughter of the audience and to burlesque this tense moment is to walk on the stage and to go through the *identical actions* with no preliminary explanations. So it is with sculpture, and this may explain in part why sculptors are so loathe to take up new forms. Everyone knows who Diana is and though the work itself may not be good enough to bring to their minds at once the character of the chaste huntress it may be good enough to pass with the proper label. But, if the sculptor has the perception and insight, if he is sufficiently skilled in his technique and if he does not cloud the subject with his own too self-centred subjectiveness it is possible to find a thousand



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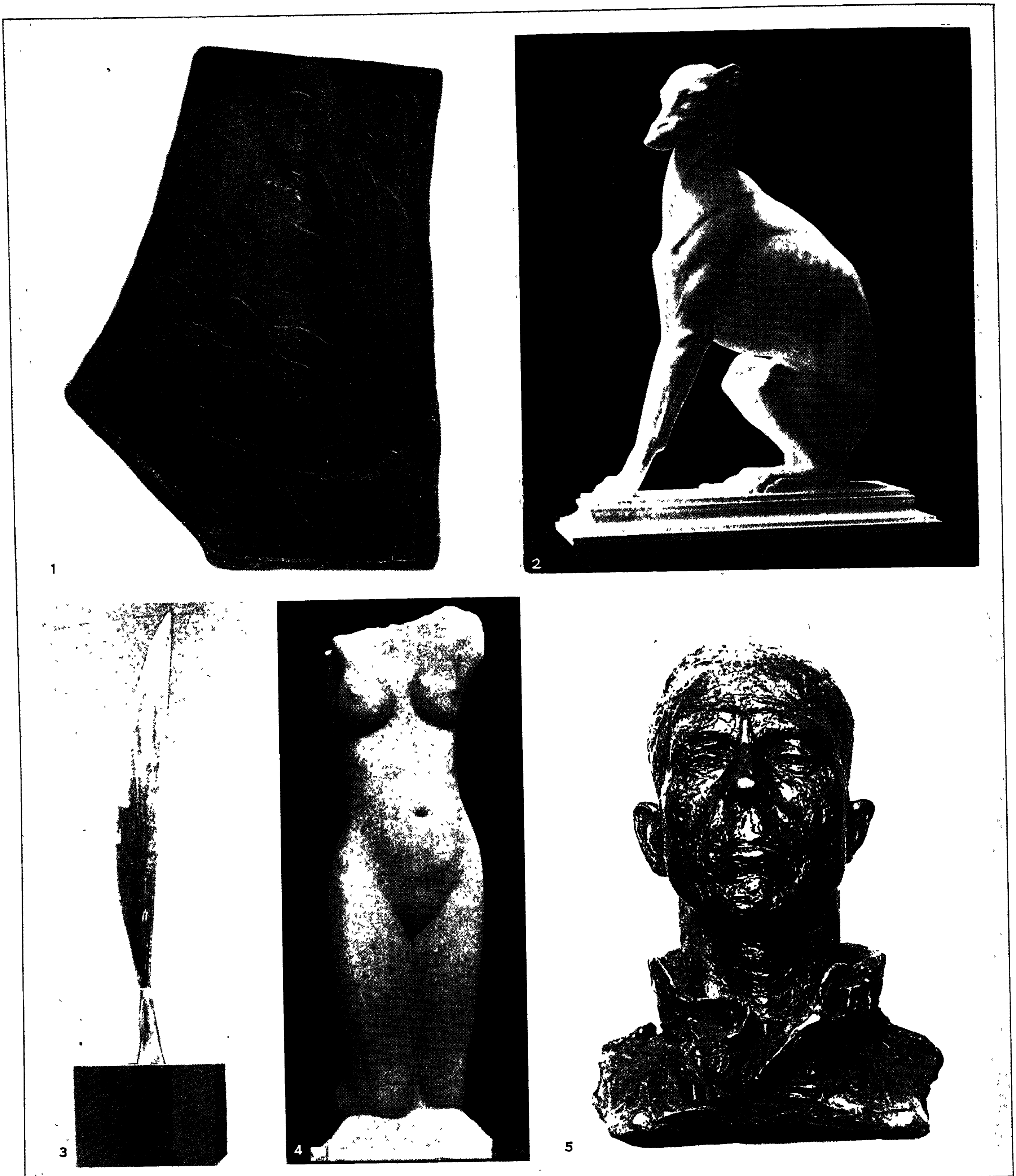
EXAMPLES OF EIGHTEENTH, NINETEENTH AND TWENTIETH-CENTURY SCULPTURE

1. "Venus Anadyomene" by Paul Manship (1885–). A masterful expression of the material marble enhanced by the rhythmical beauty of natural form
2. "Rhythm" by Arthur Lee (1881–). One of the finest modern examples of expression of perfectly modelled natural rhythms
3. "Girl Holding Fruit" by Claude Michel Clodion (1738–1814). A fine example of the expression of terra cotta, especially typifying the period in which it was made
4. "The Bather" by Jean Antoine Houdon (1741–1828). Beautifully expressive of stone and of the period during which this sculptor lived
5. "La Pleureuse" by Auguste Rodin (1840–1917). Showing a fine contrast of textures typical of this artist's style and expressive of his direct technique in marble
6. "À la gloire de Jean Goujon" by Alfred Auguste Janniot (–). A fine example of European modernist expression in stone

SCULPTURE TECHNIQUE



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DECORATIVE AND PORTRAIT SCULPTURE IN WOOD, MARBLE AND BRONZE

1. The Happy Angels, by Ivan Mestrović (1883–), Yugoslavic. A good example of the expression of the material wood
2. Greyhound, by Edward McCartan (1878–), American. An excellent example of the selection of natural rhythms. Note the lines of muscle over the shoulder and side and the rhythm of the lines of the neck carried out in the perfectly true parallel rhythm of the shoulder muscles
3. Bird in Space, by Constantin Brancusi (1876–). A simple form so subjective that it has no aesthetic meaning except to the artist
4. Homo, by Eric Gill (1882–), English. A fine simplified form expressing the quality of marble
5. American Soldier, by Jacob Epstein (1880–). Showing expressive modelling, but a texture more appropriate to clay than to bronze, the material in which it is cast

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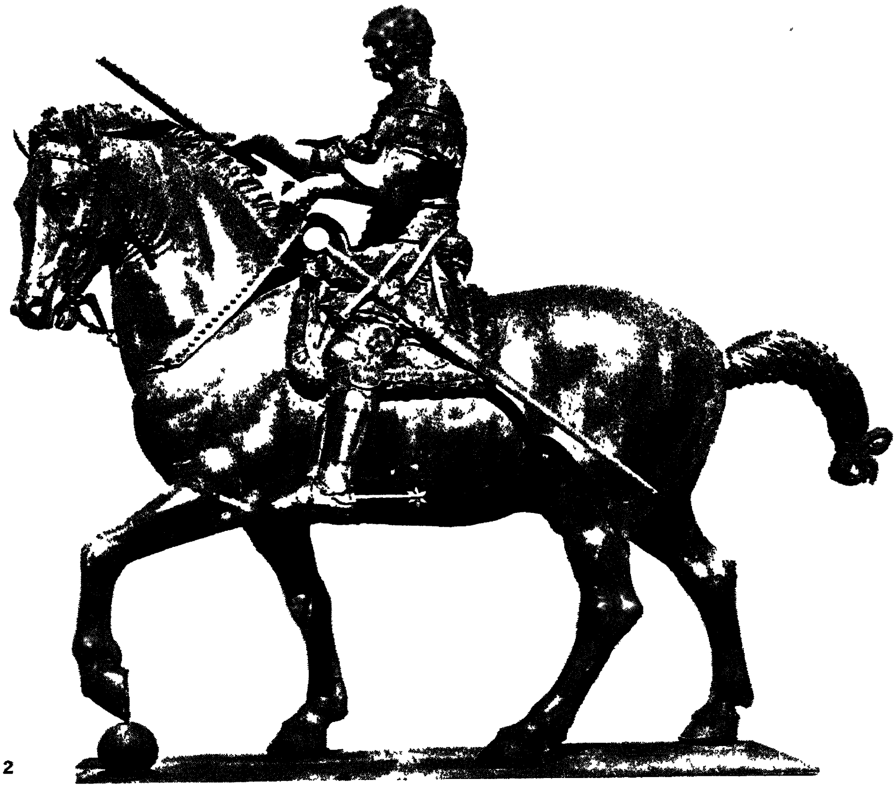

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MONUMENTAL SCULPTURES IN BRONZE

1. The Colonne Vendôme, designed by Gondouin and Lepère, 1806, Paris. The column is plated with bronze ornamented with scenes from the campaign of 1805 and is surmounted by a statue of Napoleon I. 2. "Statue of Guatamalata," Padua, completed in 1453 by Donatello (1386–1466), the first great bronze work cast in Italy during the Renaissance. 3. Gilded bronze equestrian statue of Marcus Aurelius (A.D. 121–188), an example of Roman imperial sculpturing. It was erected in the Forum, after his death, and later removed to the square of the Capitol, where it now stands. 4. Statue of Bartolomeo Colleoni, in Venice, by Andrea del Verrocchio (1435–88). The pedestal was finished in 1489 by A. Leopardi (1450–1522)

SCULPTURE TECHNIQUE

BY COURTESY OF THE PATHE EXCHANGE, INC.

STEPS IN THE PROCESS OF CASTING A STATUE IN BRONZE

1. The sculptor's original model in plaster
2. Making gelatine moulds from the original, which has been first carefully divided into sections
3. Pouring heated wax into the prepared gelatine moulds
4. Assembling the wax model
5. Attaching wax pipes which will serve to carry off the melted wax and fumes during baking
6. The wax model encased in plaster for baking
7. Putting a thick layer of fire-clay outside the plaster
8. Bricking up the kiln after the model has been placed inside
9. At the end of a few days the wax has melted and been carried off through the pipes leaving a final mould of plaster. This mould is placed in a pit and solidly packed with earth
10. Pouring the molten bronze, heated to a temperature of 1,900°F into the mould
11. Removing the mould after the bronze has set
12. Finishing the completed model with a blow torch; applying chemicals in liquid form to obtain different colours (patine)

models in the world about him capable of being understood by all men through the ages, and at a glance. (W. E. Cx.)

CASTING AND FINISHING

The discovery of copper alloys is lost in the prehistoric ages. Their name was Chalcos with the Greeks and Aes with the Latins. Aes Brundusinum was the name of the alloy used in manufacturing famous Roman mirrors, and possibly the origin of the word "bronze" came from Brindisi (Brundusium), a city on the Adriatic coast of Italy where bronze was manufactured on a large scale. The origin of art bronzes or sculpture in bronze had its birth in the most remote days of human history, but after the invasion of the Roman Empire by the Barbarians, there was a long period of obscurity. It was in Italy during the Renaissance period that the regeneration of the bronzes of art took place, especially by the efforts of Benvenuto Cellini.

Bronzes of art are cast by two different methods: (1) the sand process, (2) the *cire perdue,* or lost wax process. Judging from the early specimens of bronze castings, undoubtedly the cire perdue method, or something like it, was used long before sand casting.

Sand Process.—The original model of the sculptor is moulded in an iron flask, with the use of very fine French sand (a composition of clay, silica and alumina). The iron flasks are strongly built frames made in two halves of such a perfect mechanical construction as to fit very closely with the aid of clamps and bolts.

The moulder gently hammers the damp sand against the plaster pattern, taking care of the undercuts of the model or deep recesses, by making as many as necessary small pieces of sand in such a way as to be able to release them from the original model by taking them apart without injury either to them or to the model.

After the model is released, the packed sand mould, which bears the impression of the most minute details of the original model, is recomposed and a proper sand core is built inside of it. This core is so cut that it leaves a space between itself and the piece moulds above described.

After this operation the dampness of the sand mould must be carefully eliminated by enclosing it in an oven properly built. When the mould is completely dried, the liquid bronze at about 1,900 degrees Fahrenheit is poured into the iron flasks previously recomposed and clamped together, and it will run through channels skilfully cut in the sand, going to fill the empty spaces mentioned above.

The sand is then removed, and after the bronze is cleaned with nitric acid, it will be finished and chiselled by skilful artisans.

Cire Perdue, or Lost Wax Process.—The first stage of this process, after receiving the model from the artist, consists in preparing a negative made of plaster or gelatine. This is merely a coating of the outside of the model. In this negative, which shows all the details of the model in the reverse, a wax coating is applied in a molten state with a brush until it has acquired sufficient thickness, depending on the size of the figure.

At this stage, we will have a perfect replica of the sculpture in wax, and sufficiently hard to permit handling. The artist can work on it as much as he pleases, obtaining rare results of details, which makes this process of casting invaluable. Gates and vents in the shape of wax rods are then properly attached to the wax figure.

Finally, the mould for the metal is formed by blowing or pouring inside and around the wax a semi-liquid composition, which hardens in a few minutes. This composition of silica, plaster and other chemicals can resist high temperature, and, of course, all the wax inside of it will melt away, leaving a hollow space. This operation is accomplished in large ovens, by baking the moulds over a slow fire. As soon as all the wax is surely melted away, the mould is removed from the oven and packed in foundry earth in a pit provided in the floor. The bronze is then poured from crucibles, and the molten metal will run through the gates (melted away) and fill the space left empty by the wax figure also melted away (lost wax). The figure in bronze is then removed from the silica mould and dipped in acid for a proper cleaning.

With this process, the cast bronzes require very little finishing or chiselling, and the results are far above the sand process.

The so-called "patina" (*q.v.*) of the finished bronzes is an art in itself, and the different effects of colour are obtained by a large use of different chemicals.

Bronze is an alloy of from 85 to 90% of copper, and from 10 to 15% of tin, zinc and other non-ferrous metals. The alloy called United States Standard Bronze is composed of 90% copper, 7% tin and 3% zinc. This formula is not by any means officially approved by the United States Government, and this name was given by some bronze foundrymen only a few years ago for their own advantage, and strange to say it became an official word. Almost every specification generally written for contracts of art bronzes mentions the United States Standard Bronze as stipulated.

There are hundreds of other formulas of bronze, many of which contain other metals, such as lead, silver, aluminum, etc., which should not be left apart from the specifications of art bronze.

Some formulas of famous art bronzes will show the relative compositions:

Some Greek bronzes have: copper 62%, tin 32%, lead 6%.

Others have: copper 72%, tin 24%, lead 4·6%, zinc 2%.

The famous column Vendôme in Paris has: copper 89%, tin 10% (with traces of lead, tin and silver).

The statue of Louis XIV. in Paris has: copper 91%, tin 2%, zinc 6%, lead 1%.

Statue of Molière also in Paris has: copper 90%, tin 6%, zinc 2·5%, lead 1·5%.

The statue of Frederick the Great in Berlin has: copper 90%, zinc 10%.

There should not be any cause of alarm in judging the bronzes of art from the point of view of durability, as there are millions of specimens all over the world in an admirable condition of preservation composed of every conceivable proportion of alloy.

Not long ago some bronzes were discovered belonging to an age precedent to the Incas, with an alloy of 94% copper and 6% tin. (R. Be.)

PLASTER CASTING

In plaster casting there are at least three methods of procedure, each of which is determined by the kind of mould used: (1) the gelatine mould, (2) the piece mould, (3) the so-called waste mould. The gelatine, or glue, mould is generally employed when more than one plaster cast of the same model is desired, and this we shall consider first.

Glue Moulding.—After covering the clay or plasticine model, which is to be cast, with paper, a layer of clay about three-quarters of an inch is placed over it. Next to this is made the outer shell of plaster which will hold the glue. This shell is made in sections, when the model is in the round, so that it may be removed without disturbing the model. These sections must also be carefully keyed, both to the base and to each other, so that they may be placed in their original position, leaving an even space between the model and this outer shell. This space is filled with the melted casting glue or gelatine, which is poured in through a hole made in the top. Other holes are also made in the shell to allow the air to escape as the melted glue rises in the space, and are closed with clay when the glue reaches that level. When the gelatine, or glue, is sufficiently cooled, the shell is opened and the clay, or plastilene, is cleaned from the gelatine mould. It is then properly greased with a mixture of stearine and kerosene and the mould, with the shell to hold it, is placed together again and plaster, mixed to a normal consistency, is poured into it. Care should be taken to reopen the mould at the proper time so that the heat of the plaster, while in the process of setting, may not melt the gelatine and in this way alter the mould so that the freshness of the original surface of the model is lost in the cast. In re-casting the mould should again be cleaned and greased lightly as before.

Piece Moulding.—This method is employed for the same purpose as the gelatine moulding. It gives a sharper, more accurate reproduction but requires greater skill and time, as the mould is made in many pieces of plaster, so placed and fitted

that they may be freed from what is termed undercuts in the cast. In gelatine moulding, on account of the pliability of the mould, this difficulty with undercuts is avoided. Each part of the piece mould must be made separately. The soft plaster, placed on the section of the model that can be cast in one piece, is allowed to set, after which it is smoothed and trimmed with a chisel, and the surface against which the next piece will lie, is oiled so that the fresh plaster will not adhere to it. When the model is covered, the tops of the pieces are oiled and plaster placed over them, which, when set, forms a shell to hold them in place while they are being filled with the plaster of the cast. Before casting, however, the mould must be taken apart and the clay washed from each piece. It is then soaped and oiled and put together ready for casting. After each casting the pieces should be cleaned and oiled to prevent them sticking to the cast.

Waste Moulding.—This process is used either when only one reproduction in plaster is desired or in very large work. Proper divisions are first made in the most salient points of the model by small pieces of brass, so that when the mould is finished it may be opened and all the clay removed. The model is now covered with a coating of coloured plaster which is made by colouring the water, with which the plaster is mixed, with blueing or dry colour. In the process of chipping the plaster mould from the cast, this coating warns the moulder that he is near the cast and must chip carefully to prevent cutting into it.

After the first coating of coloured plaster, about three-eighths of an inch thick, a thicker coating of white plaster is applied. When the cast is large, or when there are parts of it that might break easily, it may be reinforced with iron pipes which are fastened to it with strips of burlap dipped in plaster.

The brass has made a natural cut in the plaster mould, thus dividing it into sections. These are removed from the model, washed with water, soaped with green soap, melted in hot water and allowed to cool. Then with a dry brush all soap is carefully removed from the mould and a slight coating of olive oil is given it to insure the proper separation of the mould from the cast. The sections are now put together and held in place by burlap dipped in plaster, or tied with wire, and the mould is ready for filling. In order to remove this mould it must be chipped from the cast, because the undercutting of the cast does not allow the sections to be lifted off as in the piece-mould.

Casting.—The cast of a bust or other simple work can be made in one piece. The sections of the mould are united, and the plaster at a proper consistency poured into it. By continually turning the mould the plaster may be evenly distributed. A thickness of three-quarters of an inch is sufficient to make a strong cast, especially when it is reinforced inside with burlap dipped in plaster, or with iron pipes. Where the model is small it may be entirely filled, thus forming a solid cast.

In the case of large works, in which there is no way of moving the mould around, the cast is made in sections. When set, the sections are joined together and properly strengthened on the inside, great care being taken that all joints are clear of plaster so that they may fit perfectly.

Chipping.—Sufficient time should be allowed for the plaster to set properly, then, with a mallet and chisel the outside iron pipes are removed and next the natural coloured plaster, leaving the thin coloured coating. This should be removed with care to insure a plaster cast without a blemish. The plaster cast can be re-touched with plaster mixed to a thinner consistency than the casting plaster and care should be taken to wet the model before applying.

Tinting Plaster Casts.—Plaster is made of equal parts of plaster and water, the plaster being slowly poured into the water and given sufficient time for absorption, after which it should be stirred gently. There are various ways of tinting plaster casts so that they may resemble bronze, terra-cotta, etc. One of the most common is the oil paint method. One coat of shellac should be given as a prime. After this has dried thoroughly a coat of oil paint of brown with a little dryer is applied and allowed to dry. If a greenish blue tint is desired a very thin mixture of light green oil paint is applied to the brown coat. When this is almost dry it is wiped off with a rag, allowing the green colour to remain in the deep parts; for a metallic effect, a little gold or bronze powder mixed with dryer may be applied to the high parts. When thoroughly dry it is rubbed with ordinary prepared furniture wax. This will subdue any unpleasant shiny effect and bring the whole thing together. Similar procedure may be used with any other colour desired.

(*See* other sections of SCULPTURE TECHNIQUE preceding this article, such as CASTING AND FINISHING; MODELLING.)

(L. LEN.)

PATINA

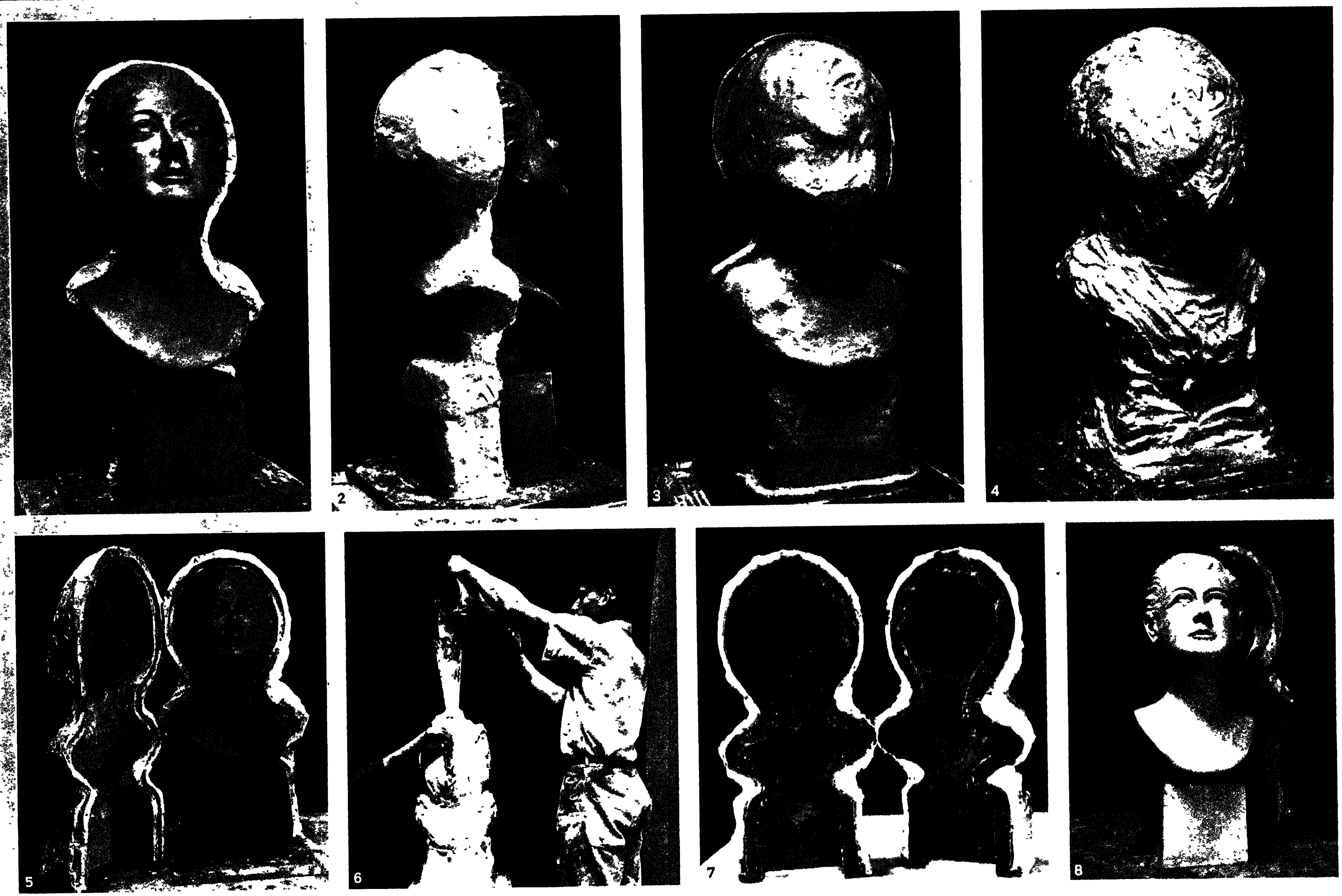
Patina, strictly defined, is an artistic product of the corrosion of copper or copper-rich alloys, notably the bronzes. It is an "incrustation which forms on bronze after a certain amount of exposure to the weather, or after burial beneath the ground. When perfectly developed it is of a dark green colour and has nearly the composition of the mineral malachite, a hydrated carbonate of copper." In the broader interpretation of the term, patina includes mineral or mineral-like coatings or deposits on metal objects of art of a large variety of shades—greens, blues, reds, greys, blacks, etc.—the deposits having been produced by either natural or artificial means.

In this article we are primarily concerned with the patina formed on bronzes, the *verde anticho* or verdigris, the usual constituent being the basic carbonates of copper, malachite and azurite. At times the patina will be distinctly red (cuprous oxide); at other times we will find it to be greyish green and frequently, as is the case with many Chinese and Japanese bronzes, it is almost black, resembling polished ebony.

A good patina of the proper composition and texture serves a double purpose. It enhances the beauty of the bronze object and secondly it protects and preserves the bronze from destruction by the very agents, such as carbonic acid, so necessary to form the patina. The second purpose of the patina, therefore, is like that of a permanent coat of protective paint.

Artistic Qualities.—Most patinas are green or greenish blue. The grey patinas are usually due to a predominance of tin oxide or lead carbonate in the crust. The black patinas are usually found on bronzes containing appreciable quantities of lead. However, there are many different intermediate shades of patina; likewise there are many different textures. The main factors that influence the shade and texture of the patina are (1) the chemical composition of the bronze; (2) the metallographic structure of the bronze, whether fine or coarse grained, presence or absence of intercrystalline impurities, etc.; (3) the location in which the bronze has remained before its discovery; and (4) the time or duration the bronze has remained in the particular location. Thus, for example, some of the finest greens are found on bronzes of pure tin-copper alloys and on objects that were fashioned of native copper. The addition of zinc and lead to the bronze darkens the shades very appreciably. A fine grained crystalline structure of the bronze favours a uniform fine textured patina. As regards location, absence of moisture and salts usually results in the characteristic bronze brown. Presence of sulphur compounds in the air to which the bronze is exposed, as for example in the path of the winds passing over active volcanoes, gives rise to very dark almost black shades of patina. Slow oxidation in alkaline soils but in the absence of carbonic acid will produce the comparatively rare red (cuprous oxide) patina. A short time in a moist salty location will produce a heavier or thicker patina than a comparatively long exposure in an almost dry location.

Durability.—Apart from the artistic quality, a patina must be durable. The major constituent of the bronzes is copper and it is primarily upon the permanency or lasting qualities of the copper compounds entering into the composition of the patina, that the formation and life of the patina depend. The permanency of the various copper compounds that come under consideration can best be judged by ascertaining the behaviour of these compounds in the crust and on the surface of the earth where they have been exposed to various corroding or disintegrating influences for millions of years as a rule.



BY COURTESY OF THE ETTL STUDIOS

THE GELATINE MOULD PROCESS OF CASTING

1. Model partly covered by clay filler. 2. Model partly covered by clay filler, seen from the side. 3. First step completed, entire model covered with clay filler. Ridge dividing front from back provides additional thickness where casing will be cut. 4. Plaster casing laid over clay filler, casing to be divided into halves where extra thickness of clay projects part way through it. 5. Front half of casing removed and clay filler cleaned out. 6. Gelatine being poured into casing after all of clay filler has been removed and the casing has been replaced around the model. Clay is placed over the vents which permit the air to escape as the level of the gelatine reaches them. 7. Finished mould with the clay model removed. 8. Finished plaster cast with front half of mould removed

Native or metallic copper occurs in Michigan, Australia and elsewhere and has been thus preserved through the ages due to the absence of corroding influences such as acidulated waters. By far the greater proportion of copper found in the crust of the earth occurs as the sulphide either alone, as chalcocite and covellite, or, more commonly, in association with other sulphides, as chalcopyrite, bornite and others. These sulphides are, however, only permanent "at depth," in the lower strata, away from corroding influences. In the upper strata where the minerals have come into contact with rain water or with moist air containing carbonic acid, the sulphides have been transformed into the more stable malachite. The very large copper deposits of the Belgian Congo are a good example of such occurrence of sulphides in the lower layers and carbonate or malachite in the upper.

Other minerals of copper that are met with in patinas are the basic chloride, atacamite, the basic sulphates, such as brochantite, the blue carbonate, azurite, and cuprite, the red cuprous oxide. All of these minerals when exposed to moist atmosphere decompose and turn into malachite. Among the valuable bronze collections, we do meet with examples of patina composed wholly or in part of one or more of these unstable compounds, *i.e.*, unstable in climates such as those of London, New York or Paris. Thus, there are a large number of instances on record where a natural blue patina (azurite) has been preserved for years by taking proper precautions. On the other hand, collectors have often lamented that a patina originally of a very attractive blue was gradually changing into a green (malachite) patina. The red copper oxide patina is highly prized. The large bronze cat, of Egyptian origin, on exhibit at the Metropolitan Museum of Art (New York) has large irregular patches of this beautiful red patina. By suitable protective measures the transition into the carbonate, malachite, can be very much retarded.

Particular attention should be paid to the basic chloride of copper, atacamite, of frequent occurrence in Egyptian bronze patinas. This chloride is perfectly stable in an absolutely dry atmosphere such as is met with in the sealed tombs of Egypt. However, as soon as this chloride-bearing patina is brought into contact with moist air not only is the transformation into malachite very rapid—very often within but a few weeks—but the chloride in presence of moisture and carbonic acid rapidly corrodes the entire bronze. A chloride, such as copper chloride, sodium chloride or ammonium chloride, is a very dangerous constituent of the patina and is one of the most active agents giving rise to the dreaded bronze "disease."

The presence of chlorides in the soil in which a bronze object lies buried will greatly hasten the formation of a patina. However, the rapid growth of a patina brings about a poor, loose structure of little or no permanence. The characteristics of the best or "noble" patina are a very slow formation, compact, solid texture, gradual transition from metal through oxide to carbonate, the malachite of fine crystalline structure, the hair line fissures of the bronze directly under the patina tightly packed with oxide or carbonate, and a smooth almost enamel-like surface free from warts and nodules.

Artificial Patinas.—The production of artificial patinas has been practised since time immemorial. Unfortunately, however, nearly every one of the hundreds of formulas prescribed involves the use of sal ammoniac or some other chloride—one of the most destructive compounds to introduce into a patina. Chlorides are very treacherous and should never be resorted to in spite of their "convenient and rapid action." Years of experimentation and testing have led us to condemn all procedures involving the use of chlorides or other strong salts. It is to be borne in mind that the ultimate compound of lasting quality which is sought after is the green basic carbonate compound of copper. The final patina produced must be free of all mineral acids such as muriatic, sulphuric or nitric since these acids will cause a rapid destruction of the entire body of the bronze.

Eliminating the mineral acids and substituting the organic acids, such as acetic, oxalic, citric and carbonic, we can produce coatings of great permanence. The artistic effects brought about are dependent primarily upon the method and means of procedure. Applying a solution of any one of these organic acids to the surface of the bronze by means of a brush seldom brings about a pleasing or attractive patina. Usually streaky deposits result. The point to bear in mind is to imitate the natural formation of the patina as closely as possible. We recommend the following procedure.

The bronze, whose surface has been carefully cleaned (*see* BRONZE) so as to expose the virgin metal or only a thin film of oxide, is placed in a gassing chamber. This chamber must be large enough so as to prevent the bronze from coming into contact with the walls. The chamber is closed on all sides, preferably hermetically sealed. The "gas" is derived from a dish of strong acetic acid situated at the bottom of the chamber. Moistening the surface of the bronze before introducing it into the chamber will hasten the formation of the copper acetate on the surface. The time of exposure is usually three to four days at room temperature. Then follows a gassing in ammonia fumes, using the same chamber and substituting a dish of aqua ammonia, concentrated, for the acetic acid. Then the third gassing is with carbonic acid taken from a cylinder. The procedure is repeated in the same rotation if a comparatively thick patina is desired. Irregular patches of blues and greens and bluish greens are produced, strikingly similar to those met with in nature. The bronze is then carefully and very slowly dried in an oven which is gradually heated up to 232° F allowing 12 to 24 hours to attain this temperature, depending upon the thickness of the patina; the thicker the patina the slower the heating.

Finally, the bronze is sprayed with a dilute solution of bees-wax in benzol and after 10 to 15 hours' drying in the air is carefully rubbed with a soft dry cloth. Lacquers are not as desirable as the bees-wax as most are not durable and fail to bring out the desired artistic effects characteristic of bees-wax. Since bees-wax is at times bleached with chlorine, the unbleached wax is to be specified.

To produce the red patina (cuprous oxide) gassing alternately in ammonia and iodine vapours may be used. We find, however, that the action is comparatively slow and quicker results are obtained by submerging the entire bronze in a suspension of precipitated chalk in water to which has been added 2 to 3% of iodine as tincture of iodine The bronze remains submerged for a period of three to eight days, depending upon the depth of colour desired. It is then dried and finished as above. The slower the patinating the more artistic the results is a good general rule to follow. (C. G. F.)

SCURVY (*Scorbutus*), a "deficiency" disease, characterized by debility, blood changes, spongy gums and haemorrhages in the tissues of the body. In former times this disease was common and very fatal among sailors. Scurvy has also frequently broken out among soldiers on campaign, in beleaguered cities, among communities in times of scarcity, and in prisons, workhouses and other public institutions. It was early recognized that scurvy and diet were connected. It is now known that the cause is deficiency of vitamin C in the food (*see* VITAMINS). This explains the occurrence of scurvy when fresh vegetables or fruit are unobtainable and its disappearance when they are administered, for these substances are rich in vitamin C.

The symptoms come on gradually with failure of strength, most manifest on making effort, and a corresponding mental depression. Then follow sallow complexion, sunken eyes, tender gums and muscular pains. This may continue for weeks, gradually getting worse, teeth fall out and haemorrhages, often of large size, penetrate muscles and other tissues. Peculiar disorders of vision have been noticed, particularly night-blindness (nyctalopia), but they are not invariably present, nor specially characteristic of the disease. The further progress of the malady is marked by profound exhaustion, with a tendency to syncope and various complications, such as diarrhoea and pulmonary or kidney troubles, any of which may bring about death. On the other hand, even in desperate cases, recovery may be hopefully anticipated when the deficient vitamin is supplied. No disease is more amenable to treatment both as regards prevention and cure than scurvy, the single remedy of fresh vegetables or some equiv-

alent securing both these ends. Potatoes, cabbages, onions, carrots, turnips, etc., and most fresh fruits, will be found of the greatest service for this purpose. Lime juice and lemon juice are recognized as equally efficacious. The regulated administration of lime juice in the British navy, which was begun in 1795, had the effect of virtually extinguishing scurvy in the service, while similar regulations introduced by the British Board of Trade in 1865 had a like beneficial result as regards the mercantile marine. It is only when these regulations have not been fully carried out, or when the supply of lime juice has become exhausted, that scurvy among sailors has been noticed in recent times.

Infantile Scurvy (*Scurvy Rickets, Barlow's disease*), a disease of childhood due to a morbid condition of the blood and tissues from defects of diet, was first observed in England in 1876 by Sir T. Smith, and later fully investigated by Sir Thomas Barlow. The chief symptoms are great and progressive anaemia, mental apathy, spongy gums, haemorrhages into various structures, particularly under the periosteum and muscles, with suggestive thickenings round the shafts of the long bones, producing a state of pseudo-paralysis.

SCUTAGE or **ESCUAGE,** the pecuniary commutation, under the feudal system, of the military service due from the holder of a knight's fee. The name is derived from his shield (*scutum*). The term is sometimes loosely applied to other pecuniary levies on the basis of the knight's fee. It used to be supposed that scutage was first introduced in 1156 or on the occasion of Henry II.'s expedition against Toulouse in 1159; but it is now recognized that the institution existed under Henry I., when it occurs as *scutagium, scuagium* or *escuagium.* Its introduction was probably hastened by the creation of fractions of knights' fees, the holders of which could only discharge their obligation in this fashion. The increasing use of mercenaries in the 12th century would also make a money payment of greater use to the crown. Levies of scutage were distinguished by the names of the campaigns for which they were raised, as "the scutage of Toulouse" (or "great scutage"), "the scutage of Ireland" and so forth. The amount demanded from the fee was a marc (13s.4d.), a pound, or two marcs, but anything above a pound was deemed abnormal till John's reign, when levies of two marcs were made without even the excuse of a war. The irritation caused by these exactions reached a climax in 1214, when three marcs were demanded, and this was prominent among the causes that led the barons to insist on the Great Charter (1215). By its provisions the crown was prohibited from levying any scutage save by "the common counsel of our realm." In the reissue of the Charter in 1217 it was provided, instead of this, that scutages should be levied as they had been under Henry II. In practice, however, under Henry III., scutages were usually of three marcs; but the assent of the barons was deemed requisite, and they were only levied on adequate occasions.

Meanwhile, a practice had arisen, as early as Richard I.'s reign, of accepting from great barons special "fines" for permission not to serve in a campaign. This practice appears to have been based on the crown's right to decide whether personal service should be exacted or scutage accepted in lieu of it. A system of special composition thus arose which largely replaced the old one of scutage. As between the tenants-in-chief, however, and their under-tenants, the payment of scutage continued and was often stereotyped by the terms of charters of subinfeudation, which specified the quota of scutage due rather than the proportion of a knight's fee granted. For the purpose of recouping themselves by levying from their under-tenants, the tenants-in-chief received from the crown writs *de scutagio habendo.* Under Edward I. the new system was so completely developed that the six levies of the reign, each as high as two pounds on the fee, applied only in practice to the under-tenants, their lords compounding with the crown by the payment of large sums, though their nominal assessment, somewhat mysteriously, became much lower (*see* KNIGHT SERVICE). Scutage was rapidly becoming obsolescent as a source of revenue, Edward II. and Edward III. only imposing one levy each and relying on other modes of taxation, more uniform and direct. Its rapid decay was also hastened by the lengths to which subinfeudation had been carried, which led to constant dispute and litigation as to which of the holders in the descending chain of tenure was liable for the payment. Apart from its financial aspect it had possessed a legal importance as the test, according to Bracton, of tenure by knight service, its payment, on however small a scale, proving the tenure to be "military" with all the consequences involved.

BIBLIOGRAPHY.—The best monograph on the subject (though not wholly free from error) is J. F. Baldwin's *The Scutage and Knight Service in England* (1897). The view now held was first set forth by J. H. Round in *Feudal England* (1895). In 1896 appeared the *Red Book of the Exchequer* (Rolls series), which, with the *Testa de Nevill* (Record Commission, re-edited as *Book of Fees,* Stationery Office 1920, 1923) and the Pipe Rolls (Record Commission and Pipe Roll Society), is the chief record authority on the subject; but many of the scutages are wrongly dated by the editor, whose conclusions were severely criticized by J. H. Round in his *Studies on the Red Book of the Exchequer* (privately issued) and his *Commune of London and other Studies* (1899). Pollock and Maitland's *History of English Law* (1895) should be consulted. McKechnie's *Magna Carta* (1905) is of value; and Scargill Bird's "Scutage and Marshal's Rolls" in *Genealogist* (1884), vol. i., is important for the later records. (J. H. R.)

SCUTARI (Albanian, SKODRA), a town of Albania. Pop. (1924) about 27,000, of whom 54% are Roman Catholics, 38% Muslims, and 8% Orthodox. Scutari lies in a plain surrounded by lofty mountains, except where it adjoins the lake. Malaria is prevalent in summer as the town is very liable to flooding, especially since the close of the 19th century, when the Drin was deflected at its junction with the Boyana. The mosques and the bazaar, lately much damaged by fire, give the town an oriental appearance, but the finest buildings are Italian, viz., the Roman Catholic cathedral, and an old Venetian citadel on a high crag. The fortress was recently almost destroyed in a storm, the pasha having fixed a brass spike to the tower containing the powder magazine. Scutari is the seat of a Roman Catholic archbishop and has a Jesuit college and seminary. Trade tends to decline and to be diverted to Salonika and other ports connected with the main European railways. A light railway was built by the Austrians from Scutari to the Voyusa during the World War and the roads were much improved during the occupation by the Great Powers after the Balkan Wars (1912–13). Grain, wool, hides, skins, tobacco, sumach, and draught horses are exported, and also large quantities of a kind of sardine called scoranza (Albanian, *seraga*) caught in the Boyana. Cotton stuffs are manufactured, and Scutari is the centre of the inlaid metal work for weapons. There are copper mines worked by an English company, and a small saltpetre factory. Textiles, metals, provisions and hardware are imported. The Imperial Ottoman bank was closed in 1915.

The Boyana is navigable for small vessels for 12 m. from its mouth, and cargoes for Scutari are then transhipped into light river boats. In the flood season goods are taken in small steamers up the Drin from the port of San Giovanni di Medua (Albanian, *Shin Ghen*), or landed at Alessio (Albanian, *Lesh*), the market and port of the Mirdite country, and conveyed thence in small vessels to Scutari. Steamers ply on Lake Scutari to and from Rijeka in Montenegro, but when the water is low, it is necessary to row out to them.

Livy relates that Škodra was chosen as his capital by the Illyrian king Gentius, who was besieged here and carried captive to Rome in 168 B.C. In the 7th century the town fell into the hands of the Serbians, but after the death of Stephen Dushan in 1355, the Balsha family, of Norman extraction, held part of Albania, with Scutari as their capital until 1394, when they sold the town to Venice. In the 15th century it became a stronghold of Skanderbeg's (*q.v.*), but on his death in 1467 reverted to the Venetians, who were, however, driven out by the Turks in 1479. In 1760 Mahomet of Bushat, pasha of Scutari, made himself an independent prince in all but name, and secured the hereditary pashalik for his family, the last of whom, Mustafa, was deposed by the Sultan in 1831. Scutari was wrested from the Turks by the Montenegrins in the Balkan Wars (1912–13) but was surrendered to an international force in the latter year and incorporated into the kingdom of Albania.

Lake Scutari, lying 20 ft. above sea level, and 135 sq.m. in extent, is almost bisected by the line of the Montenegrin frontier.

It occupies one of the depressions known as *polyes,* which are common throughout the Illyrian Karst region, and though its average depth is only 23 ft., there are a series of holes near the south-west extremity, one of which is 144 ft. deep. The Moratcha enters the lake near the Montenegrin port of Plavnitza, while the Boyana issues from its south-west extremity and flows into the Adriatic. The lake abounds in aquatic birds and fish; its brilliantly clear green waters, and its setting of rugged, many-hued mountains, render it one of the most beautiful lakes in Europe.

SCUTARI (skōō'tăh-rĭ) (anc. *Chrysopolis*), a town of Turkey in Asia, on the east shore of the Bosporus, opposite Constantinople of which it forms the 9th Cercle Municipale. Its painted wooden houses and white minarets piled upon the slopes of the shore and backed by the cypresses of the great cemetery farther inland present a very picturesque appearance from the sea. The town contains eight mosques, one of them, the Valideh Jami, built in 1547, of considerable beauty. Other remarkable buildings are the vast barracks of Selim III. and a hospital used during the Crimean War. (*See* NIGHTINGALE, FLORENCE.) The chief industry of Scutari is the manufacture of silk, muslin and cotton stuffs. The population (1927) was 155,092. The most striking feature of Scutari is its immense cemetery, the largest and most beautiful of all the cemeteries in and around Constantinople; it extends over more than 3 m. of undulating plain behind the town. Between Scutari and Haidar Pasha the British army lay encamped during the Crimean War, and in a cemetery on the Bosporus are buried the 8,000 British who died in hospital. At Haidar Pasha is the terminus of the Anatolian Railway. Chrysopolis ("Golden City"), the ancient name of Scutari, most probably has reference to the fact that there the Persian tribute was collected, as at a later date the Athenians levied there a tenth on the ships passing from the Euxine. Scutari was formerly the post station for Asiatic couriers (*Uskudar*=courier), and also, until the introduction of steam, the terminus of the caravan routes from Syria and Asia.

SCUTTLE, a term formerly applied to a broad flat dish or platter; it represents the O. Eng. *scutel,* cognate with Ger. *Schüssel,* dish, derived from Lat. *scutella,* a square salver or tray, dim. of *scutra,* a platter, probably allied to *scutum,* the large oblong shield, as distinguished from the *clypeus,* the small round shield. The name survives in the coal-scuttle, styled "purdonium" in English auctioneers' catalogues, which now assumes various forms. "Scuttle" in this sense must be distinguished from the word meaning a small opening in the deck or side of a ship, either forming a hatchway or cut through the covering of the hatchway; from which to "scuttle" a ship means to cut a hole in the bottom so that she sinks. This word is an adaptation of O. Fr. *escoutille,* mod. *écoutille,* from Span. *escotilla,* dim. of *escoti,* a sloping cut in a garment about the neck. The Spanish word is cognate with Du. *schoot,* Ger. *Schoss,* lap, bosom, properly the flap or projecting edge of a garment about the neck, O. Eng. *sceat,* whence "sheet."

SCYLAX OF CARYANDA (in Caria), Greek historian, lived in the time of Darius Hystaspis (521–485 B.C.), who commissioned him to explore the course of the Indus. He started from Caspatyrus (Caspapyrus in Hecataeus; the site cannot be identified: see V. A. Smith, *Early Hist. of India,* 2nd ed., 1908, 34 note), and is said by Herodotus (iv. 44) to have reached the sea, whence he sailed west through the Indian Ocean to the Red Sea. Scylax wrote an account of his explorations, referred to by Aristotle (*Politics,* vii. 14), and probably also a history of the Carian hero Heracleides, prince of Mylasae, who distinguished himself in the revolt against Darius (Herodotus v. 121). This work is the earliest known Greek history which centred round the achievements of a single individual. Suidas (*s.v.*), who mentions the second work, confounds the older Scylax with a much later author, who wrote a refutation of the history of Polybius, and is presumably identical with Scylax of Halicarnassus, a statesman and astrologer, the friend of Panaetius spoken of by Cicero (*De div.* ii. 42). Neither of these, however, can be the author of the *Periplus* of the Mediterranean, which has come down to us under the name of Scylax of Caryanda. This work is little more than a sailor's handbook of places and distances all round the coast of the Mediterranean and its branches, and then along the outer Libyan coast as far as the Carthaginians traded. Internal evidence shows that it must have been written long after the time of Herodotus, about 350 B.C.

Editions by B. Fabricius (1878) and C. Müller in *Geographici Graeci minores,* i., where the subject is fully discussed; *see* also G. F. Unger, *Philologus,* xxxiii. (1874); B. G. Niebuhr, *Kleine Schriften,* i. (1828); and E. H. Bunbury, *History of Ancient Geography,* i.

SCYLLA AND CHARYBDIS. In Homer (*Od.* xii. 73, 235, 430) Scylla is a dreadful sea-monster, daughter of Crataeis, with six heads, twelve feet, and a voice like the yelp of a puppy. In later authors and in art she is a mermaid, with dogs' heads springing from her loins. She dwelt in a cave in a high rock, out of which she stuck her heads, fishing for marine creatures and snatching the seamen out of passing ships. Within a bowshot was another rock under which dwelt Charybdis, who thrice a day sucked in and thrice spouted out the sea water. Between these rocks Odysseus sailed, and Scylla snatched six men out of his ship. In later classical times Scylla and Charybdis, whose position is not defined by Homer, were localized in the Straits of Messina—Scylla on the Italian, Charybdis on the Sicilian side (Strabo, i. p. 24; vi. p. 268). The well-known line, *Incidis in Scyllam cupiens vitare Charybdim,* occurs in the *Alexandreis* of Gautier de Lille, a poet of the 12th century, but the metaphor is at least as old as S. Augustine, *In Iohan. evang. tract.* 36, 9. In Ovid (*Metam.* xiv. 1–74) Scylla appears as a beautiful maiden beloved by the sea-god Glaucus and other deities, and changed by the jealous Circe (or other rival) into a sea-monster. The legend was variously rationalized.

Another Scylla, sometimes identified with the sea-monster, was a daughter of Nisus (*q.v.*) king of Megara.

See the classical dictionaries, *s.vv.*

SCYMNUS of Chios, the name assigned to a Greek geographer of uncertain date, commonly taken to be the author of a fragmentary anonymous *Paraphrasis* in verse describing the northern coasts of the Mediterranean and the shores of the Black Sea, a work which in the first edition (Augsburg, 1600) was ascribed to Marcianus of Heraclea. Meineke showed that this piece cannot be by Scymnus. It is dedicated to a king Nicomedes, probably Nicomedes III. of Bithynia (91–76 B.C.), and so would date from the beginning of the 1st century B.C. Its most valuable portions relate to the Euxine regions and to the Hellenic colonies of those shores as well as of the coasts of Spain, Gaul and Italy.

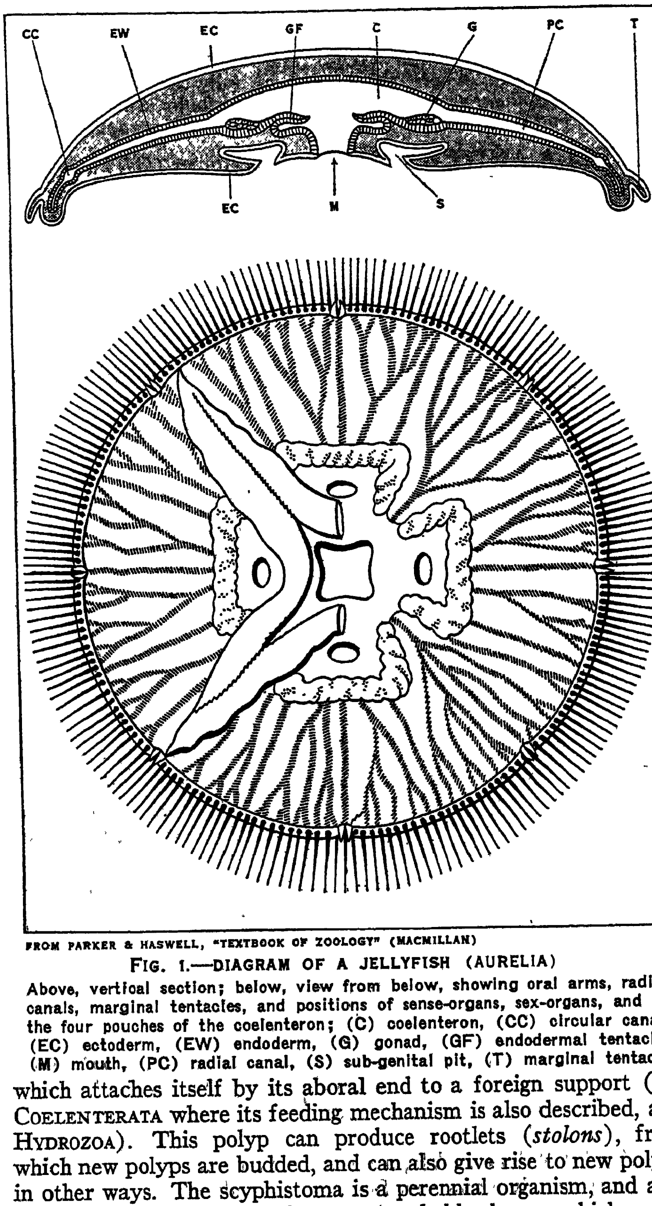
See Meineke's edition (Berlin, 1846); C. Müller, *Geographi Graeci minores,* vol. i., where the poem is edited with sufficient prolegomena (pp. lxxiv.–lxxvii.); E. H. Bunbury, *Ancient Geography,* i. 99, 100, 102, 128, 183; ii. 26, 69–74.

SCYPHOMEDUSAE, a technical name for a class of jellyfish more usually known as Scyphozoa. Jellyfish do not all belong to the Scyphozoa, others being included in the groups known as Hydrozoa (*q.v.*) and Ctenophora (*q.v.*). *See* also COELENTERATA; SCYPHOZOA; HYDROZOA; CTENOPHORA.

SCYPHOZOA, a group of jellyfish belonging to that series of animals known as the Coelenterata (*q.v.*) whose general characteristics are described in a separate article, other groups of jellyfish being dealt with in the articles HYDROZOA and CTENOPHORA. The scyphozoan jellyfish differ from all others in their anatomical characters and, speaking generally, they are larger and more substantial than hydrozoan medusae. Some of them attain extremely large size, measuring as much as 7ft. across the bell; these are the largest known coelenterates.

From the point of view of the general study of the Coelenterata the main interest of the Scyphozoa lies in their life-history. The egg sometimes develops directly into a medusa, but in other cases there is a complicated life-history, which may be exemplified by the case of the *Aurelia* (figs. 1 and 2). *Aurelia* is one of the jellyfish most commonly stranded on British shores, and is a transparent medusa usually from 3 to 6in. across in these waters. It has a rather shallow bell tinged with mauve, becoming a darker colour at the sex-glands, which show through from the inside.

It swims by a rhythmic series of contractions of the bell. The fertilized egg of *Aurelia* develops, not into a miniature medusa, but into a *polyp* of distinctive structure known as a *scyphistoma*—a small trumpet-shaped creature with long marginal tentacles,

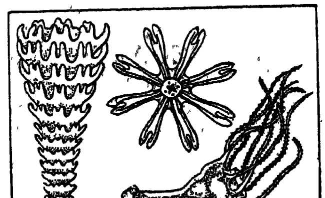


FROM PARKER & HASWELL, "TEXTBOOK OF ZOOLOGY" (MACMILLAN)

FIG. 1.—DIAGRAM OF A JELLYFISH (AURELIA)

Above, vertical section; below, view from below, showing oral arms, radial canals, marginal tentacles, and positions of sense-organs, sex-organs, and of the four pouches of the coelenteron; (C) coelenteron, (CC) circular canal, (EC) ectoderm, (EW) endoderm, (G) gonad, (GF) endodermal tentacle, (M) mouth, (PC) radial canal, (S) sub-genital pit, (T) marginal tentacle

which attaches itself by its aboral end to a foreign support (*see* COELENTERATA where its feeding mechanism is also described, and HYDROZOA). This polyp can produce rootlets (*stolons*), from which new polyps are budded, and can also give rise to new polyps in other ways. The scyphistoma is a perennial organism, and at a given time of year may undergo a remarkable change, which varies according to whether the supply of food has recently been scarce or plentiful. In the former case it differentiates from its upper end, a disc-like section of its tissues which in time becomes free and swims away. If the food has been plentiful, however, a whole succession of such sections will be formed, one above the other like a pile of saucers, so that most of the substance of the polyp becomes converted into such. The segments separate from the parent (which in its dividing condition is known as *strobila*) successively when sufficiently developed. Each of them is found on examination to constitute a small flattened medusa with eight long arms, and is termed an *ephyra*. It is quite unlike the adult *Aurelia* in shape even now, but assumes the fully developed con-



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

FIG. 2.—LIFE-HISTORY OF SCYPHOZOAN JELLY-FISH

Left, scyphistoma in the act of strobilation; centre, an ephyra; right, scyphistoma (all enlarged)

dition by degrees from this point onwards. Occasionally a segment of a strobila becomes a polyp instead of a medusa.

Such a life-history provides an interesting example of that type of polymorphism known as *alternation of generations*. (*See* COELENTERATA and HYDROZOA.) The permanent polyp-generation alternates regularly with a relatively transient medusa-generation, and the medusae alone are sexual and produce ova and sperma-

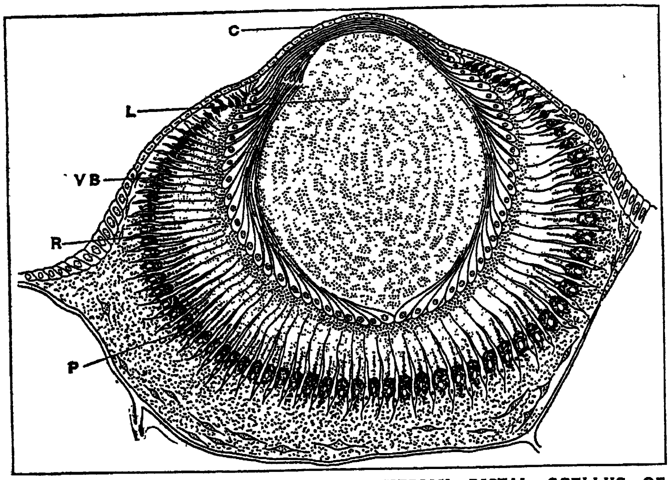


FIG. 3.—VERTICAL SECTION OF THE MEDIAN DISTAL OCELLUS OF CHARYBDAEA (ENLARGED); (C) CORNEA, (L) LENS, (R) RETINA, (V B) VITREOUS BODY, (P) PIGMENT

tozoa. The method by which the medusae are formed from the polyp, however, is a specialty of the Scyphozoa, and is quite unlike that adopted by the Hydrozoa.

The Scyphozoa constitute a large group of medusae of extremely varied and sometimes very elaborate structure. They possess in common, however, a number of features which distinguish them from the hydrozoan medusae, such as the absence of a *velum* (*see* HYDROZOA), and the presence, inside the coelenteron, of peculiar tentacles clothed by endoderm. The Scyphozoa are *cruciform* in their symmetry, that is to say, all their organs are symmetrically arranged with relation to four main radii placed at right angles to one another. Their sex-organs are endodermal. They possess well-developed sense-organs, these including not only hollow *tentaculocysts* of a distinctive nature (*see* also COELENTERATA and HYDROZOA), which occur in definite positions round the margin of the bell, but also *ocelli* or eye-spots, which attain, in the case of *Charybdaea,* an astonishingly high grade of development, possessing cornea, lens, retina, and vitreous mass, and recalling in outline the structure of a vertebrate eye (fig. 3). In certain jellyfish (Rhizostomae) a curious condition of the mouth has arisen. By basal fusion of the four long arms which depend in so many of these jellyfish from the corners of the mouth (fig. 1), the mouth itself is obliterated, and food is taken in through a multitude of pores in the surfaces of the arms, which open into canals leading to the stomach. Finally, in certain Scyphozoa (*e.g.*, *Haliclystus,* fig. 4) the animal is not a swimmer, but has a stalk by means of which it attaches itself to weed and other objects; and here the anatomy is distinctive and is rather intermediate between that of a polyp and that of a medusa.

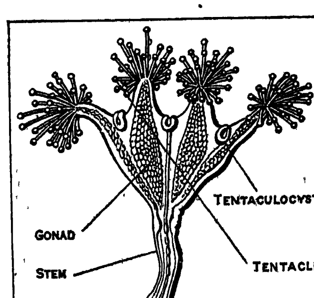


FIG. 4.—HALICLYSTUS AURICULA, A JELLY-FISH WITH A STEM AND 8 TUFTS OF KNOBBED TENTACLES

For general accounts *see* COELENTERATA bibl., and for recent lists of literature, W. Kükenthal, *Handbuch der Zoologie* (1923–25).

(T. A. S.)

SCYROS, a small rocky barren island in the Aegean Sea, off the coast of Thessaly. The earlier inhabitants of Scyros were Dolopes (Thuc. I. 98); Pelasgians, or Carians. There was a sanctuary of Achilles on the island, and numerous traditions con-

PHOTOGRAPH, F. SCHENSKY IN "TIER UND PFLANZENLEBEN DER NORDSEE" (WERNER KLINKHARDT)

JELLY FISH

A medusa of the class *Scyphozoa*, genus *Chrysaora*, a common jellyfish of the North Sea

nect Scyros with him. Disguised there as a woman, in the palace of Lycomedes, to keep him back from the Trojan War, he was discovered by Odysseus, and accompanied him to Troy. Another legend deals with the conquest of Scyros by Achilles. It was taken by Philip II. and was under Macedonian rule till 196, when the Romans restored it to Athens. It was sacked by Goths, Heruli and Peucini, in A.D. 269. The ancient city was on a rocky peak, on the north-eastern coast, where is the modern town of St. George. A temple of Athena was on the shore near the town.

SCYTHIA, originally (*e.g.,* in Herodotus iv. 1–142) the country of the Scythae or the country over which the nomad Scythae were lords; that is, the steppe from the Carpathians to the Don. With the disappearance of the Scythae as an ethnic and political entity, the name of Scythia gives place in its original seat to that of Sarmatia, and is artificially applied by geographers, on the one hand, to the Dobrogea, the lesser Scythia of Strabo, where it remained in official use until Byzantine times; on the other, to the unknown regions of northern Asia, the eastern Scythia of Strabo, the "Scythia intra et extra Imaum" of Ptolemy; but throughout classical literature Scythia generally meant all regions to the north and north-east of the Black sea, and a Scythian (*Skuthēs*) any barbarian coming from those parts. Herodotus (*l.c.*) to whom, with Hippocrates, we owe our earliest knowledge of the land and its inhabitants, tries to confine the word Scyth to a certain race and its subjects, but even he seems to slip back into the wider use. Hence there is much doubt as to his exact meaning.

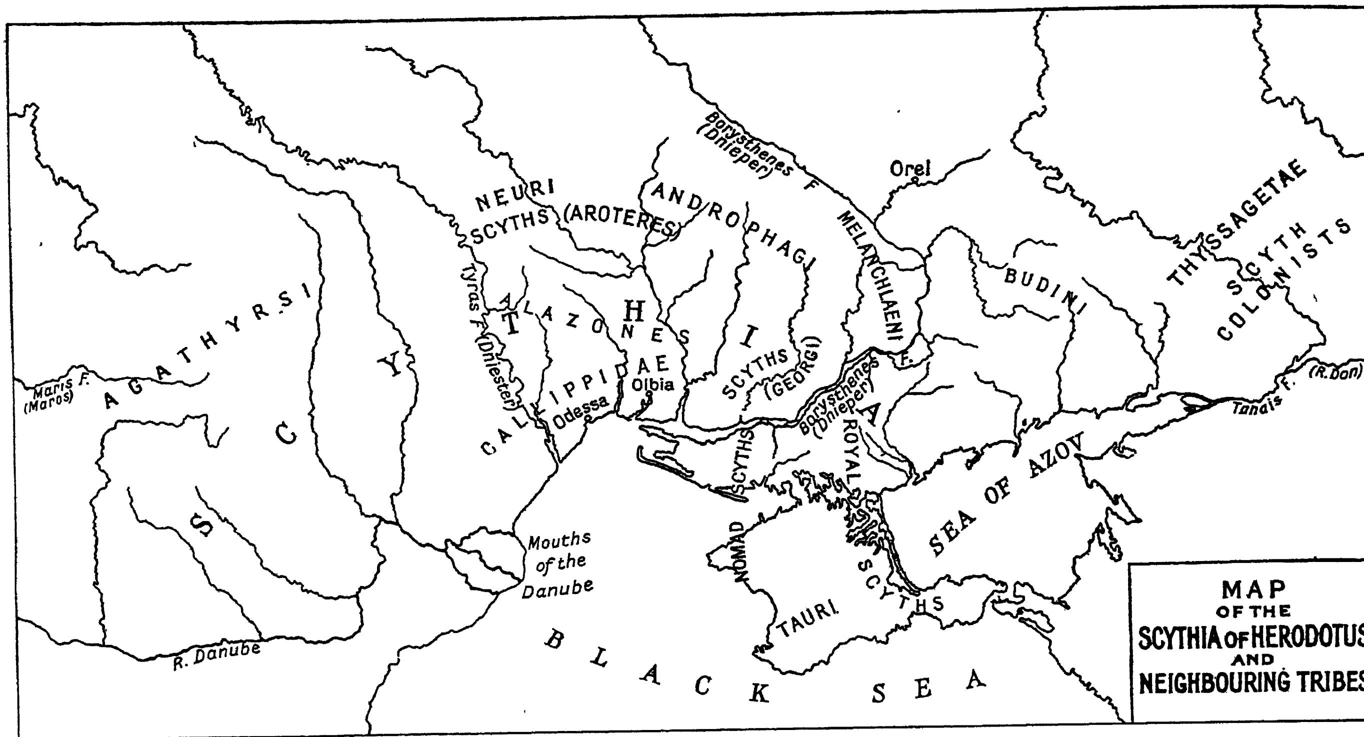
Geography.—Herodotus' account of Scythia falls into two irreconcilable parts: one (iv. 99 *et seq.*), in connection with the tale of the invasion of Darius, makes of Scythia a kind of chess board 4,000 stades square on which the combatants can make their moves quite unhindered by the great rivers; the other (16–20), founded on what he learned from Greeks of Olbia, and supplemented by the tales of the 7th-century traveller, Aristeas of Proconnesus, tallies more or less with the lie of the land. In accordance with this we can give the relative positions of the various tribes, and an excursus on the rivers (47–57) lets us define their actual seats. In western Scythia, starting from Olbia and going northwards, we have Callipidae on the lower Hypanis (Bug), Alazones (Ἀλαζῶνες) where the Tyras (Dniester) and Hypanis come near each other in their middle courses, and Arotēres ("Ploughmen") above them. These tribes raised wheat, presumably in the river valleys, and sold it for export; in the eastern half from west to east were Geōrgi (perhaps the same as Arotēres or perhaps garden cultivators not using the plough) between the Ingul and the Borysthenes (Dnieper), nomad Scyths and royal Scyths between the Borysthenes and the Tanais (Don). Behind all these stretched a row of non-Scythian tribes from west to east: on the Maris (Maros) in Transylvania the Agathyrsi (*q.v.*); Neuri in Podolia and Kiev; Androphagi and Melanchlaeni (*qq.v.*) in Poltava, Ryazan and Tambov. On the lower Don and Volga we have the Sauromatae, and on the middle course of the Volga the Budini (*q.v.*) with the great wooden town of Gelonus and its semi-Greek inhabitants. From this region started an important trade route eastward by the Thyssagetae (*q.v.*) among the southern Urals, the Iyrcae on the Tobol and Irtysh to the Kirgiz steppe, where dwelt other Scyths, regarded as colonists of those in Europe; then the traveller passed by the Argippaei in the Altai and the Issedones (*q.v.*) in the Tarim basin, to the one-eyed Arimaspi (*q.v.*) on the borders of China, who stole their gold from the watchful griffins, and who marched with goat-footed men and Hyperboreans reaching to the sea; but this is all guess work. To the south of Scythia the Crimean mountains were inhabited by a non-Scythic race, the Tauri (*q.v.*). The Sauromatae have generally been thought the same as the Sarmatae later found in their place, but Rostovtsev has raised serious difficulties.

Ethnology.—Herodotus divides the Scythians into the agriculturists (Callipidae, Alazones, Arotēres and Geōrgi) in the western part of the country, and the nomads with the royal Scyths to the east. The latter claimed dominion over all the rest. It is clear that we have to do with a mixed population called by foreigners after the ruling tribe. The evidence suggests that this tribe was itself of mixed blood. In the 2nd century A.D., when the steppes were dominated by the Sarmatae (*q.v.*), the majority of the barbarian names in the inscriptions of Olbia, Tanais and Panticapaeum were Iranian. We can infer that the Sarmatae spoke an Iranian language. Pliny speaks of their descent from the Medes. Now the Sauromatae are represented as half-caste Scyths speaking a corrupt variety of Scythian. Presumably, therefore, the Scyths also spoke an Iranian dialect. But of the Scyth words preserved by Herodotus some are Iranian; others, especially the names of deities, rather suggest a Ugrian origin. The Scyths may be regarded as a horde which came down from upper Asia and conquered Iranian-speaking people, perhaps in time adopting the speech of their subjects. The settled Scythians might be, in part, the remains of this Iranian population, or the different tribes of them may have been connected with their neighbours beyond Scythian dominion—Thracian Getae and Agathyrsi, Slavonic Neuri, Finnish Androphagi and such like. The Cimmerians (*q.v.*) who preceded the Scythians used Iranian proper names, and possibly represented this Iranian element in greater purity. Herodotus gives three legends of the origin of the Scyths (iv. 5–12); these, though they contradict each other, can be reconciled with the view stated above. The first two purport to describe the origin of a people termed Scoloti, who are said to be autochthonous and have Iranian names. Surely this is the national legend of the agricultural Scythians about Olbia, and the name Scoloti, by which modern writers have designated the royal Scyths, is the true designation of one subject race. The royal line of these is quite distinct from the true royal Scyths, who, like most nomad conquerors, allowed their subjects to preserve their own organizations.

According to the third account (which Herodotus prefers), the Scyths dwelt in Asia, and were forced by the Massagetae (*q.v.*) over the Araxes (Volga?) into the land of the Cimmerians. Aristeas says that the first impulse came from the Arimaspi, who displaced the Issedones, who in turn fell upon the Scyths. The Cimmerians appear to have given way in two directions, towards the south-west, where the tombs of their kings were shown on the Tyras (Dniester), and one body joined with the Treres of Thrace in invading Asia Minor by the Hellespont, and towards the south-east where another body threatened the Assyrians, who called them Gimirrai (Hebrew Gomer; Gen. xi.). They were followed by the Scyths (Ashguzai, Heb. *Ashkenaz*), whom the Assyrians welcomed as allies and used against the Cimmerians, against the Medes and even against Egypt. Hence the references to the Scyths in the Hebrew prophets (Jer. iv. 3, vi. 7). This is all put in the latter half of the 7th century B.C. Herodotus says that the Scyths ruled Media for 28 years, and were then massacred or expelled. The Assyrian evidence is in the main a confirmation of Herodotus.

Hippocrates says that the Scyths are quite unlike any other race of men, and very like each other. The main point seems to be a tendency to slackness, fatness and excess of humour. The men are in appearance very like eunuchs, and both sexes have a tendency to sexual indifference amounting in the men to impotence. When a man finds himself in this condition he assumes the woman's dress and habits. Herodotus (iv. 67) mentions the existence of this class, called Enarees (Ἐνάρεες), and says that they suffer from a sacred disease owing to the wrath of the goddess of Ascalon, whose shrine they had plundered. The whole account suggests a Tatar clan in the last stage of degeneracy.

The burial customs and some other institutions of the royal Scyths are certainly strongly reminiscent of those of the nomads of upper Asia. Distinctive weapons, such as a short sword that the Greeks termed ἀκινάκης, as opposed to the axes current in pre-Scythian times, are likewise oriental. Scythian art, however, may be related to a style best represented in north-eastern Europe. Yet even this art province may have extended very much farther east than it has yet been traced. The skulls dug up in Scythic graves throw no light on the question, some being round and some long. The representations of nomads on objects of Greek art show people with full beards and shaggy hair such as cannot be



reconciled with Hippocrates; but the only reliefs which seem to be accurate belong to a late date when the blood of the ruling clan was probably much mixed.

Customs.—Herodotus gives a good survey of the customs of the Scyths; it seems mostly to apply to the ruling race. They lived upon the produce of their herds of cattle and horses, their main food being the flesh of the latter, either cooked in a cauldron or made into a kind of haggis, and the milk of mares from which they made cheese and kumys (a fermented drink resembling buttermilk). They constantly moved in search of fresh pasture, spending the spring and autumn upon the open steppe, the winter and summer by the rivers for the sake of moisture and shelter. The men journeyed on horseback, the women in wagons with felt tilts. These were drawn by their cattle, and were the homes of each family. Hence the Greek epithets ἄβιοι (perhaps "of primitive life"), Ἱππημολγοί ("mare-milkers") and Ἁμαξόβιοι ("living in wagons"). The women were kept in subjection, unlike those of the Sauromatae (*q.v.*). Polygamy was practised, the son inheriting his father's wives. Both men and women avoided washing, but there was something of the nature of a vapour bath, with which Herodotus has confused a custom of using the smoke of hemp as a narcotic. The women daubed themselves with a kind of cosmetic paste. The dress of the men is well shown upon the Kul Oba and Chertomlyk vases, and upon other Greek works of art made for Scythic use. It must not be confused with the fanciful barbarian costumes that are so common upon the Attic pots. They wore coats confined by belts, trousers tucked into soft boots, and hoods or tall, pointed caps. The women had flowing robes, tall, pointed caps, and veils descending over most of the figure. Both sexes wore many stamped gold plates sewn upon their clothes in lines or semés. Their horses had severe bits, and were adorned with nose pieces, cheek pieces and saddle cloths. True stirrups were unknown. In war the nation was divided into three sub-kingdoms, and these into companies, each with its commander. The companies had yearly feasts, at which the commander honoured warriors who had slain one or more of the enemy. As evidence of such prowess, and as a token of his right to a share of any spoil, the warrior was accustomed to scalp his enemy and adorn his bridle with the trophy. In the case of a special enemy or an adversary overcome in a private dispute before the king, he would make a cup of the skull, mounting it in bull's hide or in gold. The tactics in war were the traditional nomad tactics of harassing the enemy on the march, constantly retreating before him and avoiding a general engagement. Their weapons were bows and arrows, short swords, spears and axes. The government was a despotism, but a king who aroused the extreme dissatisfaction of his subjects was liable to be murdered.

Religion.—The religion of the Scyths was nature worship. Herodotus (iv. 59) gives a list of their gods, with the Greek deities corresponding, but we cannot tell what aspect of the Greek deity is in question. He says they chiefly reverence *Tabiti* (Hestia), next *Papaios* and his wife *Api* (Zeus and Ge), then *Oitosuros* or *Goitosuros* (Apollo), and *Argimpasa* (Aphrodite Urania). These are common to all the Scythians, but Thamimasadas, or Thagimasadas (Poseidon) is peculiar to the royal Scyths[1]. They set up no images or altars or temples save to Ares only. To Ares they make a heap of faggots three stades square, with three sides steep and one inclined, and bring to it 150 fresh loads of faggots every year. Upon the top is set up a sword which is the image of Ares; to this they sacrifice captives, pouring their blood over it. The account of the cult of Ares, for whom no Scythian name is given, appears to be an addition, and the mention of such masses of faggots suggests the wooded district of the agricultural Scythians, not the treeless steppe of the royal tribe. The Scythian pantheon is not distinctive. The Scyths had a method of divination with sticks, and the Enarëes, who claimed to be soothsayers by grant of the goddess who had afflicted them, used another method by splitting bast fibres. They intervened in case of the king's falling sick, when it was assumed that some man had sworn by the king's hearth and broken his oath. If a man accused of this denied it, other diviners were called, and if these concurred, he was beheaded and his sons slain, and his goods given to the diviners. But if a majority of diviners decided against the accusers, the latter were set upon a wagon-load of brushwood and burned to death. The burial rites are the most fully described. Private persons were merely carried about among their friends, who held wakes in their honour, and then buried 40 days after. But the funerals of the kings were much more elaborate. They surrounded the dead man with everything in which he found pleasure during his life. The tombs of the kings were in the land of Gerrhus near the great bend of the Dnieper where the chief tumuli have been excavated. The body was embalmed and filled with aromatic herbs, and then brought to this region, passing through the lands of various tribes. The royal Scyths who fol-

[1]The names are read in various ways; it is impossible to establish the correct forms.

lowed the body were accustomed to cut about their faces and arms, and each tribe that the cortège met upon its way had to join it and conform to this expression of grief. Arrived at the place of burial, the body was set in a square pit with spears marking out its sides and a roof of matting. Then one of the king's concubines and his cupbearer, cook, groom, messenger and horses were strangled and laid by him, and round about offerings of all his goods and cups of gold—no silver or bronze. After this they raised a great mound, striving to make it as high as possible. A year later they strangled 50 youths of the dead man's servants (all Scyths born) and 50 of the best horses, stuffed them, and mounted them in a circle about the tomb.

Tombs.—The description is generally borne out by the evidence of the tombs opened in the Scythic area. None agrees on every point, but almost every detail finds a close parallel in some tomb or other. The chief divergence is in the presence of silver and copper objects, but making allowance for repeated robberies, the quantity of gold is stupendous and implies that the kings of Scythia controlled the inexhaustible stores of the Altai. To say that there was nothing but gold seems merely an exaggeration. Tombs to which the name Scythic is generally applied form a well-defined class. They are preceded over the whole area by a much simpler form of burial marked by the practice of staining the bones with red ochre. The grave-goods were just a few rough pots, implements of flint, stone or copper and rude ornaments of bone or copper. Yet that some were tombs of great chiefs is shown by the great size of the barrows heaped over them and the often elaborate burial chamber many contain. They have been referred to the Cimmerians, but this attribution is uncertain. The Scythic tombs can be roughly dated by the objects of Greek art that they contain. They seem to begin about the 7th century B.C., and to continue till the 2nd century. A different style of tomb, referred to the Sarmatians, begins in the East in the 5th century and gradually spreads westward. The finest of the Scythic class were opened about the bend of the Dnieper, where we should put the land Gerrhus. Others are found to the south-west of the central area, and in the governments of Kiev and Poltava we have many tombs with Scythic characteristics, but differences (*e.g.*, the fewness of the horses) which make us think of the settled tribes under Scythic domination. Others occur in the flat northern half of the Crimea, and even close to Kerch, where the famous Kul Oba seems to have held a Scythic chieftain who had adopted a veneer of Greek tastes but remained a barbarian at heart. East of the Maeotis, especially along the river Kuban, are many groups of barrows showing the same culture as those of Gerrhus but in a purer form. Very few of these barrows have come down to us unplundered, and we cannot find one complete example and take it as a type. Soon after they were heaped up, before the beams supporting the central chamber had rotted, thieves made a practice of driving a mine into the mound straight to where the valuables were deposited. It is perhaps by the collapse of such a mine and the crushing of the robber after he had thrown everything into confusion that the treasures of the Chertomlyk barrow, on the whole the most typical, were preserved to us. This was 60ft. high and 1,100ft. round; about it was a stone plinth, and it was approached by a kind of stone alley; a central shaft descended 35ft. 6in. below the surface of the earth, and from each corner of it at the bottom opened out side chambers; beyond the north-west chamber was a large irregular chamber. In the central pit all was in confusion, but here the king seems to have lain on a bier. His belongings, found piled up near the mine, included a *gorytos* (combined bow-case and quiver) and a sword sheath, each covered with plates of gold of Greek work, three swords with gold hilts, a hone with gold mounting, a whip, many other gold plates and a heap of arrow-heads. In the north-west chamber was a woman's skeleton, and she had her jewels, mostly of Greek work. She was attended by a man, and three other men were buried in the other chambers. They were supplied with simpler weapons and adornments, but even so their clothes had hundreds of stamped gold plates and strips of various shapes sewn on to them. By every skeleton were drinking vessels. A store of wine was contained in six amphorae, and in two bronze cauldrons were mutton-bones. The most wonderful object of all was a great two-handled vase standing 3ft. high and made to hold kumys. The greater part of its body is covered by a pattern of acanthus leaves, but on the shoulder is a frieze showing nomads breaking in wild mares, our chief authority for Scythian costume. To the west of the main shaft were three square pits with horses and their harness, and by them two pits with men's skeletons. In the heap itself was found an immense quantity of pieces of harness and what may be remains of a funeral car. The Greek work would seem to date the burial to the 3rd century B.C.

At Alexandropol and Solokha in the same district were equally elaborate tombs, the latter specially rich. Another tomb in this region, Melgunov's barrow, found in 1760, contained a dagger-sheath and pommel of Assyrian work and Greek things of the 6th century. In the Kul Oba tomb, mentioned above, the chamber was of stone and the contents, with one or two exceptions, of purely Greek workmanship, but the ideas underlying are the same —the king has his wife, his servant and his horse, his amphorae with wine, his cauldron with mutton-bones, his drinking vessels and his weapons, the latter being almost the only objects of barbarian style. One of the cups has a frieze with reliefs of natives supplementing that on the Chertomlyk vase.

East of the Maeotis on the Kuban we have many barrows; the most interesting are the groups called the Seven Brothers, and those of Karagodeuashkh, Kostromskaya, Ul and Kelermes, the latter remarkable for objects of Assyrian style, the others for the enormous slaughter of horses; on the Ul were 400 in one grave.

Art.—Certain of the objects which occur in these Scythic graves are of special forms typical for the Scythic area. Most interesting of these is the dagger or sword (*akinakēs*), always very short, save in the latest graves, and distinguished by a heart-shaped guard marking the juncture of hilt and blade; its sheath is also characteristic, having a triangular projection on one side and usually a separate tip; these peculiar forms were necessitated by a special way of hanging the dagger from two straps that it might not interfere with a rider's movements. Just the same form of short sword was used in Persia and is shown on the sculptures at Persepolis; the type is no doubt oriental in origin. Another special type is the bow-case (*gorytos*), made to take a short curved bow and to accommodate arrows as well. Further, there is the peculiar cauldron on one conical foot, round which the fire was built, the cylindrical hone pierced for suspension and the cup with a rounded bottom. Assyrian and afterwards Greek craftsmen working for Scythic employers were compelled to decorate these outlandish forms, which they did according to their own fashion; but there was also a vigorous native style that, more than anything else, expresses the distinctive individuality of the Scyths. The essence of Scythian art is the employment of animal figures—particularly elks, deer, bears, *felidae* and birds' heads—for the decorations of weapons, mirrors, pole-tops and horse-trappings. In every case the representation is severely subordinated to the decorative function it is to serve, and the figures are accommodated to the shape of the object to be adorned. Moreover, several motives are often blended together in a most fantastic way. Yet despite rigid stylization, the effect of this "animal style," as it is called, is to give an extraordinarily lifelike impression.

Though it uses oriental and even Greek motives, the roots of this queer compost of naturalism and stylization go right back to the carvings of palaeolithic hunters. Its immediate ancestry is to be sought in the naturalistic glyptic of the forest hunters of the so-called Arctic stone age who ranged along the border of tundra and forest from Norway eastward for an unknown distance into Siberia. In the latter region there sprang a parallel branch from the same trunk that, at the beginning of the iron age, is still very similar to the early Scythian.

In south Russia the animal style wilted under the influence of Greek culture, and, with the expansion of Sarmatians, became choked with Iranian monsters and overburdened with polychrome enamels. Yet through this medium it was transmitted to the Teutons at the time of their great migrations, and so to mediaeval Europe. On the other hand the reaction of Scytho-Siberian art can be traced to the borders of China at the beginning of our era,

and some carpets of that date, brought back by Kozlov from Mongolia, illustrate its application to textile decoration.

History.—The oldest inhabitants of Scythia were the Cimmerii; some of them were nomads, while others tilled some land in the river valleys and in the Crimea, where they left their name to ferries, earthworks and the Cimmerian Bosporus. (*See* Bosporus Cimmerius.) They were, perhaps, of Iranian race, though others regard them as Thracian. In the 7th century B.C. these Cimmerians were attacked and partly driven out by a horde of newcomers from upper Asia called Scythae; these imposed their name and their yoke upon all that were left in the Euxine steppes, but the basis of the population remained unaltered. Their tombs even occur in Bulgaria and Hungary. The new-comers brought with them new customs and a new artistic taste. About the same time similar peoples harassed the northern frontier of Iran, where they were called Saka (Sacae), and in later times Saka and Scyths, whether they were originally the same or not, were regarded as synonymous. It is difficult always to judge whether given information applies to the Sacae (*see* Saka) or the Scyths. Figures of Saka appear at Persepolis.

About 512 B.C. Darius Hystaspis (*q.v.*) undertook an invasion of Scythia which, according to Herodotus, he traversed as far as the Oarus (probably the Volga). He burned the town of Gelonus and returned to the Ister (Danube) in 60 days. In this march he was much harassed by the nomad tribes, with whom he could not come to close quarters. After losing many men, he found on his return that the Ionian Greeks were still guarding the bridge over the Ister in spite of the attempts of the Scyths to make them desert, and thus he safely re-entered his dominions. Ctesias, the Persian historian, says that the whole campaign only took 15 days and that Darius did not get beyond the Tyras (Dniester). This is also the view of Strabo. Ctesias admits, however, that the great king suffered heavy losses. The whole of Herodotus' account bristles with difficulties. A full discussion of these will be found in G. B. Grundy, *The Great Persian War* (1901) pp. 48–76. Grundy represents the expedition as a necessary strategical preliminary to the subjugation of European Greece, undertaken with the object of making sure that no large Greek communities should be left upon Darius' flank (*see* Graeco-Persian Wars). We may conclude that Darius made an attempt to secure the Danube frontier, suffered serious reverses and retired with loss.

The Greeks had been trading with the Scyths ever since their coming, and at Olbia there were many tales of their history. We can make a list of Scythian kings—Spargapeithes, Lycus, Gnurus, Saulius (whose brother, the famous Anacharsis [*q.v.*], travelled over all the world in search of wisdom, was reckoned a sage among the Greeks and was slain among his own people because they did not like his foreign ways), and Idanthyrsus, the high king at the time of Darius, probably the father of Ariapeithes. This latter had three wives—a Greek woman from Istrus, Opoea, a Scythian, and a Thracian, daughter to the great chief Teres. Scyles, his son by the Greek mother, affected Greek ways, had a house in Olbia, and even took part in Bacchic rites. When this came to the knowledge of his subjects he was murdered, and Octamasadas, his son by the third wife, reigned in his stead. Herodotus adduces this to show how much the Scyths hated foreign customs, but with the things found in the graves it rather proves how strong was the attraction exercised upon the nomads by the higher culture of their neighbours. Octamasadas died shortly before the time of Herodotus. We cannot place Ariantas, who made a kind of census of the nation by exacting an arrow-head from each warrior and cast a great cauldron out of the bronze, nor Taxacis and Scopasis, the under-kings in the time of Idanthyrsus. After the retreat of Darius the Scythians made a raid as far as Abydos, and even sent envoys to King Cleomenes I. of Sparta to arrange that they should attack the Persian empire from the Phasis while the Spartans marched up from Ephesus. Henceforward the Scyths appear as a declining power: by the middle of the 4th century their eastern neighbours, the Sarmatae, have crossed the Tanais (Don) and the pressure of the Scyths is felt on the Danube. Here Philip II. of Macedon defeated and slew their king Ateas in 339 B.C., and from this time on the representatives of the old Scythic power are petty chieftains in the western part of the country about Olbia, where they could still be dangerous, and about Tomi. Towards the second half of the 2nd century B.C. this kingdom seems to have become the nucleus of a great state under Scilurus, whose name appears on coins of Olbia, and who at the same time threatened Chersonesus in the Crimea. Here, however, he was opposed by the might of Mithridates VI. of Pontus and his power was broken, but some Scyths survived until the migration period. Meanwhile most of Scythia had become the land of the Sarmatae (*q.v.*). These were definitely Iranian; like the Scyths they were pressed towards the west by yet newer swarms, and with the coming of the Huns, Scythia enters upon a new cycle, though still keeping its old name in the Byzantine historians.

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SCYTHOPOLIS: *see* Beisan.

SEA, a term used to describe that part of the earth's surface which consists of salt water in distinction from "dry land." Its major divisions, as contrasted with continents, are called oceans (*q.v.*). The scientific study of the sea in this sense is termed oceanography (*q.v.*). (*See* Sea Power; Surveying and Meteorology.)

SEABOARD AIR LINE RAILWAY COMPANY, known until 1915 as Seaboard Air Line Railway, was formed in 1901 through merger or consolidation of nine separately operated railroads, comprising approximately 1,162 m., running southward from Richmond, Va., through North Carolina, South Carolina and Georgia. In 1902, it acquired a line from Savannah, Ga., to Montgomery, Ala., with branches; and in 1903 a line from Savannah, Ga., to Jacksonville and Tampa, Fla., besides important branches. In 1915, it merged with certain other lines in North and South Carolina, and the name of the corporation was changed to the present title. Since the original consolidation, much new mileage has been acquired and constructed, the system in 1928 comprising approximately 4,500 m., running through or into the States of Virginia, North Carolina, South Carolina, Georgia, Alabama and Florida, and reaching the capitals and principal cities of these States. The Seaboard serves a rapidly developing agricultural and industrial territory and has become one of the principal trunk-line systems in the south-east. On Dec. 31, 1926, operating mileage was 4,032 m.; gross revenues for the year, $67,-024,000; on Dec. 31, 1927, capital stock outstanding amounted to $60,950,500; and unmatured funded debt $187,245,667. (R. L. N.)

SEABURY, SAMUEL (1729–1796), American Protestant Episcopal bishop, was born on Nov. 30, 1729, in Groton, Conn. He graduated at Yale in 1748; studied medicine at Edinburgh; became a catechist at Huntington; was ordained in 1753; was missionary in New Brunswick, N.J., in 1754–56; and rector in Jamaica, N.Y., in 1757–66, and of St. Peter's, Westchester, N.Y., in 1766–75. He was one of the signers of the White Plains protest of April 1775 against "all unlawful congresses and committees," in many other ways proved himself a devoted loyalist, and wrote the *Free Thoughts on the Proceedings of the Continental Congress* (1774) by "A. W. Farmer" (*i.e.*, a Westchester farmer), followed by *The Congress Canvassed* (1774). These "Farmer's Letters," which combined with the bluntness and plain speaking of the countryman, eloquence and knowledge of history, politics and constitutional law, created consternation among the radicals. The most notable of the answers they called forth was by Alexander Hamilton, *A Full Vindication of the Measures of the Congress, from the Calumnies of their Enemies.* To this Seabury

replied in *A View of the Controversy between Great Britain and her Colonies,* an acute and learned treatment of the whole controversy. When seeking episcopal consecration in England in 1783, Seabury also claimed a fourth unsigned pamphlet, *An Alarm to the Legislature of the Province of New York* (1775), which discussed the power of this, the only legal political body in the colony. On the suspicion that he was the author of the tracts, he was seized in his schoolroom, in Nov. 1775, by a mob of lawless Whigs and was kept in prison in Connecticut for six weeks; his parochial labours were broken up, and after some time in Long Island he took refuge in New York city, where he was appointed in 1778 chaplain to the king's American regiment. In March 1783, he was chosen their bishop by ten episcopal clergymen of Connecticut; as he could not take the British oath of allegiance, Seabury was shut out from consecration by the English bishops and he was consecrated by Scotch bishops at Aberdeen in Nov. 1784. The validity of his consecration was at first questioned by many but was recognized by the General Convention of his church in 1789. In 1790 he took charge of the diocese of Rhode Island also. He died in New London, Conn., on Feb. 25, 1796. He was a great organizer and a strict churchman as well as one of the ablest controversialists on the Tory side in the American Revolution.

See E. E. Beardsley, *Life and Correspondence of the Rt. Rev. Samuel Seabury* (Boston, 1881); M. C. Tyler, *Literary History of the American Revolution* (1897); W. J. Seabury, *Memoir of Bishop Seabury* (1908); and G. B. Hertz, "Bishop Seabury," *Engl. Hist. Rev.*, vol. xxvi., p. 57–75 (1911).

SEA-COW, a term sometimes used for any member of the mammalian order Sirenia (*q.v.*), but properly restricted to Steller's sea-cow (*Rhytina*), a large animal, reaching a length of seven or eight metres, formerly inhabiting the Behring strait. It was killed in large numbers by the Russian sealers and whalers, and about 1868, less than 30 years after its discovery, became extinct. (*See* RHYTINA, SIRENIA, UNGULATA.)

SEA DAHLIA (*Coreopsis maritima* or *Leptosyne maritima*), a North American plant of the family Compositae, native to the coast of California and cultivated for its showy flowers. It is a stout fleshy perennial, about 2 ft. high, bearing much divided leaves and large flower-heads, about 3 in. across, encircled by bright yellow rays.

SEADIAH (or SAADIA; in Arabic Sa'id) **BEN JOSEPH** (892–942), was born in A.D. 892 at Dilaz in the Fayyum, whence he is often called al-Fayyūmī. Although he is justly regarded as the greatest figure in the literary and political history of mediaeval Judaism, nothing certain is known of his father or of his early life. Saadia's literary work appears at a time when learning seemed to be dead both in East and West. Since the completion of the Talmud very little of any literary importance, if we except certain midrashim, had been produced among the orthodox (Rabbanite) Jews, although the Babylonian schools at Sura and Pumbeditha continued to enjoy a somewhat intermittent prosperity. On the other hand, learning was cultivated among the Qaraites (q.v., *see* also HEBREW LITERATURE). In Saadia, however, the Rabbanites found a powerful champion. Almost his first work was an attack on the teaching of 'Anan, the founder of Qaraism, who lived in the 8th century. This, like most of Saadia's polemical writings, is no longer extant, but we can gather something of its contents from references in the author's other works, and from the statements of his opponents. The controversy turned largely on the calendar, which of course involved the dates of festivals, and, since the Rabbanite calendar had come down from ancient times, opened up the whole question of oral tradition and the authority of the Talmud. The conflict raged for many years, the chief representative of the other side being Solomon ben Yeruham, a virulent if not successful opponent. In 922 Ben Meir, a person of importance in Palestine, attempted to make alterations in the calendar, against the authority of the Babylonian schools. Saadia, who was then at Baghdad, warned him of his errors, refuted him in a work called *Sefer ha-Mō'adīm* (the Book of the Festivals), and finally procured his excommunication by David ben Zakkai, the exilarch or head of the Jewish community in Babylonia. The exilarch appointed Saadia as Gaon (president) of Sura, but within two years the exilarch, influenced by rival scholars, dismissed Saadia, while Saadia retorted by declaring the exilarch deposed (930). After three years of contention David succeeded in sufficiently bribing the new and needy Caliph (Qāhir, 932–934; *see* CALIPHATE), who definitely forbade Saadia to act as Gaon. The next four years, spent in retirement at Baghdad, were devoted to literary labours. Eventually a reconciliation was effected with David, favoured probably by the new Caliph Radi (934–940; *see* CALIPHATE), and Saadia was reinstated as Gaon of Sura in 938. Under his brief rule the school attained the highest reputation among the Jewish communities of East and West—but his health was broken and he died in 942.

Works.—Saadia's works were for the most part written in Arabic, the vernacular of the Jews in the East, so that after the break-up of the Babylonian schools in the middle of the 11th century, they would only be studied in Spain, the new centre of Jewish learning, and in Egypt. After the expulsion of the Jews from Spain, Arabic practically ceased to be used by them for literary purposes, and in the rest of Europe (except perhaps in S. Italy) it was never understood. Even some Hebrew works, of great interest to us now, must have been regarded at the time as of purely temporary value, such as, *e.g.*, the *Sefer ha-Mō 'adīm*, fragments of which have only recently been recovered in the Geniza at Cairo. The anti-Qaraite works against 'Anan, Ibn Sākawaihī and Ben Zūṭā, the *Kitāb at-tamyīz, Kitāb al-Shara'i, Kitāb al-'Ibbur* (calendar) and a book on anthropomorphisms, all in Arabic, are now lost and only known from quotations. So also are the refutation of the sceptic Ḥīvī of Balkh, and the *Sefer 'Orayōth* (on prohibited marriage, against Qaraites). Of the *Sefer ha-Mo-'adīm* and *Sefer ha-Galūī* (against David ben Zakkai), both in Hebrew, some fragments have been recovered recently.

Closely allied to his polemical writings are his *exegetical* works. He translated most of the Bible into Arabic, and commented on at least some of the books. The memorial edition[1] contains the (1) version of the Pentateuch (1893), (3) of Isaiah (1896), (5) of Job (1899), (6) of Proverbs (1894), the last three with commentary. The translation of the 5 Meghilloth, and of Daniel (with commentary), usually ascribed to Saadia, is not really by him, but a genuine translation of Daniel, with commentary, exists in manuscript. There is also ascribed to him a midrashic work on the Decalogue. These all, no doubt, exhibit the defects necessary to the time in which their author lived. But it must be remembered that Saadia was a pioneer. Ḥayyūj, the father of Hebrew grammar, was not yet born, nor had the scientific and comparative study of the language begun. In this respect Saadia contributed little to the subject. But both translations and commentaries are remarkable for their great learning, sound sense and an honest endeavour to arrive at the true meaning of the original. They were thus admirably suited for their purpose, which was, like the earlier Targums and the later work of Moses Mendelssohn, to render the sacred text more intelligible to the faithful generally and to check the growth of error.

The *grammatical* work called *Agron,* a sort of dictionary, is now lost, as are also the *Kutub al-Lughah* and perhaps other treatises on Hebrew grammar. The explanation of the 70 (really 90) hapaxlegomena in the Bible is still extant, and a poem on the number of letters in the Bible.

On *Talmudic* subjects again little is preserved beyond the *Kitāb al-Mawārith,* which was published as vol. ix. of the *Oeuvres complètes,* together with the short treatise in Hebrew on the 13 *Middōth* or canons of exegesis of R. Ishmael and some *Responsa* mostly in Hebrew. The translation of the Mishna, the introduction to the Talmud and other works of the kind are known only by repute.

Of the *Siddur* or arrangement of the liturgy by Saadia, a large part exists in a single manuscript at Oxford, and several fragments have been recovered from the Cairo Geniza. Numerous other liturgical poems, or parts of them, have been obtained from the same source, and several have been published in periodicals. His *Azharōth,* a poetical enumeration of the 613 precepts, in Hebrew, is included in vol. ix. of the *Oeuvres complètes.*

[1] *Oeuvres complètes de R. Saadia,* ed. by J. Derenbourg (Paris, 1893 ff.).

His *philosophical* works are (1) a commentary on the *Sefer Yeẓira,* a mystical treatise ascribed to the patriarch Abraham, which, as the foundation of the Kabbala, had great influence on Jewish thought, and was the subject of numerous commentaries; (2) the *Kitāb al-Amānāt w'al-I'tiqādāt* (*Book of Beliefs and Convictions*), written in 933, called, in the Hebrew translation by Judah ibn Tibbon, *Emūnōth we-Dē'ōth.* Its system is based on reason in conjunction with revelation, the two being not opposed, but mutually complementary. It is thus concerned, as the title implies, with the rational foundation of the faith, and deals with creation, the nature of God, revelation, free will, the soul, the future life and the doctrine of the Messiah. It shows a thorough knowledge of Aristotle, on whom much of the argument is based, and incidentally refutes the views of Christians, Muslims, Brahmans and sceptics such as Ḥīvī. From its nature, however, the work, although of great interest and value, never had the same wider influence as that of Ibn Gabirol (*q.v.*). The Arabic text was published by S. Landauer (Leiden, 1880), the Hebrew version at Constantinople in 1562 and frequently since.

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SEA-ELEPHANT or **ELEPHANT-SEAL,** a genus (*Mirunga*) of seals, so named less on account of their large size than by reason of the presence of a flexible trunk or proboscis. There are two species. The Northern sea-elephant, *M. leoninus,* was formerly abundant on Juan Fernandez Island and thence northward to Lower California, but it is now very rare. The southern species, *M. patagonica,* is larger, males reaching a length of 21ft. This, too, is much reduced in numbers, but it inhabits the Falkland Islands, Kerguelen, and the Macquarie Islands and visits the Antarctic pack-ice. In both species the males are larger than the females. Sea-elephants yield valuable oil.

SEAFORD, an urban district and watering-place in the Eastbourne parliamentary division of Sussex, England, 58 m. S. by E. from London on a branch of the S.R. Pop. (1931) 6,570. In recent years there has been a considerable increase in the number of visitors. The climate is bracing, and the town is sheltered by high cliffs. There are golf links on the neighbouring downs. The church of St. Leonard is Norman of various dates, but received large additions in the Perpendicular period. In former days the river Ouse entered the English channel here, and the natural harbour so formed accounts for the origin of Seaford (Sefford, Safford, Seford), probably in Roman times, though it is not mentioned in Domesday. In the "Domesday of Cinque Ports" (which existed in the reign of Edward III., but was lost before 1728), it stood first among the members of Hastings, and was doubtless of considerable importance until about the end of the 14th century, when its rapid decline began owing to the constant alteration of the sea-coast and the decay of the harbour. In the 16th century the town was finally deserted by the Ouse, which now runs into the sea at Newhaven, 2 m. westward, and no revival of its prosperity occurred until the early 19th century, when it began to be frequented as a watering-place. Fishing has always been the chief industry.

SEAFORTH, EARL OF, a Scottish title held by the family of Mackenzie from 1623 to 1716, and from 1771 to 1781. The 5th earl, WILLIAM, joined the Jacobites in 1715, and then, having raised 3,000 men, was present at the battle of Sheriffmuir and was appointed lieutenant-general of the northern counties. He also took part in the Jacobite enterprise of 1719, being wounded at Glenshiel. In 1716 he was attainted and his titles and estates forfeited; before his death in January 1740, he had been relieved of some of the penalties of his treason, although his titles were not restored. His grandson KENNETH (*c.* 1744–1781) was created earl of Seaforth in 1771, but his peerage became extinct when he died in August 1781, although there were still heirs to the older earldom, which was under attainder. This earl raised the regiment of Highlanders, the 78th, known later as the 2nd battalion of the Seaforth Highlanders.

SEAHAM HARBOUR, a seaport and urban district in the Seaham parliamentary division of Durham, England, 6 m. S. of Sunderland by a branch of the L.N.E. railway. Pop. (1931) 19,394. The harbour was built (1828) in an uninhabited spot by the third marquis of Londonderry to facilitate the export of coal from the mines on his adjacent property. The harbour facilities were extended in 1905 and there is now a coal export of about 1,750,000 tons per annum. Besides the coal trade there are extensive bottle and chemical works. Much timber, including pit props, is imported.

SEA-HORSE (*Hippocampus*), the name for small marine fishes, in which, as in others of the pipe-fish family (Syngnathidae), the body is enclosed in bony rings, the small mouth is placed at the end of a tubiform snout, and the gills are lobate. Sea-horses, of which about 50 species are known from tropical and sub-tropical seas, are distinguished by having the head, which somewhat resembles that of a horse, set at an angle to the body and freely movable, and by the tapering tail, without caudal fin, which is prehensile and can be curled round the stem of sea-weeds, etc. They live in a vertical position, swimming by rapid undulations of the small dorsal and pectoral fins. The eggs are carried by the male in a pouch on the under-side of the tail, in which they are hatched. Their coloration, the tubercles and spines on the head and body, and the skinny flaps, tend to conceal these fishes among the weeds; the flaps are most developed in an allied genus (*Phyllopteryx*) from Australia.

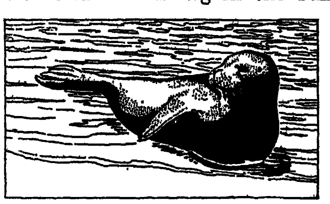
BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY

SEA-HORSE (HIPPOCAMPUS)

SEA-KALE, *Crambe maritima,* a hardy perennial, a member of the family Cruciferae, which grows wild along the coasts of England, of Ireland and of the Scottish lowlands, along the western coasts of Europe, and on the Baltic, reappearing on the Black Sea. The cultivated form is extensively grown as a vegetable.

SEAL, the name applied to members of the family *Phocidae* of the suborder Pinnipedia of the Carnivora (*q.v.*) and sometimes even to all the Pinnipedia except the walrus.

Seals are all marine and swim and dive with ease. They feed on fish, crustacea, molluscs and even sea-birds and form the main food of the Eskimo, the killer whale and the polar bear. They are fond of basking in the sun on sandy beaches, rocks or ice-floes and resort to the land for breeding purposes, often in immense numbers. One young one is usually produced annually and many species are polygamous but do not form true "harems" except in the eared seals and sea-elephants (*q.v.*); the males fight fiercely for possession of the females. The young are taught to swim by their parents. When on land, the hind limbs take no part in the seal's progression. Seals are very inquisitive animals. The sense of smell is acute and the voice varies from a harsh bark to a plaintive bleat. The common seal (*Phoca vitulina*) is found on the coasts of the north Atlantic and north Pacific. In the female, the teeth are smaller than in the male. The grey seal (*Halichoerus grypus*) is larger, reaching a length of 8ft. It is confined to the north Atlantic and is rare on the American side, where it has never been seen south of Nova Scotia. It is the only seal which has its young late in autumn.



BY COURTESY OF THE ZOOLOGICAL SOCIETY, LONDON

THE COMMON SEAL (PHOCA VITULINA), A MARINE MAMMAL

See FUR-SEALS, SEAL-FISHERIES, SEA-ELEPHANT, SEA-LEOPARD, SEA-LION.

SEA LAWS, a title which came into use among writers on maritime law in the 16th century, and was applied by them to certain mediaeval collections of usages of the sea recognized as having the force of customary law, either by the judgments of a maritime court or by the resolutions of a congress of merchants and shipmasters. These mediaeval codes were preceded by the Rhodian sea law, a monument of Byzantine jurisprudence. Among the mediaeval sea laws the most important are the laws of Oléron, embodying the usages of the mariners of the Atlantic and the source of much of the English Maritime law; next the laws of Visby (Wisby).

The earliest collection of such usages received in England is described in the *Black Book of the Admiralty* as the "Laws of Oléron," whilst the earliest known text is contained in the *Liber Memorandorum* of the corporation of the City of London, preserved in the archives of their Guildhall. These laws are in an early handwriting of the 14th century, and the title prefixed to them is *La Charte d'Oleroun des juggementz de la mier.* How and in what manner these "Judgments of the Sea" came to be collected is not altogether certain. Cleirac, a learned advocate in the parlement of Bordeaux, in the introduction to his work on *Les Us et coustumes de la mer* (Bordeaux, 1647), states that Eleanor of Aquitaine (*q.v.*), having observed during her visit to the Holy Land that the collection of customs of the sea contained in *The Book of the Consulate of the Sea* (*see* CONSULATE OF THE SEA) was held in high repute in the Levant, directed on her return that a record should be made of the judgments of the maritime court of the island of Oléron (at that time a peculiar court of the duchy of Guienne), in order that they might serve as law amongst the mariners of the Western sea. He states further that Richard I. of England, on his return from the Holy Land, brought back with him a roll of those judgments, which he published in England and ordained to be observed as law. Though some writers doubt the story of Richard I. having brought back *La Leye Olyroun* to England, the general outline of Cleirac's account accords with a memorandum on the famous roll of 12 Edw. III., "De Superioritate Maris Angliae," for many years preserved in the archives of the Tower of London, now deposited in the Public Record Office. According to this memorandum, the king's justiciaries were instructed to declare and uphold the laws and statutes made by the kings of England, in order to maintain peace and justice amongst the people of every nation passing through the sea of England.

The earliest version of these Oléron sea laws comprised certain customs of the sea which were observed in the wine and the oil trade, as carried on between the ports of Guienne and those of Brittany, Normandy, England and Flanders. No English translation seems to have been made before the *Rutter of the Sea,* printed in London by Thomas Petyt in 1536, in which they are styled "the Lawes of ye Yle of Auleron and ye Judgementes of ye See." A Flemish text, however, appears to have been made in the latter part of the 14th century, the *Purple Book of Bruges,* preserved in the archives of Bruges, in a handwriting somewhat later than that of the *Liber Memorandorum.* Prefixed to this Flemish version is the title, "Dit es de Coppie van den Rollen van Oleron van den Vonnesse van der Zee." Certain changes, however, have been made in the *Purple Book of Bruges* in the names of the ports mentioned in the original Gascon text. For instance, Sluys is in several places substituted for Bordeaux, just as in the *Rutter of the Sea* London replaces Bordeaux. That these sea laws were administered in the Flemish maritime courts may be inferred from two facts. First, a Flemish translation of them was made for the use of the maritime tribunal of Damme, which was the chief Flemish entrepôt of the wine trade in the 13th century. The text of this translation has been published by Adriaen Verwer under the title of the *Judgments of Damme.* In the second place, there is preserved in the archives of the senate of Danzig, where there was a maritime court of old, an early manuscript of the 15th century, containing a Flemish reproduction of the Judgments of Oléron headed "Dit is Twater Recht in Vlaenderen." So far there can be no doubt that the Judgments of Oléron were received as sea laws in Flanders as well as in England in the 14th century. Further enquiry can trace them as they followed the course of the wine trade in the North sea and the Baltic sea. Boxhorn, in his *Chronyk van Zeelande,* has published a Dutch version of them, which van Leeuwen has reproduced in his *Batavia Illustrata,* under the title of the *Laws of West-Capell* in Zealand. Verwer has also published a Dutch text of them in his *Nederlant's See-Rechten,* accompanied by certain customs of Amsterdam, of which other mss. exist, in which those customs are described as usages of Stavoren, or as usages of Enkhuizen, both ports of active commerce in the 15th century.

A new and enlarged collection of sea laws, purporting to be an extract of the ancient laws of Oléron, made its appearance in the latter part of the 15th century in *Le Grant routier de la mer,* printed at Poitiers in France by Jan de Marnef, at the sign of the Pelican. The title-page is without a date, but the dedication, which purports to be addressed by its author, Pierre Garcie, *alias* Ferrande, to his godson, is dated from St. Gilles on the last day of May 1483. It contains 47 articles, of which the first 22 are identical with articles of the "Judgments of the Sea," in the *Liber Memorandorum,* the remaining articles being evidently of more recent origin. A black-letter edition of this work in French, without a date, is preserved in the Bodleian Library at Oxford, and to the last article this colophon is appended: "Ces choses précédentes sont extraictes du très utille et profittable Roolle Doloyron par le dict Pierre Garcie alias Ferrande." An English translation is printed in the appendix to *A View of the Admiral Jurisdiction,* published in 1661 by Dr. John Godolphin, in which the laws are described as "an Extract of the Ancient Laws of Oléron rendered into English out of Garsias alias Ferrand." This new text seems to have been superseded in a short time by Cleirac's *Us et coustumes de la mer,* to which was appended the following clause of authentication: "Tesmoin le Seel de l'Isle d'Oléron, estably aux contracts de la dite Isle, le jour du Mardy après la Feste Sainct André l'an mille deux cens soixant-six." Cleirac does not inform us from what source or under what circumstances he procured his text, nor on what authority he has adopted in certain articles readings at variance with those of Garcie, whilst he retains the same number of articles, to wit, 47. The clause of authentication cannot be accepted as a warranty above suspicion, as the identical clause of authentication with the same date is appended to the early Norman and Breton versions of the rolls, which contain only 26 articles. Cleirac's version, however, owing probably to the superior style in which it was edited, and to the importance of the other treatises on maritime matter which Cleirac had brought together for the first time in a single volume, seems to have obtained a preference in England over Garcie's text, as it was received in the High Court of Admiralty during the judgeship of Sir Leoline Jenkyns, and an English translation of it was introduced into the English translation of the *Black Book of the Admiralty* made by John Bedford, the deputy registrar of the High Court. It seems to have been Bedford's intention to print this translation under the title of "Sea Laws"; but the manuscript passed into the hands of Sir Leoline Jenkyns, who gave it to the College of Advocates in 1685. The Black Book itself, which was mislaid for a long time from the Admiralty Registry, was discovered in the 19th century and placed in the Record Office.

The parent stock of the Visby sea laws, which guided the mariners and merchants of the North sea and the Baltic, may have been a code preserved in the chancery of Lübeck, drawn up in the Old Saxon tongue, and dated 1240. On the other hand the Visby sea laws may have been a separate code drawn up at Visby. The fact of a resemblance between the two is not conclusive for all the mediaeval sea laws in general treated maritime questions, which were then of a simple nature, in much the same way.

No definite answer can be given to the question, How did this collection of sea laws acquire the title of the "Visby sea laws" outside the Baltic? Under this title they were received in Scotland in the 16th century, as may be inferred from extracts from them cited in Sir James Balfour's *System of the more Ancient Laws of Scotland,* which, although not printed till 1754, was com-

pleted before his death in 1583. The text of the Visby sea laws generally current in England is an English translation of a French text which Cleirac published in 1641 in his *Us et coustumes de la mer,* and is an abbreviated, and in many respects mutilated, version of the original sea laws. From a practical point of view the question is not of importance; the existence of this well known code is the matter of interest.

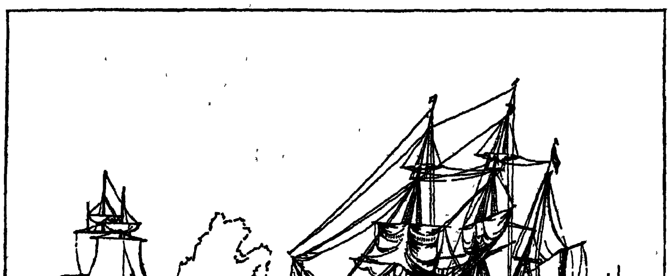
See Pardessus, *Collection de lois maritimes antérieures au XVIII.e siècle* (6 vols., 1828–45); Schlyter, "Wisby Stadslag och Sjörätt," being vol. viii. of the *Corpus Juris Sueco-Gotorum Antiqui* (Lund, 1853); *The Black Book of the Admiralty,* ed. by Sir Travers Twiss (4 vols., 1871–76); W. Ashburner, *The Rhodian Sea Law* (1909); W. S. Holdsworth, *History of English Law,* vol. i. (1922).

(T. T.; E. S. R.)

SEA-LEOPARD or **LEOPARD-SEAL** (*Stenorhynchus leptonyx*), a large seal (*q.v.*) inhabiting Antarctic regions and often reaching a length of 12ft. The variegated colours of the fur have given it its name. During the summer, the leopard-seal feeds largely on penguins (*q.v.*). It is an especial foe of the Adélie penguin; in the stomach of one killed by Levick (*Antarctic Penguins*) the remains of no fewer than 17 were found.

SEAL FISHERIES. The animals taken by sealers are members of several genera, but are alike in being gregarious in habit, and in producing their young on shore, at well defined seasons, at places which are revisited year after year. Their meat, hides, fur and blubber are of the greatest value to primitive peoples for food, for canoe making, light and heat—even the sinews are utilized as thread—and except in the Antarctic, have made them a quarry from time immemorial; but when sealing on a large scale became important as a commercial undertaking, their habits both dictated the chief methods employed and rendered them in the highest degree vulnerable. One species, the sea cow (*Rhytina stelleri*), indeed became extinct only some 20 years after its discovery, and in some regions the depletion of others led to a cessation of sealing. The first and usual method employed by sealers was to attack the herds both on the ice or, particularly, on the breeding grounds or "rookeries." In the pursuit of the fur seals of the Pacific (*Otaridae*) hunting in the open sea, or "pelagic" sealing was developed, and proved most wastefully destructive, owing to the frequency with which the dead seals sank before they could be taken into the boats; pelagic sealing, however, was first restricted by various regulations and ultimately prohibited.

Early Seal Fishing.—Seals, and particularly walruses or "morses" (*Trichechus rosmarus*), were taken in the north Atlantic,



THE WHALER "HARMONY," BUILT IN 1809, WHICH LATER BECAME A TRADER, FROM A COLOUR AQUATINT BY E. DUNCAN, AFTER W. J. HUGGINS

in the borders of the Arctic region, by whalers from the beginning of the northern whaling at the dawn of the 17th century, for their skins, blubber and tusks, the latter being a somewhat inferior ivory, and their teeth were bought also from natives. In the most prosperous days of northern whaling the whalers neglected seals, but in the latter part of the 19th century the whalers again were glad to include them in their catch. Meanwhile, sealing as a separate occupation had developed during the previous century. The skins were at that time of more value than at any later time. The chief species taken were the Greenland seal (*Phoca groenlandica*), hooded seal (*Cystophora cristata*), and bearded seal (*Erignathus barbatus*). The grey seal (*Halichoerus grypus*), and the common seal (*Phoca vitulina*), are not at present the subject of commercial exploitation, though the latter is killed by fishermen under the conviction, not at present too well founded, that it causes great depredations among the food species.

Atlantic sealing occurs in the spring and early summer, from Novaya Zemlyá to Newfoundland and Labrador. For the eastern grounds sealers sail chiefly from Norwegian ports, for the western from those of Newfoundland and the United States of America. They are not usually large vessels. It is probable that the western sealers may, in the future, be aided materially by the location of the herds by air craft. The young Greenland seals are born along the eastern grounds about the first half of March, and on the western grounds in the latter half of the same month. Some other seals keep somewhat the same season. The regulations made by most nations engaged in Atlantic-Arctic sealing are based on these facts. Newfoundland prohibits sealing before the middle of March, and all grounds as far east as Jan Mayen (and a little farther) are closed to European sealing nations until early April; further east the industry is the subject of Russo-Norwegian agreements. Atlantic-Arctic sealing is still a considerable industry, accounting annually for 600,000 or 700,000 seals.

The Fur Seal.—The fur seals (*Otaridae*) differ from those mentioned above in possessing a permanent under coating of short, soft fur, the "seal skin" of the costumier. They were opened to exploitation by the voyage of Bering in the Pacific-Arctic zone in 1741. Their migrations cover great areas, from the latitude of southern Japan on the west and from southern California in the east, to the great rookeries on Commander and Prybiloff islands respectively; late in the 19th century the latter held some $2\frac{1}{2}$ million seals, and the former over a million. Another rookery, on Robben island, in the Sea of Okhotsk, was of very minor importance. All these herds were greatly reduced, and by 1897 did not exceed 600,000 individuals in all.

The typical adult male or bull (*sikatch*) of the second group attains maturity about the seventh year, and weighs from 400 to 500 lb. It is 6 ft. in length, with a girth of $4\frac{1}{2}$ feet. The fur is blackish or dark brown, with long yellowish-white hairs, especially long and firm on the back of the neck, forming the so-called "wig" or mane. The animal stands erect and runs or "lollops" along the ground when on land. The adult female, or cow (*matka*), is much smaller, averaging about 80 lb. in weight, with length and girth in proportion. The fur is of varying shades of brown; she bears her first young at the age of three years. The breeding-grounds are boulder-strewn beaches or rocky hill slopes near the shore. On these the she-bears congregate in close-set masses called "rookeries." The unit of rookery life is the family group, or "harem," each bull collecting as many females as he can control. The number ranges from one to 100 or more, averaging about 30. The bulls reach the islands early in May and take up their places. The cows begin to arrive the first week in June. The number on the rookeries from day to day grows steadily to a climax about the middle of July, when about one-half are present, the number actually on the ground diminishing to about one-fourth at and after the close of the breeding season with the end of July. The single young, or pup (*kotik*), weighing 10 to 12 lb. and jet black in colour, is born within six to 48 hours after the arrival of the cow. Within a week the latter is served by the bull, and by the end of another week she goes to sea to feed, returning at gradually lengthening intervals through the summer to nourish her young, left in the meantime to care for itself on the rookeries. The bulls, having fasted since their arrival in May, go away in August to feed. The pups learn to swim at the age of a month or six weeks, and in November, with the approach of winter, swim away with their mothers to the south. The migration of the seals is said to keep fairly well to the 100 fathom line.

At first the catch averaged 75,000 per annum, but after about 1868 it increased rapidly, and from 1879 sailing vessels carrying numerous canoes were employed to attack the migrating seals,

which were thus deprived of their natural closed season; these vessels at one time exceeded 100 in number; some of them carried as many as 25 canoe crews. It has been estimated that by 1902 a million seals had been taken at sea, and, unfortunately, the breeding females were killed with the rest, to the great detriment of the recuperative powers of the stock. In the Bering sea pelagic sealing indeed well over half the catch was of this class. The greatest catch, however, was always on shore. From the Pribyloff and Commander herds nearly 2½ million were taken on land between 1868 and 1897.

Pelagic Sealing.—Fortunately, the conduct of the seals on land permit of the catch being made with the least possible attendant depletion of stock. The young males, or bachelors, "haul out" to rest and sleep on beaches adjacent to, but distinct from, the breeding-grounds. Here they are surrounded at night by the sealing gangs, rounded up in droves of from 1,000 to 3,000, and driven inland to the killing-grounds. The large droves are broken up into successive "pods," or groups, of from 20 to 50, of which the "killable" seals (animals of three years of age or approximating to such in size) are knocked down with clubs, those too large or too small being allowed to escape. The skins are removed, salted in kenches and, when cured, are exported.

Apart from this degree of economy, however, a long series of enactments have been made for the protection of the seals (and of sealing). The last of these, a treaty between the British empire, the United States, Russia and Japan, not only regulates land sealing, but prohibits pelagic sealing.

The fur seal (*Arctocephalus australis*) of the south was once taken at the Galapagos islands, Tierra del Fuego, Lobos islands, and this or other species at South Africa, Australia, New Zealand and many points about the Antarctic circle. In South Georgia and other dependencies of the Falkland islands it was abundant at one time, and was taken before 1793. Sealing and exploration were mutually helpful, much geographical discovery being due to whalers and sealers, while sealing, like whaling, followed exploration in other cases. Great numbers of sea leopards (*Hydrurga leptonyx*), sea elephants (*Mirounga leonina*), Weddel's seals (*Leptonychotes weddelli*) and other species were seen by early voyagers, but at first the skins of the fur seals alone seem to have been taken. One of the earliest recorded landings was that of the Argentine ship, "Juan Nepomucena," which brought in 13,000 skins in 1820. In this and the two following years over 90 vessels, roughly equally divided between Great Britain and the United States, worked the southern grounds. In the first season, catches of 18,000 were not unusual, and five British ships took 95,000 seals in all. Seal oil and blubber, particularly from the elephant seal, began to be taken. Weddel estimated that in the two seasons, 1820–21 and 1821–22, 1,200,000 fur seals were taken from South Georgia, and 320,000 from the South Shetlands alone, with 940 tons of elephant seal oil. It is not surprising that the sealing rapidly disappeared. By 1892 sealing vessels sailed from South American ports homeward with mixed cargoes; and though in the early '90s a Scottish whaling expedition to the Ross sea took 20,000 skins with four ships, by the end of the 19th century the fur seal had almost completely disappeared from the Falkland island dependencies at least. Other seals, sea elephants in particular, had very greatly diminished in number. From 1881 sealing in these territories has been regulated; close seasons were introduced, and sealing is now only permitted under licences, which may determine both the kind and number of seals taken. The capture of fur seals is prohibited, and a proposal, not yet put into effect, was made by a British inter-departmental committee for the re-stocking of the rookeries by transplantation from other southern rookeries on the line of the migrations of the stocks found in the dependencies in former times.

The Elephant Seal.—The chief modern sealing of this region, and one which has responded in a satisfactory way to the regulations which govern it, is that for the elephant seal. This seal is taken by whalers, but pups may not be taken, nor, as far as practicable, female seals—an effort to put into force the same trend of regulation as that followed in northern waters for the fur seals. There is also a close season (the last three months of the year), and closed areas along certain stretches of coast. The absence of segregation of young males on the rookeries is a hindrance to the observance of the regulations, but since their inception the numbers of the species appear to have kept up or increased. Elephant seals are of great size, the females reaching 8 or 9 ft., and the male sometimes 20 ft. in length. Pairing takes place immediately after the young are born, early in October, and the young, which are born singly, are usually weaned in November; these circumstances have determined the closed periods enforced. During February and March the large males haul out on the beaches, and are there for some time in good condition, yielding some five or six barrels of oil. In recent years the number of seals taken at South Georgia is in the neighbourhood of 3,000 per annum; there are elephant seals (except sea leopards) which never reach 100, and Weddel's seals, which seldom reach 20 and never 50.

See reports by D'Arcy W. Thompson and others, *Parliamentary Papers No. 3 (1897), and No. 1 (1898)*; David S. Jordan and others, *Treasury Department (U.S.A.) Document No. 2,017*, "Fur Seals and Fur Seal Islands of North Pacific Ocean" (Washington, 1898); H. W. Elliot, "Monograph of the Seal Islands of Alaska," *U.S. Fish Commission, Bulletin 147* (1882); C. H. Merriam and T. C. Mendenhall, *Proc. Paris Arbitration (1891)*; *Report* of the Inter-departmental Committee on Research and Development in the Falkland Island Dependencies (1920).

SEALING WAX. In mediaeval times, when the principal use of sealing wax was for attaching the impression of seals to official documents, the composition used consisted of a mixture of Venice turpentine, beeswax and colouring matter, usually vermilion. The preparation now employed contains no wax. Fine red stationery sealing wax is composed of about seven parts by weight of shellac, four of Venice turpentine, and three to four of vermilion. The rosins, or colophny, are melted together in a copper or earthenware pot over a moderate fire, and the colouring matter is added slowly with careful stirring. The mass when taken from the fire is poured into oiled tin moulds the form of the sticks required, and when hard the sticks are polished by passing them rapidly over fire or through a spirit flame, which melts the superficial film. For the highest qualities of sealing wax bleached lac is employed, and a proportion of perfuming matter—storax or balsam of Peru—is added. In the commoner qualities considerable admixtures of chalk, carbonate of magnesia, baryta white, or other earthy matters are employed, and for the various colours appropriate mineral pigments. In inferior waxes ordinary rosin takes the place of lac, and the dragon gum of Australia (from *Xanthorrhoea hastilis*) and other rosins are similarly substituted. Such waxes, used for bottling, parcelling, and other coarser applications, run thin when heated and are comparatively brittle, whereas fine wax should soften slowly and is tenacious and adhesive. The most important use of sealing wax, at the present time, is in the construction of dry batteries (*see* BATTERY).

SEA-LION, the name for the larger members of the eared seals (*Otariidae*) forming the genus *Otaria*. The largest species is the northern sea-lion (*O. stelleri*) from the North Pacific and Bering sea; it reaches 13ft. in length. The Patagonian sea-lion (*O. jubata*) possesses a distinct mane and small ears. The Californian form (*O. gillespii*) is much smaller, and the commonest species in captivity where it is well known for its intelligence, activity and hoarse, barking voice. There are two other species. During the breeding season the males fast for a week or ten days. The period of gestation is nearly 12 months, or, more probably, thirteen lunar months.

SEALS. The word "seal" (Lat. *sigillum*, O.Fr. *seel*) is employed as a term to describe both the implement for making the impression, and the impression itself; this article will be confined to the latter usage only, except when the seal is referred to as the matrix. In the East the age-old custom of using the seal as a stamp of authentication of a document is parallel to the western habit of inscribing a signature. However, the seal is sometimes used in Europe and America for the same purpose, especially in the case of sovereigns, courts, officials, bishops, States, corporations, etc. The subject is treated here under two heads: (1) *European*, and (2) *Japanese and Chinese*.

EUROPEAN

The practice of sealing is of great antiquity; gems and cylinder seals were used in the ancient world. But the custom died out in the West on the fall of the western Roman Empire, and except that bullae were used by the popes from the middle of the 7th century, and very debased examples by the Merovingian kings, it was not revived until the Carolingians under Pippin (d. 768). The seals then employed were either antique gems or copies, generally set in a mount on which the legend was engraved. This use of gems continued throughout the middle ages. Under the Saxon emperors the seal began to approximate the normal later type, consisting of a figure or half-figure surrounded by the legend. Apart from papal bullae, Edward the Confessor seems to have originated the pendent double seal, which was not used in France until the beginning of the 12th century.

Kinds of Seals.—At one time or another almost everyone had a seal, and while the private individual was generally content with one, sovereigns had a great seal, privy seal and signet, as well as seals for their courts and officials, and for customs and staples. Bishops and corporations had a great seal, and sometimes a seal *ad causas* for ordinary business. Bishops and other dignitaries also frequently had a secret or private seal and a signet.

The Matrix.—The matrix was usually of latten or silver, but occasionally of gold, ivory, lead or other material. To ensure the impressions being correctly centred, double seals usually had two or more pierced lugs through which pins were passed and frequently a cross or nick engraved on the rim of each half. Occasionally double seals were hinged together. Single seals were fitted with a handle, the most common being a six-sided cone terminating in a trefoil. A few matrices had the centre made to screw out about ⅛ inch, enabling the device to be used without the legend. The great majority of seals are circular, but bishops generally used a vesica form, not from any religious significance but because a standing figure could thus be more artistically accommodated. For the same reason standing figures of ladies are placed on a vesica seal. Oval seals became common in the 16th century, and square, lozenge- and shield-shaped matrices are also found.

The Engravers.—The names of several engravers are known. Roman in his *Manuel* gives a list of French engravers and in England may be mentioned Luke, who about 1180 made the seal of Exeter and by analogy that of Taunton, Walter de Ripa, the engraver of the first great seal of Henry III., Derrick Anthony, the engraver of the second great seal of Elizabeth, the design for which was by Nicholas Hilliard the miniaturist, and, greatest of all, Thomas Simon who made the seals of Cromwell and Charles II.

Material.—The impressions themselves are generally of wax, but leaden bullae were used by the popes and in parts of southern Europe. Golden bullae were occasionally employed by the popes and western emperors, while Edmund Crouchback used one as titular king of Sicily, and Henry VIII. and Francis I. for sealing the treaty of 1527.

Methods of Attachment.—Seals were attached to the deed either by impression on its face or by suspension. The former was the earlier system with the exception of bullae, and although in England suspended seals came in in the 11th century, in France impression on the deed continued till the beginning of the 12th and intermittently until its close, to be revived before the end of the 13th. For suspending seals, either a piece of the deed was cut along one edge and the seal impressed on the tag thus made, or the deed was pierced and a piece of parchment or a cord of twisted silk passed through, doubled back and joined together by the seal. Towards the end of the middle ages sealing direct on the document came into general use again.

The Counter-seal.—To make it difficult to detach a seal from its tag, it was usual to furnish at least the larger seals with a counter, that is an impression on the back. In double seals the reverse die served this purpose, but in others, the secret, signet or seal *ad causas* was generally used, and there are instances, especially among the Cistercians, of a special seal, called in the legend *contra-sigillum*, being employed. In double seals there are a few examples of an additional legend in the position occupied by the milling of a coin, and this would make detachment practically impossible.

The Legend.—The legend usually sets forth the name and style of the owner, although on small private seals it is often a motto or pious ejaculation. The simplest form is *Sigillum* followed by the name in the genitive case, but sovereigns and occasionally bishops used the nominative without the word *sigillum*. Abbreviations and contractions are usual. Occasionally the date of the matrix is included in the legend and frequently a sovereign used his predecessor's seal, the name being altered where necessary.

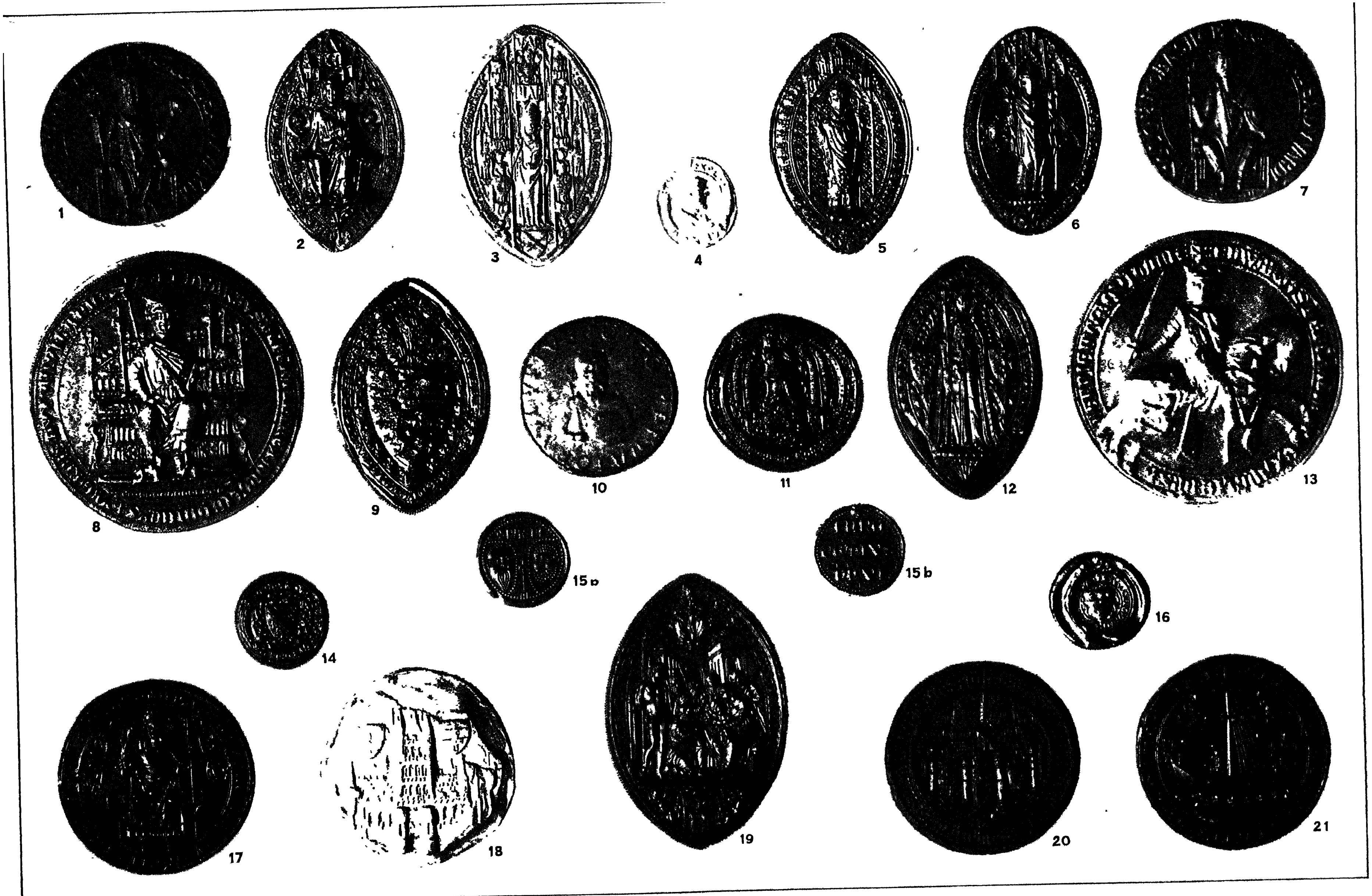
Roman capitals were first used, but from at least the last half of the 11th century they are mixed with Lombardic which slowly displaced them. Black letter was first used in England in 1345, and became general for a century after 1375. But Lombardic capitals were usual for initial letters during the whole of that period. When capital letters alone again became usual, it was a modified form of Lombardic that was employed, and this was only slowly ousted by the Roman, which however became the regular type after about the middle of the 16th century.

The Great Seal of England.—The first royal seal of England which ranks as a "great seal" is that of Edward the Confessor, impressions of which are extant. This seal was furnished with a counterseal, the design being nearly identical with that of the obverse. William the Conqueror, as duke of Normandy, used an equestrian seal, representing him mounted and armed for battle. After the conquest of England, he added a seal of majesty, copied from the seal of Henry I. of France, as a counterseal. In subsequent reigns the order of the two seals was reversed, the seal of majesty becoming the obverse, and the reverse being the equestrian seal, a pattern which has been followed almost uniformly down to the present day. (H. S. K.)

The Small Seals supplemented the great seal. They were not duplicates of it, nor, although in an emergency they could be used in its stead, were they intended to be substitutes. They were introduced for certain private business of the sovereign, but as the daily task of government grew in volume and complexity they widened their scope. Except in England, they were invariably controlled by chancery (*q.v.*), as, for example, in the papacy and in France. The English small seals' freedom from such discretion allowed them to evolve autonomous offices which gave rise to some of the chief ministries of State.

The first small seal to appear in England was the privy seal, *priuatum sigillum*, discernible in the reign of John. It was kept by the clerks of the king's chamber (*q.v.*), and was used principally for matters connected with that office. Besides witnessing certain of the king's letters, it ordered the issue of great seal writs and instructed the exchequer (*q.v.*) to make payments. To begin with, chancery enrolled privy seal letters but they were soon recorded in rolls of their own. The seal was transferred to the custody of wardrobe clerks in the reign of Henry III., when the king's wardrobe began to relieve the .chamber of housekeeping cares (*see* WARDROBES). During the reign of Edward I. the controller of the wardrobe assumed sole responsibility for it. In 1312 an independent keeper was appointed, and two clerks were detailed to help him. By 1318 two more clerks had joined them. Although they all remained within the wardrobe, receiving from its keeper their wages, robes and expenses, they formed a self-contained subsection. Before Edward II.'s deposition the keeper was a foremost servant of the Crown, and as early as 1330 it was promotion to resign the keepership of the wardrobe for that of the privy seal. Yet until after 1340 the keeper of the privy seal was a member of the household, though he was by then third minister of State. How far the privy seal had travelled can be measured by the Walton ordinances of 1338, which laid down that privy seal warrants were to be compulsory on exchequer and chancery for all business outside routine. The keepership gained further authority and prestige as a result of the great seal being entrusted to the keepers who went abroad with Edward III. Nicholas Carew (1371–77) excluded, the keepers were clerks until the 16th century, in the course of which lay nobles began to be appointed.

After 1350, unhampered by wardrobe interference, for from

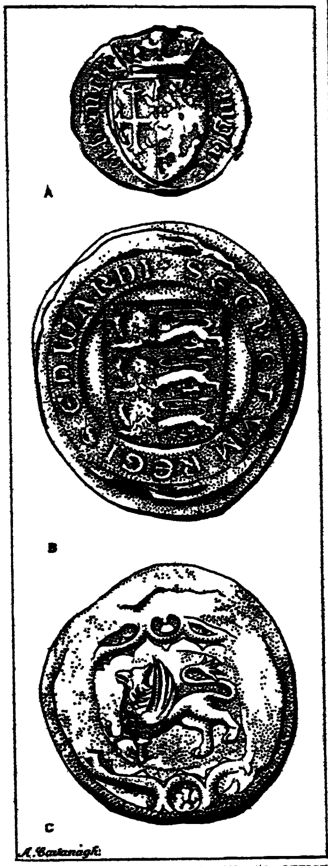


BY COURTESY OF THE SOCIETY OF ANTIQUARIES

EARLY EUROPEAN SEALS, REDUCED NEARLY ONE HALF

1. First great seal of Edward the Confessor, 1043–66, the initial double pendant seal in Europe. 2. Seal of Merton Priory, Surrey, 1241. 3. Seal of Alexander Neville, Archbishop of York, 1374–88, composed of canopy with saints and angels. 4. Seal of Charlemagne as emperor, 800–814, gem in an inscribed mounting. 5. Reverse of fig. 2. 6. Seal of John Stratford, Archbishop of Canterbury, 1333–48, with simple canopy and emblems in the field. 7. Reverse of fig. 1. 8. Great seal of Edward I., 1272–1307. 9. Reverse of seal of Margaret, 2nd wife of Edward I., 1299; shield of arms hanging from a tree. 10. Seal of Otto I., as emperor, 962–973, the beginning of the normal type. 11. Seal of Thomas, Duke of Clarence, 1412; arms between ostrich plumes. 12. Margaret's seal (fig. 9), showing standing figure of a lady in heraldic dress. 13. Reverse of fig. 8. 14. Seal of William de Bohun, 1st Earl of Northampton, 1337, showing shield of arms. 15-a. Bulla of Pope Innocent VI., 1352–62; archaic style. 15-b. Reverse of 15-a. 16. Seal of John Camoys, 1300. 17. Seal of Yarmouth, England, showing patron saint. 18. Seal of Ypres, Belgium; the Cloth Hall within the town wall. 19. Renaissance seal of Cardinal Andreas de Valle, died 1553; pictorial art influence. 20. Seal of Shrewsbury, England, dated 1425. 21. Reverse of fig. 17

that year the exchequer paid practically all costs and salaries, the office rapidly constituted itself into a public department, with headquarters at Westminster by 1360. It was *extra curiam* (out of court) before the 14th century closed, the process being hastened since, once the privy seal began to walk in the footsteps of the great seal, the king preferred another small seal for his personal service. This was the secret seal, *secretum sigillum*. As in the 13th and 14th centuries the privy seal was alternatively described as *secretum sigillum*, a habit which lingered on into Tudor times in the legend on the seal, some confusion is unavoidable. But early in Edward II.'s reign there was a secret seal distinct from the privy seal. It authenticated the king's private correspondence, authorized the issue of privy seal writs, and soon was commonly used interchangeably with the privy seal as warranty for letters under the great seal. It was consigned to the care of chamber clerks, of whom the receiver was its recognized custodian under Edward III. Before the 15th century dawned, the renamed signet was in charge of a clerk of the chamber who made his own the once less specialized title of king's secretary, *secretarius regis* (*see* SECRETARY OF STATE). The secret seal aped its forerunner still more closely by preparing to become in its turn a public instrument. The term signet was applied to the secret seal as early as 1337, yet in the fourth decade of the century it also denoted a different seal. In 1354 this, and a mysterious seal called *signum* (sign) in use between 1338 and 1344, gave way to the *nouel signet* (new signet), the old secret seal in another guise. In the last 14 years of Richard II. there began to develop a signet office, staffed in Edward IV.'s time by four clerks.



BY COURTESY OF THE PUBLIC RECORD OFFICE

SEALS OF THREE ENGLISH KINGS

A. Privy seal of Edward I, one-faced; B. Signet seal of Richard II, one-faced; C. Griffin seal of Edward III, one-faced

The rise of the signet restricted the privy seal and in practice the signet was the originating force in administration. From 1540 there were two secretaries, each having two signets. The Tudors advanced the signet to the position of a prerogative instrument, and the attitude to it of the 16th century opposition to the king was not unlike that of the baronial opposition to the privy seal of Edward II. The secretaries, with their seals, gradually drifted away from the signet office, which was not, however, abolished until 1851, long after it had ceased to be of value. Each modern secretary of State, of whom there are now seven, has two or three signets for different types of transactions. These even yet show something of their personal origin, for their custodians still receive the seals from the hands of the king on appointment, and are the means of communication between sovereign and people. The privy seal, and its office, were abolished in 1884, but the lord keeper, whose duties diminished as his dignity increased, was retained and is to-day a member of the cabinet (*q.v.*). Another secret seal, the king's secret seal called the griffin, *secretum sigillum vocatum griffoun*, was used between 1335 and 1354 for business connected with chamber lands (*see* KING'S CHAMBER). It was kept by a clerk of the chamber and naturally disappeared when the estate was given up. Yet another secret seal made an appearance in 1367, but it was little used.

See F. H. O. Morel, *La grande chancellerie royale, 1328–1400* (1900); C. V. Langlois, *St. Louis-Philippe le Bel, Les derniers capetains directs 1226–1328* (1901); W. R. Anson, *Law and Custom of the Constitution* (1907–09); E. Deprez, *Etudes de diplomatique anglaise, 1272–1485* (1908); L. Perrichet, *La grande chancellarie de France des origines à 1328* (1912); T. F. Tout, *Chapters in the Administrative History of Mediaeval England* (vols. I.–II., 1920, III.–IV., 1928, V. [and last] in preparation; bibl.); F. M. G. Evans, *The Principal Secretary of State* (1923); Sir H. C. Maxwell-Lyte, *The Great Seal of England* (1926). (D. M. B.)

Other Devices.—Amongst the seals of officers of state may be noted those of the admirals, who used for device a ship, generally with their personal arms on the sail. A bishop was represented on his seal of dignity in mass vestments. Later his figure was placed under a canopy, which at first simple, gradually grew in splendour, eventually becoming the principal element in the design. On seals *ad causas* and secrets saints take the chief place, the bishop being shown kneeling below. After the Reformation the design naturally changed, scenes from the Old Testament being common, and by the middle of the 17th century a shield of arms had generally become the only device.

On the seals of cathedrals and religious houses there is often a conventional view of the church sometimes with the patron saint, or the patron saint alone. The universities show the chancellor and masters in convocation, while the colleges have patron saints and founders, a religious emblem or a shield of arms. In foreign universities the faculties and nations generally had seals, a common design being a doctor or master lecturing. On seals of towns a representation of the town itself, sometimes with the patron saint, is frequent; or the patron saint alone or some prominent building might be used, while in France it is not uncommon to find the heads of the civic dignitaries.

At first the shield appears alone, but delicate tracery panels are later introduced to contain it. Wyverns or other animals are often placed round the shield, badges were frequently added, while the shield was sometimes shown hanging from a tree or held by an angel or eagle. In addition to an heraldic seal the noble, like his sovereign, often had an equestrian seal, on which he is occasionally shown in civil costume. Standing figures of ladies, often holding shields or a hawk, and in heraldic dress, are common down to the middle of the 14th century. Persons not entitled to bear arms had usually to be content with such objects as stars, flowers, beasts and birds, while a common device for the lesser clergy was the Agnus Dei, Virgin and Child or other saints.

Papal bullae in design are *sui generis*. On the obverse are the heads of SS. Peter and Paul, and on the reverse the pope's name. Archaic from the beginning, they have so continued, in spite of attempts by Paul II. to alter and by Julius II. to improve the design.

Evolution of the Art.—At first crude and ill designed, an improvement rapidly set in and by the middle of the 13th century the art reached its highest point, the seal of Merton priory, Surrey, made in 1241, being probably the finest ever cut. At this level the art remained for upwards of a century. By the beginning of the 14th century the whole surface had become covered with ornament, and elaborate canopies crowded with tabernacle work are a common feature, so much so that the figure became subordinate. This over-elaboration, which imples no failure in technique but the contrary, finally led to the decline of the art.

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(1912); O. Posse, *Die Siegel der deutschen Kaiser und Könige von 751 bis 1806* (Dresden, 5 vols., 1909–13), *Die Siegel des Adels der Wettiner Lande bis zum Jahre 1500* (Dresden, 4 vols., 1903–11); M. Tosi, *Bullaria e Bullatores della Cancellaria pontificia*, in *Gli Archivi Italiani*, 1917; F. de Sagarra, *Sigillografia catalana*.

The greater part of the literature on this subject is to be found in the transactions of learned societies. The above is a selection of some of the more general books and articles. (H. S. K.)

JAPANESE AND CHINESE

The use of seals for the purposes of identification and ornament has existed in China since earliest times and was emulated in Korea and in Japan from the inception of her imitation of Chinese usages and manners. The word seal may be applied with equal propriety to the stamped impression and the object with which the impression is made. These impressions appear in an infinite variety of shapes and sizes, the more common shapes being square, oblong, elliptical, round and gourd-shaped. In size they run from the huge imperial seals (sometimes as large as 4⅞″ by 6⅜″) to miniature seals which are often as small as ⅛ in. square or in diameter. The ink used is usually a vermilion red, but black and purple are also employed.

Seals have two general uses: one is for identification, the equivalent of a personal signature or guarantee; the other, while it often identifies, is almost purely ornamental and has no legal significance whatever. The identification seal must bear the *hsing* (姓) or family name of its owner, and the *ming* (名), which is the equivalent of our Christian name. It must be understood that the Chinese use several varieties of individual names, so that when we translate the *hao* (號) or intimate name as nickname, we are incorrect, nickname being properly the translation of what the Chinese call *wai-hao* (外號),which is very rarely if ever used on seals. The *hao* is an intimate name often selected by the bearer himself or given to him by his friends as being appropriate to his pursuits or character. The Chinese also use another intimate name, the *tzŭ* (字) (sometimes absurdly and meaninglessly translated as "style") which is created in much the same manner as the *hao*, except that it properly carries some direct literary allusion to the *ming*, and is in its use somewhat more elegant and formal than the *hao*. On ornamental seals the *hao* or *tzŭ* may be used with or without the *hsing*, but in practice usually without. The *ming* may be employed on ornamental seals without the *hsing*. A painter is much more likely to sign his *hao* or *tzu* and stamp his ornamental seal or seals underneath his signature than he is to use his full legal name and seals.

It is very difficult to generalize about Chinese seals because of the frequent departures that Chinese writers and artists indulge in, especially with their ornamental seals. An artist may have as many as, say, 50 to 100 seals, bearing his *ming, tzŭ, hao* or *wai-hao*, the name of his studio, the name of his native district with his family name, etc. These different names, with such characters as *yin* (印), *chang* (章), *chih yin* (之印, seal of), etc., present an almost inexhaustible possibility for variations. Sometimes the identical inscriptions are duplicated or triplicated in different styles of writing. Saito Ken's *Signatures and Seals of Chinese Artists* (支那畫家落欵印譜, *Shina Kwaka Rakkwan Infu*, Tokyo, 1906), gives reproductions of 38 seals used by Tung Ch'i-ch'ang (董其昌), an artist of the Ming dynasty, and these do not purport to be exhaustive. As well as personal and official seals, there are countless seals bearing the names of temples, public offices, palace halls, personal libraries, manufactories, shops, family seals, and even, on occasion, small houses.

The materials of which seals are made are as varied as the seals themselves. Practically any hard, fine-grained stone may be used, with the semi-precious stones preferred. Metals are used also, most commonly bronze but, on occasion, gold and silver, either solid or plated. The cheapest and most common materials in general business and private use are wood and soapstone, the latter often as beautifully carved as the rarest jade.

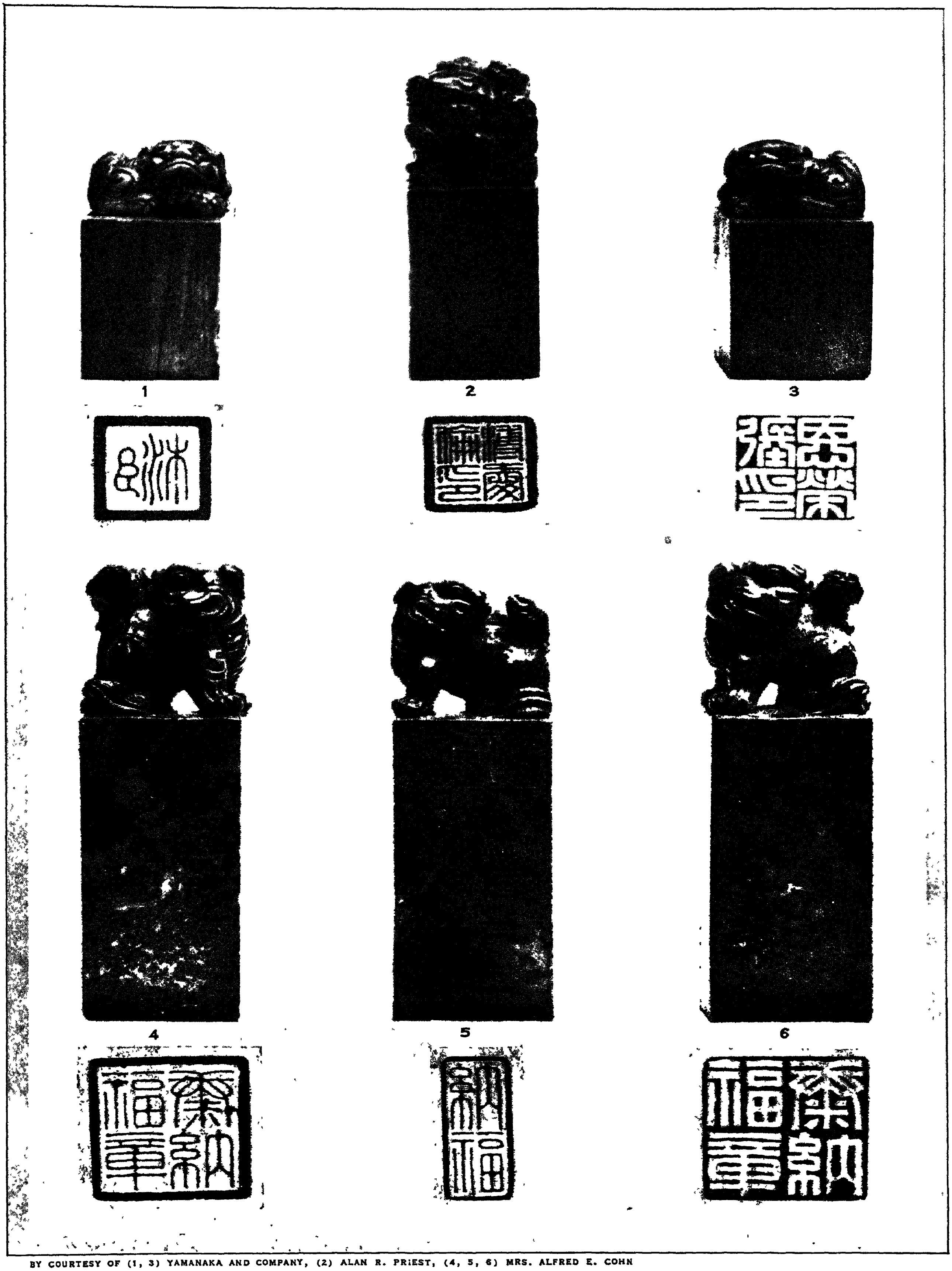
The type of character most used is the *chuan* (篆), which we translate as "seal character," but there is great latitude in the arrangement and period of the characters employed, archaic and historic forms being very popular. Flourishes, embellishments and variations are often indulged in (in spite of the fact that the practice is frowned upon by writers on the subject), making it exceedingly difficult to read or decipher the inscriptions. *See* Hsüeh Ku Pien (學古編), *Studies in Antiquities*, a work on seals written by Wu Chi-ch'eng of the Yüan dynasty, quoted in the *Ku Chin T'u Shu Chi Ch'êng* (古今圖書集成), the K'ang Hsi Encyclopaedia. The lines of the characters may be raised or depressed, giving, in the first instance, vermilion lines against a white background, and in the second, white lines against a vermilion background. The first are variously known as *yang wên* (陽文) or "male" writing, and *chu wên* (朱文) or vermilion writing; the second as *yin wên* (陰文) or "female" writing, and *pai wên* (白文) or white writing. In describing seals, writers invariably mention which of these two styles is used. Seals usually have only one inscription, but early seals, usually made of brass, with inscriptions on both ends or on all six sides, were not uncommon.

There are references to seals in the Four Books (四書) and Five Classics (五經). The *Chi Chia Chou Shu* (汲冢周書) (history of the Chou dynasty unearthed in the 4th century A.D. at Chi, quoted in the K'ang Hsi Encyclopaedia) tells us that when T'ang (湯), the founder of the Shang dynasty (1767–1122 B.C.) deposed Chieh (桀), the last of the Hsia (2205–1767 B.C.) emperors, and convened the feudal princes, he placed the imperial seal at the seat of the emperor. The first report of the use of seals in what we would call authenticated history is in the *Tso Chuan* (左傳, the commentaries of Tso-ch'iu Ming, 左丘明, on *Spring and Autumn Annals*, 春秋 of Confucius, quoted in the K'ang Hsi Encyclopaedia) which tells us: "In the 29th year of Duke Hsiang of Lu (魯襄公, 544 B.C.) the Duke was at Ch'u (楚) for the funeral of Prince K'ang (康王). When he was at Fang Ch'eng (方城) Chi Wu Tzŭ (季武子 the minister of Lu) took possession of Pien (汴) and sent Kung Yeh (公冶) with a sealed document (*hsi shu*, 璽書) to report the matter to Duke Hsiang." We must not infer, however, that this was the beginning of the use of seals, for if it was, the philosopher Chuang Chou (莊周, 4th to 3rd century B.C.) would not have attacked its vogue, declaring that men would return to simplicity and virtue if "tallies were burned and seals destroyed." In fact, it is safe to assume from this pronouncement of Chuang Chou that seals were in general use centuries before his time, probably throughout the Chou dynasty (1122–256 B.C.).

From then on the use and classification of seals became exceedingly complicated. In general seals may be classified as *yin* (印) and *hsi* (璽). The latter character has come to be applied to the seals of the emperor and other important members of the imperial family, such as the empress, the crown prince and ex-emperors; and the former to seals of officials and private individuals, though in ancient times, as late as the Han dynasty, the two characters were used synonymously. It must be observed, however, that during the Han dynasty the distinction began to apply.

In the *Han Chiu I* (漢舊儀, a work on the organization of the governmental machinery by Wei Hung [衛宏] of the Han dynasty) the following regulations were provided for the use of seals: (1) Seals of feudal princes, *chu hou wang* (諸侯王), are to be known as *hsi* (璽), to be made of yellow gold with camel knob or handle. (2) Seals of nobles, *lieh hou* (列侯), are to be known as *yin* (印) and are to be made of yellow gold with tortoise knobs. (3) Seals of ministers or generals are to be known as *chang* (章), to be made of gold with tortoise knobs. (4) Seals of officials with a pension of 2,000 piculs of grain or more are to be known as *chang*, to be made of silver with tortoise knobs. (5) Seals of officials with pensions from 400 to 1,000 piculs of grain are to be known as *yin*, to be made of brass with nose (*pi*, 鼻) knobs.

At the present day such regulations if they exist at all are completely disregarded by the average Chinese, who uses any form he chooses on his personal seals even to representations of landscape. The broadest classification is perhaps the one followed by the *Chi Ku Yin P'u* (集古印譜, *Collection of Ancient Seals* by Wang Chang 王常, 1575) which divides all seals into two main



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CHINESE SEALS

1. Ivory seal with lion handle, probably late 19th century. Inscription, Mu-Ch'en, evidently an intimate name of Chang En-Jung. 2. Contemporary soapstone seal with lion handle. Inscription, P'u Ai-Lun. 3. Late 19th century ivory seal, lion handle. Inscription, Chang En-Jung. 4, 5, 6. Set of three seals made of soapstone with lion handles. 4 and 6 give the full name of original owner, T'ai Na-Fu. 5 gives only the given name, which probably in this case was used as the tzu or intimate name. The name appears to be Manchu

categories: (1) *Kuan Yin* (官印), official or public seals, or, in other words, seals that indicate rank or office. (2) *Ssu Yin* (私印), private seals, used by individuals. Under each main classification the material and the type of knob are mentioned. Private seals may be further classified, as in the *Chieh Tzŭ Yüan Shu Hua Chuan* (芥子園書畫傳, *The Mustard Seed Garden Cyclopaedia of Painting and Calligraphy*, by Li Li-weng, 李笠翁, 1679) which gives six classifications with suggestions as to how each class is to be made: (*a*) *Ming yin* or name seal (名印) used as means of identification. Only such words as *yin*, seal (印), *hsin* (信, faith), *yin chang* (印章, seal), *chih yin* (之印) and *chih chang* (之章), seal of; *ssŭ yin*, private seal (私印) should be used after the *hsing* (surname) and *ming* (given name) without other embellishments. (*b*) *Tzŭ yin* or intimate name seal (字印), originated during the T'ang and Sung dynasties, should be used only for ornamentation and not for identification. It should not contain such words as *yin* and *hsin*. The character *shih* (氏), family, alone should be used. (*c*) *Ch'en yin* or subject seal (臣印). All under heaven are the subjects (臣) of the emperor. Therefore anyone can prefix the character *ch'en* to his name, omitting the surname. It was extensively used during the Han dynasty. (*d*) *Hao yin* (號印), another intimate name seal may include *wai hao*. Such terms as *tao jen* (道人), Taoist person, *chü shih* (居士), resident, *i shih*, retired scholar (逸士), *chu jen* (主人), master, may be used with one's *hao* or the name of one's "retreat." (*e*) *Chien shu yin* (箋書印), or letter seal. During the Ch'in and Han dynasties only the name seal was used after one's signature but lately seals bearing inscriptions such as "so-and-so discourses affairs," "so-and-so announces affairs," etc., are beginning to be used. (*f*) *Shou ts'ang yin* (收藏印) or collector's seal. This class of seals also had their origin in the T'ang and Sung dynasties. Either the name, the *tzŭ* or the *hao* may be used followed by such expressions as *chien shang chang* (鑒賞章, seal of critical examination and enjoyment), *chên ts'ang* (珍藏, treasured and guarded), etc.

The first seal to have much historical backing was the imperial seal made by Chin Shih Huang Ti with a piece of Lan T'ien (藍田) jade of rare quality, with a *li* (螭, one-horned dragon) knob and the following inscription: *Shou t'ien chih ming huang ti shou ch'ang* (受天之命皇帝壽昌, by the command of heaven, long-lived and glorious the emperor). This seal was handed down to the Hans. Since then it has come to be known as the *ch'uan kuo hsi* (傳國璽, seal of succession of the empire) and looked upon as the essential symbol of imperial authority. Six additional imperial seals were made, according to the *Han Chiu I*. The first was used for creating princes, etc., the second for letters and documents to the feudal princes, the third for orders for mobilization, etc., and the fourth for treaties, etc., with tributary States. In succeeding dynasties various forms of imperial seals were made, but it is beyond the confines of this article to enumerate them. We might observe, however, that Empress Wu Tse T'ien (武則天) of the T'ang dynasty changed the character *hsi* to *pao* (寶, treasure) and that this character has since prevailed as the name of the imperial seal with the exception of the two T'ang emperors immediately following the empress. During the reign of these two emperors the imperial seal was again known as *hsi*. We might observe further that the *ch'uan kuo hsi* of Ch'in Shih Huang Ti survived, through many vicissitudes, to the reign of Emperor Fei Ti (廢帝 A.D. 934–936) of the Posterior T'ang dynasty (後唐) who perished with the seal in the flames rather than surrender to the Posterior Chin dynasty (後晉). In 1098 a seal purporting to be the genuine *ch'uan kuo hsi* was discovered and offered to Emperor Che Tsung (哲宗) but this was later discredited as was a still later seal discovered (A.D. 1295) in the Yuan dynasty. (*See also* FAR EASTERN ART.)

See also essays, monographs, memorials, etc., by writers of the Sung Yüan and Ming dynasties reprinted in the K'ang Hsi Encyclopaedia. (A. R. PR.)

SEA-LUNGWORT (*Mertensia maritima*), a smooth, fleshy, perennial of the borage family (Boraginaceae), called also sea bugloss, sea gromwell and oyster plant. It is a characteristic maritime herb, found on rocks and sand along the northern coasts of Europe and Asia and also of North America, from Massachusetts to Greenland and from Oregon to Alaska. The plant has pale green herbage; spreading or prostrate branches, sometimes 15 in. long; and small white, rose-pink or blue flowers that bloom throughout the summer. (*See* MERTENSIA.)

SEAMAN, SIR OWEN (1861–), English humorist and author, was educated at Shrewsbury school and Clare College, Cambridge, where he took a first-class in the classical tripos in 1883; in the next year he became a master at Rossall school; and in 1890 he was appointed professor of literature at the Durham College of Science, Newcastle-on-Tyne. He was called to the bar at the Inner Temple in 1897. He was introduced to *Punch* in 1894, with his "Rhyme of the Kipperling," a parody of Rudyard Kipling's "Rhyme of the Three Sealers." He also wrote for *The National Observer* and *The World*. In 1894 he published a volume of parodies which is a classic of its kind, *Horace at Cambridge*, followed by *The Battle of the Bays* (1896), *In Cap and Bells* (1899), *Borrowed Plumes* (1902), and *A Harvest of Chaff* (1904). He joined the staff of *Punch* in 1897, and in 1902 became assistant-editor, succeeding Sir F. C. Burnand as editor in 1906. In 1914 he was knighted. His later publications include *War Time* (1915); *Made in England* (1916) and *From the Home Front* (1918).

SEAMANSHIP is the art of handling a ship or boat under any and all conditions of weather, tide, current or other influence affecting its immediate movement or safety. The term is also applied to the skill attributed to a good seaman. It should not be confused with navigation (*q.v.*), which is the art of determining the correct course of a ship from one place to another when out of sight of land, nor with pilotage (*q.v.*) which is the art of determining the correct course of a ship when working along a coast or up a buoyed channel. Nevertheless it is a companion art, for without good seamanship being displayed in the actual manoeuvring of the ship, practical effect cannot be given to the calculations and guidance afforded by good navigation or pilotage.

Good seamanship is essentially one of those accomplishments which can only be acquired by practise and that natural adaptability to the sea which is a marked characteristic of certain races, particularly the British. It cannot be taught by precept or mastered by a study of books on the subject. The capable seaman is made by long service in ships and boats at sea, where alone can he obtain the necessary experience. In an elementary form seamanship is involved in the handling of even the smallest floating craft in a manner which ensures that it responds safely and with certainty to the will of the mariner. In achievement and difficulty it increases with the conditions under which she has to be handled or the size of the vessel until it reaches a culminating point in the sailing of a full rigged ship out of harbour in a gale of wind, the berthing of a giant liner in a narrow port or the manoeuvring of a great fleet of warships.

It is a mistake to think that with the elimination of masts and sails seamanship has become a dead art. The power-driven ship of to-day may have many attributes which facilitate handling her, but ultimately she is dependent on good seamanship for her safe conduct and security afloat no less than the sailing ship of the past. The officers and ship's company of a modern steamship may not be efficient sailors in the old sense of the word, but they must be none the less proficient seamen. In sailing ships, seamanship was, and still is, largely concerned with the rigging (standing and running), the making and shortening of sail, the correct manipulation of sails and rudder for such operations as putting the ship about, wearing or club hauling (*see* NAUTICAL TERMS), and for making the best passage whether "on a wind" or "running free." But the handling of all vessels, whether sailing or power driven, requires a knowledge of such matters as the influence on their movement of wind, tide or current, their behaviour in a seaway and the various methods of tethering them to land, whether by anchor in a roadstead or by moorings to a jetty.

Seamanship also involves a multitude of other services incidental to maritime work, such as the proper loading of cargoes, shifting of weights, battening down hatches and making the ship

"snug" for heavy weather, the lowering, handling and hoisting in of ship's boats, the embarking and disembarking of passengers or other personnel, proper attention to ship's fittings, such as spreading and furling of awnings and side screens and innumerable other incidentals to life afloat.

In the case of power-driven ships a knowledge of the use of sails is replaced by one of the action of the screws. While certain general laws govern the behaviour of nearly all such ships, they vary appreciably in their response to helm and engines. However handy or unhandy a ship may be, a good seaman will get the best out of her, whether in carrying capacity, rapidity of voyage, safety in handling, or general power of manoeuvre, whereas a captain who does not know or understand his ship will often find himself in difficulties. The same applies to the good order of the ship and her fittings; a good set of seamen will keep her clean, trim, pleasing to the eye and ready for any emergency, while the ill-manned ship is slovenly in appearance and some essential for her safety or that of her personnel will be found wanting at a critical juncture.

Seamen have been wont to be regarded as a people apart and writers, like Clarendon, have believed them to be definitely jealous of and hostile to landsmen, while it was reputed to be their endeavour to preserve their knowledge as "an art and mystery." There is certainly a good deal of truth in the impression that seamen as a class lack ability to put their knowledge into words and the British navy itself has long been termed "the Silent Service." This, while it is a very proper tribute to a disinclination on the part of naval personnel to obtrude themselves and their work unduly or advertise their merits, is also attributable to the fact that, until lately, naval training did little to encourage powers of self-expression. It has now been recognised that this is a definite defect, certainly in the higher ranks, and under modern conditions the seaman must, if he is to play his part in the world, take his place with and be understood by the rest of the community. The importance of this principle particularly applies to the people of the British Empire, whose interests, and indeed existence, is so closely interwoven with maritime matters. While it is not possible for the great mass of men and women who live on shore to acquire a seaman's knowledge, facilities are increasing rapidly to enable them to gain an insight into his life and to understand what the work he is doing means to the community on land. Ocean travel, water transport generally, the press and the cinema all assist to bring a knowledge of ships and their ways to the general public. In fact the seaman is no longer one of a race apart, even if he is still and must always remain something of a specialist.

Two examples may be given of fine seamanship; one in the days of masts and sails and the other not long after the introduction of steam. On Dec. 16, 1814, a British 74 gun ship, the "Magnificent," was in danger of being driven on shore by a violent storm when in the Basque Roads on the French coast. She was saved by the skill and resource of her captain, John Hayes, who "club-hauled" his ship, thereby getting her round on to a safe tack when within her own breadth of a reef and escaping from the enemy. He was known as "Magnificent Hayes" to the day of his death. On March 16, 1888, the cruiser "Calliope" was lying in Apia, Samoa, when a storm came on and rapidly increased to hurricane violence. Captain Kane put to sea, and thanks to the good order of the engines and the fine work of her engineers, she got out in the teeth of the storm and rode it out safely at sea, whereas the shipping in harbour was blown from its moorings and wrecked. Machinery has now become the handmaid of the seaman and the engineer his indispensable colleague. (E. A.)

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SEAMEN, LAWS RELATING TO: *see* LAWS RELATING TO SEAMEN.

SEAPLANE, a type of aircraft which is capable of arising from or alighting on the water. Seaplanes may be subdivided into the following classes. (1) *Float seaplanes,* in which the landing gear consists of one or more floats or pontoons. (2) *Boat seaplanes,* in which the centre portion of the structure consists of a boat providing flotation. (3) *Amphibians,* which may be of either of the above types, but with the addition of a landing gear enabling the aircraft to arise from or alight on the land as well as on the water.

Float Seaplanes.—The float seaplane in practically every case consists of a normal land type of aeroplane in which the landing wheels have been replaced by one or more floats.

The addition of floats to an aeroplane usually increases the weight of the structure by about 8 to 10% of its fully loaded weight, and this weight must be deducted from the load the aircraft would carry as an aeroplane. The air resistance of floats is always greater than that of aeroplane wheels and in consequence there is a loss in speed in converting an aeroplane to a seaplane. This loss is usually about 10% of the full speed of the aircraft.

In spite of this loss of speed, the highest speeds ever recorded have been obtained by seaplanes, and these have in all cases been of the float type. The reason for this is that aircraft having a very high maximum speed, have also a very high minimum speed —often as much as 100 miles an hour for a racing type—due to the very heavy wing loading employed. Floats can now be designed that will alight on smooth water at these speeds, and with large expanses of sheltered water available, the seaplane becomes the most suitable type of aircraft for very high speed flying.

Types of Float Seaplanes.—Float seaplanes may be of the following types:—(1) Central float, (2) Two float and (3) Three float. The central float type, having one large central float, with usually small additional floats on the wings to assist in maintaining lateral stability on the water, is now almost obsolete. In the "two float" type the floats are made long enough to give the required longitudinal stability when at rest on the water and when leaving the water the altitude of the aircraft is determined almost entirely by the dynamic characteristics of the floats. In the "three float" type static stability on the water is obtained by the addition of a small float below the tail. In taking off the water the fore and aft inclination of the aircraft is controlled by the pilot by means of the longitudinal air controls.

Lateral stability at rest in twin float or three float seaplanes may be obtained by placing the floats sufficiently far apart but these are often supplemented by "wing tip" floats.

Principle of the Hydroplane.—The float or hull forms employed are designed to act as hydroplanes when the aircraft is leaving the surface of the water, *i.e.*, that as the speed over the water increases, the hydrodynamic forces acting upon the float tend to raise the float thus reducing its displacement and consequently its resistance. The reduction in water resistance is also enhanced by the use of one or more lateral steps on the bottom of the float.

As resistance is caused by the water film drawn along by the passage of the float through the water, the step tends to break this water film and replace it by a vortex layer of water and air. As the speed of the float is increased from zero its resistance at first increases rapidly and then decreases with further increase of speed. The speed at which this maximum resistance occurs is known as the "hump" speed. This hump speed is of the greatest importance in seaplane design. When taking off from the water this speed must be passed through and, as the air resistance of the wings, body, etc., must be added to the water resistance the total resistance may be very high.

Effect of Forms of Floats.—The dynamic characteristics of the floats or hull may be varied by changes in the size of the "planning area," the position, size and number of steps, and by making the bottom float or "V" cross section. As the angle of this "V" section is decreased, *i.e.*, the form is given a deeper keel, the hydroplane effect is reduced, though the hump speed resistance may also be reduced. Tests have shown that by employing a "V" or rounded bottom, stresses due to striking the water when alighting are greatly reduced. With modern seaplanes having a high power to weight ratio, if the hydroplane effect is too great there is a danger of the aircraft being thrown off the water before sufficient speed is obtained to enable the aerodynamic controls to function.

Flying Boat.—Much advance has been made recently in the design and construction of large boat seaplanes or flying boats. Boats of a total loaded weight of up to 33,000 lb. and total horse power of over 2,600 have been built and operated successfully. Such aircraft are capable of working as independent units away from fixed bases, as they possess a high degree of "seaworthiness" when moored, have sufficient internal accommodation to enable a full crew of five or six to live on board with comfort, and can carry all necessary equipment.

In the smaller types of aircraft up to approximately 10,000 lb. total weight the float seaplane shows advantages over the boat seaplane, the body, wings, airscrew, etc., may be well clear of the water, a high positive metacentric height can be obtained by suitably spacing the two floats, and clean external lines giving a minimum air resistance can easily be obtained.

In larger types of aircraft, the boat seaplane improves on the float type. As the dimensions of the central hull increase so the seaworthiness of the aircraft is improved beyond that of the float type.

Again in the larger types, the hull replacing both the fusilage and the leading gear of the float seaplane, there is a considerable saving in weight. This saving in weight in the largest flying boats is sufficient to enable them to compare favourably with land aeroplanes of equal dimensions in regard to structure weight. In medium sized boat or float seaplanes, however, the ratio of structural weight to load carried compares unfavourably with that of land aeroplanes.

Lateral stability at rest in boat seaplanes is usually obtained by means of "wing tip" floats, though certain designers have modified this method. Dornier, for example, employs two small rudimentary wings of symmetrical section projecting from the sides of the hull at the water line, while in the Rohrback boat seaplane two fairly large floats similar to those of a two float seaplane are mounted on either side of the hull.

In boat seaplanes the metacentric height of the hull itself is very small or negative, so that additional methods, such as described above, of obtaining stability must be employed. If the hull were to be given a large positive metacentric height the seaworthiness of the aircraft would be improved, but to obtain this condition, the centre of gravity of the aircraft would be too low for air stability requirements.

Longitudinal dynamic stability in boat seaplane hulls is usually obtained by using the main step slightly abaft the centre of gravity of the aircraft and by the addition of a smaller step further aft. This small step is usually only operative when the hull is running at fairly large positive angles and is intended to neutralize any tendency to pitch fore and aft when taking off or alighting.

In boat seaplanes the engines and airscrews are situated high above the hull in order that they may be clear of water and spray, the result being that the centre of thrust is above the centre of gravity of the aircraft. This high position of the centre of thrust above the centre of gravity forms a negative couple tending to drop the nose of the aircraft when the engines are running, and a boat seaplane in trim for level flight under these conditions would tend to increase its angle of incidence should the engines be stopped, in which case a dangerous loss of speed might result. To counteract this change of trim, a negative angle of incidence is given to the tail plane which is often of cambered aerofoil section inverted, *i.e.*, with its convex surface downwards. This tail plane being in the slip stream of the airscrews, causes a positive movement with the engines running, the movement decreasing when the engines are stopped, thus counteracting the change in thrust and centre of gravity couple.

Hulls constructed of wood have developed on two lines. Firstly, the rigid hull, in which the hull is itself strong enough to withstand the impact of striking the water when taking off in a rough sea or alighting; and secondly, the flexible type of hull. In the flexible hull the impact stresses are absorbed by the elasticity of the hull structure. These hulls are usually of circular or elliptical section with the steps added by forming double bottoms for certain longitudinal sections only. (J. C. B.)

SEA POWER. The term means, essentially, the influence which a nation can exert to secure its rights and uphold its interests on the seas and oceans of the world both in peace and in war. It also implies the ability to deny the free use of the sea to an enemy. A nation which possesses a sizeable navy is often referred to as a "sea Power." It should not be confused with the one time prevalent but generally misused expression "command of the sea," or with the still popular but often indefinite "freedom of the seas." It must also be regarded as being quite distinct from the old phrase "sovereignty of the sea," which had a very definite meaning.

"Command of the sea," in a literal sense, has always been a vainglorious claim. From time to time one nation or another has secured such a predominating influence at sea that enemy ships could only venture forth with grave risk of capture or destruction, while even neutral shipping only plied its trade on sufferance; but, even so, this influence varied both as regards its extent and its duration and in no case has it been so absolute in character that it justified the use of such a term as "command."

To-day it is generally recognised that no nation has the right, nor is it practicable, to claim appropriation of the seas, as a whole, even in time of war. In time of peace the complete "freedom of the seas" is one of the unwritten canons of normal international relations; an essential condition for world wide security and all that civilisation stands for, and one which no Power would wish to challenge. In time of war, however, sea power comes into play as a force to preserve the "freedom of the seas" for friendly interests and to make them perilous for enemy interests.

This force may operate in a variety of ways, the chief of which may be summarised as follows. (1) It may safeguard friendly shipping from attack on the most frequented or important sea routes. (2) It may deny the use of the sea to the enemy for the transport of armed forces and supplies which would enable him to invade friendly territory or carry on a campaign overseas. (3) It may deny the use of the sea to shipping which would directly or indirectly assist the enemy by conveying to him essential commodities for his people's existence as well as warlike materials in raw or manufactured form for his fighting forces. (4) It may enable a nation to exercise complete control of local waters for the purpose of effecting a landing in enemy territory or of securing the approaches to friendly harbours or to a fleet base.

All these are practical forms which sea power has assumed in time of war. The right to exercise it in full has often been disputed, and efforts have been made, notably by the Declaration of Paris of 1856, and by the unratified Declaration of London of 1909, to safeguard the interests of neutrals on the seas. But the World War showed that, actually, it is exceedingly difficult, if not impossible, to make fine distinctions between articles which are contraband and those which are non-contraband and between the nominal and real ownership of shipping conveying the former, and between the ports and firms to which goods are ostensibly consigned and their real and final destinations. War on such a scale involves the entire rival nations and not merely their armed forces; this means that all commodities which sustain a nation's resistance, whether they be essentially warlike or merely of use for civil comfort, will come to be regarded as contraband. From this it follows that sea power may be directed to cutting off all possible channels of supply.

Nevertheless this does not mean that, today, there can be no International Law relating to war at sea, no Courts of Appeal for the ill-used ship owner and no Prize Courts to adjudicate on what are and what are not good and proper prizes. Such is not the case. While, in a life and death struggle, a desperate nation may defy all international codes, as Germany did in the conduct of her submarine campaign (*q.v.*) in the World War, yet, there can be little doubt that adherence to the spirit of international usages in the application of sea power, as in that of all other forceful methods, will, in the long run, prove the best course for a belligerent to follow.

Under present day conditions the interdependence of nations

in regard to their economic interests is such that no community of people, however rich or powerful, can afford to regard itself as "above the law." Such an attitude must, eventually, call down the overwhelming condemnation of the greater part of the civilised world, and this condemnation is always liable to be translated into concerted action. Britain and her allies in the World War had very great difficulty in securing recognition of their need to interfere with the free shipment to their enemies of so-called non-contraband goods in neutral vessels. At the outset of the War it had not been recognised that "business as usual" on the high seas for friends and neutrals alike would mean that vital supplies would reach the enemy by devious routes. There can be no denying the fact that at one time, British traders themselves were, probably in most cases unwittingly, assisting to supply the enemy. At any rate it was not until the United States came into the war that the strain on international relations was relieved and sea power was applied to encompass the economic extinction of Germany and her Allies with a thoroughness and intensity such as has never been achieved before in the history of the world.

There can be very little doubt now that had the British Government of the day not enmeshed itself by pronouncing its intention to adhere to the impractical terms of the Declaration of London and had it enforced rigidly on British traders the restrictions which, subsequently, it desired neutrals to observe, that the enemy would have been weakened by being starved of essential supplies much sooner than was actually the case.

The British fleet, with the assistance of the naval forces of France, Italy and Japan, could have effectually controlled the flow of supplies through every continental port, whether neutral or hostile; but lack of comprehension of the needs of a modern war and of a clear-cut policy on the part of the Governments of Britain and her allies hampered the work of their navies and complicated international relations with neutrals.

Since the war, the whole subject has been regarded as too delicate to be allowed to obtrude itself into diplomatic discussions, especially at a time when there is a general demand for peaceful relations to be stabilised as much as possible. But it is very natural that nations should continue to study their interests on the seas and desire to feel that their sea-borne commerce and the ocean routes which link them with vital sources of supply are secure. It is this anxiety about security which produces a certain nervousness and an attitude savouring of suspicion when proposals are made for drastic reductions of navies. Every sea Power has its own maritime problems and until the millennium of universal trust arrives each will require a navy suitable both in composition and in size for its own particular needs. The British Empire, for instance, is a community of nations and peoples so scattered over the whole world that their mutual support and common interests demand the complete security of the long sea routes which knit them together. Sea power to safeguard these routes is not only vital to their well being but, in the case of the people of Britain itself, means nothing less than their very existence. It is indispensable, physically, because unless sea-borne supplies to the home country are assured her people would rapidly starve and the whole commercial life of the nation would cease. It is indispensable, economically, because Britain pays for her huge imports by her exports overseas and by her mercantile marine, which is the principal carrying agency on the oceans of the world. It is indispensable, politically, because sea communications are a potent factor in the cohesion of the Empire.

The Dominions owe their growing prosperity mainly to overseas trading. The consciousness of this fact is leading most of them to take an increasing part in bearing the burden of the cost of sea security. As yet, it is difficult for a community like the farmers in the Western Provinces of Canada, for example, to realize that sea power is anything more than a name to them. Certainly an appreciation of what it means and what it is worth will not be conveyed to them by rhetorical allusions to the glories of the past. Rather is it necessary to trace the course of the products of the land which they till from the time they leave the local wagon or lorry until they reach their final market on the opposite side of the Atlantic. Road and rail are safe because a force of police exists to deter any ill-disposed persons from interfering with them. The sea-police force which safeguards the Canadian farmer's wheat on passage is the British navy and it is only by reason of the security which it gives that he can be sure of receiving the fruits of his labours.

For the policing of the seas which wash the coast of British and Dominion territory and of the long ocean routes used by the mercantile marine, a large number of warships are indispensable. These vessels must be big enough to be able to withstand anything except abnormally bad weather and they must be powerful enough to be able to hold their own, in the event of war, against enemy ships of a type which might be sent to attack trade. This sea-police force is represented for the most part by the cruiser (*q.v.*) and sloop types. The present (1928) numerical superiority in units of the British navy is mostly made up of cruisers and their substitutes; but it is a mistake to think that such a superiority constitutes an excess of sea power or a threat to the interests and security of other nations. These units are to a great extent widely scattered over the oceans of the world and could only be united into one large force at grave risk to the sea security of the Empire as a whole. It is no exaggeration to say that it would be more difficult and more dangerous for the British and Dominions naval forces to be concentrated into one vast fleet to be used for aggressive purposes than it would be in the case of those belonging to any other naval power.

The United States has a great length of coast line (over 21,000 miles apart from the Great Lakes), a large and valuable tonnage of coastal shipping and a steadily increasing ocean-growing mercantile marine, all of which must be safeguarded. Already the U.S. navy is the equal of the British one in battleships, while it is very greatly superior numerically, in destroyers and submarines. It is not unnatural, and it is certainly not a matter which causes resentment or suspicion amongst well-informed British people, that the American nation should desire some expansion of their "sea-police types" as their sea-borne trade and American owned shipping increases.

France, Italy and Japan (*q.v.*) have their own problems which they solve in their own way so far as their financial limitations permit. The two former are, of course, most concerned with their interests in the Mediterranean and their communications with North Africa. To them a large battle fleet makes less appeal than numerous torpedo craft and submarines, but both nations adhere to the battleship as being the predominant surface warship, while both find it necessary to build new and powerful cruisers. Japan has a navy second only to those of the British Empire and the United States. Her maritime interests necessarily relate mainly to far eastern waters; her own defence and her trade in the China Seas and the Pacific.

So we can picture these five principal guardians of the oceans with their fleets balancing rather than challenging each other; their sea power centring in their main fleets, each with its quota of battleships, but radiating to the distant seas, where representative cruisers and lesser craft are wont to co-operate harmoniously, no matter what their nationality, in keeping the peace and rendering the seas safe for those who pass upon their lawful occasions.

To the student of history the influence which sea power has wielded in shaping the destinies of nations makes fascinating study. He will be able to trace the part which it played in the early struggles between Rome and Carthage and between the ancient Greeks and Persians; in the Peloponnesian War; in the extension westward of Mohammedan conquest; in the crusades and in the progress of the Italian Republics and of the Ottoman Empire; in the rise and fall of one-time great sea nations like Spain, Portugal and the Dutch. But most of all must he be struck by the history of the birth and growth of the British Empire and the part which sea power has played in promoting them.

He will find an exponent of the subject in as early a writer as Thucydides. But doubtless he will consider the works of Captain Mahan, U.S.N., particularly *The influence of sea power upon history, The influence of sea power on the French revolu-*

tion and empire and *Nelson: The embodiment of the sea power of Great Britain* to be more profitable studies. If, however, he would read the story of the most titanic struggle for sea power there has ever been and if he would realise all that victory at sea meant in the World War, let him turn to more recent works such as *The official history of the war—naval operations,* Winston Churchill's *World Crisis,* or Earl Jellicoe's *Grand Fleet* and *The Crisis of the Naval War.* (*See* also, WORLD WAR, NAVAL; SUBMARINE CAMPAIGN.)

In analysing the source of sea power it will not do to regard it as emanating solely from a fighting navy nor being dependent in scope and magnitude on the number and size of warships which a nation may acquire. Another important factor is the position and number of suitably placed bases for fuelling and refitting, as these are essential if naval influence is not to be confined to home waters or dependent on the goodwill of neutrals in time of war. (*See* NAVAL BASES.) But perhaps the most potent element from an economic point of view in all that goes to give a nation power on the seas, is its mercantile marine because this represents solid wealth in the commerce which is borne across the oceans day by day and year by year and in the value of the ships which carry it. Navies, bases and all the machinery which goes to make up the defence of a nation's sea interests exist for two main purposes: to deny the seas to those who would make use of them for aggression, and to safeguard the shipping which bears passengers and freight from shore to shore. Ultimately, therefore, sea power is manifested in the use to which a nation puts sea transport in furthering its business and developing its trade and in giving facilities to its nationals to travel.

Allusion was made earlier in this article to the phrase "sovereignty of the sea." At one time the Kings of England claimed the sovereignty or dominion of the seas surrounding the British Isles, and this was recognized for a long period as involving certain responsibilities as well as establishing certain rights. It was the general conviction of the chief maritime nations of those days that the Lord of the Sea would provide for policing the waters over which he exercised dominion. At a time when piracy was rampant this was recognized as being of very real importance to trade. In 1299 not only English merchants but also "the maritime people of Genoa, Catalonia, Spain, Germany, Zeeland, Holland, Fresia, Denmark, Norway and several other places of the Empire" declared that Kings of England had from time immemorial been in "peaceable possession of the sovereign lordship of the seas of England," and had done "what was needful for the maintenance of peace, right and equity for the people of all sorts, whether subjects of another kingdom or not, who passed through those seas." (S. K. Laughton, "Sovereignty of the Seas," Fortnightly Review, August 1866.)

"The English Sovereignty of the Seas" was not taken as authority to exact toll but a salute was expected as a form of acknowledgment of the more or less effective policing of the waters. But in the 17th century the Dutch objected to the demand for this salute and insistence upon it was one of the causes of the war which ensued. In the end that nation acknowledged by solemn treaty its obligation to render the salute, but the fact of the matter was that conditions had so changed that the whole system of "sovereignty of the seas" was out of date. There was not much piracy in the waters surrounding the British Isles and merchant vessels were generally able to look after themselves, while in the case of those belonging to other nations, their Governments always possessed means of affording the necessary protection. In 1805 Great Britain wisely gave up her claim to exact the salute, but the custom of dipping the ensign when passing still survives. British merchant shipping is in the habit of saluting British men of war in this fashion, doubtless in token of the protection which the latter afford them and as a mark of loyalty to the King's ships, and such salutes are promptly and punctiliously returned. Similarly warships of different nations passing each other are wont to salute mutually in like manner. Thus the old demand for recognition as the "sovereign of the seas" has now become a form of politeness which may be regarded as a "courtesy of the seas." (E. A.)

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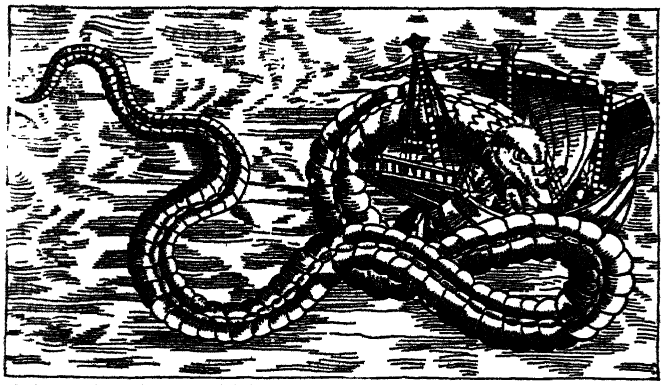
SEARCH: *see* VISIT AND SEARCH.

SEARS, ROEBUCK AND COMPANY, a large mail order house with executive offices in Chicago (Ill.), was founded by Richard W. Sears, who, about 1886, while a railroad agent in a small Minnesota town, began selling watches by mail, securing his customers through personal correspondence. His early venture proving very successful, Sears soon moved to Chicago to secure a more central situation for a business rapidly growing nation wide. There he joined forces with A. C. Roebuck and organized the Richard W. Sears Watch Company, which later was sold. Not long after they branched out in a more general line, constantly adding merchandise of varied character and steadily increasing sales. A corporation was formed under the name Sears, Roebuck and Company in 1893.

The first Sears's catalogue of general merchandise contained less than 300 small pages. In 1928 the current Sears's catalogue had more than 1,000 pages, $8\frac{1}{2} \times 11$in. and showed more than 35,000 items. These included an enormous variety of merchandise, comprising practically everything needed in the home or on the farm, including complete homes and complete farm buildings, with their entire equipment. In 1928, Sears, Roebuck and Company had ten complete mail order plants in various metropolitan centres of the United States. These were: Chicago (Ill.), Philadelphia (Pa.), Kansas City (Mo.), Boston (Mass.), Memphis (Tenn.), Atlanta (Ga.), Dallas (Tex.), Minneapolis (Minn.), Seattle (Wash.) and Los Angeles (Calif.). With each of these is incorporated a complete retail department store. In 1928 the company had 16 additional retail stores not connected with the mail order division, each carrying a full line of general merchandise. In 1928 the company had well over 11,000,000 customers on its books, filled more than 37,000,000 orders and was showing steady increase in both customers and sales. The gross sales for 1925 were more than $258,000,000; for 1926, above $272,000,000; for 1927 they were in excess of $290,000,000, and in 1928 they passed $319,000,000. (E. H. P.)

SEA-SERPENT. Enormous serpents, both terrestrial and marine, are subjects around which have arisen such an array of legends and stories that it is almost impossible to disentangle fiction from fact. So far as terrestrial snakes are concerned it seems fairly safe to assume that there are none in the few remaining unexplored parts of the world which greatly exceed in size those that are already known; in the depths of the sea, however, there may still be gigantic creatures of which we have no knowledge; and with this possibility, remote though it may be, in the background it is unwise to deny the existence of the sea-serpent. Up to the present no animal has been captured which has not on examination by competent persons proved to belong to a previously well-known group, and a large number of the well-authenticated stories of monstrous marine creatures seem to be explicable as incorrect observations, due to abnormal visual conditions or to ignorance, of animals already quite well-known. Some of the possible explanations which have been put forward may be mentioned:—(1) A number of porpoises swimming one behind the other and rising regularly to take breath might produce the appearance of a very large serpentiform creature progressing by a series of vertical undulations. (2) A flight of sea-fowl and a brood of ducks have been mistaken for a large snake swimming at the surface of the water. (3) Large masses of sea-weed half awash

have, on more than one occasion, been believed to be some gigantic animal. (4) Basking Sharks (*Cetorhinus maximus*) which have a habit of swimming in pairs one behind the other with the dorsal fin and the upper lobe of the tail just above the surface produce the effect of a body 60 or more feet long, and a partially decomposed specimen which was cast ashore was reported in all good faith as a sea-serpent. In the same category as Basking Sharks



FROM CHARLES GOULD, "MYTHICAL MONSTERS"

SEA SERPENT ATTACKING A VESSEL (AFTER A 16TH CENTURY WOODCUT)
This type of sea serpent, according to Olaus Magnus in "Histor. Septentrion." inhabited Norwegian coast waters where it occasionally would snap men from the deck of a vessel. It was 200 feet in length and 20 feet around

may be mentioned Tunnies (*Thynnus thynnus*), Porbeagles (*Lamna cornubica*) and Chimaeras (*Chimaera monstrosa*) which at various times have been incorrectly recorded by observers unfamiliar with them. (5) Ribbon or Oar Fishes (*Regalecus*) which attain a length of 20–30 feet and are snake-like in shape have been suggested as the possible explanation of some so-called sea-serpents, particularly of those reported from the Mediterranean where these animals are most common. (6) Nemertines, which may reach a length of 30–45 feet, have also been suggested as a possible explanation of some records. (7) Sea-Lions when breaking surface for breath might, if seen from an unfamiliar viewpoint or in a fading light be mistaken for much larger, snake-like animals. (8) Gigantic Squids (*Architeuthis*) are undoubtedly the foundation on which many accounts are based; these animals, which attain a total length of 50 feet, are sufficiently uncommon to be unfamiliar to the majority of people but do occasionally frequent those regions from which many accounts of sea-serpents have come, viz., Scandinavia, Denmark, the British Isles and the eastern coasts of N. America. One of these animals swimming at the surface with the two enormously elongate arms trailing along through the water would produce almost exactly the picture which many of the strangely consistent independent accounts require; a general cylindrical shape with a flattened head (=posterior end of the squid's body), appendages on the head and neck (=lateral fins and edge of mantle), colour dark, lighter beneath, progression steady and uniform, body straight but capable of being bent and spouting water (=water ejected from siphon). Further, Sperm Whales are known to kill and devour *Architeuthis* and similar cephalopods, and one of the most graphic accounts of the sea-serpent speaks of it as in conflict with a whale around which it had thrown two coils and which it ultimately dragged below the surface; actually it seems very probable that the whale was eating a giant squid whose tentacles, thrown round the whale in the struggle, were mistaken for the coils of a snake, and that the whale, so far from being dragged under, merely "sounded" with its prey in its mouth.

When, however, all these and similar possibilities have been explored, there still remain a number of independent and apparently credible stories which are not satisfactorily explained. To account for these, the continued existence of plesiosaurs or some other huge marine reptiles, usually believed to be extinct, has been advocated in the past. More recently Oudemans[1], who gives a very full account of the whole subject, has pointed out that the known characters of plesiosaurus do not in the least agree with the features described in the unexplained accounts of sea-serpents and has boldly suggested the existence of an undiscovered, long-tailed mammal allied to the seals and walruses. (H. W. P.)

[1]Oudemans, *The Great Sea Serpent* (1892).

SEA-SICKNESS, the symptoms experienced by many persons when subjected to the pitching and rolling motion of a vessel at sea. Identical symptoms are liable to occur in flying, and in some persons even in railway travelling. They generally show themselves, soon after the vessel has begun to roll, by giddiness, nausea and sinking at the stomach, which soon culminate in vomiting. With the sickness there are great physical prostration, pallor, cold sweats and feeble pulse, accompanied with mental depression and wretchedness. The condition depends upon disturbance of the balancing system contained in the semicircular canals (*see* EAR, ANATOMY OF) but visual, mental and olfactory impressions contribute.

No means has yet been discovered which can altogether prevent sea-sickness. Swinging couches or chambers have not proved of practical utility, nevertheless there is less risk of sickness in a large and well-ballasted vessel than in a small one. None of the medicinal agents proposed is infallible even in the same person on different occasions. Nerve sedatives, *e.g.*, bromide of potassium, acetanilide, bromural or chloral, appear to act usefully in many persons. On the other hand, some authorities have recommended nerve stimulants, such as a small cupful of very strong coffee, to be taken about two hours before sailing. The recumbent position and warmth, especially to the feet, often help; so soon as they can be taken small amounts of dry biscuit or toast and weak brandy and soda aid recovery. As a rule the individual is well again in 24 hours or less but in lengthened voyages sea-sickness may be so severe that the help of the ship's doctor is necessary. Even the ship's doctor is sometimes subject to sea-sickness.

See R. A. Bennett, "Sea-sickness and Its Treatment," *Brit. Med. Jour.*, 1928, 1,751.

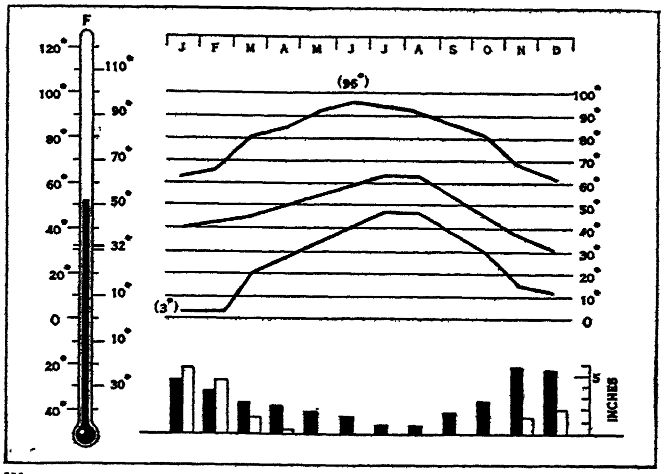
SEA-SQUIRT, the common name for the Tunicata (*q.v.*), animals representing a degenerate off-shoot of the vertebrate stem. The sac-like adults live fixed to rocks or other substrata, but, in the more typical cases, have a free-swimming larva which reveals their affinities by its possession of a dorsal, hollow central nervous system, gill-slits and notochord; the first and last of these are lost on metamorphosis.

SEATTLE (sē-ăt'ĕl), the chief city of Washington, U.S.A., situated on a neck of land between Elliott bay (Puget sound) and the freshwater Lake Washington; 125 nautical miles from the Pacific ocean, 140 m. S. of the Canadian border, 965 m. by water N. of San Francisco, and 2,200 m. by rail from Chicago; a port of entry, headquarters of the Washington customs district, the county seat of King county, the largest city of the Pacific Northwest, and the largest city of its age in the world. It is on Federal highways 10 and 97 and the Pacific Coast air-mail route; is served by the Chicago, Milwaukee, St. Paul and Pacific, the Great Northern, the Northern Pacific and the Union Pacific railways, has through train service over the Burlington Route and the Southern Pacific Lines, and has connection through both boat and train service at Vancouver, B.C., with the Canadian Pacific railway; and is the terminus or a port of call for numerous lines of steamers with sailings across the Pacific ocean, to Alaska and California, and through the Panama Canal to eastern American and European ports. It is the centre of interurban trolley and motor-coach lines, and of the "mosquito fleet" of steamers serving the 2,000 m. of Puget Sound shores. The population (1920) was 315,312 (113·5 males to 100 females), of whom 80,976 were foreign born, including 6,016 Japanese; and was 365,583 by the Federal census in 1930.

Seattle is situated on a series of hills above its fine harbour (reaching a maximum of 500 ft. above sea-level), in surroundings of great natural beauty. To the west, across Puget Sound, rises the jagged sierra of the Olympics. The eastern boundary of the city is Lake Washington (27 m. long), backed by the Cascade range. To the south rises snow-capped Mount Rainier. Within the city are Union and Green lakes, the latter bordered by a public park. The area of the city includes 68·5 sq.m. of land and 36 sq.m. of water.

The outer (salt water) harbour measures 5 m. across from

West Point on the north to Alki Point on the south, and includes the East, West and Duwamish Waterways, extending inland on the south side of the bay; Smith Cove, on the north side; and Shilshole bay, the western outlet of the Lake Washington Ship Canal, north of West Point. The ship canal (8 m. long, with a minimum depth of 26 ft.) connects Puget Sound with the fresh-water harbour, Lake Washington, passing through Lake Union.



WEATHER GRAPH OF SEATTLE. THE MERCURY INDICATES THE NORMAL ANNUAL MEAN TEMPERATURE, THE CENTRE CURVE SHOWS THE NORMAL MONTHLY MEAN TEMPERATURE AND THE CURVES ON EITHER SIDE THE LOWEST AND HIGHEST RECORDED EACH MONTH. THE COLUMNS INDICATE THE NORMAL MONTHLY PRECIPITATION, THE SHADED PART SIGNIFYING TOTAL PRECIPITATION, THE WHITE PART, SNOWFALL

The locks near the west end of the canal, which overcome the difference of 16 ft. between sea and lake levels, accommodate ships 780 ft. long. Elliott Bay proper, where the greater part of the shipping is concentrated, lying between Magnolia Bluff on the north and Duwamish Head on the south, has an entrance width of 2·5 m., a shore line of 9·7 m., and a surface area of 3,800 ac., and is very deep and free from natural obstructions or dangers throughout its entire extent. Harbour development and administration of public terminal facilities are in the hands of a public corporation called "the Port of Seattle," created in 1911 by the people of Seattle and King county, and administered by a board of elected commissioners. Under its jurisdiction harbour facilities were developed by 1928 to a value of $15,000,000, and included terminal wharves, transit sheds, waterside warehouses, cold-storage plants, grain elevators and tanks for vegetable and fuel oils.

Along the water front the hills have been graded down to give a comparatively level area for the business district. This is built up with many large and substantial hotels, public buildings (some of them grouped around a civic centre), the fine public library (1905), and high business buildings (one of them 42 stories high), most of which have been erected since the World War. Beyond this narrow strip rises a succession of heights, crowned with residential districts commanding fine views, and reached by cable railways or by electric lines ascending by winding routes. There are 35 m. of boulevard (skirting the sound and the three lakes and following the high ridges), 44 parks and 24 playgrounds, with an aggregate area of 1900 acres. The 582 ac. campus of the University of Washington, lying between Lakes Union and Washington, with a shore line on both, and the fine grounds of Ft. Lawton (605 ac., given to the Federal Government by the city) are practically additions to the city's park system. The climate is moderate, favourable to industry and to health, and encouraging outdoor recreation the year round. The extremes of temperature on record are 3° and 96° F. The average annual precipitation is 34 in., distributed through all 12 months, but two-thirds falling in the winter months October to March. The average wind velocity is 7·4 m per hour (compared with 17 m. in New York city). The death rate is low.

The city is governed under a charter of 1896, with various amendments, one of which (1908) provides for initiative and referendum petitions. The mayor is elected every two years. The city council is composed of nine members, elected at large for a one-year or a two-year term. The city owns its street railway, water-supply and hydro-electric generating and distributing systems. The water supply is obtained from the Cedar river, and is stored in reservoirs with a capacity of 300,000,000 gal., in the Cascade mountains, 26 m. S.E. In 1911 the city took its first step towards acquiring the street railways, and by 1928 it owned 235 m. of track out of the total of 265 miles. The municipal light and power plant built up its patronage, against determined opposition from the private companies in the city, until by 1928 it was serving 80% of all the customers. A zoning ordinance was adopted in 1923. The assessed valuation of property for 1928 was $288,882,721. Building permits in the nine years following the World War represented values averaging $23,000,000 per year. The percentage of home ownership is high. The public school system includes 82 grade and special schools and 9 high schools. Attendance in the higher grades is unusually large, and the percentage of illiteracy in the general population is very low. The public library maintains ten stations, and has a total circulation of over 2,000,000 volumes per year. The city has a cosmopolitan press, including two Japanese dailies and a Swedish weekly.

Seattle is the leading commercial, industrial and financial centre of the Pacific North-west. Its geographical position (the nearest United States port to the Orient, and the nearest large city of the United States to Alaska) makes it a natural receiving and distributing point for trans-Pacific and Alaska traffic, and the Panama Canal gives easy access to Atlantic and Gulf markets; while the products of its tributary territory and its own manufactures supply staple articles for outgoing freight. About 80% of the mail moving across the Pacific is handled in Seattle. The traffic of the port in 1927 amounted to 8,544,910 tons, valued at $705,255,761, of which $251,203,678 represented imports from foreign countries, $398,283,008 exports, and $55,769,075 domestic coastwise receipts and shipments. The Washington customs district, of which Seattle is the headquarters, ranked first in 1927 among the Pacific Coast districts in value of imports, and third (after New York and Boston) among all the customs districts of the country. Raw silk (valued at $223,789,870 in 1925) constitutes nearly 80% (according to value) of all the imports entering through the port of Seattle, and this is about 80% of the total amount of raw silk imported into the country. Other imports of consequence are coffee and tea, rice, vegetable oils, porcelain and silk goods. Exports consist largely of tobacco and cigarettes, raw cotton, lumber products, canned salmon, flour and machinery. Every State in the Union and almost every Canadian province contributes to the foreign commerce of Seattle, but the great bulk of the exports come from the north-western States and the south-western cotton-producing States (Oklahoma, Texas, Arkansas and Louisiana). Seattle is the principal outfitting point for the whaling industry and the fisheries of the North Pacific, the principal trading centre for Alaska, and the principal supply point and wholesale market for the 300 logging camps of Washington and the agricultural North-west in general. Cheap electric power, combined with abundant raw materials of certain kinds and distance from the older industrial centres, has stimulated manufactures, and in 1927 the city had 1,154 plants, representing an investment of more than $120,000,000 and producing goods valued at $168,032,381. Seattle is the seat of a branch of the Federal Reserve Bank of the 12th district. Debits in the local banking institutions amounted in 1927 to $2,615,826,000.

Seattle was founded in 1852 by 21 white settlers who had arrived at Alki Point the preceding year, and was named after a friendly Indian chief (d. 1866). In 1853 a town plat was filed, King county was created, and Seattle became the county seat. By 1855 it had a population of 300. In Jan. 1856, it was attacked by neighbouring Indians and successfully defended by the U.S. sloop-of-war "Decatur." Growth was slow at first. The city was incorporated in 1869, with an area of 10·86 sq. miles. In 1870 the population was 1,107, and in 1880 only 3,533. The first railroad (the Northern Pacific) reached the city in 1884, and by 1890 the population had increased to 42,837, though a destructive

fire had in 1889 burned down most of the buildings. Seattle was still a little-known lumbering town when in 1897 the discovery of gold in Alaska and the Yukon Territory changed it almost overnight into an important commercial centre, the outfitting point for prospectors, and the port to which they shipped their gold; and by 1900 the population was 80,671. The arrival of the first steamer from the Orient in 1896, marked the beginning of considerable foreign trade, and in 1910 the Union Pacific and the Milwaukee railroads were connected with Seattle. In 1909–10 the Alaska-Yukon-Pacific Exposition was held, on grounds which are now part of the university campus. Between 1905 and the close of 1910 ten adjacent cities and towns were brought within the city limits, and in 1910 the population was 237,194. The opening of the Panama Canal in 1914 gave a new stimulus to the city's commerce, and the years of the World War, when Seattle built more ships than any other port of the United States, were a period of rapid and hectic growth. The average number of wage-earners in the city's manufacturing establishments rose in five years (1914 to 1919) from 11,523 to 40,843; the value of the output, from $64,475,000 to $274,431,000. Since the first incorporation of the city in 1869 successive annexations of territory have increased its area about sevenfold.

SEA-URCHIN, any animal belonging to the Echinoidea, a class of Echinoderma (*q.v.*). The simplest living forms are the Cidaridae (*Cidaris*, "jewelled tiara"). In them the test when denuded of prickles, which thickly cover its surface, is of flattened turban shape, beautifully ornamented with tubercles. The test is built of thin but solid plates closely united. It is divided into five parts by five double columns of smaller plates, and to each of these plates is attached an extensile tube (podium, or "little foot") connected through two holes in the plate with the hydraulic system inside the test. These double columns are called ambulacra ("garden walks"). The five portions of the test between them are the interambulacra, and each is composed of larger plates, also arranged in double alternating columns. The terminal plate at the upper end of each ambulacrum is pierced with a pore for a sensitive papilla, and is termed an "ocular," because in sea-stars the corresponding plate bears an eye. Between the oculars and at the top of the interambulacra are five larger plates, each pierced with a pore for the extrusion of the generative products; they are therefore termed "genitals." One of the genital plates has also many small pores leading to the hydraulic system, and is termed the "madreporite." Within the circlet formed by these ten plates is a finely-plated membrane through which opens the vent. On the under side of the test is a larger circular space covered with membrane, in the centre of which is the mouth. The pore-plates of the ambulacra pass over the membrane to the edge of the mouth.

Each interambulacral plate bears a large tubercle, set in a circlet of smaller tubercles. Each main tubercle bears a long prickle or "radiole," attached to it by a socket and a covering of muscles, which can move the radiole in any direction. The joint is protected by flattened prickles or radioles attached to the smaller tubercles. Prickles also protect the various pores and the delicate organs issuing from them. This species is dredged at depths of 50 to 1,800 metres along the east coast of the Atlantic, and Scottish fishermen call it the piper, from the resemblance of its long radioles to the drones of a bagpipe.

Projecting from the mouth of a *Cidaris* are five pointed teeth; these are long, curved and chisel-ended, and are supported by a frame-work of 30 bones, with the necessary muscles, forming a five-sided structure which Aristotle compared to a ship's lantern. From the top of the lantern rises the gut, which passes in a looped curve round the inside of the test till it reaches the vent. Inside the test are also the five double rows of hollow balls connected with the podia (*see* ECHINODERMA, fig. 7), and in the interspaces the five genital glands. The suckers of the podia are poorly developed, and are chiefly used as feelers when the animal walks about in search of food; because they have no gripping power, *Cidaris* is not found in waters disturbed by waves and currents. *Cidaris* usually moves by using the large radioles as stilts. It can climb over obstacles, and has even been seen to swarm up a glass rod by grasping it with the curved and serrate radioles round the mouth; it uses these also to seize its prey. Though the small prickles protect the openings in the test, the true defensive organs are its pedicellariae, scattered over the test between the prickles. These are like little pincers, each having three teeth at the end of a flexible stalk, and each tooth with a poison-gland. Pedicellariae are found in all sea-urchins, but differ in size and shape according to the genus. Besides gripping and poisoning enemies and prey, pedicellariae clean the test from particles of dirt, and in some shallow-water urchins they hold bits of sea-weed on the upper surface of the test to hide it.

The most familiar British echinoid is the egg-urchin, *Echinus esculentus* (ECHINODERMA, fig. 3), which owes its name to the fact that the ripe ovaries are eaten, both raw and cooked. Essentially a shore-dweller, it grips the sea-weed with its podia, which have well-developed suckers and are far more numerous than in *Cidaris;* E. Forbes estimated their number as 1,860. To accommodate them, the number of plates in the test is increased, and the ambulacral plates are crowded, so that the pore-pairs are arranged in oblique groups of three on each side of the avenue, instead of in single rows as in *Cidaris*. The prickles are all short, and locomotion is effected mainly by the podia; the animal can also drag itself along by its teeth.

The purple egg-urchin (*Paracentrotus lividus*), which ranges from the south of the British Isles to the Azores and into the Mediterranean, lives among *Zostera* leaves and on rocky shores in holes which it bores in the rocks. Some of the turban-urchins (*Diadema*), which live on rocky bottoms in smoother water, have very long thin prickles, which can pierce the stoutest boot; some of these urchins have organs sensitive to light and shade, so that they quickly direct their prickles to the point of danger. Reef-dwelling urchins exposed to the surf have their prickles thickened and crowded, and sometimes the ends are expanded like parasols to form a complete outer covering.

In some deep sea-urchins, as in most of those that lived in early ages, the test is flexible, and in one of them the podia are protected by sharp prickles each bearing a poison-gland. These and all previously mentioned are of regular five-rayed symmetry. Many urchins that have taken to live in sand or mud are irregular. In them the mouth tends to move forward, and to become wide, with projecting under-lip; the vent moves from the top to the hinder end of the test; the prickles are fine and directed backwards; the podia of the upper surface subserve respiration and are concentrated in five petal-shaped areas. Among such forms are the shield-stars or cake-urchins (*Clypeaster*), which live just below the surface of the sand, and use their reduced teeth for shovelling sand, with its small animals, into the mouth. The sand-dollars (*Scutella*) are thin and flat, and in some the test grows out like the spokes of a wheel (*Rotula*). More familiar are the heart-urchins, such as the common *Echinocardium cordatum* (ECHINODERMA, fig. 19), which lives at the bottom of a burrow and has the podia of its front ambulacrum modified so that they can be stretched right up the tube of the burrow to collect food.

The position of sea-urchins in the Economy of Nature has been mentioned in ECHINODERMA (*q.v.*).

BIBLIOGRAPHY.—Besides works mentioned under ECHINODERMA, a specialist work is H. L. Clark, *Catalogue of the Recent Sea-urchins in the British Museum* (1925); an illustrated popular account is in *Animals of all Countries* (1924). (F. A. B.)

SEA-WOLF, SEA-CAT or **WOLF-FISH** (*Anarrhichas*), a marine fish, the largest of the blenny group (*see* BLENNY). The body is long, subcylindrical in front, compressed in the tail region, smooth and slippery, with rudimentary scales embedded in the skin. An even dorsal fin extends the whole length of the back, and a similar fin from the vent to the caudal fin, as in blennies. The pectorals are large and rounded, the pelvic fins entirely absent. Both jaws are armed in front with strong conical teeth, and on the sides with two series of large tubercular molars, a double band of similar molars occupying the middle of the palate. By these teeth the sea-wolf is able to crush the hard carapaces or shells of the crustaceans and molluscs on which it feeds. It is doubtful if it deserves the character of ferocity often attributed

to it. Sea-wolves inhabit the northern seas of both hemispheres, one (*A. lupus*) being common on the coasts of Scandinavia and North Britain, and two in the seas round Iceland and Greenland. Two others occur in corresponding latitudes in the North Pacific. They attain a length of over 6ft., and in the north are esteemed as food, both fresh and preserved. The oil extracted from the liver is said to be in quality equal to the best cod-liver oil.

SEAWRACK, the detached seaweeds thrown up, often in great quantities, by the sea and used for manure, also formerly for making kelp. It consists largely of species of *Fucus*—brown seaweeds with flat branched ribbon-like fronds, characterized in *F. serratus* by a saw-toothed margin and in *F. vesiculosus,* another common species, by bearing air-bladders. Also of *Zostera marina,* so-called sea-grass, a marine flowering plant with bright green long narrow grass-like leaves. (*See* EEL-GRASS.)

SEBASTIAN, ST., a Christian martyr whose festival is celebrated on Jan. 20. According to St. Ambrose (in Psalm 118, oct. 20) Sebastian was a native of Milan, went to Rome at the height of Diocletian's persecution, and there suffered martyrdom. The *Acta* of St. Sebastian, falsely attributed to the same St. Ambrose, are far less sparing of details. They make him a citizen of Narbonne and captain of the first cohort under the emperors Diocletian and Maximian. He made many converts, several of whom suffered martyrdom. Diocletian remonstrated with him, but, finding him inflexible, ordered him to be bound to a stake and shot to death. After the archers had left him for dead, a devout woman, Irene, came by night to take his body away for burial, but, finding him still alive, carried him to her house, where his wounds were dressed. No sooner had he wholly recovered than he hastened to confront the emperor, who ordered him to be instantly carried off and beaten to death with rods. The sentence was forthwith executed, his body being thrown into the *cloaca,* where, however, it was found by another pious matron, Lucina, whom Sebastian visited in a dream, directing her to bury him *ad Catacombas juxta vestigia apostolorum.* It was on this spot, on the Appian way, that was built the basilica of St. Sebastian, which was a popular place of pilgrimage in the middle ages. The translation of his relics to Soissons in 826 made that town a new centre of his cult. St. Sebastian is specially invoked against the plague. As a young and beautiful soldier, he is a favourite subject of sacred art, being most generally represented undraped, and severely though not mortally wounded with arrows.

See *Acta Sanctorum,* January, ii. 257–296; *Bibliotheca hagiographica Latina* (Brussels, 1899), n. 7,543–7,549; A. Bell, *Lives and Legends of the Evangelists, Apostles and other early Saints* (London, 1901).

SEBASTIAN, king of Portugal (Port, *Sebastião*) (1554–1578), the posthumous son of Prince John of Portugal and of his wife, Joanna, daughter of the emperor Charles, was born in 1554, and became king in 1557, on the death of his grandfather John III. of Portugal. During his minority (1557–68), his grandmother Queen Catherine and his great uncle the Cardinal Prince Henry acted jointly as regents. Sebastian was a mystic and a fanatic, whose sole ambition was to lead a crusade against the Mohammedans in north-west Africa. He entrusted the government to the Jesuits; refused either to summon the Cortes or to marry, although the Portuguese crown would otherwise pass to a foreigner, and devoted himself wholly to hunting, martial exercises and the severest forms of asceticism. His first expedition to Morocco, in 1574, was little more than a reconnaissance; in a second expedition Sebastian was killed and his army annihilated at Al Kasr al Kebir (Aug. 4, 1578). Although his body was identified before burial at Al Kasr, reinterred at Ceuta, and thence (1582) removed by Philip II. of Spain to the Convento dos Jeronymos in Lisbon, many Portuguese refused to credit his death. "Sebastianism" became a religion. Its votaries believed that the *rei encuberto,* or "hidden king," was either absent on a pilgrimage, or, like King Arthur in Avalon, was awaiting the hour of his second advent in some enchanted island.

Four pretenders to the throne successively impersonated Sebastian; the first two, known from their places of birth as the "King of Penamacor" and the "King of Ericeira," were of peasant origin; they were captured in 1584 and 1585 respectively. The third, Gabriel Espinosa, was a man of some education, whose adherents included members of the Austrian and Spanish courts and of the Society of Jesus in Portugal. He was executed in 1594. The fourth was a Calabrian named Marco Tullio, who knew no Portuguese; he impersonated the "hidden king" at Venice in 1603 and gained many supporters, but was ultimately captured and executed. The Sebastianists had an important share in the Portuguese insurrection of 1640, and were again prominent during the Miguelite wars (1828–34). At an even later period Sir R. F. Burton stated that he had met with Sebastianists in remote parts of Brazil (Burton, *Camoens,* vol. i. p. 363, London, 1881), and the cult appears to have survived until the beginning of the 20th century, although it ceased to be a political force after 1834.

See PORTUGAL, *History;* J. Barbosa Machado, *Memorias para . . . . . o governo del rey D. Sebastião* (4 vols., Lisbon, 1736–41); Miguel d'Antas, *Les Faux Don Sébastien* (1866); São Mamede, *Don Sébastien et Philippe II* (1884).

SÉBASTIANI, HORACE FRANÇOIS BASTIEN, COUNT (1772–1851) French marshal and diplomatist. Of Corsican birth, he was in his early years banished from his native island during the civil disturbances, and in 1789 he entered the French army. In 1793, as a French lieutenant, he took part in the war in Corsica, serving later in the Army of the Alps. He became *chef de brigade* in 1799. Attached to the future Emperor Napoleon, he took part in the *coup d'état* of 18th Brumaire (Nov. 9, 1799). He was present at Marengo in 1800. Sébastiani next appears in his first diplomatic post, in Turkey and Egypt (1802). Promoted general of brigade in 1803, he served in 1805 in the first of the great campaigns of the Empire. At Austerlitz he was promoted (Dec. 2) general of division. As French ambassador at Constantinople he induced the Porte to declare war on Russia; as a soldier he directed the defence of Constantinople against the British squadron. But the deposition of the Sultan Selim III. put an end to French diplomatic success. Sébastiani was recalled in April 1807, and made count of the empire. He commanded a corps in the Peninsular War, but his cavalry genius did not shine in the laborious and painful operations against the careful English and the ubiquitous *guerrilleros.* In the *grande guerre* of Russia and Germany he did brilliant service. He accepted the Restoration government in 1814, but rejoined Napoleon on his return from Elba. After Waterloo he retired into England for a time. From 1819 he was a prominent member of the Chamber of Deputies. He held the posts of minister of marine, and later of foreign affairs and was the author of the historic saying "Order reigns at Warsaw." He became consecutively minister of state without portfolio (1832), ambassador at Naples (1833), and ambassador to Great Britain (1835–40). On his retirement he was made marshal of France. He died in Paris on July 21, 1851.

See E. Driault, *La Politique orientale de Napoléon: Sébastiani et Gardane* (1905).

SEBASTIANO DEL PIOMBO (1485–1547), Italian painter of the Venetian school, was born at Venice in 1485. His family name was Luciani. At first a musician, chiefly a soloplayer on the lute, he soon showed a turn for painting, and became a pupil of Giovanni Bellini and afterwards of Giorgione. His first painting of note was done for the church of San Giovanni Crisóstomo in Venice. It represents Chrysostom reading aloud at a desk, a grand Magdalene in front, and two other female and three male saints. Towards 1511 Sebastiano was invited to Rome by the wealthy Sienese merchant Agostino Chigi, and came under the powerful influence of Michelangelo.

Four leading pictures which Sebastiano painted in pursuance of his admiration for Buonarroti are the "Pietà" (earliest of the four), in the church of the Conventuali, Viterbo; the "Transfiguration" and the "Flagellation," in the church of S. Pietro in Montorio, Rome; and, most celebrated of all, the "Raising of Lazarus," now in the National Gallery, London. This grand work is more than 12 by 9 ft. in dimensions, with the principal figures of the natural size; it is inscribed "Sebastianus Venetus faciebat," and was transferred from wood to canvas in 1771.

It was painted in 1517–1519 for Giulio de' Medici, then bishop of Narbonne, afterwards Pope Clement VII.; and it remained in Narbonne cathedral until purchased by the duke of Orleans early in the 18th century—coming to England with the Orleans gallery in 1792. How much of the design is directly due to Michelangelo is a matter of speculation. Among other important works are "The Holy Family" in the National Gallery and in the Naples Museum; "the Visitation" in the Louvre (1521); the "Martyrdom of St. Agatha" (1520) in the Pitti, Florence; and the "Birth of the Virgin" a late work, in S.M. del Popolo, Rome.

After the elevation of Giulio de' Medici to the pontificate, the office of the "piombo"—that is, the office of sealer of briefs of the apostolic chamber—became vacant; two painters competed for it, Sebastiano Luciani and Giovanni da Udine. Sebastiano, assuming the habit of a friar, secured the very lucrative appointment—with the proviso that he should pay out of his emoluments 300 scudi per annum to Giovanni. If he had heretofore been slow in painting, he now became supine in a marked degree. One of the few subject-pictures which he executed after taking office was "Christ carrying the Cross" for the patriarch of Aquileia, also a "Madonna with the body of Christ." The former painting is done on stone, a method invented by Sebastiano himself. He likewise painted at times on slate—as in the instance of "Christ on the Cross," now in the Berlin gallery, where the slate constitutes the background. In the same method, and also in the same gallery, is the "Dead Christ supported by Joseph of Arimathea, with a weeping Magdalene"—colossal half-length figures. Late in life Sebastiano had a serious disagreement with Michelangelo with reference to the Florentine's great picture of the "Last Judgment." Sebastiano encouraged the pope to insist that this picture should be executed in oil. Michelangelo, determined upon nothing but fresco, replied to his holiness that oil was only fit for women and for sluggards like Friar Sebastian; and the coolness between the two painters lasted almost up to the friar's death, which took place in Rome in 1547.

Numerous pupils sought training from Sebastiano del Piombo; but, owing to his dilatory and self-indulgent habits, they learned little from him, with the exception of Tommaso Laureti. Sebastiano was celebrated as a portrait painter: the likeness of Andrea Doria, in the Doria Palace, Rome, is one of the most renowned. In the National Gallery, London, are also two fine specimens.

See F. Propping, *Die künstlerische Laufbahn des Sebastiano del Piombo* (Leipzig, 1892); E. Bonhard, *Die Venezianische Frühzeit des Sebastiano del Piombo* (Heidelberg, 1907); G. Bernardini, *Sebastiano del Piombo* (Bergamo, 1908); B. Berenson, *Drawings of Florentine Painters* (1904).

SEBORRHOEA, a medical term applied to accumulation on the skin of the normal sebaceous secretion with formation of scales or a distinct incrustation. Often the condition is associated with eczema. On the head, where it is commonly seen, it may interfere with the nutrition of the hair and cause partial baldness. A form of this disease occurs in young infants. The main treatment consists in thoroughly cleansing the parts. In uncomplicated Seborrhoea the crusts may be softened with oil and the affected skin regularly washed with soft soap and rectified spirit. Sebum frequently accumulates in the sebaceous ducts, giving rise to the minute black points often noticed on the face, back and chest in young adults, to which the term *comedones* is applied.

SECAUCUS, a town of Hudson county, New Jersey, U.S.A., 3 m. N. of Jersey City; served by the Erie and the Lackawanna railways. Pop. (1920) 5,423 (36% foreign-born white); 1930 Federal census 8,950. It has embroidery and button factories, nurseries, and market gardens. The borough of Secaucus was formed in 1900 from part of North Bergen and in 1917 it was incorporated as a town.

SECESSION, a term used in political science to signify the withdrawal of a State from a confederacy or composite State, of which it had previously been a part; and the resumption of all powers formerly delegated by it to the Federal Government, and of its status as an independent State. To secede is a sovereign right; secession, therefore, is based on the theory that the sovereignty of the individual States forming a confederacy or Federal union has not been absorbed into a single new sovereignty. Secession is a right claimed or exercised by weaker States of a union whose rights are threatened by the stronger States, which seldom acknowledge such a principle. War generally follows the secession of a member of a union, and the seceding State, being weaker, is usually conquered and the union more firmly consolidated.

Secession in theory and practice is best exhibited in the history of the United States. Most of the original States, and many of the later ones, at some period when rights were in jeopardy proclaimed that their sovereignty might be exercised in secession. The right to secede was based, the secessionists claimed, upon the fact that each State was sovereign, becoming so by successful revolution against England; there had been no political connection between the Colonies; the treaty of 1783 recognized them "as free, sovereign and independent States"; this sovereignty was recognized in the Articles of Confederation, and not surrendered, they asserted, under the Constitution; the Union of 1787 was really formed by a secession from the Union of 1776–87. New States claimed all the rights of the old ones, having been admitted to equal standing. Assertions of the right and necessity of secession were frequent from the beginning; separatist conspiracies were rife in the West until 1812; various leaders in New England made threats of secession in 1790–96 and 1800–15—especially in 1803 on account of the purchase of Louisiana, in 1811 on account of the proposed admission of Louisiana as a State, and during the troubles ending in the War of 1812. Voluntary separation was frequently talked of before 1815. In 1832–33 the "Union" Party of South Carolina was composed of those who rejected nullification, holding to secession as the only remedy; and from 1830 to 1860 certain radical abolitionists advocated a division of the Union. But as the North grew stronger and the South in comparison grew weaker, as slavery came to be more and more the dominant political issue, and as the South made demands concerning that "peculiar institution" to which the North was unwilling to accede, less was heard of secession in the North and more in the South. Between 1845 and 1860 secession came to be generally accepted by the South as the only means of preserving her institutions from the interference of the North. The first general movement toward secession was in 1850. In 1860–61, when the Federal Government passed into the control of the stronger section, the Southern States, individually, seceded and then formed the Confederate States, but in the war that followed they were conquered and forced back into the Union.

See Jefferson Davis, *Rise and Fall of the Confederate Government* (1881); A. H. Stephens, *Constitutional View of the War between the States* (Philadelphia, 1868–70); J. Hodgson, *Cradle of the Confederacy* (Mobile, 1876); B. Samuel, *Secession and Constitutional Liberty* (1920); B. J. Sage, *Republic of Republics* (Boston, 1876); Woodrow Wilson, *The State* (Boston, 1900); A. L. Lowell, *Government and Parties in Continental Europe* (Boston, 1896); J. W. Burgess, *Political Science and Comparative Constitutional Law* (1895), and C. E. Merriam, *American Political Theories* (1902). *See* also STATE RIGHTS; NULLIFICATION; and CONFEDERATE STATES. (W. L. F.)

SECONDARY EDUCATION. The word secondary is used in contradistinction to primary or elementary both in England and America to describe a system above that of elementary standard.

ENGLAND AND WALES

The term secondary was first used by Matthew Arnold, who adopted it from French education, to indicate that grade of general education which lies between the elementary or preparatory school and the university. His famous cry, "organize your secondary education," marks the beginning of a movement which led to the appointment of the Bryce Commission on secondary education and eventually to the acts of 1902 and 1918. Before 1902 this kind of education had been carried on by the public schools (*q.v.*), by little local grammar schools or schools of nonconformist foundation, together with a certain number of recently founded schools, due to private initiative or public spirited societies like the Girls' Public Day School Company, supplemented to some extent by more or less efficient private ventures. The most that local authorities could do was to make grants to existing schools. It was not till after 1902 that they were able to build schools of their own. Henceforth the move has been one of steady progress, aided by the liberal scholarship schemes estab-

lished by local authorities, and further stimulated from 1907 onwards by the provision, as a condition of receiving grants from the Board of Education, of free places for pupils from elementary schools (normally 25% of the entrants, but since 1926 often higher). In the ten years ending 1914–15 the number of schools on the grant list in England and Wales rose from 575 to 1,047, and the number of pupils per 1,000 of the population from 2·9 to 5·5; moreover the average size of the schools has shown a remarkable increase. In 1908–09, 64 out of 912 schools had less than 50 pupils; at the present time not more than 7% of the total have less than 100. The free place system greatly helped the efficiency of the schools; it was largely responsible, especially through the establishment of intermediate scholarships at 15–16, for raising the standard of work up to and beyond the matriculation stage, and through the fixing of age limits for scholarships and free places it helped to bring about a general standardization of the age of entry; and this affected both the leaving age and the length of school life.

The number of schools in which a considerable amount of sixth form work is done has increased steadily, and though the economic conditions which tend to the premature withdrawal of boys and girls from school are slow to change, there has been a steady improvement in this respect; the average school life of boys rose from two years and seven months in 1908–09 to three years and nine months in 1926–27, and that of girls in the same period from two years and seven months to three years and ten months, while the average leaving age rose in the case of boys from 15·5 to 16·3, and in the case of girls from 15·11 to 16·4.

Most of this development, however, belongs to the period beginning in 1914. Within a few months after the beginning of the World War, it became evident that there was an astonishing increase in the demand for secondary education. This demand persisted all through the war and shows no sign of general diminution; it has shown itself not merely in the increase in the numbers applying for admission to secondary schools but even more in the support given to important educational measures.

As to the schools, the numbers on the grant list for England and Wales in 1926–27 were 1,319 (487 boys', 467 girls' and 365 mixed schools), containing 196,289 boys and 175,204 girls; the number of pupils per 1,000 of population, which in 1904–05 had been no more than 2·9 (1·9 boys, 1·0 girls), was now 9·5 (5·0 boys, 4·5 girls); between 1908 and 1926 the number of boys proceeding to universities increased from 695 to 2,057, and the number of girls from 361 to 1,312. Besides the schools on the grant list, the Board of Education has now recognized as efficient after inspection 326 public and private secondary schools and 108 private preparatory schools. The number of free place pupils rose from 57,933 (32·1 of the total numbers) in 1914–15 to 131,309 (37·6 of the total numbers) in 1927–28.

Financial Aspects.—This expansion entailed a great increase in expenditure from both rates and taxes; since, though fees have been generally raised by about 50%, there are few schools on the grant list in which any pupil's fees cover as much as half the cost of his education. The Board's grant was increased from £5 per pupil over 12 to £7 in 1917, and special grants were made for advanced courses; finally the Act of 1918 repealed the twopenny limit on rate aid to higher education, and also provided that the State contribution should be not less than one-half of the local education authority's approved expenditure.

Status of Teachers.—A great improvement in the salaries of teachers was secured in 1920 by the standing joint committee of representatives of local educational authorities and teachers, constituted under the chairmanship of Lord Burnham, at the suggestion of Mr. Fisher. The Teachers' Superannuation Act of 1918 had established a liberal pension system, and though before long contributions were required from the teachers to the cost of pensions, and in 1925 a modification of the salary agreement became necessary, the position of the teachers is much better than before 1920 in schools of all kinds.

Examination Reforms.—(*See* also EXAMINATIONS.)—A valuable reform in the examinations affecting secondary schools was initiated by the Board of Education in 1917. The secondary schools had suffered from the number and variety of external examinations, many of which had served a useful purpose in stimulating work, but had become oppressive and confusing. The consultative committee of the Board had issued a report on the subject in 1911; in 1914 the Board issued proposals for the recognition of two grades of examinations—one for pupils of 16–17 and another for pupils of 18–19—to be conducted by university examining bodies. In 1917 the Secondary Schools Examinations Council, representative of the examining bodies, the local education authorities and the teaching profession was established, and since then the first and second school examination of one or other of eight university examining bodies have gradually become a useful element in the organisation, not only of schools under the Board's control but of secondary schools of every kind. In grant-aided schools the Board pays the examination charges for each pupil up to a maximum of £2. In 1926–27, 43,752 pupils in grant-aided schools took a first examination and 6,681 a second.

Advanced Courses.—A second reform was the provision of grants for recognized advanced courses in certain groups of subjects; the grouping at first conceived on a rather rigid formula, has been greatly modified, and almost any kind of advanced work likely to be done in a secondary school, *e.g.*, in music and art, may now be recognized; but the grant, except for schools taking no aid from local education authorities, has now been merged in the general provision made by the act of 1918. In 1926–27, 479 advanced courses were recognised (232 in science and mathematics, 38 in classics, 189 in modern studies, seven in classical with modern studies, four in geography, nine in other combinations of subjects).

Connection with Universities.—The relation of the schools to the universities and other places of university rank has become increasingly important. The first and second school examinations are gradually simplifying the conditions of entrance to the universities and the professions, and even also to commerce and industry. Most local education authorities interest themselves in finding openings for the pupils leaving their schools. In London, two joint committees of heads of schools and employers find employment for a very large number of boys and girls. (*See* EDUCATION AND INDUSTRY.) In 1920 the Board instituted a scheme for the award of 200 State scholarships to universities for pupils in grant-aided secondary schools; the scheme was dropped in 1922 and 1923, but revived in 1924. The award is based on the second school examination; the amount varies with circumstances, but is calculated to finance the whole of the scholar's university course. (R. F. CH.; C. BR.)

IN THE UNITED STATES

The chief stages in the development of secondary education in the United States may be best visualized by reference to the main types of secondary schools. (1) The type operative in colonial America was the Latin grammar school, an institution borrowed from contemporary England and continental Europe. Its curriculum was restricted to the classical languages and literatures, and its chief purpose was to prepare boys for college. There were in this period no secondary schools for girls. (2) At a period near that of the American Revolution there arose a new type of institution, the academy. Its curriculum was much broader than that of the Latin grammar school, comprehending both college-preparatory and non-college-preparatory subjects. In many instances, in some areas predominantly, it opened its doors to both sexes. (3) Before the middle of the 19th century there arose another type of institution, the public high school, whose chief distinguishing characteristic was that it afforded free secondary education at public expense. Its curriculum aimed to serve both the college-going and the non-college-going groups. In this respect and in the fact that it was open to students of both sexes it was similar to the academy. Since the opening of the 20th century there has been developing a fourth type of secondary school which may be best described as the extended secondary school. The extension has been in two directions—both horizontal (by including an increasing proportion of the population and a wider variety of curriculum content) and vertical. Attention is here directed

chiefly to the latter type of extension. School systems are increasingly extending the secondary-school period downward by adding the last two elementary-school grades through junior high-school organization and upward by adding the junior-college years (*see* UNIVERSITIES and COLLEGES), that is, the work of the first two college years, often considered to be essentially secondary in character. Many school systems have provided for extension in one or both directions and the number is rapidly increasing.

JUNIOR HIGH SCHOOLS

The junior high school, or, as it is sometimes called, the "intermediate school," is one manifestation of a fundamental realignment which has been affecting educational organization in the United States. This particular phase of the realignment has been concerned primarily with the later years of the seven-year and eight-year elementary schools and typically, although not universally, the first year of the four-year high school, the usual junior high school being a two-grade or three-grade division of the school system.

The results of the influences of reorganization at work began to make themselves most apparent five to ten years after the opening of the 20th century, but there were evidences of reorganization having something in common with this movement before that time. The earliest were in Berkeley and Los Angeles in California. The movement made rapid gains from 1912 until 1916, and excepting for the period of the World War, has continued its growth at an accelerated rate since that time. Studies of the extent of the movement have shown that by 1923 fully three-fourths of school systems in cities with populations exceeding 100,000 either had junior high schools in operation or had been committed to junior high school reorganization. Smaller cities have also been effecting this reorganization. Data made available by the U.S. bureau of education show that in 1925 there was a total of 2,548 "non-four-year" high schools, these including as predominant types 879 "segregated" junior high schools, that is, junior high school units not housed with other units in the system, and 1,389 "junior-senior" high schools, that is, high schools comprising both junior and senior units. The movement would have made even greater gains were it not necessary in many communities to wait for new buildings. Even with this obstacle the junior high school reorganization will be before long a common feature of school systems in the United States and will in all probability develop still farther.

The features more commonly incorporated in the junior high school plan may be considered under the following sections:

(1) Although the junior high school often includes only two grades (that is, the seventh and eighth in systems formerly having eight grades in the elementary school and four in the high school), the trend of preference has been toward the three-grade unit, including the seventh, eighth and ninth grades. This is because a two-grade unit is too short to provide much leeway for fundamental change and because it often leaves the four-year high school without modification.

(2) The curriculum or programme of studies is frequently acknowledged to be the most important feature of the junior high school. Typically, besides requiring certain subjects of all pupils, it allows some choice, sometimes in seventh grade, but more often in eighth and ninth grades, to make up the remainder of the pupils' work. The work required of all is often referred to as the "core," the elective portions being drawn from the industrial arts, the home arts, elementary commercial subjects and foreign languages. In the better schools the curriculum in both required and elective work represents a vigorous effort to enrich the training programme in these grades of the junior high school as contrasted with that in the corresponding grades of the conventional organization. (3) Grouping by ability, which aims to place pupils of more nearly equal ability in the same class groups, is advocated. (4) The most common feature of junior high schools is departmentalization, that is, the assignment of subjects to teachers so as to permit at least some measure of specialization, in contrast with the unspecialized teaching formerly universal in upper grammar grades.

(5) The junior high school has also been a vehicle for innovations in teaching methods, such as directed or supervised study (in which the pupil prepares his assignments in whole or in part under supervision of the teacher of the subject), the project and problem methods and individualized instruction.

One of the most remarkable developments in American education has been the rapid expansion, since 1890, of public secondary schools. The increase has affected both the numbers of schools and the numbers of pupils enrolled. Of the latter there were in 1926 about three and three quarter millions, excluding pupils in junior high schools. The proportionate increase has been far in excess of the gain in the population. Between 1890 and 1920 the percentage of those enrolled in public high schools of all the population of normal ages for the four-year high school (14 to 17 years, inclusive) increased from 3·8 to 24·0. Influxes of pupils since 1920 have resulted in a percentage much larger than this. The proportion is far in excess of that for any other large nation.

No account of the status of secondary education in the United States is complete without reference to schools on private foundations. During the 30 year period from 1890 to 1920, the public schools increased from 60·8% to 87·3% of all schools reporting to the U.S. Bureau of Education, while the pupils enrolled increased from 68·1% to 91·0%. This means primarily that public schools were growing so rapidly as to become increasingly dominant numerically. What was taking place in private secondary education may best be shown by reference to data reported to the bureau in 1895 and 1922. The number of schools on Roman Catholic foundations increased more than three-fold, while the number of pupils in these schools increased even more rapidly; the number of schools of all other denominations combined decreased somewhat, although they experienced some gains in total enrolment; non-sectarian schools decreased both in numbers of institutions operating and in the total number of pupils enrolled. It appears that sectarianism is the dominant factor in the persistence of private secondary education, and that it is most effectively operative with Roman Catholics. *See* PAROCHIAL SCHOOLS.

Reference has already been made to the expanding concepts of purpose of American secondary education from service to college-going pupils only, toward service to both college-going and non-college-going pupils. This expansion is made much more apparent in a comparison of literature on the subject from an earlier day with that issued recently. Three types of purpose appear in the older literature, namely, college preparation, selection for higher levels of training, and what was referred to as "mental discipline." More recent statements of leaders in secondary education emphasize training for civic, social and moral relationships; training for the proper use of leisure; training for health; and training for occupation. There is also emphasis on such matters as even greater popularization of educational opportunities on the secondary-school level, recognition of individual differences, and guidance. A significant conclusion to be drawn from such a comparison of older and modern concepts is that the latter are stressing values having obvious relationships to every day needs, whereas the former are cast in terms of remoter and deferred values. Such a shift of concepts was certain to manifest itself as soon as this period of education came more frequently to be looked upon as terminal or culminal rather than preparatory. At the same time the leaders whose writings were consulted recommend the continuance of the function of preparation for college for such of the graduates of the high school who continue to higher levels of training.

It is to be expected that these shifting concepts would be reflected in the make-up of the curriculum of secondary schools. This is shown in the marked shift of registrations from certain subject-groups to others, for example from foreign language and mathematics to the social studies and the practical arts. It is shown also in the rapid multiplication of new courses formerly unrepresented or much less frequently represented in the high-school offering. One large field of expansion has been the vocational, but there are others also, like the fine arts and physical training. It is shown again in the much greater flexibility of programmes of studies than was characteristic before the opening of the 20th century, including the opportunity to select one from a

number of "courses" or curricula, and even within a curriculum to elect from a variety of different subjects. These expansions have been accompanied by the advocacy of the "comprehensive" high school, an institution which aims to care for all the needs of general and occupational training of all pupils who may care to enter. There are, nevertheless, those who advocate the restriction of the high schools to general education, the occupational training to be provided in separate vocational schools.

An interesting development contemporary with popularization and expansion of the offering has been the increase of extra-curricular activities, that is, that great body of activities in which young people engage spontaneously, for example, athletics, debate, journalism, dramatics, music and subject clubs. Those in charge of these activities are coming to regard them as possessing large values in training and are making efforts to integrate them with the curriculum proper. On this basis these activities may in an important sense be looked upon as an extension of the curriculum.

The expanded secondary school, inclusive of popularization and the enriched and flexible offering, has brought with it the problem of the proper distribution of the secondary-school population to the training opportunities, that is, the problem of guidance. The necessity for guidance in the modern school is made more apparent if one keeps in mind not only these factors of popularization and enlarged offerings, but also the complexity of occupational life outside the school with its increasing tendency to specialization, the shift of the rural population to urban centres, and the changing status of women. All these factors have stimulated the development of guidance programmes, which are becoming characteristic of the better schools. The proportion of secondary schools without some development along this line is not large. Among the means of guidance used are exploratory, or "try-out," courses (particularly in the junior high school); a course affording a survey of occupations; intelligence, aptitude and achievement tests; adequate records; summer and other part-time employment; placement and employment supervision; and the provision of special personnel officers, referred to as "advisers" or "counsellors."

In comparison with teachers in European secondary schools, instructors in high schools in the United States are criticized for their lack of professionalization. It is pointed out that both the extent of training and the period of service are shorter. Both these conditions are often explained by the large proportion of women teachers. Whatever the cause, the extent of preparation and the period of service *are* shorter. Better systems have been able for some time to insist, for teachers in four-year high schools, on the minimum represented in the bachelor's degree from a standard college, and in some quarters, notably California, there is insistence on a year of graduate work. It is likely that in time the schools will more generally move to this as the next stage of professionalization. This should assist somewhat in extending the average period of experience. Whether or not it is the determining factor of duration of training or experience, women teachers over a long period have outnumbered the men. It is not generally known, however, that with a single exception the proportion of men has ranged between 40 and 50 per cent. The exception was the period immediately following the Great War. The question of standards of preparation is being reopened owing to the appearance of junior high schools and junior colleges, for both the extent and nature of training for these teachers will need to differ.

Mention is often made in discussions of the expanding programme of secondary education in the United States of the mounting cost of these schools, a cost that is increasing not only because more pupils are in attendance, but also because the cost per pupil has increased. The question is sometimes raised as to whether the nation will continue to go forward with the programme of providing secondary education for all. Although no final pronouncement may be made on this score, the evidences point toward assumption of this larger burden. Usually, when issues involving greater outlays for schools are placed before the voters in a local situation, they respond in unmistakable terms in favour of expansion. Moreover, the aspirations to a democratic society are based on a popularization of intelligence which is not to be achieved through a system of free schools limited to what we think of as elementary education: it requires the training of almost the whole population above the traditional common-school level. For the nation to admit unwillingness or inability to afford this higher training would be tantamount to abandonment of democratic convictions.

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SECOND LIEUTENANT. The lowest grade of officer rank in the British and U.S. armies. In the former the corresponding rank was Ensign until its abolition in 1871 and the rank "Sub-Lieutenant" substituted, which in turn was abolished in 1876 and "Second Lieutenant" introduced. The corresponding rank in some other armies is—French and Belgian, *Sous Lieutenant;* German, *Leutnant;* Swiss and Japanese, *Second Lieutenant;* Netherlands, *Tweede-Luitenant;* Italian, *sub-lieutenant.*

SECOND SIGHT, a term denoting the opposite of its apparent significance, meaning in reality the seeing, in vision, of events *before* they occur.

Though we hear most of the "second sight" among the Celts of the Scottish Highlands (it is much less familiar to the Celts of Ireland), this species of involuntary prophetic vision, whether direct or symbolical, is peculiar to no people. Perhaps our earliest notice of symbolical second sight is found in the *Odyssey*, where Theoclymenus sees a shroud of mist about the bodies of the doomed Wooers, and drops of blood distilling from the walls of the hall of Odysseus. The Pythia at Delphi saw the blood on the walls during the Persian War; and, in the *Argonautica* of Apollonius Rhodius, blood and fire appear to Circe in her chamber on the night before the arrival of the fratricidal Jason and Medea. Similar examples of symbolical visions occur in the Icelandic sagas, especially in *Njala*, before the burning of Njal and his family. In the Highlands, and in Wales, the chief symbols beheld are the shroud and the corpse candle or other spectral illumination. The Rev. Dr. Stewart, of Nether Lochaber, informed the present writer that one of his parishioners, a woman, called him to his door, and pointed out to him a rock by the sea, which shone in a kind of phosphorescent brilliance. The doctor attributed the phenomenon to decaying sea-weed, but the woman said, "No, a corpse will be laid there to-morrow." This, in fact, occurred; a dead body was brought in a boat for burial, and was laid at the foot of the rock, where, as Dr. Stewart found, there was no decaying vegetable matter.

Second sight flourished among the Lapps and the Red Indians, the Zulus and Maoris, to the surprise of travellers, who have recorded the puzzling facts. But in these cases the visions were usually "induced," not "spontaneous." Ranulf Higdon's *Polychronicon* (14th century) describes Scottish second sight, adding that strangers "setten their feet upon the feet of the men of that londe for to see such syghtes as the men of that londe doon." This method of communicating the vision is still practised. (For the method *see* Kirk's *Secret Commonwealth of Elves, Fauns and Fairies*, 1691, 1815, 1893.) It is, by some, believed that if a person tells what he has seen before the event occurs he will lose the faculty—a belief which renders the proof of the vision impossible. There are many seers, as Lord Tarbat wrote to Robert Boyle, to whom the faculty is a trouble, "and they would be rid of it at any rate, if they could."

Perhaps the visions most frequently reported are those of funerals, which later occur in accordance with "the sight," of corpses, and of "arrivals" of persons, remote at the moment, who later do arrive, with some distinctive mark of dress or equipment which the seer could not normally expect, but observed in the vision. A fair example of second sight is the following from Balachulish. An aged man of the last generation was troubled by visions of armed men in uniform, drilling in a particular

field near the sea. The uniform was not "England's cruel red," and he foresaw an invasion. "It must be of Americans," he decided, "for the soldiers do not look like foreigners." The Volunteer movement later came into being, and the men drilled on the ground where the seer had seen them. Another case was that of a man who happened to be sitting with a boy on the edge of a path in the quarry. Suddenly he caught the boy and leaped aside with him. He had seen a runaway trolly, with men in it, dash down the path; but there were no traces of them below. "The spirits of the living are powerful to-day," said the percipient in Gaelic, and next day the fatal accident occurred at the spot. These are examples of what is, at present, alleged in the matter of second sight.

"The sight" may, or may not, be preceded or accompanied by epileptic symptoms, but this appears now to be unusual. A learned minister lately made a few inquiries on this point in his parish, at the request of the present writer. His beadle had "the sight" in rich measure: "it was always preceded by a sense of discomfort and anxiety," but was not attended by convulsions. Out of seven or eight seers in the parish, only one was not perfectly healthy and temperate.

The phenomena, as described, may be classed under "clairvoyance," "premonition," and "telepathy" (*q.v.*), with a residuum of symbolical visions.

Bibliography.—The literature of second sight is not insignificant. *The Secret Commonwealth* of the Rev. Mr. Kirk (1691), edited by Sir Walter Scott in 1815 (a hundred copies), and by Andrew Lang in 1893, is in line with cases given in Trials for Witchcraft (*cf.* Dalyell's *Darker Superstitions of Scotland,* and Wodrow's *Analecta*). Aubrey has several cases in his *Miscellanies,* and the correspondence of Robert Boyle, Henry More, Glanvil and Pepys, shows an early attempt at scientific examination of the alleged faculty. The great treatise on Second Sight by Theophilus Insulanus (a Macleod) may be recommended, with Martin's *Description of the Western Isles* (1703–16) and the work of the Rev. Mr. Fraser, Dean of the Isles (1707, 1820). Fraser was familiar with the contemporary scientific theories of hallucination, and justly remarked that "the sight" was not peculiar to the Highlanders; but that, in the south, people dared not confess their experiences, for fear of ridicule. (A. L.)

SECOND (SOCIALIST) INTERNATIONAL: *see* International, The.

SECRET, that which is concealed from general knowledge. In special senses the word is applied to (*a*) a prayer in the Roman and other liturgies, said during mass by the priest in so low a voice that it does not reach the congregation, and (*b*) a covering or skull-cap made of steel fitting close to the head.

See also such articles as Secret Societies; Official Secrets; Espionage.

SECRETARY-BIRD (*Serpentarius secretarius*), an African bird with long legs, standing nearly 4 ft. high. From the back of the head and nape hangs an erectile tuft of long black feathers. Round the eyes is orange skin; the head, neck, and back are bluish-grey, the lower surface black; the tail quills are banded with black and tipped with white. The beak is hooked. There is a second species, also African. The secretary-bird feeds on insects and reptiles and can kill the most venomous snakes, striking them repeatedly with its taloned feet. The long legs together with the bird's habit of leaping back after each stroke, preserve it from being bitten. The huge nest is placed in a bush or tree and in it are laid two white eggs, spotted with rust-colour. The bird is found locally over most of Africa, south of the Sahara. It is one of the most powerful of the birds of prey (Falconiformes).

BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY

SECRETARY BIRD (SERPENTARIUS SECRETARIUS), A LARGE BIRD OF PREY, FOUND WIDELY IN AFRICA

SECRETARY OF STATE, in Great Britain, the designation of certain important members of the administration (*see* Ministry); in the U.S. the ranking member of the President's cabinet. The ancient English monarchs were always attended by a learned ecclesiastic, known at first as their clerk, and afterwards as secretary, who conducted the royal correspondence; but it was not until the end of the reign of Queen Elizabeth that these functionaries were called secretaries of State.

Until the reign of Henry VIII. there was generally only one secretary of State, but at the end of his reign a second principal secretary was appointed. Owing to the increase of business consequent upon the union of Scotland, in 1708 a third secretary for Scotland was created, but a vacancy occurring in this office in 1746 the style lapsed and the third secretaryship was dispensed with. In 1768 a third secretaryship was again instituted to take charge of the increasing colonial business. In the 17th century the duties of the first two principal secretaryships had come to be divided between the Northern and the Southern departments, dealing respectively with the business of the Protestant and Catholic States. But in 1782 this style was changed to the Home and Foreign, and the office of the third secretary was again abolished, and the charge of the Colonies transferred to the home secretary. But owing to the war with France in 1794 a third secretary was once more appointed to superintend the business of the War Department, and seven years later the colonial business was transferred to his department as secretary for war and for the Colonies from 1801 to 1854. In that year a fourth secretary of State for the exclusive charge of the War Department and in 1858 a fifth secretaryship for India were created.

In 1917 the secretaryship for air was created, and in 1926 the office of the secretary for Scotland, which had been revived in 1885, was raised to that of a principal secretary of State. In 1925 the prime minister announced that the Government contemplated the creation of a new secretaryship of State for dominion affairs, which "for reasons of practical convenience" would continue to be vested in the secretaryship for the Colonies, although accompanied by the creation of a new under-secretaryship and the organization of a separate office for dominion affairs. There are therefore now seven principal secretaries of State, namely, for foreign affairs, home affairs, dominion affairs and the Colonies, war, India, air and for Scotland. One of these secretaries of State is always a member of the House of Lords. The secretaries of State are the only authorized channels through which the royal pleasure is signified to any part of the body politic, and the counter-signature of one of them is necessary to give validity to the sign manual. The secretaries of State constitute but one office, and are co-ordinate in rank and equal in authority. Each is competent in general to execute any part of the duties of the secretary of State, the division of duties being a mere matter of arrangement. For the existing division of duties, *see* under separate headings, Government Departments, Foreign Office, etc.

In the United States the "secretary of State" is that member of the President's cabinet who deals with foreign affairs, and who, in the event of a vacancy in the office of president, is next in succession after the vice-president. The title of "secretary"—"of the Treasury," "of war," etc.—is used for some other members of the cabinet. In the various States there is an executive officer called "secretary of State," whose duties are those belonging properly to a secretary for the State.

SECRET COMMISSIONS. The giving of a commission, in the sense of a bribe or unlawful payment to an agent or employé in order to influence him in relation to his principal's or employer's affairs, has grown to considerable proportions in modern times; it has been rightly regarded as a gross breach of trust on the part of employés and agents, inasmuch as it leads them to look to their own interests rather than to those of their employers. In order to suppress this bribing of employés the English legislature in 1906 passed the Prevention of Corruption Act, which enacts that if an agent corruptly accepts or obtains for himself or for any other person any gift or consideration as an inducement or reward for doing or forbearing to do any act, or for showing or forbearing to show favour or disfavour to any person, in relation to his principal's affairs, he shall be guilty of a misdemeanour and shall be liable on indictment and conviction to imprisonment with or without hard labour for a term not exceeding two years, or to a fine not exceeding £500, or to both, or on summary conviction to imprisonment

not exceeding four months with or without hard labour or to a fine not exceeding £50, or both. The act also applies the same punishment to any person who corruptly gives or offers any gift or consideration to an agent. Also if a person knowingly gives an agent, or if an agent knowingly uses, any receipt, account or document with intent to deceive the principal, he is guilty of a misdemeanour and liable to the punishment already mentioned. For the purposes of the act "consideration" includes valuable consideration of any kind, and "agent" includes any person employed by or acting for another. No prosecution can be instituted without the consent of the attorney-general, and every information must be upon oath.

Legislation to the same effect has been adopted in Australia. A federal act was passed in 1905 dealing with secret commissions, and in the same year both Victoria and Western Australia passed drastic measures to prevent the giving or receiving corruptly of commissions. The Victorian act applies to trustees, executors, administrators and liquidators as well as to agents. Both the Victorian and the Western Australian acts enact that gifts to the parent, wife, child, partner or employer of an agent are to be deemed gifts to the agent unless the contrary is proved; also that the custom of any trade or calling is not in itself a defence to a prosecution. When a bribe has been given to an agent, his principal is not bound by the resulting contract, and the agent is accountable to him for the amount of the bribe, and also forfeits any remuneration to which he would otherwise be entitled. (*See* BRIBERY.)

SECRET LANGUAGES. Many societies, ancient and modern, comprise special groups—distinct by racial, political, functional differences from the main community—and these special groups often preserve their identity and guard their independence by the use of a secret language. In secret societies, passwords are used and where hieratic functions are discharged by a special permanent class, the members of that group converse by means of secret languages. In cases like the Todas the use of a secret language is due to the desire to keep private affairs hidden from the preying curiosity of their neighbours—Kotas and Badagas (W. H. R. Rivers, *The Todas*). The use of slang as a secret language is recorded of the Sema Nagas (J. H. Hutton, *Sema Nagas*, 1921, p. 296), where the advantage of being able to irritate one's neighbours is associated with its value in trade, and in personal intrigue. Similarly of the Langos (J. H. Driberg, *The Lango*) the secret language "consists entirely of different words for substantives but apparently the rest of the grammar and syntax remains unchanged. The language is much used by lovers and is normally employed if it is desired to keep the conversation secret from others. It is widely distributed but whether or not it is confined to a group of initiates is unknown."

Political conditions have often occasioned the use of secret languages (*see* BILINGUALISM) and in thieves' patter we have a rudimentary form.

See Hutton Webster, *Primitive Secret Societies* (1908); L. Lévy-Bruhl, *Les fonctions mentales dans les sociétés inférieures* (1910), trans. L. A. Clare, *How Natives Think* (1926); O. Jesperson, *Language* (1922).

SECRET SOCIETIES. This term has been loosely used for a medley of associations which have little in common beyond an element of secrecy, which may vary from a mere password to an elaborate ritual of initiation with a private language, peculiar ceremonials and symbols and every circumstance calculated to lend an air of mystery. It may be applied to the Masonic Order or the Ku Klux Klan as well as to similar phenomena in primitive cultures.

From this angle Maciver's definition of an Association as "an organization of social beings . . . for the pursuit of some common interest or interests" applies equally to secret societies with the proviso that it must be re-enforced by secrecy either for the maintenance of the internal solidarity of the society or for its more effectual domination over non-members. Secrecy alone however does not necessarily imply a secret society, and other criteria have to be taken into consideration. Thus many systems of age-grades (*q.v.*) contain rites or doctrines, knowledge of which is prohibited to such members of the tribe as have not yet been affiliated; but age-grades cannot properly be termed secret societies. What differentiates age-grades from secret societies is the fact that initiation into the former is compulsory to every member of the tribe, but entrance into a secret society is optional. Moreover in all secret societies entrance or promotion from rank to rank is purchasable, whereas in age-grades promotion is inevitable and automatic. The Crow Indians combine the two systems by compulsory purchase, the compulsory element of age-grades having been added to the idea of purchase inherent in secret societies.

Theories.—The wide correlation of masks with secret societies (and it would appear that even stilts are possibly also involved) suggested to Frobenius that primarily these societies by feigning the death and resurrection of the candidate were the means of bringing the members into closer contact with the spirits of their dead and deified ancestors. To Van Gennep they symbolize a process of rebirth or separation from the world outside and a passage from immaturity to full tribal membership. Webster traces secret societies to initiation ceremonies, and it seems probable that ultimately all such societies are the outgrowths of puberty rites, and what again differentiates secret societies from age-grades is the fact that the former have developed away from these rites while the latter retain them as an essential element in the system. For secret societies are always changing, however imperceptibly, as in the change which has transformed the Human Leopard Society from a Mendi war medicine to a definitely cannibalistic institution. Thus, societies which are secret in one area are elsewhere public associations though their functions appear to be identical.

Secret societies, like all other associations, cut across the social units of the family and the clan, though instances do occur which suggest a connection with a totemic clan system. Among the Pueblo Indians the totemic clans on uniting into the tribe still continued to exist as esoteric fraternities, and in certain parts of Melanesia where totemism flourishes fraternities are unknown, but are found where totemism does not exist. This may be due however to other factors. In Africa there is evidently a correlation between secret societies and the political structure of the tribe, and with the evolution of authority from local councils to a tribal autocracy there is a parallel development of secret societies, which though often extra-legal serve to uphold the law and at the same time to act as checks on what would otherwise be complete despotism. The secret societies, or at any rate the higher degrees of the societies, become the ruling aristocracy, and in certain cases, such as the Tenda in French Guinea, it is the secret societies which are the sole means of government.

From the point of view of function secret societies among primitive peoples may be roughly classified as magical, religious and social, and the last must again be subdivided into mutual help societies, like the Nkimba of the lower Congo, certain occupational groups, such as doctors and blacksmiths, feasting clubs, sexual societies, like the Kore of the Mandingo, and governmental or police organizations, the last of which not infrequently degenerate into a system of extortion and tyranny. The Ogboni society of the Yoruba is probably the most conspicuous of these political societies, with the Oro society as their subordinate police. However for all these social functions a religious sanction must be predicated.

Despite contrary examples, such as the Imandwa, a secret society of the Banyaruanda, which is religious rather than social, the secret societies of the North American Indians have in the main religious functions, as contrasted with those of Melanesia and Africa which are primarily social and governmental.

The term secret society obviously implies that there are members of a community outside the society. In the majority of societies membership is generally limited on sex lines, but sometimes as among the Tenda along lines of social status. Some societies like the Poro admit women in exceptional circumstances, others like the Yewe admit them only to certain degrees, and others again like the Ndembo of the Lower Congo are completely bisexual. But the great majority refuse admission to women, with the result that parallel women's societies are instituted, the functions of which are mainly magico-religious and are concerned with fertility and cultivation.

Bibliography.—R. E. Dennett, *At the Back of the Black Man's Mind* (1906); Sir J. G. Frazer, *Totemism and Exogamy* (1910); L. Frobenius, *Die Masken und Geheimbunde Africas* (1898); A. Van Gennep, *Les Rites de Passage* (1909); K. G. Lindblom, *The Use of Stilts* (1927); R. H. Lowie, *Primitive Society* (1921), *The Origin of the State* (1927); H. Schurtz, *Altersklassen und Männerbunde* (1902); P. Amaury Talbot, *In the Shadow of the Bush* (1912); H. Webster, *Primitive Secret Societies* (1908). (J. H. D.)

CHINESE

Most of the Chinese secret societies are merely trade guilds or friendly societies, but the Hung or Triad Society comes in an entirely different category. It has the largest membership of any secret society in the world, and has existed since A.D. 386, in close association with the White Lotus. Contemporary with the ancient mysteries, it is itself a great mystery rite over 1,500 years old.

In A.D. 386 it was founded, or perhaps re-organized, by the Buddhist patriarch Eon or Hwui-Yin at Rozan, to spread the cult of Amitabha Buddha. In A.D. 630 Zendo joined it to gain instruction, and in 1344 it rebelled against the Mongolian or Yüen dynasty. In 1662 it fell under the ban of Khang Hsi, who in his *Sacred Edict* instituted a persecution of the Buddhists and Taoists, and ordered the suppression of five religious societies, among which the White Lotus and the Hung were specifically named. The exact relation between these societies is still obscure, but, if they were not alternative titles for the same organization, they were probably the names of different degrees of one common rite. It is just possible, however, that they were similar, but separate, mystical societies.

Partly as a result of this persecution, the Hung Society became political and anti-dynastic, and has raised numerous insurrections against the Manchus, one of the most famous being the Taiping revolt in 1851. The rituals were peculiarly suitable for conversion from religious to political aims, since the slogan of the brotherhood is "Overthrow Ching and restore Ming."

Ming means light, and especially the perfected spirit in man; while Ching means the vital force, or, as we should say, the soul immersed in matter. By slightly changing the way in which the character for Ching is written, it becomes the name of the Manchu dynasty, while the last Chinese dynasty was the Ming. Hence it will be seen that the change from a Buddhist-Taoist mystical initiatory rite to a dangerous political society was easy.

The rituals show a blending of Taoist-Buddhist ideas having curious analogies with the Egyptian *Book of the Dead,* and with certain "Higher Degrees" in western speculative Freemasonry. The ceremony symbolizes the journey of the soul through the Underworld and Paradise to the Holy City of the Gods, here called the City of Willows, and interwoven with this is an allegory of the experiences of the mystic in his quest for union with the Supreme Being. As regards its analogies with Masonry, practically every important incident is found in certain "Higher Degrees" in England and America, while most of the hand signs are known to many Freemasons.

The ceremony falls into four sections. First comes the traditional history, which is given to the candidates in the anteroom before they enter the lodge. It is a moving story, wherein a body of monks who had helped the emperor are requited by him with the foulest treachery, all being murdered, save five who became the founders of the order. There are three villains, and for political purposes one is a Manchu emperor, either Khang Hsi, or, in some versions, his son, but originally the story was allegorical.

After this the candidates are "prepared" in the anteroom. The most notable incidents are (*a*) ceremonial washing and changing into white robes to symbolize not only mourning but that they themselves are dead; (*b*) the right arm, shoulder and breast, and also the left knee, are made bare; (*c*) the substitution of grass slippers for ordinary boots. Meanwhile the master opens and consecrates the lodge and invests his officers.

The third section deals with the actual admission of the candidates, who have to pass through three gates inside the lodge, and take the oath of blood brotherhood by mingling their blood with that of all members present in a cup of wine, from which each person present drinks. (Women as well as men are eligible.)

The last section consists of a catechism; the master asks a series of questions, which the conductor answers for the candidates. From these we learn that they have been on a long and mysterious journey, first by land and then by boat, till they reached the City of Willows. Throughout the whole of this part of the ceremony great stress is laid on numbers, which have a definite mystical significance. The triangle also plays an important part in the ritual, hence the name "Triad" Society. The brotherhood has many aliases, the most famous being "The Society of Heaven and Earth." The significance of the ceremony is revealed by the opening questions:

Master: Whence come you?
Vanguard: From the East.
Master: At what time?
Vanguard: At sunrise, when the East was light.

Bibliography.—There are only three really important books on the subject, and the two earlier have not the complete ritual. G. Schlegel, *Thian Ti Hwui; the Hung-League* (Batavia, 1866), out of print; W. Stanton, *The Triad Society; or, Heaven and Earth Association of Hong-Kong* (1900); J. S. M. Ward and W. G. Stirling, *The Hung Society* (1925–26). (J. S. M. W.)

SECULAR, a word with two main branches of meaning: (1) lasting or occurring for a long indefinite period of time (Lat. *saecularis,* of or belonging to an age or generation, *saeculum*), and (2) non-spiritual, having no concern with religious or spiritual matters. The first sense, which is directly taken from the classical Latin, is chiefly found in scientific applications, of processes or phenomena which are continued through the ages and are not regularly recurrent or periodical, *e.g.,* the secular cooling of the earth, secular change of the mean annual change of the temperature. The word is thus used widely of that which is lasting or permanent. In mediaeval and late Latin, *saecularis* was particularly used of that which belongs to this world, hence non-spiritual, lay, e.g., *vitam venturi saeculi* as contrasted with this present life; and the Church as opposed to the world. It is thus used, first to distinguish the "regular" or monastic clergy from those who were not bound by the rule (*regula*) of a religious order, the parish priests, the "seculars," who were living in the world, and secondly in the wide sense of anything which is distinct, opposed to, or not connected with religion or ecclesiastical things, temporal as opposed to spiritual or ecclesiastical. Thus property transferred or alienated from spiritual to temporal hands is said to be "secularized"; "secularism" (*q.v.*) is the term applied in general to the separation of state politics or administration from religious or church matters; "secular education" is a system of training from which definite religious teaching is excluded.

SECULAR GAMES were celebrated at Rome for three days and nights to mark the commencement of a new *saeculum* or generation. It is important to note that there was a *saeculum civile,* the length of which was definitely fixed at 100 years, and a *saeculum naturale,* which, under Greek and Etruscan influence, came to be accepted by the quindecimviri as 110 years. According to tradition, the secular games (*Ludi Saeculares,* originally *Terentini*) had their origin in certain sacrificial rites of the gens Valeria, which were performed at the Terentum, a volcanic cleft in the Campus Martius. According to the Roman antiquarians themselves, they were derived from the Etruscans, who, at the end of a mean period of 100 years (as representing the longest human life in a generation), presented to the chthonian deities an expiatory offering on behalf of the coming generation. The first definitely attested celebration of the games took place in 249 B.C., on which occasion a vow was made that they should be repeated every 100th year (their name being also changed to *Saeculares*), a regulation which seems to have been immediately disregarded, for they were next held in 146 (not 149, although the authorities are not unanimous); in 49 the civil wars prevented any celebration. They would probably have fallen entirely into oblivion, had not Augustus revived them in 17 B.C., for which occasion the *Carmen Saeculare* was composed by Horace. In explanation of the selection of this year, it is supposed that the quindecimviri invented celebrations for the years 456, 346, 236, 126, the *saeculum* being taken as lasting 110 years.

In later times various modes of reckoning were adopted. The dates were: A.D. 47 (under Claudius), celebrating the 800th year of the foundation of the city; 88 (under Domitian), an interval of only 105 instead of 110 years; 147 (under Antoninus Pius), the 900th year of the city; 204 (under Septimius Severus), exactly two *saecula* (220 years) after the Augustan celebration; 248 (under Philip the Arabian), the 1000th year of the city; 262 (under Gallienus), probably a special ceremony in time of calamity; in 304 (which should have been 314) Maximian intended to hold a celebration, but does not appear to have done so. From this time nothing more is heard of the secular games, until they were revived in the year 1300 as the papal jubilees instituted by Boniface VIII.

At the beginning of the harvest, heralds went round and summoned the people to the festival. The quindecimviri distributed to all free citizens on the Capitol and in the temple of Apollo on the Palatine various means of expiation—torches, sulphur and bitumen. Here and in the temple of Diana on the Aventine, wheat, barley, and beans were distributed, to serve as an offering of first-fruits. The festival then began, at which offerings were made to various deities. On the first night the emperor sacrificed three rams to the Parcae at an underground altar on the banks of the Tiber, while the people lighted torches and sang a special hymn. On the same or following nights, a black hog and a black pig were sacrificed to Tellus, and dark victims to Dis (Pluto) and Proserpine. On the first day white bulls and a white cow were offered to Jupiter and Juno on the Capitol, after which scenic games were held in honour of Apollo. On the second day noble matrons sang supplicatory hymns to Juno on the Capitol; on the third, white oxen were sacrificed to Apollo and 27 boys and maidens sang the "secular hymn" in Greek and Latin.

BIBLIOGRAPHY.—The above particulars are from Zosimus (ii. 5, and 6, which contain the Sibylline oracle), who, with Censorinus (*De Die Natali*, 17), Valerius Maximus ii. 4, and Horace (*Carmen Saeculare*) is the chief ancient authority on the subject; *see* also Mommsen, *Römische Chronologie* (1858); C. L. Roth, "Über die römischen Säcularspiele" in the *Rheinisches Museum*, viii. (1853); and Marquardt, *Römische Staatsverwaltung*, iii. (1885), p. 386. The inscription commemorating the *ludi* of 17 B.C. was discovered in 1890 and is printed in the *Ephemeris epigraphica*, vol. viii. The best account of the whole subject is in H. Diels, *Sibyllinische Blätter* (1890), p. 109 et seq.

SECULARISM, a term applied specially (*see* SECULAR) to the system of social ethics associated with the name of G. J. Holyoake (*q.v.*). As the word implies, secularism is based solely on considerations of practical morality with a view to the physical, social and moral improvement of society. It neither affirms nor denies the theistic premises of religion, and is thus a particular variety of utilitarianism. Holyoake founded a society in London which subsequently under the leadership of Charles Bradlaugh advocated the disestablishment of the Church, the abolition of the Second Chamber and other political and economic reforms.

See Holyoake's *Principles of Secularism* (1885).

SECUNDERABAD, one of the chief British military stations in India, situated in the state of Hyderabad, 1,830 ft. above sea-level, 6 m. N.E. of Hyderabad city and a junction on the Nizam's state railway. Pop. (1921) 9,515 (with Bolarum). It is the headquarters of an infantry brigade. Secunderabad includes Bolarum, the headquarters of a cavalry brigade, covering an area of 17 sq.m.

SECURITY. (The following article is an authoritative statement of M. Jules Cambon of the French point of view, which is the chief practical factor in the European controversy on this subject.) The question of security dominates contemporary politics. After a war which set the whole universe aflame, the nations have only one preoccupation, and that is to avoid its return. The history of the ten years after the war is only the history of efforts—more or less fortunate—to prevent this danger. Surprising it may well be that it should be so difficult for Governments to achieve the purpose though at one in their aim; and that they have been unable to reach an understanding as to methods. The truth is that though the nations desire to ensure their security, each one of them has its own particular view; and the word security does not represent to them all exactly the same thing. A Lorraine peasant, an English working man, the grandson of an emigrant in the far west of America, may be equally desirous of peace, but in their minds they do not conceive it in the same way; and the conditions for its realization are different in their eyes.

Different Aspects.—In continental Europe, where the nations have so often seen their fields ravaged by the enemy, and where the frontiers have been incessantly changed according to the fortunes of war, to ensure security means guaranteeing a country against invasion. But England, on the contrary, has suffered no invasion for centuries, and its territorial integrity cannot be brought into question. Security, therefore, in the eyes of the English people, is the certainty of a naval supremacy which alone can assure the feeding of the country and efficaciously protect its ties with the other parts of the Empire. As for the United States, two oceans protect them from any serious encroachment. Moreover, the vastness of the American continent, and the variety of its agricultural and mineral products, relieve them from every apprehension as to the subsistence of the population. They will never lack the primary resources and one imagines that the word "security" signifies to the citizen of the United States the protection of freedom of commerce, of industrial output, and of the country's economic power.

Thus, every nation has a different conception of security; and since nations, as a rule, live in a state of mutual misunderstanding of their essential needs, they readily accuse each other of imperialism, or of blind egoism. Their interests, however, are interwoven, and their community of interest grows with the progress of civilization. The result is that there is no such thing as separate security for any one State, and that no State is assured of living in peace, unless the general security is assured. Formerly it used to be said of the liberty of the individual, that its limit was the liberty of others. So, now, it may be said the safety of each nation is measured by the safety of the others.

The defensive necessities of each nation must, therefore, be compared in order to adjust them, in a general organization for peace, taking into consideration the geographical, the economic, and even the historical conditions of their national life. Some compromises are necessary, and those will entail certain sacrifices, but no agreement is possible amongst mankind without sacrifices. The courage of the statesman consists, precisely, in consenting to those compromises upon which, as Burke says, is founded the government of nations.

Some sophists, however, have tried to separate the question of disarmament from that of security; and this idea has been supported in the League of Nations. To adopt it would mean a deadlock. One cannot imagine England giving up the fleet which she considers necessary for maintaining her overseas communications; nor France—or any other Continental nation—ceasing to guard its territory against the danger of invasion. Doubtless, the possible help which other nations can bring to a country unjustly attacked, is a certain guarantee for that country; but human nature is weak and it may be feared that, at times, the promises undertaken in virtue of the Covenant of the League of Nations may be paralysed by the sudden success of an invader, confronting neutrals at once with an accomplished fact.

Moreover, Article 8 of the Covenant, in fixing the reduction of armaments at the minimum compatible with national safety, has coupled the two questions. Limitation of armaments and security are the two sides of one and the same problem. In reality, by limiting armaments, the wish is simply to spend less than has been spent upon intimidating the enemy. Everything can be bought in this world; the difficulty is to fix the price.

However that may be, and in spite of the deceptions sometimes suffered by statesmen who have sought to solve these problems, it must be recognized that, little by little, the question has ripened. At Geneva, the persevering efforts of the representatives of nearly all the nations have ended in certain results, which are the precursors of others. Despite national rivalries, the desire for peace is gaining strength. Any man, who, to-day, would dare to proclaim the idea of solving European difficulties by war, would be an anachronism, and a scandal.

ATTEMPTS TO SOLVE THE PROBLEM

In reality, that patriotic anxiety which gave birth to this problem of security goes back to 1919. The United States and England had rejected the suggestion of Clemenceau, who proposed to constitute an independent State, between Germany and France, on the left bank of the Rhine. Instead, these two Powers proposed to him a real alliance treaty. This treaty was signed, but the Washington Senate refused to ratify it, and with that, the undertakings which the British Government had made conjointly with the United States fell to the ground. President Wilson must have neglected to submit this treaty to the Senate at Washington. Only about a fortnight after that Assembly had been informed of the Treaty of Versailles, did Wilson communicate to them the Treaty of Alliance. It is possible that this negligence, at which the Senate took offence, may have been the cause of the trouble from which we are still suffering.

Mr. H. Cabot Lodge, chairman of the commission for foreign affairs in the Senate, wrote to Jules Cambon on the subject, on July 6, 1919:

"If there had been no League of Nations presented to the Senate, I think it might have been possible to ratify the triple agreement between France, England and the United States, but the League of Nations and the opposition to it in the Senate pushed everything else aside and in the contest which ensued and which resulted in the defeat of the treaty of Versailles, the traditional feeling, which is very strong in this country, against any treaties of alliance became constantly more intense. By overwhelming majorities such as had never been seen before in any election, the people of the United States declared not merely for the Republican candidate for President, but against the League of Nations, which was the leading issue in the campaign and discussed on every platform."

Negotiations between Great Britain and France.—The British Government, none the less, felt that France might justly be disturbed by the refusal of the American Senate and by its consequences. It seemed desirable to endeavour to attain by other means the object which was the aim of this treaty. It was thus that in 1921 negotiations were opened between Lloyd George, Lord Curzon and Briand, with a view to concluding a security pact which would reinforce the guarantees already offered by the League of Nations. Lloyd George suggested to France a close political and economic union, but he asked her to renounce the building of submarines and all tendency towards maritime rivalry. Briand, on his side, wanted the undertakings of the two Governments to be bilateral, and insisted on a military convention being concluded between the general staffs of the two countries. He consented to the meeting of a conference at Genoa where all the nations, even Soviet Russia, were represented; but disagreeing on some points with his own Government, he had to retire.

Poincaré, who succeeded him, revived the proposal for a military agreement between France and England, but it was soon apparent that the two Governments did not look at it from the same point of view. At the same time, Great Britain refused to conclude a defensive agreement with Belgium. Thus, the private "pourparlers" between the cabinets came to nothing. From that time on, it seemed as if the League of Nations alone was in a position to contrive a solution for the problem of security. We shall see that the League, too, came up against considerable difficulties.

The Temporary Mixed Commission.—Article 8 of the Covenant, to which we have referred, expressly charged the Council of the League of Nations with preparing plans for the reduction of armaments, which were to be submitted to the decision of the Governments; and Article 9 instituted a permanent technical Commission which was to give its advice upon military, naval and aerial questions. In 1921, the League of Nations, whose tendency is to multiply Commissions, asked its Council to constitute a new consulting body which would study, in their entirety, the political and economic questions raised by the study of the reduction of armaments. This new organization was presided over by M. Viviani. It was called the Temporary Mixed Commission, and existed up to the 1924 session of the League of Nations Assembly.

When this commission assembled, one of its members, Lord Esher, suggested fixing a unity of comparison for land forces, such as the Washington Conference had done for naval armaments. The committee considered that armies are not the same thing as fleets, nor are military effectives like warships: that the number of soldiers is not the only factor to consider in the military strength of nations. This latter could not be expressed by a mathematical formula which took no account of either economic power, or of industrial resources. The commission pointed out that by reason of the character of war between armed nations, each nation possessed, behind the visible front of its peace time armaments, potential war-waging capacity. These conclusions were submitted to the League of Nations Assembly which, in its 1921 session, proposed that its Council should proceed to an enquiry into the armaments of the different countries since 1913; it demanded precise details about the different war budgets, about the requirements of national security in every country, about its international obligations. Thus, by degrees, the complexity of the disarmament problem appeared. Lord Robert Cecil therefore, in the Temporary Commission itself, proposed to solve the problem in a very general way, by offering to all the Governments guarantees for the security of their countries, in return for their firm undertaking to reduce armaments. On the other hand, the Permanent Advisory Commission declared that all the guarantees would be inefficacious, unless a plan of defence were previously drawn up; and from that very point arose the question how can it be determined from which side comes the aggression. The mechanism of the mutual guarantee was in itself a subject of discussion. While Lord Robert Cecil contented himself with a general undertaking, the French delegate, M. de Jouvenel, showed more confidence in private treaties. It is a long time ago since Lord Chancellor Bacon said "a mean must be observed in every doctrine, and science, and in the rules and axioms thereof, between the rocks of distinctions and the whirlpools of universalities."

The third Assembly of the League of Nations (1922) adopted a celebrated resolution which is known by the name of "resolution XIV." and which, although trying to conciliate the themes under discussion, adopted, for the most part, the proposals of Lord Robert Cecil. It acknowledged that in the actual state of the world it was impossible for a great number of Governments to proceed to a serious reduction of armaments, if they had not sufficient guarantees for the security of their countries. These guarantees could be furnished by a defensive agreement open to all countries and resting upon a plan for defence previously drawn up. The Council of the League was to establish and submit to the different Governments the plan of political and military mechanism calculated to realize and assure this resolution.

Draft Treaty for Mutual Assistance.—In conformity with resolution XIV., a draft of a treaty for mutual assistance was submitted to the League of Nations Assembly in its fourth session (1923) by the Temporary Mixed Commission. M. Beneš, the Czechoslovakian delegate, was the "rapporteur." According to him, the proposed treaty constituted a solemn pact of non-aggression. It upheld the general assistance indicated by Lord Robert Cecil, but at the same time it contemplated particular defensive agreements, by which the signatory nations undertook to put into execution immediately, in case of aggression against one of them, the plan of assistance previously determined. As for the Council, it could immediately apply against the aggressor the sanctions provided by Article 16 of the Covenant; it could nominate the Powers whose assistance it would claim; determine the forces which each of them was to put at its disposal; appoint the commander-in-chief, and prepare a plan of financial co-operation between the States. Lastly, Beneš suggested that the Council should at once propose an armistice to the belligerents, specifying that the State which refused to accept it should be considered as the aggressor, and adding that the mutual assistance would only come into force after the States signatory to the treaty had reduced their armaments.

This draft of the treaty was communicated to the Powers, who made known their answer in 1924. Eighteen among them gave it their adhesion in principle, but on the whole, it was plain that it

would not be favourably received. The British Government especially, through Ramsay MacDonald, raised numerous objections. The guarantees suggested did not seem to him to imply strictly the reduction of armaments: the judicial guarantees, such as the acceptance of arbitration or the jurisdiction of the international court of justice, appeared to be left on one side; the particular agreements recalled the system of alliances; lastly, the rule of unanimity in the decisions of the Council would paralyse its action in determining the aggressor, and indefinitely delay its intervention. These criticisms carried great weight, and the projected treaty of mutual assistance was abandoned.

The Geneva Protocol.—When, in Sept. 1924, the League of Nations Assembly met, for the fifth time, it found itself therefore once more faced with a check. Nevertheless, some light resulted from the very objections which had been made to its previous decisions; it did not abandon the great object which it had in view—security and the limitation of armaments.

Ramsay MacDonald supported the cause of arbitration; he refused to consider anything beyond it. "Our interests," he said, "our interests for peace are far greater than our interests in creating a machinery of defence. A machinery of defence is easy to create but beware lest in creating it you destroy the chances of peace. The League of Nations has to advance the interests of peace. The world has to be habituated to our existence; the world has to be habituated to our influence; we have to embody into the world confidence in the order and rectitude of law, and then nations—with the League of Nations enjoying the authority, with the League of Nations looked up to, not because its arm is great but because its mind is calm and its nature just—can pursue their destinies with a feeling of perfect security, none daring to make them afraid." Ramsay MacDonald placed confidence in human nature. He forgot Pascal's words, that justice without force is powerless, that one must bring justice and force together, and so act that what is just may also be strong.

M. Herriot answered that arbitration was necessary, but that it was not sufficient; that it was a means and not an end. He added that the three terms—arbitration, security, disarmament—went together, but that they would be vain abstractions if they did not rest upon living realities.

Agreement was reached in the course of the session. On Oct. 2, the Assembly voted the Protocol of Geneva. While M. Politis, the Greek delegate presented to the Assembly the report upon arbitration, M. Beneš submitted to it his report on security and the reduction of armaments. In the event of aggression, all the signatories of the Protocol were loyally to apply the sanctions provided against the aggressor. As to the particular agreements, they could only come into play when the Council had addressed its behests to the signatory States. Lastly, as in the eyes of M. Beneš, there could be no arbitration and security without disarmament, nor disarmament without arbitration and security, the signatories of the Protocol were to take part in an international conference for the reduction of armaments, which was to meet June 25, 1925. On Oct. 3, the Assembly elected a committee charged with preparing the work of this conference.

In the midst of this, the British parliament was dissolved and another Government took the direction of affairs. The new secretary of State for foreign affairs, Austen (afterwards Sir Austen) Chamberlain, asked for the adjournment of the Disarmament Conference and on March 12, 1925, on the re-assembly of the Council of the League of Nations, he made it known that his Government rejected the Geneva Protocol, and gave the reasons for this.

While acknowledging the aspirations of the authors of this Protocol, it seemed to him that the responsibilities already assumed by the members of the League of Nations were gravely increased by it; the absence from the League of Nations of powerful economic Powers, such as the United States, was calculated to modify the point of view from which the authors of the Covenant had considered economic sanctions. Chamberlain added that it might be imprudent to forbid a State threatened by one of its neighbours from proceeding with defensive preparations. Especially from a naval point of view, it was impossible to force a Government to leave its ships dispersed in every ocean, as they may find themselves in time of peace. Lastly, the arrangements of the Protocol appeared to him too absolute; and he ended by suggesting the idea that the nations whose differences might cause the renewal of conflicts, should bind themselves by special agreements, conceived in the spirit of the Covenant and carried out in close harmony with the League of Nations.

This important communication was the subject of a general discussion; but this latest attempt of the League of Nations to assure the security of nations failed like its predecessors. M. Beneš was not discouraged: "There is no reason," he said from the tribune, "to be pessimistic; time is necessary to enterprises like these."

An examination of the successive proposals which the League of Nations had unavailingly adopted, shows that it was dominated by the memory of those days of 1914, which had preceded the war. It wanted to spare Europe fruitless efforts at negotiations such as those which at that time had broken against the uncompromising refusal of the Vienna cabinet to prolong the time allowed for Serbia's reply to the ultimatum; which also were unable to overcome the inertia of the Berlin chancellery obstinately declining the reiterated proposals of Sir Edward Grey. Moreover, it is plain that the absence of Germany from the League of Nations weighed in some measure on the assembly at Geneva, and that her attitude in the future was the principal concern of many.

It was noticed that Chamberlain, at the end of his communication to the Council, had suggested that special, purely defensive, agreements might be concluded by the interested Powers, whose differences were of such a nature as to give rise to fresh conflicts.

Negotiations Leading to Locarno.—Now, a new situation was created by a memorandum which Herr von Hoesch, the German ambassador in Paris, had remitted on Feb. 9, 1925 to M. Herriot, then minister for foreign affairs. The German Government proposed the conclusion of an agreement by which England, France, Italy and Germany herself, undertook—for a period of time to be determined—not to make war upon each other. Germany declared herself ready to conclude arbitration treaties with all the other Powers, and agreed to guarantee absolutely the *status quo* on the Rhine, as well as the demilitarization of the Rhine territories. The conclusion of such an agreement seemed to be the first step towards a world convention embracing all nations.

Herriot welcomed these suggestions, but he replied that it was necessary for him to inform his allies of them, and on May 12, following, Briand, who had succeeded Herriot at the Quai d'Orsay, communicated to Chamberlain his draft reply to Germany. Among other things, he expressed the opinion that the renouncing of war should not be limited to a period and that Belgium as a Power directly interested ought to be associated with this new pact. After a voluminous correspondence, Briand, in complete accord with Chamberlain, was able to reply on June 16 to Stresemann. In this reply, he emphasized the fact that the settlement of the question of security did not imply a modification of the Peace Treaties, and that the Allies, being members of the League of Nations, were bound by the Covenant which comprehended for them both rights and obligations. He concluded that an agreement with Germany could not be conceived unless Germany, enjoying the same rights, but assuming the same obligations, herself entered into this League.

It was agreed, after an exchange of notes, that the judicial experts appointed by the interested Powers, should examine the technical sides of the problem thus raised, and finally that the ministers for foreign affairs should meet on Oct. 5 in Switzerland, for the German ambassador had declared that in the interest of a good understanding, it was necessary to settle the points of difference that separated the Powers, before his country became a member of the League of Nations.

The Treaties of Locarno.—It was thus, that on Oct. 16, 1925, after a laborious conference lasting ten days, the celebrated Locarno agreements were initialled, whose text was definitely signed in London on Dec. 1 following. These agreements comprise a Treaty of Security between Germany, Belgium, France, Great Britain and Italy, and four Arbitrations Conventions

between Germany on the one hand, and Belgium, Poland and Czechoslovakia on the other.

By the Treaty of Security, the signatory Powers individually guarantee the maintenance of the territorial *status quo* between Germany, Belgium and France, as well as the observance of the Peace Treaty as far as the demilitarization of the Rhine is concerned. These three countries undertook never to have recourse to war, except in three cases: legitimate defence, the application of Article 16 of the Covenant, the appeal of the League of Nations in view of common action. In no circumstances whatever can this treaty be considered as a restriction of the mission of the League, the signatories having undertaken by a final Protocol to give their help to its work for disarmament.

It is, moreover, stipulated that in case of a conflict arising between Germany, Belgium and France and diplomacy failing to put an end to it, the question, if bearing on a disputed question of right, should be judicially determined; while questions of another kind should be dealt with by a Commission of Conciliation. Finally, if this latter course failed, the affair was to be settled by the Council of the League of Nations in conformity with Article 15 of the Covenant.

The four Arbitration Conventions between Germany, Belgium, France, Poland and Czechoslovakia stipulate that all points of dispute between them, before being submitted to arbitrators or to the Permanent Court of International Justice at The Hague, may be taken before a permanent Commission to be constituted in the three months following the coming into force of the treaty.

It is, moreover, specified that these treaties make no attack on the rights and obligations resulting from the Treaty of Versailles, and do not impose any obligation whatsoever, either on British India, or on the dominions of the British empire.

On Dec. 14, 1925, Sir Austen Chamberlain and M. Paul-Boncour laid on the table of the Council of the League of Nations, the Treaties of Locarno. The secretary of State for foreign affairs recalled the fact that the League of Nations had often remarked with what favour it would see the achievement of the efforts of certain nations to conclude Arbitration and Security Conventions, and that the Locarno Agreements were but the realization of this wish. Paul-Boncour read a telegram from Briand which stated that these conventions established new relations between their signatories, founded upon the respect of treaties and upon the rights of each.

Thus Germany re-entered the European Concert, as a party to a pacific agreement. Was a new order of things arising in Europe? If so, in order to make it lasting all the signatories to this agreement must show persevering good-will and fidelity to what has since been called "the Locarno spirit."

Preparatory Commission for Disarmament Conference.—The League of Nations, however, had been informed since Sept. 1925 of the negotiations which were to end at Locarno in the month of October following. Acting on the suggestion of the Spanish Delegate, Señor Quiñones de Léon, it had associated itself with them in anticipation, expressing the wish that these agreements might apply to the whole world. The Council carried out the resolution of the Assembly by constituting in Dec. 1925, a preparatory commission for a Disarmament Conference. At the same time, it drew up a list of the questions submitted to this commission, and instituted the preparation of a draft international agreement for the control of private manufacture of arms and munitions of war.

This preparatory commission has become an essential organ of the activity of the Council since it foreshadows the assembling of a Disarmament Conference in the relatively near future. It includes even representatives of States which are not members of the League of Nations, such as the United States and the Union of Soviet Republics. It has created two sub-committees, the one military, the other economic, and it assembled for the first time under the presidency of M. Loudon, the Netherlands delegate.

From the very beginning it encountered serious difficulties: sufficient to detail a few of the questions it had to solve in order to realize where it was. To begin with, it put the question, what is meant by the expression "armaments"? How is a limit to be fixed, and how may they be compared as between one country and another? Are some armaments offensive, others defensive? Can civil aviation be distinguished from military aviation? How are we to calculate the degree of security of a country in case of attack, so as to apply Article 16 of the Covenant, which calls upon the members of the League of Nations to give it their material support? This last question led the United States delegate to retire. He did not wish to take part in a debate of interest only to the members of the League of Nations.

On the other hand, the British delegates raised some objections, for they feared that Article 16 of the Covenant might lead back to solutions similar to those of the Protocol which Sir Austen Chamberlain had rejected in 1925. Finally, the German delegates also made certain reservations which they supported by diplomatic overtures in London and Paris; they wished to be heard by the Council, of which Germany was not yet a member. It must be allowed that the Convention which Germany had recently concluded with Soviet Russia, in virtue of which these two Powers had promised each other reciprocal neutrality, placed her in a peculiar situation from the point of view of the obligation of mutual assistance which the Covenant of the League of Nations imposes upon all its members.

However, such is the power of words that in the eyes of a certain number of delegates, a great many difficulties raised by the study of Article 16 of the Covenant regarding the measures to be taken in the event of aggression were removed by the initiative of the Belgian delegate M. de Brouckère, who proposed to substitute in its place the study of the application of Article 11 regarding the measures to be taken in the event of the threat of war.

The economic sanctions were also the cause of serious deliberations. The abstention of the United States, the greatest economic Power in the world, weighed heavily upon these negotiations; especially the proposal for a peaceful blockade of the aggressor State of a nature to awaken the susceptibilities of the American Government, always alert in matters of this kind.

As to the military measures, Briand and Chamberlain, faced with the difficulties of applying these, caused their examination to be deferred until the next Assembly of the League of Nations which was to meet in Sept. 1927.

When, at that date, at Geneva, the Assembly had to make decisions, it defined its ideas and took practical measures with a view to facilitating arbitration and the reduction of armaments. The *rapporteur*, M. de Brouckère—struck once more with the close tie existing between security and the limitation of armaments—declared plainly that it was useless to bring together the Disarmament Conference so long as the preparatory technical work was not finished. He proposed that the preparatory commission of this conference should name a committee of Arbitration and Security which should pursue its study parallel with the other preparatory body, and in close co-operation with it.

In the course of the discussions of the preparatory commission, the distinctive attitude of some of its members was noticed. The German delegates, through Count Bernstorff, insisted on the meeting of the Disarmament Conference to discuss only present conditions of security. That would have been to separate completely the two questions, contrary to the text of the Covenant, and to the obvious wish of the League of Nations. On the other hand, M. Litvinof and M. Lunacharski, of the Soviet Delegation, lodged a proposal aiming at the general and complete disarmament of all nations. They demanded the complete and immediate abolition of all military, naval and aerial forces, the destruction of fortresses and naval bases, the suppression of all military legislation, of all service—compulsory or voluntary—and the prohibition of all military education of the young.

The Arbitration and Security Committee.—The Arbitration and Security Committee, of which we spoke just now, met on Nov. 3, 1927. Beneš was made president, and Politis was charged with preparing a memorandum on security. The report was presented and discussed at the second meeting of the committee which took place at Geneva from Feb. 20 to March 7,

1928. Politis dismissed as at present unrealizable the idea of a general agreement, adding to the obligations of the Covenant, and recommended the conclusion of regional agreements (particular or collective) of non-aggression, of arbitration or of mutual assistance, or of non-aggression only. These regional pacts were always to include the renunciation of recourse to force, the organization of pacific procedure for the settlement of all differences, and the establishment of a system of mutual assistance consistent with the principles of the League of Nations. These pacts, in case of war, would enable the Council to name the aggressor, and to exercise the right of prescribing armistice. The connection between security and disarmament could be stipulated, and the Council of the League of Nations could co-ordinate the different regional pacts as between each other and in relation to the Covenant of the League.

After this report, a drafting committee was charged by the Arbitration and Security Committee with preparing a certain number of model treaties of conciliation, arbitration, non-aggression, and mutual assistance. M. Rolin-Jaequemyns, the Belgian delegate, was charged with reporting upon them to the third meeting of the committee which took place from June 27 to July 4, 1928. Certain delegates were led to make some reservations upon the conclusions submitted to them. It was thus that the Yugoslav delegate asked for the insertion of a clause directed against flagrant aggression, and the question of the territorial *status quo* was raised by the representative of Poland; but the most remarkable suggestions came from the German delegates. They demanded that in the event of international conflicts the measures to be taken by the Council of the League of Nations should be determined by a majority vote, and not by a unanimous vote. If there were danger of war, the German delegates proposed that the normal peace time military establishment should be re-established, and that if hostilities had broken out there should be an armistice and a withdrawal of the troops that had penetrated into foreign territory. These proposals were worthy of attention, but they could only be efficacious, if they were subject to rapid control and organized beforehand. That is what the French delegate, Paul-Boncour, demanded, and in so doing came into opposition with the Italian and Japanese delegates. Lord Cushendun, for his part, rejected in the name of the British Government the greater part of the German suggestions.

Nevertheless, Beneš succeeded in introducing enough harmony into the committee to allow Rolin-Jaequemyns to present his report. It was under these conditions that the work of the Arbitration and Security Committee was presented to the 9th Assembly of the League of Nations, which met at Geneva in the month of Sept. 1928.

The Kellogg Pact.—But before this meeting, a considerable event had taken place, which essentially concerns the problem of security—the signature of the general pact renouncing war, known by the name of the Kellogg Pact.

Is its origin understood? In April 1927, Briand, in a message addressed to the American people on the occasion of the tenth anniversary of the entry of the United States into the World War, had proposed to the Washington Government to subscribe publicly with the United States, to a mutual undertaking whose aim was to "outlaw war"—according to the American expression—between the two countries. Mr. Kellogg, secretary of State, welcomed this suggestion favourably, but it seemed to him that the pact would have more authority if, instead of being concluded only between the United States and France, it bore the signatures of all the Great Powers. There was an exchange of correspondence on the subject between Kellogg and Briand and especially about the fact that the French minister employed the term "war of aggression," and by that desired to reserve the right of legitimate defence, whilst the American secretary of State preferred to speak of war, simply and generally. On April 13, 1928, the Government of the United States communicated its scheme to Great Britain, Germany, Italy and Japan, and on the 30th of the same month the French Government transmitted its own. It was agreed that the projected pact, if it were realized, should not in any way restrict the right of legitimate defence, that if one of the signatories were to violate the undertakings, all the others should be released from theirs with regard to that signatory, and that the respect of obligations under the Covenant of the League and the Treaty of Locarno should remain the fundamental law of the States which had signed these diplomatic documents. Finally, Sir Austen Chamberlain, on May 19, was careful to make a reservation—which the Government that makes the Monroe Doctrine a cardinal point of its foreign policy could not reject. He drew attention to the fact that there exist certain parts of the world whose welfare and safety present a special and vital interest for the British empire, and that no outside intervention whatsoever could be tolerated.

On Aug. 27, 1928, the general Pact renouncing war was signed in Paris. As Briand, who presided at the signing, pointed out, this pact was lacking in sanctions. In that, it complied with the wish of the American Government to reserve in every case the liberty of its decisions, but it was none the less the recognition of the interdependence of nations upon each other, and at a time when public opinion rules the world, it constituted a moral and preventive sanction against Governments who might tend towards a wish to resort to force.

9th Session of the Assembly of the League.—It was under these conditions that the ninth session of the Assembly of the League of Nations opened in Sept. 1928.

The discussions which took place showed how fortunate it was that the Powers had reached agreement some days previously when signing the Pact renouncing war. The questions of disarmament and security occupied an important place in the deliberations and one felt this time that the hour of idealism had passed. No longer was that sort of sentimentality displayed which in the early sessions of the Assembly coloured the language of the delegates in an attempt at union more apparent than real. Perhaps one must attribute this to the presence of the German delegates. The Chancellor, Herr Muller, who replaced Herr Stresemann, requested that everyone should make a great effort for sincerity. Briand did not fail to reply to this suggestion, and drew attention pointedly to the disturbing possibilities concealed by German military organization.

Beneš presented to the Assembly the conclusions of the aforementioned Arbitration and Security Committee. They encountered on the part of the German, Hungarian and Austrian delegates an opposition which showed the persistence of the unity between these erstwhile allies. The projected treaties of non-aggression and mutual assistance were voted with insignificant amendments, in spite of the criticism which they raised, notably on the part of Poland, who on account of the insufficiency of the guarantees which she discovered in them would only consider the insufficiency of her actual armaments. At last, Paul-Boncour, with the support of Politis, pointed out that the Committee of Security had only accomplished one part of its task. It was therefore decided that this committee as well as the Preparatory Commission should proceed with their work in such a way as to allow a progressive reduction of armaments in proportion to the development of the conditions of security. This is a decision not to be overlooked, at a time when the Council of the League of Nations tends more and more to bring into political disputes the intervention of the technical organizations of the League.

Such is the actual state of the question of security. It is plain that whatever efforts the League of Nations may make for ensuring the benefits of peace to the world, nations can only enjoy it if they bring equal goodwill into their relations with each other. We must condemn the passion with which certain people in all countries try to excite distrust in public opinion and suspicion of the purest intentions. (J. Cn.)

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SEDAINE, MICHEL JEAN (1719–1797), French dramatist, was born at Paris on July 4, 1719. His father, who was an architect, died when Sedaine was quite young, leaving no fortune, and the boy began life as a mason's labourer. He was later taken as pupil by an architect whose kindness he eventually repaid by the help he was able to give to his benefactor's grandson, the painter David. Meanwhile he had done his best to repair his deficiencies of education, and in 1750 he published a *Recueil de pièces fugitives,* which included fables, songs and pastorals. His especial talent was, however, for light opera. He produced *Le Diable à quatre* (1756), the music being by several composers; *Blaise le Savetier* (1759), for the music of Danican Philidor; *On ne s'avise jamais de tout* (1761) and others with Pierre de Monsigny; *Aucassin et Nicollet* (1780), *Richard Coeur de Lion* (1784), and *Amphitryon* (1788) with André Grétry.

Sedaine's vaudevilles and operettas attracted the attention of Diderot, and two plays of his were accepted and performed at the *Théâtre Français.* The first and longest, the *Philosophe sans le savoir,* was acted in 1765; the second, a lively one-act piece, *La Gageure imprévue* in 1768. These two at once took their place as stock pieces. Except these two pieces little or nothing of his has kept the stage or the shelves, but Sedaine may be regarded as the literary ancestor of Scribe and Dumas. He had the practical knowledge of the theatre, which enabled him to carry out the ideas of Diderot and gave him claims to be regarded as the real founder of the domestic drama in France. Sedaine, who became a member of the Academy (1786), died at Paris on May 17, 1797. He wrote two historical dramas, *Raymond V. comte de Toulouse,* and *Maillard, ou Paris sauvé.*

His *Oeuvres* (1826) contain a notice of his life by Ducis.

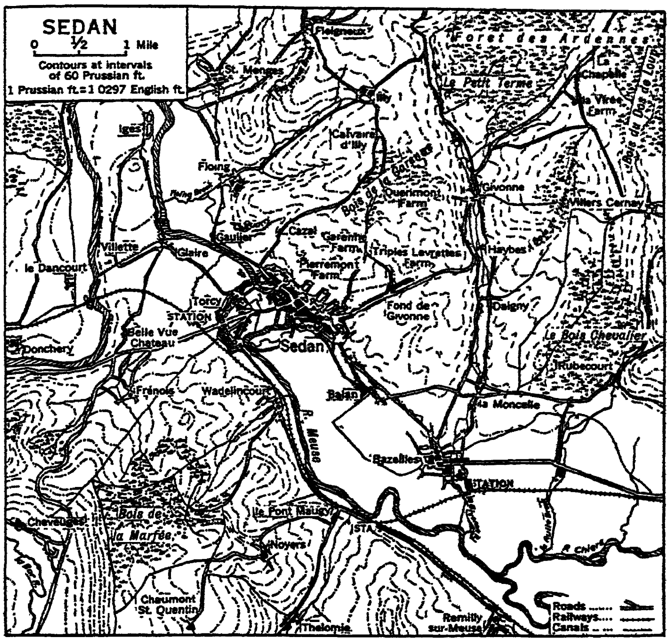
SEDALIA, a city of Missouri, U.S.A., 85 m. S.E. of Kansas City, on Federal highways 50 and 65, and served by the Missouri-Kansas-Texas and the Missouri Pacific railways. Pop. (1920) 21,144 (87% native white and 10% negroes); and 20,806 in 1930 by the Federal census. The city has a pleasant site of 1,440 ac. on a rolling prairie, 910 ft. above sea-level, and is laid out in an exact square. Industries include railroad shops, flour-mills, ice and poultry-packing plants and factories making mattresses, fixtures and clothing. Sedalia was founded in 1858, and in 1864 was chosen as the county seat in place of Georgetown. Throughout the Civil War it was a Union post, except for one day (Oct. 15, 1864) when it was occupied by a detachment from Sterling Price's raiding column. The city was chartered in 1889.

SEDAN, a town of northern France, in the department of Ardennes, on the right bank of the Meuse, 12 m. E.S.E. of Mézières by rail. Pop. (1926) 16,300. Sedan was in the 14th century a dependency of the abbey of Mouzon, the possession of which was disputed by the bishops of Liége and Reims. United to the crown of France by Charles V., it was ceded by Charles VI. to Guillaume de Braquemont, whose son sold it to his brother-in-law Evrard de la Marck, whose family for two centuries continued masters of the place, and Henri Robert adopted the title "prince of Sedan." In the 16th century Protestant refugees laid the basis of its industrial prosperity, and it became the seat of a Protestant seminary. Robert I. de la Marck (d. 1489) was lord of Sedan when he acquired Bouillon. His grandson, Robert III., seigneur of Fleurange and Sedan (d. 1537), was marshal of France. Robert IV. de la Marck (d. 1556), also marshal of France, erected Sedan on his own authority into an independent principality. By the marriage of his granddaughter Charlotte with Henry I. de la Tour d'Auvergne, the duchy of Bouillon and the principality of Sedan passed to the house of Turenne. When the new duke attempted to maintain his independence, Henry IV. captured Sedan in three days; and the second duke Frédéric Maurice de la Tour d'Auvergne, was obliged to surrender his principality. Sedan thus became part of the royal domain in 1642. On Sept. 1, 1870 the fortress was the centre of the most disastrous conflict of the Franco-German War (*see* below). On the left bank stands the suburb of Torcy. There are remains of a castle of the 15th century. Sedan has a municipal school of weaving. The chief industries are the manufacture of woollen goods and of machinery. (X.)

Battle of Sedan (Sept. 1, 1870).—During the course of Aug. 31 (*see* FRANCO-GERMAN WAR) the retreating French army (I., V., VII., and XII. corps) under Marshal MacMahon assembled in and around Sedan, watched throughout the day by the German cavalry but not severely pushed by them. Sedan is a small old-fashioned fortress, lying in a depression between two ridges which converge in the plateau of Illy about 2½ m. N.E. of the town. The only part which its defences played, or might have played, in the ensuing battle lay in the strategic possibilities contained in the fine and roomy bridge-head of Torcy, covering an elbow bend of the Meuse whence the whole French army might have been hurled into the gap between the German III. and Meuse armies, had there been a Napoleon to conceive and to execute this plan. But MacMahon seems to have been too despondent to contemplate anything further than a battle for the honour of the army, and though communications with Mézières, where Vinoy's corps (XIII.) was gathering, lay open throughout the day, he neither sent orders nor made arrangements for the disposition of his forces to meet the coming danger.

The troops received food and ammunition, the disorders consequent on the successive days' fighting in retreat were remedied,

and the men themselves got what they needed most of all, an almost unbroken day's rest. Locally their position was strong, particularly to the east, where the stream flowing through the Fond du Givonne, though fordable, presented a serious tactical obstacle. But as a whole it was far too cramped for the numbers crowded into it; it could be completely overlooked from the heights of Frénois, where the king of Prussia's headquarters took



their stand, and whence in the afternoon the German artillery fire began to cross over the town itself. At nightfall on the 31st the leading German infantry were approaching. The Army of the Meuse was on the right bank of the river, with the II. Bavarians moving towards Bazeilles to reinforce it, while the III. Army was heading for Donchéry to cut off the French from Mézières, and only a weak cavalry screen closed the gap between them.

During the night of August 31 the Bavarians threw a pontoon bridge across the Meuse below Rémilly, and soon after daybreak, in a fog which lay thickly over the whole country, they began their advance towards Bazeilles, held by Vassoigne's division. The firing called all troops within reach of the sound to arms, and before 5 A.M. the Meuse Army was marching to the battle-field, the Guards on the northern road via Villers-Arnay, the Saxons and IVth corps to the south along the river.

Vassoigne's division contained a number of Marine battalions, and their stubborn resistance completely disconcerted the Bavarians. Deprived of all artillery co-operation owing to the fog, the latter spent themselves in fruitless and disconnected efforts in the gardens and streets of the village. About 6 A.M. the fog lifted, and the German batteries at once intervened. One of the first shells wounded Marshal MacMahon. The next senior officer, General Ducrot, at once assumed command (7 A.M.). But it happened that General Wimpffen, who had only joined the army from Algiers on the night of the 30th, brought with him a secret commission to assume command in the event of the death or disablement of MacMahon. Of this power he did not at first avail himself, since he was a stranger both to the army and the country, whilst Ducrot possessed the confidence of the one and a knowledge of the other. But when about 9 A.M. he learnt that Ducrot proposed to move the whole army under cover of rearguards to the west towards Mézières, he produced his commission and countermanded the movement, being himself convinced that eastward towards Bazaine at Metz lay the road to salvation. Orders once issued on a battle-field are not easily recalled, and the result of this change of command was dire confusion. The French troops northward of Bazeilles, along the Fond du Givonne, were already commencing their withdrawal, when the leading troops of the Saxon XII. corps began to arrive about Daigny, and being only opposed by a weak rearguard, easily carried the ridge south of the Givonne-Sedan road, thus threatening the retreat of Vassoigne's division in and about Bazeilles, which then fell into the hands of the Bavarians between 10 and 11 A.M. At the same moment the Guard corps had begun to form up between Daigny and Givonne, and there being no serious force of the enemy in front of them, the artillery was deploying along the western heights above the valley of Givonne, covered only by weak advanced guards of infantry, when suddenly a great column of French infantry, some 6,000 strong, moving west in pursuance of Wimpffen's orders, came over the eastern border of the valley and charged down at full speed towards the guns. Then followed one of the most dramatic spectacles of the entire war. The whole of the corps artillery of the Guard turned upon these devoted men, and tore the column in half, shrouding it in dense clouds of dust and smoke from the bursting shells, above which could be seen the trunks and limbs of men flung upwards by their explosion. The head of the column nevertheless kept on its way, but under the combined fire of the Guard rifle battalion and the flanking fire from other guns its impetus died out and its débris disappeared by degrees under convenient cover. The German Guards were now free to stretch out their right towards the Belgian frontier (where the scouts of the III. Army were already moving) and prepare with all deliberation for the attack on the Bois de la Garenne.

The III. Army had moved off as early as 2.30 A.M., and by 4 A.M. was already crossing the Meuse at Donchéry, aided by several pontoon and trestle bridges thrown over during the night. Their right was covered from sight by the peninsula formed by a bend of the river, and the march of the several columns was unopposed till, clearing its northern extremity, they began to deploy to their right between St. Menges and Floing. Here they encountered French outposts, which fell back on their main position on the ridge, to the south of the Floing-Illy road. Against this position the German artillery now pressed forward, and seeing their exposed position, General Gallifet brought forward his brigade of Chasseurs d'Afrique and delivered a most dashing charge. But being unsupported he was compelled to withdraw again behind the cover of the Cazal-Illy ridge.

It was now about 11 A.M., and, whether moved by the belated impulse of Ducrot's orders or attracted by the apparent weakness of the Prussians within sight, the French infantry now made a brilliant counter-attack out of their position in their usual manner. But German reinforcements coming suddenly into view, and their *élan* having spent itself, they fell back again to their former position.

About noon Wimpffen rode up to General Douay and asked him whether he could hold on to his position. The latter, possibly elated by the success of his recent attack, replied in the affirmative, pointing out only the importance of maintaining the Calvaire d'Illy to the north. Wimpffen promised him support from the I. corps on the right rear, part of which, hidden in the Bois de la Garenne, had as yet been little engaged, and then rode south to Balan, where he found the XII. corps fighting desperately. He then sent back to Douay for reinforcements, and the latter despatched all he could spare. These, marching south, crossed the troops of the I. corps sent to Douay's assistance. The Prussian shells were already crashing into the woods from all sides, and countless stragglers and riderless horses caused most serious delay. To gain time, Margueritte's division was ordered to charge. Margueritte was killed as he rode forward to reconnoitre, and Gallifet took command. "For the next half-hour," says the Prussian official account, "the scene defies description. Gallifet and his squadrons covered themselves with glory, but he had not 2,000 sabres at his disposal. Under the storm of shell and over the broken ground manoeuvring was impossible." It was not until about an hour after this series of cavalry charges that, between 3 and 4 P.M., the Germans at length gathered weight enough to attempt the assault of the French main position, and moved by a common instinct, lines of men almost 2 m. in extent, pressed on, gaining cover from the convex slope of the hill, till at length they

ration of ice or a melting out in sea-water, for it usually consists of a non-bedded heterogeneous mixture of coarse boulders, pebbles, sand and fine clay.

Under the action of the wind, sand grains become well rounded and "frosted," because the lubricating action of water is absent. Sorting is usually well-marked, and silt and dust are carried far beyond the area of sand-deposition (of which the dune is a characteristic form). By this means fine terrigenous material becomes incorporated with sediments of even deep-water type. Where, in late glacial times, the wind has played upon areas of boulder clay, it has brought about the deposit of an extra-glacial belt of a sandy clay called loess which almost encircles the earth, in about latitude 40–45° N. Indurated boulder-clays or tillites occur in deposits of Cretaceous, late Carboniferous, Cambrian and Pre-Cambrian age (although some are disputed) in various parts of the world. They are often associated with kame-like gravels and varved shales.

The term "facies" has been used to connote the sum-total of the features which characterize any particular sedimentary rock. Thus we may have a sandy facies or a coaly facies, depending on the constitution; a lagoon facies or a reef-facies, from a geographical or community standpoint; or a graptolite-facies or brachiopod facies according to the dominant life.

Apart from physical changes such as consolidation under renewed deposition, and drying, sedimentary rocks may undergo chemical and other changes during their formation on the sea-floor, or but slightly subsequent to it (penecontemporaneous changes). Coral reefs or other limestones may be dolomitized by partial replacement by magnesia from warm sea-water. (*See* DOLOMITE.) While flint and chert may be in part deposited directly by chemical or organic action, they doubtless also represent in part a penecontemporaneous or subsequent segregation of silica in limestones and replacement of calcareous material. Before consolidation, clays and coals enclose large quantities of water, often saturated with carbonate of lime, iron, etc. By rapid segregation and crystallization of the latter substances, masses of septaria or cement-stone are formed in the clay, but where the action is slower and proceeds from many centres, beds may be formed consisting almost wholly of "spherulites" of spheroidal form and radiating structure. Where anaerobic bacteria are present, large quantities of iron (ferrous) sulphide may be formed throughout the clay, giving it a black colour, but not necessarily inhibiting other life. Subsequent segregation of this material yields nodules of pyrite or marcasite.

For additional information *see* ALLUVIUM, BRECCIA, CLAY, COAL, CONGLOMERATE, FLINT, LIMESTONE, MARL, OCEANOGRAPHY, SAND, SANDSTONE, etc. (P. G. H. B.)

SEDITION, in law, an attempt to disturb the tranquillity of the State. In English law it is a very elastic term, including offences ranging from libel to treason (*q.v.*). It is rarely used except in its adjectival form, *e.g.*, seditious libel, seditious meeting or seditious conspiracy. Sedition is a common law indictable misdemeanour, and embraces everything whether by word, deed or writing which is calculated to disturb the tranquillity of the State, and lead ignorant persons to endeavour to subvert the Government and laws of the empire.

The principal enactments now in force dealing with seditious offences were all passed during the last 25 years of the reign of George III. They are the Unlawful Oaths Act 1797, prohibiting the administering or taking of unlawful oaths (*see* OATH) or the belonging to an unlawful confederacy; the Unlawful Drilling Act 1819, which prohibited unlawful drilling and military exercises; and the Acts for the suppression of corresponding societies, the Unlawful Societies Act 1799 and the Seditious Meetings Act 1817. No proceedings can be instituted under these last two Acts without the authority of the law officers of the Crown. By the Prison Act 1877, any prisoner under sentence for sedition or seditious libel is to be treated as a misdemeanant of the first division.

In the United States, Congress has passed sedition acts for the supposed protection of the Government. The Alien and Sedition laws passed during the administration of President Adams were partly responsible for the defeat of the Federalist party. During the World War, Congress passed with the approval of President Wilson sedition measures for the purposes of minimizing domestic opposition to the war.

SEDLEY, SIR CHARLES (*c.* 1639–1701), English wit and dramatist, was born about 1639, and was the son of Sir John Sedley of Aylesford in Kent. He was educated at Wadham College, Oxford. The college was then under the direction of John Wilkins, whose other pupils included Rochester and Car Scroop. Sedley is famous as a patron of literature in the Restoration period, and was the "Lisideius" of Dryden's *Essay of Dramatic Poesy.* His most famous song is "Phyllis is my only joy." His first comedy, *The Mulberry Garden* (1668), hardly sustains Sedley's contemporary reputation for wit in conversation. The best of his comedies is *Bellamira; or The Mistress* (1687), an imitation of the *Eunuchus* of Terence, in which the heroine is supposed to represent the duchess of Cleveland, the mistress of Charles II. His two tragedies, *Antony and Cleopatra* (1667) and *The Tyrant King of Crete* (1702), an adaptation of Henry Killigrew's *Pallantus and Eudora,* have little merit. He also produced *The Grumbler* (1702), an adaptation of *Le Grondeur* of Brueys and Palaprat.

An indecent frolic in Bow Street, for which he was heavily fined, made Sedley notorious. He was member of parliament for New Romney in Kent. His *bon mot* at the expense of James II. is well known. The king had seduced his daughter, Catherine (*c.* 1657–1717), and created her countess of Dorchester, whereupon Sedley remarked that he hated ingratitude, and, as the king had made his daughter a countess, he would endeavour to make the king's daughter a queen. He died on Aug. 20, 1701.

See *The Works of Sir Charles Sedley in Prose and Verse* (1778), with a slight notice of the author; and V. de Sola Pinto, *Sir Charles Sedley 1639–1701: A Study in the Life and Literature of the Restoration* (1927).

SEDUCTION, a term generally used in the special sense of wrongfully inducing a woman to consent to sexual intercourse. The action for seduction of an unmarried woman in England stands in a somewhat anomalous position. The woman seduced has herself no right of action, for she must have given her consent to the connection, and *volenti non fit injuria.* The foundation of the action is the relationship of master and servant, and the plaintiff in order to succeed must prove that the woman seduced was at the time of the seduction in his service, actual or constructive, and that he has lost her services by reason of her confinement and illness (*Peters* v. *Jones,* 1914, 2 K.B. 781). A father may maintain the action in respect of a daughter who is under 21 years of age and living with him, without proof of any actual services rendered, for he has a right to the services of his daughter, so that she is constructively in his service (*Terry* v. *Hutchinson,* 1868, L.R. 3 Q.B. 599). But if the daughter is over 21 years of age, the father must give evidence of actual services rendered by the daughter, although such slight services as making tea, or looking after children are sufficient evidence of service to support the action (*Bennett* v. *Allen,* 1787, 2 T.R. 166). On the other hand, if the girl is not living at home but was in the service of a third person, only that third person can sue, since the loss of service falls on him (*Carr* v. *Clarke,* 1818, 2 Chitty 260). In such a case the mere fact that the girl comes home at intervals and on such occasions does some of the household work does not create the relationship of master and servant between her father and herself so as to enable the father to maintain an action (*Williams* v. *Whitbourne,* 1901, 2 K.B. 722). Where the girl was at the time of the seduction in the service of the seducer himself no action is maintainable, unless the hiring was merely a pretence and contrivance for the purpose of seduction (*Speight* v. *Oliveira,* 1819, 2 Stark, 493).

The relationship of master and servant must have existed at the time of seduction and also at the time of the illness consequent upon it that deprives the plaintiff of the girl's services. Thus where a girl was in service as a governess and was seduced by the defendant whilst on a four days' visit, with her employer's permission, to her widowed mother, but at the time of her confinement was in the service of another employer, it was held that no action lay

(*Hedges* v. *Tagg*, 1872, L.J. Ex. 169). Similarly where a girl was seduced whilst living at home with her father and mother, but the father died before her confinement, it was held that the widowed mother, to whom she rendered ordinary household duties after her father's death, could not maintain an action, as the girl was not in her service at the time of the seduction but in that of the father (*Hamilton* v. *Long*, 1903, 2 Ir.R. 407; affirmed, 1905, 2 Ir.R. 252).

Although the action is nominally for loss of service, the plaintiff can, if a parent, recover in addition to the actual loss sustained damages for distress and anxiety of mind (*Andrews* v. *Askey*, 1837, 8 C. and P. 7), for the loss of the society of the daughter seduced, and for the dishonour which he receives (*Bedford* v. *McKowl*, 1800, 3 Esp. 119). But where the action is not brought by a parent, the plaintiff can only recover the actual pecuniary loss which he has sustained (*McKenzie* v. *Hardinge*, 1906, 23 T.L.R. 15).

The defendant can, in mitigation of damages, give evidence as to the general loose character of the girl (*Carpenter* v. *Wall*, 1840, 11 A. and E. 803), and also call witnesses to prove that they have had sexual intercourse with the girl previously to the seduction (*Verry* v. *Watkins*, 1836, 7 C. and P. 308).

As to seduction of a married woman, the old action for criminal conversation was abolished in England, but in Ireland, by the Divorce Act 1857 which substituted for it a claim for damages against the co-respondent in a divorce suit; but if a married woman were living apart from her husband in her father's house, and giving her services to her father in the slightest degree, an action for seduction would lie. Seduction in England is not as a rule a criminal offence. But a conspiracy to seduce a woman is indictable at common law. And the Criminal Law Amendment Act 1885 (which extends to the United Kingdom) makes it a felony to seduce a girl under the age of 13, and a misdemeanour to seduce a girl between 13 and 16 (ss. 4, 5). The same act also deals severely with the cognate offences of procuration, abduction and unlawful detention of a girl or woman with intent that she should be carnally known by any man (ss. 2, 7, 8). The Children Act 1908 gives a further protection to young people, enacting that if any person having the custody, charge or care of a girl under the age of 16 causes or encourages the seduction of that girl, he shall be guilty of a misdemeanour, and be liable to imprisonment, with or without hard labour, for a term not exceeding two years (s. 17).

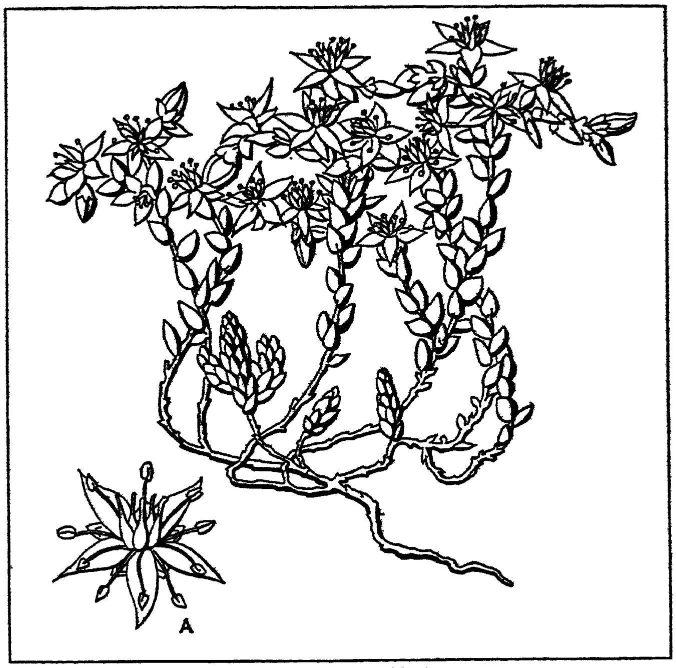
Scotland.—In Scotland the seduced woman may herself maintain an action, but only if some species of fraud or deceit was practised on her, *e.g.*, if her consent to the connection was induced by a promise of marriage, or by a profession of honourable love leading her to expect marriage. Indeed, if a man, by an abuse of the confidence resulting from his position as master, and by the exercise of dominating influence, has induced a girl in his service to allow him to have connection with her, or by gradually debauching the mind of the girl and by continued solicitations, has overcome her resistance to the act of intercourse, an action of seduction will lie at her suit, though marriage was not thought of.

United States.—In the United States the common law tort of seduction exists, but by statute the woman, if previously of chaste character, is usually given a right of action in her own name. The element of the offence is the accomplishment of the seduction by deceit or false promises, illicit intercourse by itself being insufficient. Most States also make seduction a criminal offence, some, however, limiting the crime to cases where the seduction is accomplished by false promises of marriage. Previous chaste character is an essential element of the crime. Subsequent marriage of the parties is generally a defence to both civil and criminal actions. The seduction of married women is covered by the maintenance of an action for criminal conversation or, where abolished, for the alienation of affections. Illicit intercourse unaccompanied by false artifices may constitute the statutory crimes of fornication or adultery.

SEDULIUS, Coelius or Caelius (a praenomen of doubtful authenticity), a Christian poet of the first half of the 5th century, is termed a presbyter by Isidore of Seville and in the Gelasian decree. He must not be confused with Sedulius the Irish-Scot grammarian of the 9th century. His fame rests mainly upon a long poem, *Carmen paschale*, based on the four gospels.

Sedulius's works were edited by F. Arevalo (Rome, 1794), reprinted in J. P. Migne's *Patrol. Lat.* vol. xix.; and finally by J. Huemer (Vienna, 1885). *See* J. Huemer, *De Sedulii poëtae vita et scriptis commentatio* (Vienna, 1878); M. Manitius, *Geschichte der christlich-lateinischen Poesie* (Stuttgart, 1891); Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. trans.), 473.

SEDUM, in botany, a genus of the family Crassulaceae, containing about 150 species, natives chiefly of the north temperate



BY COURTESY OF THE BRITISH MUSEUM (NATURAL HISTORY)
BITING STONECROP (SEDUM ACRE) SHOWING THE CREEPING STEMS WHICH BECOME PARTLY ERECT, (A) SINGLE FLOWER ENLARGED

and frigid regions, and mostly perennial herbs with succulent leaves of varied form, but never compound. The white or yellow, rarely pink or blue, flowers are usually small and grouped in cymes. They have a calyx of five sepals, as many petals, usually ten stamens and five distinct carpels, which have as many glands at their base and ripen into as many dry seed-pods. Several species are British, including some with tuberous roots and large leaves (*S. Telephium*), and others of smaller size, chiefly found on rocks, walls and dry banks; *S. acre* is stonecrop, well known also in gardens, a variety of which, *aureum*, is in cultivation with golden-yellow tips to the leaves and shoots. Upwards of 30 species are native to North America, widely distributed across the continent. In addition, the Old World *S. Telephium* and *S. acre* have become widely naturalized in the eastern States and Canada. Many species are cultivated for the beauty of their foliage or flowers, and many are remarkable for their vitality under adverse circumstances. They succeed on rockwork, old walls or as border plants; some, e.g., *S. Lydium*, a native of Asia Minor, are excellent for carpet bedding. *S. spectabile*, 1 to 1½ ft., with pink flowers in great cymose heads, is a fine plant for the borders.

SEE, a seat or throne, particularly the throne of a bishop, the *cathedra*, the symbol of his office and dignity, the placing of which in a church makes it a cathedral (*q.v.*). The term is thus applied to the place where the bishop's cathedral is situated and from which he properly takes his title, and so is to be distinguished from diocese (*q.v.*), the territorial province over which his jurisdiction extends (*see* Bishop).

SEEBOHM, FREDERICK (1833–1912), English historian, born at Bradford on Nov. 23, 1833, the son of a Quaker wool-merchant, was educated at the Bootham school, York, and read law in London. In 1856 he began to practise as a barrister, finally moving to Hitchin, where he became a partner in the bank of Sharples and company (amalgamated with Barclay and company in 1896). He played an active part in municipal affairs, was a

Poor Law guardian, justice of the peace, and member of the Hertfordshire County Council education committee. His interest in the social and religious problems of modern life led him to study the conditions of English rural life in the past, and the religious movements of the Reformation. In 1867 he published *The Oxford Reformers,* and in 1874 *The Era of the Protestant Revolution.* But Seebohm's best known and most valuable contributions to history were made in connection with the history of the village community, in his *The English Village Community* (1883); *The Tribal System in Wales* (1895); and *Tribal Custom in Anglo-Saxon Law* (1902). He argued that the open-field manorial system of villages had its basis in the Roman villa, in opposition to those who held that Roman civilization was practically wiped out from Roman Britain by the Teutonic invasions. Seebohm was working on another volume, *Customary Acres,* which was published posthumously in 1914, when he died at Hitchin on Feb. 6, 1912.

See the obituary of Seebohm in *The Collected Papers of Paul Vinogradoff* (1928).

SEECKT, HANS VON (1866–), German soldier, was born in Schleswig April 22, 1866. He entered the Kaiser Alexander Grenadier Regiment as ensign (fahnenjunker). In 1897 he was appointed to the general staff, becoming chief of staff of the III. Army Corps (Berlin) in 1913, in which capacity he went on active service in Aug. 1914, with the rank of lieutenant-colonel. On Jan. 27, 1915, he was promoted colonel, and soon after became chief of staff to Mackensen's army group. He had a large share in conducting the break-through of the Central Powers at Gorlice-Tárnow, May 1915, and the subsequent invasion of Serbia. After the collapse of the Monarchy he became adjutant-general (*Chef des Truppenamtes*) in the *Reichswehrministerium* (Nov. 1919). After the Kapp "putsch" of March 1920 he was appointed chief of the German Army Command. In Jan. 1926 he was again promoted to the rank of general by President von Hindenburg.

SEED. The seed is formed from the ovule as the result of fertilization (*q.v.*). It is contained in a seed vessel (*see* FRUIT)

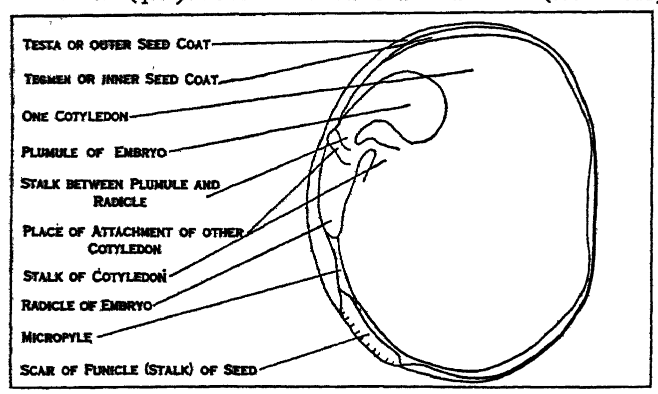


FIG. 1.—SEED OF PEA (PISUM SATIVUM) WITH ONE COTYLEDON REMOVED

formed from the ovaries in the plants called *angiospermous;* while in *gymnospermous* plants, such as Coniferae and Cycadaceae, it is naked, or, in other words, has no true pericarp. It sometimes happens in angiosperms, that the seed-vessel is ruptured at an early period of growth, so that the seeds become more or less exposed during their development; this occurs in mignonette, where the capsule opens at the apex, and in *Cuphea,* where the placenta bursts through the ovary and floral envelopes, and appears as an erect process bearing the young seeds. After fertilization the ovule is greatly changed as a result of the formation of the embryo. In the embryo-sac of most angiosperms (*q.v.*) there is a development of cellular tissue, the endosperm, more or less filling the embryo-sac. In gymnosperms (*q.v.*) the endosperm or embryo sac tissue is formed preparatory to fertilization. The fertilized egg enlarges and forms the embryo. The embryo-

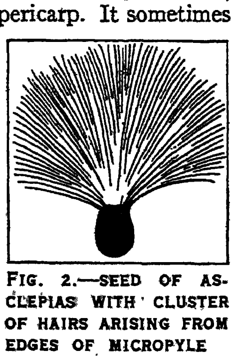


FIG. 2.—SEED OF ASCLEPIAS WITH CLUSTER OF HAIRS ARISING FROM EDGES OF MICROPYLE

sac enlarges greatly, displacing gradually the surrounding nucellus, which eventually forms merely a thin layer around the sac, or completely disappears. The remainder of the nucellus and the integuments of the ovules form the seed-coats. In some cases a delicate inner coat or *tegmen* can be distinguished from a tougher outer coat or *testa;* often, however, the layers are not thus separable. The consistency of the seed-coat, its thickness, the character of its surface, etc., vary widely, the variations being often closely associated with the means of seed-dispersal. An account of the development of the seed from the ovule will be found in the article ANGIOSPERMS. When the pericarp is dehiscent the seed-covering is of a strong and often rough character; but when the pericarp is indehiscent and encloses the seed for a long period, the outer seed-coat is thin and soft. The cells of the testa are often coloured, and have projections and appendages of various kinds. Thus in *Abrus precatorius,* it is a bright red; in French beans it is beautifully mottled; in *Asclepias* it has hairs attached to it; and in *Bignonia* and the pines and firs it is expanded in the form of wing-like appendages. In *Collomia* and other seeds, it contains spiral cells, from which, when moistened with water, the fibres uncoil in a beautiful manner; and in flax (*Linum*) and others the cells swell up and become mucilaginous. These structural peculiarities of the testa in different plants have relation to the scattering of the seed. But in some plants the pericarps subserve the same purpose; this especially occurs in small pericarps enclosing single seeds, as achenes, caryopsides, etc. Thus in Compositae, the pappose limb of the calyx forms a parachute to the pericarp; and the epicarp is prolonged as a wing in *Fraxinus* and *Acer.*

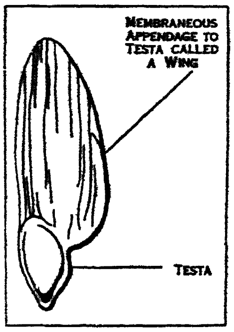


FIG. 3.—SEED OF PINE (PINUS)

Sometimes there is an additional covering to the seed, formed after fertilization, to which the name *arillus* has been given. This is seen in the passion-flower. In the nutmeg this additional coat constitutes a laciniated scarlet covering called *mace.* The fleshy

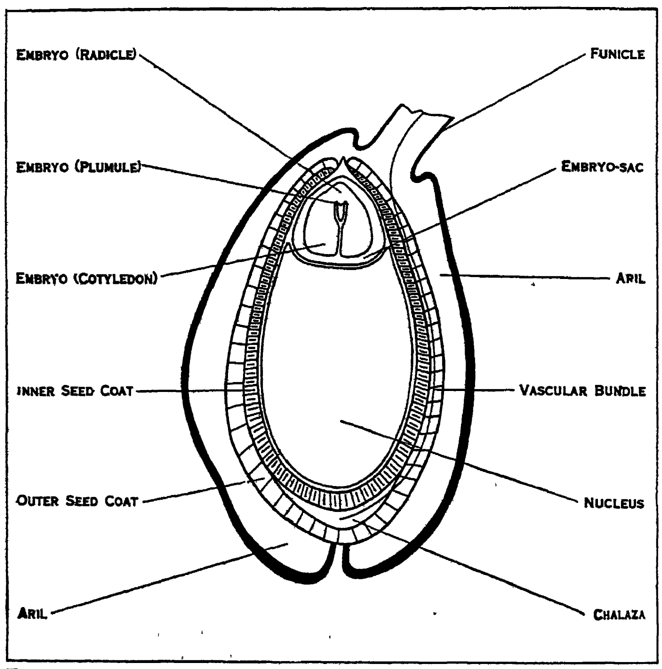


FIG. 4.—YOUNG ANATROPAL SEED OF THE WHITE WATER LILY (NYMPHAEA ALBA), CUT VERTICALLY

scarlet covering formed around the naked seed in the yew is by some considered of the nature of an aril. On the testa, at various points, there are produced at times other small outgrowths to which the name *caruncles* has been given. The funicles of the ovules frequently attain a great length in the seed, and in some magnolias, when the fruit dehisces, they appear as long scarlet

cords suspending the seeds. The hilum or umbilicus of the seed is usually well marked, as a scar of varying size; in the calabar bean it extends along a large portion of the edge of the seed; it frequently exhibits marked colours, being black in the bean, white in many species of *Phaseolus*, etc. The *micropyle* of the seed may be recognizable by the naked eye, as in the pea and bean tribe, etc., or it may be minute or microscopic. It indicates the true apex of the seed, and is important as marking the point to which the root of the embryo is directed. At the micropyle in the bean is observed a small process of integument, which, when the young plant sprouts, is pushed up like a lid. The chalaza is often of a different colour from the rest of the seed. In the orange it is reddish-brown, and is easily recognized at one end of the seed when the integuments are carefully removed.

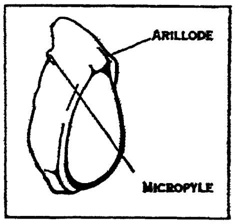


FIG. 5.—ARILLODE, OR FALSE ARIL, OF THE SPINDLE-TREE (EUONYMUS) ARISING FROM THE MICROPYLE

The position of the seed as regards the pericarp resembles that of the ovule in the ovary, and the same terms are applied—erect, ascending, pendulous, suspended, curved, etc. These terms have no reference to the mode in which the fruit is attached to the axis. Seeds exhibit great varieties of form. They may be flattened laterally (*compressed*), or from above downwards (*depressed*). They may be round, oval, triangular, polygonal, rolled up like a snail, as in *Physostemon*, or coiled up like a snake, as in *Ophiocaryon paradoxum*.

The endosperm formed in the embryo-sac of angiosperms after fertilization, and found previous to it in gymnosperms, consists of cells containing nitrogenous and starchy or oily material, destined for the nutriment of the embryo. It occupies the whole cavity of the embryo-sac, or is formed only at certain portions of it, at the apex, as in *Rhinanthus*, at the base, as in *Vaccinium*, or in the middle, as in *Veronica*. As the endosperm increases in size along with the embryo-sac and the embryo, the substance of the original nucellus of the ovule is gradually absorbed. Sometimes, however, as in Zingiberaceae, no endosperm is formed; the cells of the original nucellus, becoming filled with food-materials for the embryo, are not absorbed, but remain surrounding the embryo-sac with the embryo, and constitute the *perisperm*. Again, in other plants, as Nymphaeaceae, both endosperm and perisperm are present. There is a large class of plants in which although at first after fertilization a mass of endosperm is formed, yet, as the embryo increases in size, the nutrient matter from the endospermic cells passes out from them, and is absorbed by the cells of the embryo plant. In the mature seed, in such cases, there is no separate mass of tissue containing nutrient food-material apart from the embryo itself. Such a seed is said to be *exalbuminous*, as in most Leguminosae. When either endosperm or perisperm or both are present the seed is said to be *albuminous*.

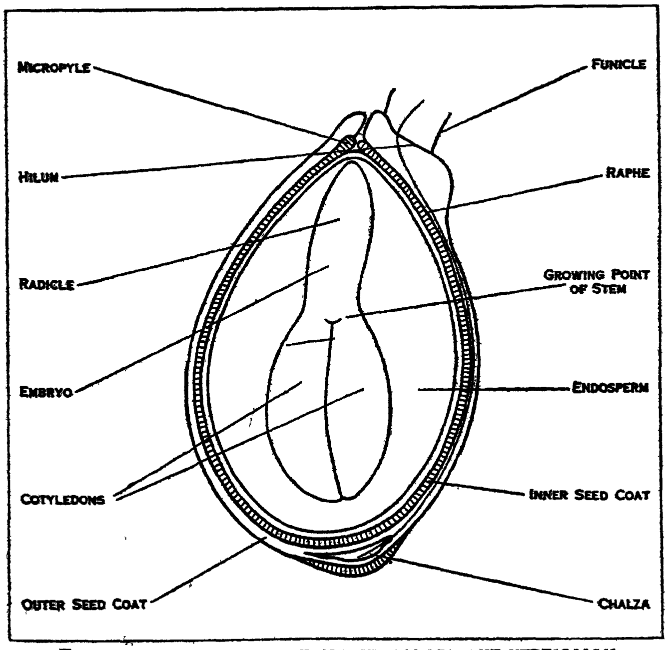


FIG. 6.—SEED OF PANSY (VIOLA TRICOLOR) CUT VERTICALLY

The albumen varies much in its nature and consistence, and furnishes important characters. It may be farinaceous or mealy, consisting chiefly of cells filled with starch, as in cereal grains, where it is abundant; fleshy or cartilaginous, consisting of thicker cells which are still soft, as in the coco-nut, and which sometimes contain oil, as in the oily albumen of *Ricinus* and poppy; horny, when the cell-walls are slightly thickened and capable of swelling, as in date and coffee; the cell-walls sometimes become greatly thickened, filling up the testa as a hard mass, as in vegetable ivory (*Phytelephas*). A cavity is sometimes left in the centre which is usually filled with fluid, as in the coco-nut. The relative size of the embryo and of the endosperm varies much.

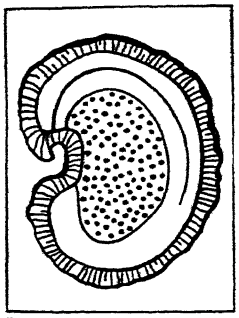


FIG. 7.—SEED OF RED CAMPION (LYCHNIS), CUT VERTICALLY

In monocotyledons the embryo is usually small, and the endosperm large, and the same is true in the case of coffee and many other dicotyledons. The opposite is the case in other plants, as in the Labiatae.

The embryo consists of an axis bearing the *cotyledons* or the first leaves of the plant. To that part of this axis immediately beneath the cotyledons the term *hypocotyl* has been applied, and continuous backwards with it is the young root or *radicle*, the descending axis, their point of union being the collar or neck. The terminal growing bud of the axis is called the *plumule*, and represents the ascending axis. The radicular extremity points towards the micropyle, while the cotyledonary extremity is pointed towards the base of the ovule or the chalaza. Hence, by ascertaining the position of the micropyle and chalaza, the two extremities of the embryo can in general be discovered. It is in many cases difficult to recognize the parts in an embryo; thus in *Cuscuta*, the embryo appears as an elongated axis without divisions; and in *Caryocar* the mass of the embryo is made up by the radicular extremity and hypocotyl, in a groove of which the cotyledonary extremity lies embedded. In some monocotyledonous embryos, as in Orchidaceae, the embryo is undifferentiated, being a mere cellular mass showing no parts. When the embryo follows the direction of the axis of the seed, it is axile or axial; when it is not in the direction of the axis, it becomes abaxile or abaxial. In campylotropous seeds the embryo is curved, and in place of being embedded in endosperm, is frequently external to it.

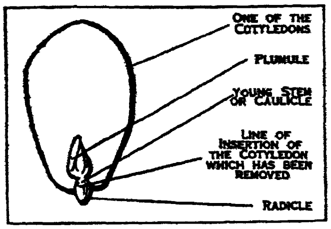


FIG. 8.—MATURE DICOTYLEDONOUS EMBRYO OF THE ALMOND WITH ONE OF THE COTYLEDONS REMOVED

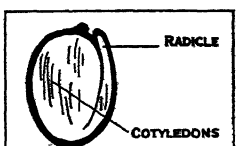


FIG. 9.—EXALBUMINOUS SEED OF WALLFLOWER (CHEIRANTHUS), CUT VERTICALLY

It has been already stated that the radicle of the embryo is directed to the micropyle, and the cotyledons to the chalaza. In some cases, by the growth of the integuments, the former is turned round so as not to correspond with the apex of the nucellus, and then the embryo has the radicle directed to one side, and is called excentric, as is seen in Primulaceae and many palms, especially the date. The position of the embryo in different kinds of seeds varies. In an orthotropal seed the embryo is inverted or *antitropal*, the radicle pointing to the apex of the seed, or to the part opposite the hilum. Again, in an anatropal seed the embryo is erect or *homotropal*, the radicle being directed to the base of the seed. In curved or campylotropal seeds the embryo is folded so that its radicular and cotyledonary extremities

are approximated, and it becomes *amphitropal*. In this instance the seed may be exalbuminous, and the embryo may be folded on itself; or albuminous, the embryo surrounding more or less completely the endosperm and being peripherical. According to the mode in which the seed is attached to the pericarp, the radicle may be directed upwards or downwards, or laterally, as regards the ovary. In an orthotropal seed attached to the base of the pericarp it is superior as also in a suspended anatropal seed. In other anatropal seeds the radicle is inferior. When the seed is horizontal as regards the pericarp, the radicle is either centrifugal, when it points to the outer wall of the ovary; or centripetal, when it points to the axis or inner wall of the ovary. These characters are of value for classification, as they are often constant in large groups of genera.

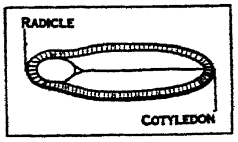


FIG. 10.—TRANSVERSE SECTION OF SEED OF WALLFLOWER, WITH RADICLE FOLDED ON EDGES OF ACCUMBENT COTYLEDONS

Plants in which there are two cotyledons formed in the embryo are *dicotyledonous*. The two cotyledons thus formed are opposite to each other, but are not always of the same size. Thus, in the Nyctaginaceae, one of them is smaller than the other (often very small), and in *Carapa guianensis* there appears to be only one, in consequence of the intimate union which takes place between the two. The union between the cotyledonary leaves may continue after the young plant begins to germinate. The texture of the cotyledons varies. They may be thick, as in the pea, exhibiting no traces of venation, with their flat internal surfaces in contact, and their backs more or less convex; or they may be in the form of thin and delicate laminae, flattened on both sides, and having distinct venation, as in *Euonymus*, etc. The cotyledons usually form the greater part of the mature embryo, and this is remarkably well seen in such exalbuminous seeds as the bean and pea.

Cotyledons are usually entire and sessile. But they occasionally become lobed, as in the walnut; or petiolate, as in *Geranium molle;* or auriculate, as in the ash. Like leaves in the bud, cotyledons may be either applied directly to each other, or may be folded in various ways, the same terms being applied as to the foliage leaves. The radicle and cotyledons are either straight or variously curved. Thus, in some cruciferous plants, as the wallflower, the cotyledons are applied by their faces, and the radicle is folded on their edges, so as to be lateral; the cotyledons are here *accumbent*. In others, as *Hesperis*, the cotyledons are applied to each other by their faces, and the radicle is folded on their back, so as to be dorsal, and the cotyledons are *incumbent*. Again, the cotyledons are *conduplicate* when the radicle is dorsal, and enclosed between their folds. In other divisions the radicle is folded in a spiral manner, and the cotyledons follow the same course.

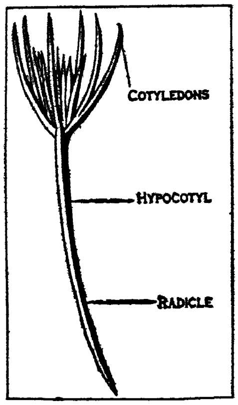


FIG. 11.—POLYCOTYLEDONOUS EMBRYO OF THE PINE (PINUS), BEGINNING TO SPROUT

In many gymnosperms more than two cotyledons are present, and they are arranged in a whorl. This occurs in Coniferae, especially in the pine, fir, spruce and larch, in which six, nine, twelve and even fifteen have been observed; they resemble in their form and mode of development the clustered or fasciculated leaves of the larch. In species of *Streptocarpus* the cotyledons are permanent, and act the part of leaves. One of them is frequently largely developed, while the other is small or abortive.

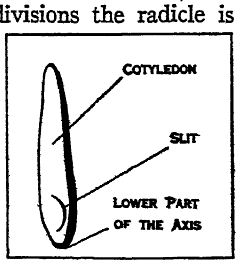


FIG. 12.—EMBRYO OF A SPECIES OF ARROW-GRASS

In those plants in which there is only a single cotyledon in the embryo, hence called *monocotyledonous*, the embryo usually has a cylindrical form more or less rounded at the extremities, or elongated and fusiform, often oblique. The axis is usually very short compared with the cotyledon, which in general encloses the plumule by its lower portion, and exhibits on one side a small slit which indicates the union of the edges of the vaginal or sheathing portion of the leaf. In grasses, by the enlargement of the embryo in a particular direction, the endosperm is pushed on one side, and thus the embryo comes to lie outside at the base of the endosperm. The lamina of the cotyledon is not developed. Upon the side of the embryo next the endosperm and enveloping it is a large shield-shaped body, termed the *scutellum*. This is an outgrowth from the base of the cotyledon, enveloping more or less the cotyledon and plumule, in some cases, as in maize, completely investing it; in other cases, as in rice, merely sending small prolongations over its anterior face at the apex. (*See* GRASSES.) In many aquatic monocotyledons (e.g., *Potamogeton*) there is a much-developed hypocotyl, which forms the greater part of the embryo and acts as a store of nutriment in germination. In some grasses, as oats, a projection of cellular tissue is seen upon the side of the embryo opposite to the scutellum, that is, on the anterior side. This has been termed the *epiblast*. This by some was considered the rudimentary second cotyledon; but is now generally regarded as an outgrowth of the sheath of the true cotyledon.

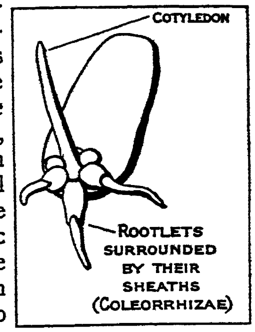


FIG. 13.—GRAIN OF WHEAT (TRITICUM) GERMINATING

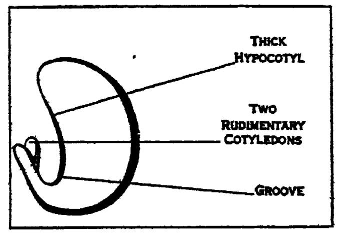


FIG. 14.—EMBRYO OF CARYOCAR

SEED TESTING. Sixty years ago the seed trade of Great Britain was in a most unsatisfactory state, and the dishonourable manner in which seeds were treated and sold was widely known. It had, of course, long been recognized by progressive men that a good seed supply was as essential a part of farming as sound cultivation, proper manuring, and safe harvesting. Nevertheless, large quantities of very low grade seeds were sown. Whereas it would seem that as long ago as 1816 steps had been taken in Switzerland to prevent fraud in the seed trade, the first official steps taken in England were in 1869 and 1878 when the Adulteration of Seeds Acts were passed. These Acts made it a criminal offence to sell or cause to be sold seed that had been killed or dyed, or to kill or dye seeds.

The first official seed testing stations or seed control stations were started in 1869 at Tharandt in Saxony by Nobbe and in 1871 at Copenhagen by Möller Holst. In 1875 Nobbe published his *Handbuch der Samenkunde*, and this gave a new impetus to seed testing work throughout Europe. Later a Swiss station was started under Stebler at Zürich, and for many years thereafter a considerable number of British seedsmen had their seeds scientifically examined at that station. An official seed testing station was started at Dublin in 1900 and in Edinburgh in 1914, but it was not until 1917 that an official seed testing station was organised for England. Seed testing is conducted under official auspices in practically all civilised countries, the seed "control" stations, as they are termed, being of inestimable value to agriculture. The Seeds Act was passed in England in 1920, and the administration of this act has undoubtedly been highly beneficial, this being recognised by farmers and the seed trade alike.

Seeds for sowing need to be true to name; to have a high degree of purity, or freedom from weed seeds, rubbish, or seeds of a species not required; to have a high germinating capacity, or be capable of growing and producing strong plants under suitable conditions; they should be of the origin and strain required, home-grown or foreign seed or seeds of a certain strain being the better as the case may be; and they should be free from injurious insects and fungi. Considered generally, good seed will be plump, bright, have an "alive" appearance, and an average colour which varies according to the species.

The number and kind of weed seeds contained in a sample of

seeds for sowing has an important bearing upon the value of the sample. Below a certain point of purity and germinating capacity, or if it contains more than a given quantity of certain species of injurious weed seeds, the sample should in no circumstances be accepted from the seed merchant. Under the British Seeds Act, 1921, and the Seeds Regulations, 1922, the seeds merchant is bound to declare certain facts relating to the seeds he offers for sale, and it is to the farmer's interest to ensure that he knows all about the seeds which he purchases, and he should only purchase under guarantee. On receipt of his seed, samples may be submitted to the official seed testing station (Huntingdon Road, Cambridge) for examination and report, for which only a small fee is charged (to farmers, 6d. per sample). Full particulars may be obtained from the Station.

What is commonly called the true value of a seed sample (which is represented by the combined purity and germinating capacities, per cent) is not in itself a complete guide to the value of the sample for sowing, as it is necessary to take into consideration the kind of impurity or "other seeds" present; while it is commonly impossible to determine by analysis whether the species is of the variety or strain desired. Knowledge of seed samples is now, however, so excellent that it is commonly possible to determine at any rate the country of origin, a decision being based not only upon the appearance of the seed sample itself but upon the species of weed seeds included in it—since the species are liable to vary widely with the country from which the seed sample is derived. The possibilities were abundantly shown in a case early in 1928 in which the British Ministry of Agriculture and Fisheries prosecuted a seeds merchant for falsely selling imported seed as Kentish wild white clover. The botanical analyses clearly demonstrated that the seeds sold were of New Zealand and central European origin. (*See* also SEED TRADE.) (H. C. L.)

In the United States, seed testing followed the work done in Europe by about 25 years. Quite rapid strides have been made since 1876 toward placing the testing of seeds for both purity and viability on a comprehensive basis. Connecticut, North Carolina and Michigan have long urged the importance of seed testing and the University of Nebraska has taught seed testing as a part of the botanical training of students for many years. In 1897, Maine enacted a State law governing the sale of agricultural seeds. Other States followed until in 1928, 45 of the States have laws regulating the quality of agricultural seeds which may be sold within these States, and maintain seed-testing laboratories as an aid and protection to agriculture. The individual States may regulate trade within each State, while the Federal Government controls trade between individual States and with foreign countries.

As a result of the work carried on by the States in the improvement of agricultural seeds, many of the larger seed firms throughout the United States have well-equipped laboratories in which analysts test their seeds, thus enabling them to offer high grade seeds to the public. Seed testing as a definite line of investigation was organized in the U.S. Department of Agriculture in 1896, where seeds from farmers, seedsmen and other sources are tested free of charge. In 1912, Congress passed the Seed Importation Act, restricting the quality of specified seeds imported into the United States. This act established standards of live pure seed, and of freedom from adulterants and weed seeds which must be conformed to by all seeds before they are allowed into the United States. In 1926, the Seed Importation Act was amended and the name changed to the Federal Seed Act, the amended act requiring the colouring of imported seed of red clover and alfalfa to indicate the origin.

In addition to the enforcement of the Federal Seed Act and the testing of samples from all sources for purity and viability, samples of seed are bought in the open market, tested for adulteration, and when found to contain more than 5% of adulterants, these amounts, together with the name of the seedsmen handling such seeds, are published. The Federal seed laboratory and many of the State seed laboratories carry on various phases of research work, prominent among these being the physiology of germination, including such problems as hard seeds, retarded germination and after-ripening of seeds; the identification of seeds by comparison with material in an authentic herbarium and by growing tests in greenhouses and field plots; methods of determining the origin of seeds and their adaptation for different localities. (E. F. SI.)

SEED TRADE. Seeds are the keystone to the agricultural and horticultural industry, an industry which is vital to the life and prosperity of every country. The responsibility resting on the shoulders of those who grow and distribute these essential articles is therefore a heavy one. Factors operating in the production of satisfactory food crops include seed, soil fertilisers, cultural methods, weather and control of insects and disease. By far the most important of these is the supply of seeds. Moreover seeds must be of suitable stocks or strains, have a high vitality and be free from disease and weed seeds. To ensure that the demand for high quality seeds is met is the constant study and duty of the seed trade.

The Seed Grower.—To give an adequate representation of the activities of the trade, it is necessary to refer, in the first place, to the seed grower on whom the trade relies, to a large extent, for the production of its supplies, although many seedsmen grow large quantities of seed on their own ground. Seed growing is a highly specialised branch of agriculture which requires the best intelligence and the exercise of considerable skill. A suitable soil and climate is a primary consideration. The "stock," "foundation" or "mother" seed, used must be of the highest quality and, in particular, it must be absolutely pure as regards variety. In growing the seed crop, the best cultural practices must be employed and care must be taken to ensure adequate isolation from growing crops of a similar kind in order to prevent cross-pollenation with inferior or allied plants. Control of insects and other pests is effected by the use of sprays and other methods. During the growing season, especially when the seed crop is approaching maturity, all plants which show characteristics dissimilar to those of the particular variety under cultivation are carefully removed—a process known as "roguing." Plants of the same species found growing along the margin of the field are also cut down before they develop a flowering head and thus endanger the purity of the seed crop by cross-fertilisation. Harvesting the crop when it has reached the proper stage of maturity calls for great care and experience. Unripe seeds give unsatisfactory results and an over-ripe crop will lead to serious loss by shedding. Methods of curing and threshing vary according to the kind of seed produced, each calling for special knowledge and many for particular treatment.

Seed-growers fall roughly into two classes, the one furnishes his own "stock" seed and sells his produce to the seed merchant, the other is supplied by the seed merchant with "stock" seed which is grown under a form of contract. The latter class ranges from the large established grower down to the small tenant farmer who has built up a reputation which enables the seed merchant to enter with confidence into a contract for the growing of his "stock" seed.

The Plant Breeder.—Before passing from the subject of the production of seed, mention should be made of the plant breeder whose business it is to create new and improved strains and varieties. This work is largely in the hands of official or semi-official establishments, experiment stations, crop improvement associations and the like, although much is also done by the seedsmen themselves. These have been responsible in recent years for marked improvements in the yield, early maturity, disease resistance, adaptability, ability to withstand frost and drought and other important characteristics of many kinds of plants.

The Wholesale Seed Merchant.—The wholesale seed merchant, as has been seen, obtains his supplies of seeds largely by growing "stock" seed on contract, or from the commercial grower. In the former case the merchant usually undertakes the roguing of the growing crops by his own experts. On delivery of bulks of seed from the grower, there are many important operations to be undertaken before the seed can be stored in readiness for disposal. Newly harvested seed is sometimes delivered in a damp condition which renders it liable to the attacks of fungi and bac-

teria. If stored in bulk in this condition it would "heat" and spoil owing to fermentation due to micro-organisms or its own physiological activities. Excessive moisture must therefore be removed, and this is sometimes effected by circulating or passing hot air through the seed placed in sacks or spread out on a specially constructed floor. The cleaning operations, if any, performed by the grower, are generally limited to the removal, by winnowing and sieving, of such dirt, chaff and weed and other foreign seed as are much heavier or lighter, or much larger or smaller than the seed that is being dealt with. Further and more drastic cleaning must be carried out by the seedsman, his object being to bring the bulk as near a hundred per cent purity as is possible without loss of too much of the seed of which the bulk consists. This entails the use of a battery of machines and apparatus, including air fans, screens, agitators, electro-magnets and other processes.

The possibilities of mechanical mixture or accidental substitution of one variety for another during handling, cleaning and storage of seed must be most carefully guarded against. The similarity in appearance of many kinds of seed would, with careless handling, lead to hopeless confusion and to the probability of heavy claims for damages from the purchaser who planted mixed seed. Various methods are therefore employed with the object of checking the identification of the bulks of stored seed. In addition to a careful and rapid double check system of keeping stock most of the large seed merchants maintain trial grounds in which a small quantity of every lot of seed handled is grown. In this way they are in a position to satisfy themselves as to the genuineness of the varieties and the general quality of the seed supplied by their growers. In these trial grounds too, the old varieties are constantly under test and new varieties are the object of close observation in order to determine their merits. Finally, it is necessary, by a laboratory test, to ascertain the vitality and analytical purity of the seed. Many seed merchants maintain their own laboratories and employ expert analysts for this purpose, others make use of the facilities offered by the State seed testing stations. The facts established by these tests enable the purchaser to gauge with some degree of accuracy the quality of the seed he is buying. The percentage of purity will show him what proportion of the bulk is the seed he requires and how much other seed, weed seed and foreign matter is present. The percentage of germination, ascertained as it is by a test carried out under the most favourable conditions in the laboratory, does not necessarily show the number of plants that will be obtained from the seed when it is planted in the field or garden, but it does give a fair indication of the vitality of the seed and is absolutely reliable when comparing the quality of various lots of seed. Other facts which can be elicited as a result of a laboratory inspection include the freedom or otherwise of the seed from seed borne diseases, insect and fungus attacks and, with certain definite limitations, proofs as to accuracy of variety and country of origin.

The Retail Seedsman.—The retail seedsman is responsible for the final distribution of the seed to the farmer and gardener. He purchases from the wholesale seed merchant those varieties and kinds of seed which best suit his class of trade and, in most cases, places particulars of his stocks before his clientèle in the shape of an attractively prepared catalogue. Some retailers rely largely on the sales effected to customers who visit their shops, others on the orders received through the post. Whether the retailer comes into personal contact with his customers or whether he approaches them by means of a catalogue, he is in a position to give considerable assistance in the way of cultural information, advice as to choice of varieties, the best time to sow, depth of sowing, and treatment during the growing period.

A transaction in seeds is not completed with the sale of the seed. The seller cannot assume responsibility for the methods adopted by his farmer or gardener customers, nor for the weather and soil conditions; nevertheless a satisfied customer is not secured until the harvest is reaped. Therefore it is one of the duties of the retailer to educate his customer to purchase the kind of seed which will bring the most satisfactory results.

It is not even sufficient for the seedsman to sell seeds of good appearance and with a high percentage of germination, freedom from weeds and so on: knowledge as to the adaptability of particular stocks and strains is advancing rapidly, and it is the business of the seedsman to supply his customers with those stocks or strains which are best adapted to the soil and climate in which they are to be grown.

See also SEED TESTING. (H. CH.)

SEED TRADE IN UNITED STATES

The trade in seeds is carried on along two main lines; farm seeds and vegetable and flower seeds. Each line is represented by a trade association and in the main dealers in vegetable and flower seeds belong to the American Seed Trade Association, and dealers in grass, clover and other farm seeds belong to the Farm Seed Association of America. Some of the larger firms deal in both lines of seeds; in fact, a few firms doing a large volume of business not only handle farm and vegetable seeds both at wholesale and retail, but engage as well in the contract growing of vegetable seed. With a few exceptions, however, the largest dealers in farm seeds handle no vegetable or flower seeds and most of the larger vegetable and flower seed dealers carry grass, clover and other farm seeds in a small way only, to provide for retail trade.

Farm Seeds.—The trade in farm seeds flows in general in two directions. The farmer producing clover or grass seed commonly sells to a local jobber or elevator man who is either an agent of some wholesaler or is in touch with the general market. Such lots are shipped to a large dealer having facilities for recleaning, by whom the seed is cleaned, graded, bulked and bagged in accordance with quality and designated by the various grade names used by the dealer. Sales are then made to country merchants who, in turn, sell to the farmer. In some seed producing sections, especially those far removed from terminal markets, large dealers have established cleaning plants where country run seed is cleaned. The cleaned seed is then shipped to the central warehouses for assembling, bulking and distributing. While the bulk of the farm seeds passing from the wholesaler to the consumer goes through the hands of the country or city merchant, some firms do what is known as a "mail order business" in farm seeds. Such dealers advertise in farm papers and sell direct to consumers in any quantity desired. In some cases such business is known to reach a volume of one to three million dollars per year.

Cleaning, Grading and Bulking.—Preparing field seeds for marketing is the most important function of the wholesale dealer in farm seeds. Alfalfa, clover and grass seed, especially as it comes from the producer, contains a certain proportion of dirt and weed seeds, all of which must be removed. The size and colour of the "berry" also vary in different lots and these must be mixed and blended to produce a uniform sample. The large dealer is, therefore, equipped with cleaning mills of various kinds, some designed for special purposes as the removal of dodder or buckhorn seed. In the process of cleaning, a given lot of seed may be handled five or six times before it is considered fit for market. Country run seed is bought either on the basis of a certain price for the clean seed, the screenings being returned to the producer, or on sample, the buyer estimating the loss and paying for what clean seed he believes will be secured.

Production of Farm Seeds.—Seed of some hardy varieties of alfalfa is produced by special growers but in general there are no special growers of grass and clover seed. There are, however, regions where the production of certain farm seeds is so common that such production is a regular part of the cropping system practiced. This is the case with alfalfa seed in the Southwest, in Utah, Idaho and portions of Kansas; with red clover seed in Idaho and the Arkansas Valley in Colorado; with white clover seed in Wisconsin and Louisiana; with meadow fescue seed in Missouri and Kansas; with Kentucky Bluegrass seed in Kentucky, Missouri and Iowa; with orchard grass seed in Kentucky; with lespedeza seed in Louisiana, Mississippi and Tennessee; and with sorghum and Sudan grass seed in Kansas, Oklahoma and Texas. There are some special seed corn growers and the organization of Crop Improvement Associations in many states has stimulated some of the best farmers in the production of improved vari-

eties of small grains. Much of the seed thus produced finds its way to the consumer through the better seedsmen. Important as this movement is, it represents but a small portion of the small grain and corn seed handled by the farm seed trade; the larger part of such seed differs from market grain only in being more carefully cleaned and graded.

Trade in Farm Seeds.—The greater portion of the farm seeds, except small grains, entering consumption is handled by the seed trade. According to figures collected in 1919 by the Bureau of Economics, U.S. Department of Agriculture, the proportion of clover and alfalfa seed handled by the trade varied from 52 per cent in the central to 91 per cent in the eastern states. In the same territory the proportions of grass seed handled by the trade are 65 and 93 while comparable figures for small grains are 9 and 44.

Clover and timothy are traded in on some exchanges in the same way as wheat and corn. The trade in grass and clover seed is international in character, prices being affected by available supplies abroad as well as by those in the United States. There is consequently a more or less constant movement back and forth and a given lot of clover seed, for example, may be exported and later imported, depending on price fluctuations.

Co-operative Marketing.—The movement for the co-operative marketing of farm seeds has attained some size, but the methods of handling and distributing used by the co-operative organizations are much the same as those employed by the wholesale trade. The distinctive claim made by co-operatives is that they supply the consumer with seeds of strains and origin best suited to his needs.

Verification of Origin.—A service providing for the verification of origin of alfalfa seed has been inaugurated by the Bureau of Agricultural Economics, U.S. Department of Agriculture. In this service the dealer gives the state of production of alfalfa seed offered and keeps certain records which may serve as evidence of the correctness of the claim. Officials of the Bureau check these records from time to time. If defective records are found the dealer may be removed from the list of dealers to whom the service is extended. This service derives its importance from the fact that alfalfa seed from sections with mild winters is unsuited for seeding in sections with severe winters.

Legislation Affecting the Trade.—Most states have laws regulating the sale of seed but there is no uniform seed law. In general these laws require the giving of certain information covering percentage of purity and germination and the percentage of weed seeds present. In some states the sale by the trade of seed containing more than a specified number per unit of weight of certain noxious weed seeds as dodder, is prohibited. Owing to the fact that seed laws are not uniform in the various states, large dealers are compelled to use various tags to be attached to shipments in accordance with the laws of the state to which the seed is consigned. These laws do not apply to the sale of seed by farmers and, although they apply to the sale of vegetable as well as field seeds, their effect is felt more strongly by the field seed than by the vegetable seed dealers.

There is also national seed legislation covering the importation of seed. Under this law percentages of purity and germination are fixed for specified kinds of field seeds and any lot of such seed falling below these percentages may be refused entry. Adulteration of seed is prohibited. This law also requires the staining of red clover and alfalfa seed to indicate, so far as practicable, the country of origin of such seed and prohibits misbranding of seed in interstate commerce. Similar legislation is in force in Canada.

Seed Testing Laboratories.—In order to comply with the various seed laws the larger dealers have established seed testing laboratories and employ competent seed analysts. All lots of seed entering the warehouses of such a firm are tested for purity and germination.

Vegetable and Flower Seeds.—While the wholesale dealers in field seeds issue periodic or regular price lists, these are simple and contain little descriptive matter. The vegetable and flower seed trade, however, is built up largely on the catalogue, which in some cases is elaborate and richly illustrated. In it are given descriptions of the varieties offered and a special feature of the catalogue is commonly the "novelty" section, in which new or especially recommended varieties are described.

Those engaged in the vegetable and flower seed trade may be roughly grouped into professional seed growers, growers and dealers, dealers, wholesale or retail or both, and the small local retailer. In many cases the functions performed overstep these designations, some of the largest dealers being at the same time growers, wholesalers and retailers.

A special feature of the vegetable and flower seed business is the box trade. In this the dealer prepares boxes designed for holding and displaying assorted varieties of vegetable seeds or of flower seeds. These boxes are placed with local merchants, usually in drug stores or hardware stores, in every city and village. The packets are sold at a fixed price and the local dealer receives a commission on the total sales. This trade is very extensive and is in the hands of a relatively small number of dealers. Boxes offering seeds from more than one dealer are commonly found in the same store even in small cities.

Production of Vegetable and Flower Seeds.—In contradistinction to farm seeds, vegetable and flower seeds are produced almost wholly by special growers or by farmers under contract with dealers or larger growers. The nature of such a seed-growing establishment may vary from that of the large general grower producing a variety of seeds limited only by the climatic conditions to that of the highly specialized grower producing but one article, as cabbage seed.

In general, such seeds as peas, beans, sweet corn and vine seeds are grown under a contract system. In this the large wholesale grower makes contracts with farmers in suitable territory for the planting of a definite acreage with stock seed furnished by the wholesale grower. The grower retains the right to send his representatives into the field at the proper time in order to "rogue" the field. This work is necessary to maintain a high standard of purity in the stock. The farmer delivers the crop at a fixed price.

Such seeds as onion, radish, lettuce, carrot, cabbage and sweet peas are generally produced by the professional seed grower on his own farms or on nearby farms under his direct supervision. Flower seeds other than sweet peas are produced by special growers; in many cases these growers specialize on one crop, as double petunias or pansies, and devote great care to the production of the best quality seed.

While there is scarcely a section of the United States in which some kind of vegetable or flower seed is not produced, the main producing region is California. All the lettuce, sweet pea seed, and most of the onion seed is produced in this state, as well as flower seeds in great variety. Pole and lima beans are also exclusively produced in California as well as carrot and much of the radish seed. Considerable quantities of radish, dwarf beans and vine seeds are produced in Michigan.

Garden peas are produced in the Northwest, while dwarf beans, sweet corn and vine seeds are grown in various parts from New England to the Rocky Mountains. The production of cabbage seed is confined to Long Island and the Puget Sound region in Washington State.

Seed for the Canning Trade.—This is an important branch of business for a number of the large growers, the most important single item in this trade being peas. Here the purity of stocks is a first consideration, since faulty stocks may cause enormous damage. The volume of business is large, as one acre of seed peas will supply seed for only three acres of canning peas. For some other crops as tomatoes, small quantities of seed are needed and the canner either produces his own or has seed grown by specialists in this work.

Trial Grounds and Stocks.—An important feature of the business of every prominent vegetable and flower seed grower and dealer is the stock record and trial ground. The reputation of a grower and dealer is built on the purity of his stocks. Most dealers depend on the grower to attend to this feature and seeds of the standard varieties offered by a hundred or more dealers may all have been produced by one grower. In a few cases, how-

ever, dealers maintain extensive stock seed farms and all good dealers and growers maintain careful records of the history and quality of their stocks.

Trial grounds in which samples of a grower's or dealer's stocks are planted for observation and selection are maintained by some of the larger firms, and on a smaller scale by many growers of special lines. These trials are of value not only in checking the quality of the dealer's stocks but in determining the value of varieties offered by competitors. Since there is no final authority in the matter of names some varieties may be offered under more than one name and an alleged new variety may be only an old acquaintance under a new label. (A. J. Pi.)

SEELEY, SIR JOHN ROBERT (1834–1895), English essayist and historian, was born in London on Sept. 10, 1834. His father, R. B. Seeley, was a publisher, and author of several religious books and of *The Life and Times of Edward I.* Seeley was educated at the City of London School and at Christ's College, Cambridge, where he was head of the classical tripos and senior chancellor's medallist, was elected fellow and became classical tutor of his college. For a time he was a master at his old school, and in 1863 was appointed professor of Latin at University College, London. His essay *Ecce Homo,* published anonymously in 1866, and afterwards owned by him, caused much controversy at the time. His later essay on *Natural Religion,* which, premising that supernaturalism is not essential to religion, maintains that the negations of science tend to purify rather than destroy Christianity, satisfied neither the Christian nor the scientist. In 1869 he was appointed professor of modern history at Cambridge.

His *Life and Times of Stein* (1879) is a valuable narrative of the anti-Napoleonic revolt, led by Prussia mainly at Stein's instigation. The famous essay, the *Expansion of England* (1883), shows how and why Great Britain gained her colonies and India, the character of her empire, and the light in which it should be regarded: it secured him the K.C.M.G. His last book, *The Growth of British Policy,* written as an essay and intended to be an introduction to a full account of the expansion of Great Britain, was published posthumously. Seeley died on Jan. 13, 1895.

See G. W. Prothero, *Memoir* prefixed to *Growth of British Policy* (1895).

SEELY, JOHN EDWARD BERNARD (1868–), British politician, was born on May 31, 1868, the third son of Sir Charles Seely, Bart. Educated at Harrow and at Trinity college, Cambridge, he became a barrister. In 1900–01 he served with the Imperial Yeomanry in South Africa, winning the D.S.O. and during his absence was returned to parliament as Conservative M.P. for the Isle of Wight. His later career as a politician was somewhat varied. Forsaking the Conservative party when Chamberlain introduced his tariff reform proposals, Seely was returned to Parliament after the general election of 1906 as Liberal M.P. for a Liverpool division, and in 1908 he took office as under-secretary for the Colonies. In 1911 he was appointed to a similar position at the War Office and in 1912 he succeeded Lord Haldane as secretary of State for War. He held this position until the Curragh incident in 1914, when, having initialled a demand by certain officers that they should not be asked to serve against Ulster, he was compelled to resign. During the World War he served on the staff and later commanded a brigade of Canadian cavalry. In 1918–19, having been M.P. for the Ilkeston division of Derbyshire since 1910, he was under-secretary at the Ministry of Munitions, and then under-secretary of State for Air in the Coalition Ministry. In 1923 he again became M.P. for the Isle of Wight, but he lost his seat in 1924.

SÉES, a town of north-western France, in the department of Orne, on the river Orne 3 m. from its source and 13 m. N.N.E. of Alençon by rail. Pop. (1926) 2,710. The first bishop of Sées (*Saium, Sagium*) was St. Lain, who lived about the 4th century. In the 9th century Sées was a fortified town and fell a prey to the Normans. At that period Sées consisted of two distinct parts, separated by the Orne—the bishop's burgh, and to the south, the new or count's burgh (*Bourg le Comte*). From 1356 the counts of Alençon were its possessors. In the Hundred Years' War it fell into the hands of the English (1418). Pillaged by the Protestants during the Wars of Religion, Sées attached itself to the League in 1589, but voluntarily surrendered to Henry IV. in 1590. The town is a bishop's see and has a Gothic cathedral which dates from the 13th and 14th centuries and occupies the site of three earlier churches. The west front, which is disfigured by the buttresses projecting beyond it, has two stately open work spires 230 ft. high. The nave and the choir are 13th century.

SEGANTINI, GIOVANNI (1858–1899), Italian painter, was born at Arco in the Trentino on June 15, 1858. His mother, who belonged to an old family of the mountain country, died in 1863. His father then went to Milan, and there left Giovanni in the care of a step-sister. At the age of seven the child ran away; he was found perishing of cold and hunger, and was employed by peasants as a herdsman. He spent his long hours of solitude in drawing. Owing to his fame having reached the ears of a syndic, he was sent back to Milan; he led a wandering life, and finally remained at Milan to attend classes at the Brera, earning a living meanwhile. In 1882 he settled in Brianza, near Como and four years later sought the Swiss Alps, finally settling in the Engadine. There he gave himself up to the study of mountain life, and became in truth the painter of the Alps. The "Ave Maria" took a gold medal at the Amsterdam Exhibition (1883). Like Millet he depicted the hard life of the peasant. The atmosphere of his picture is clear and crystalline and his figures stand out in clear relief. "The Drinking-place" received a gold medal in Paris (1889), "Ploughing in the Engadine" (Munich Pinakotek) gained a gold medal at Turin (1892). Besides those works in which he studied simple effects of light and Alpine scenery, such as "Midday on the Alps" and "Winter at Savognino," he also painted symbolical subjects: "The Punishment of Luxury" and the "Unnatural Mothers" (in the Walker Art Gallery, Liverpool). Segantini died on Sept. 28, 1899, at Maloja, where a museum contains many of his works, including the great unfinished triptych of "The Alpine World."

See L. Villari, *G. Segantini* (London, 1901); F. Servaes, *G. Segantini* (Leipzig, 1907); G. Segantini, *G. Segantini* (Munich, 1918); G. Segantini, *Scritti e Lettere* (Turin 1910).

SEGESTA (Gr. Ἔγεστα), an ancient city of Sicily, 8 m. W.S.W. of the modern Alcamo and about 15 m. E.S.E. of Eryx. It was a city of the Elymi, but, though the Elymi were regarded as *barbari,* Segesta, in its relations with its neighbours, was almost like a Greek city. Disputes with Selinus over questions of boundary were frequent from 580 B.C. onwards. One of the ostensible objects of the Athenian expedition to Sicily in 415 was to aid Segesta against Selinus in a dispute, not only as to questions of boundary, but as to rights of marriage. After the Athenian *débâcle,* the Segestans turned to Carthage; but when Hannibal in 409 B.C. established the Carthaginian power in western Sicily, Segesta became a dependent ally, and was besieged by Dionysius in 397, being at last relieved by Himilco. In 307 Agathocles marched on the city, massacred 10,000 men, sold the rest of the inhabitants into slavery and changed its name to Dicaeopolis; but it soon recovered its old name and returned to the Carthaginians. Early in the First Punic War, however, the inhabitants, having massacred the Carthaginian garrison and allied themselves with Rome, had to stand a severe siege from the Carthaginians. Segesta was treated with favour by the Romans; perhaps the territory of Eryx was assigned to it.

The town lay upon the Monte Barbaro (1,345 ft.); scanty remains of its external walls, of houses and of a temple are to be seen. The theatre is well preserved. The *Thermae Segestanae* were situated about 5 m. to the north on the road to Castellammare: the hot sulphur springs are still in use. (T. A.)

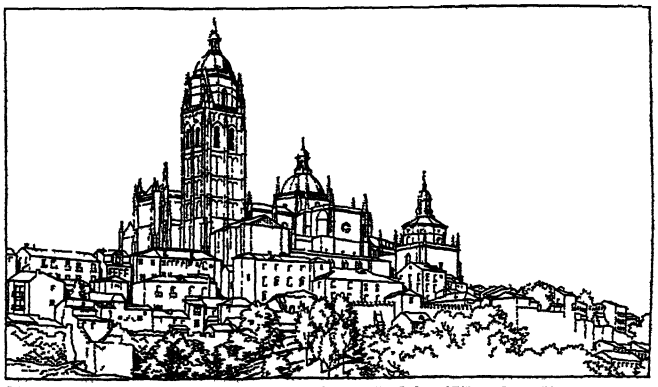
SEGO LILY (*Calochortus Nuttallii*), a North American plant of the lily family (Liliaceae), native to dry soil from South Dakota to Washington and south to California and Oregon. Its slender stem rises from a coated corm and bears narrow leaves and large, beautiful, somewhat tulip-like, white flowers, variously marked with yellow, purple and lilac. Like manna in the wilderness, the edible roots are said to have been used for food by the early Mormon settlers in the Salt Lake valley. The plant has

since been identified with the symbolism of the Mormon Church in Utah, of which State it has been formally adopted as the floral emblem or State flower. (*See* MARIPOSA LILY.)

SEGOVIA, a province of Spain, formerly part of Old Castile, bounded on the north and north-east by the provinces of Burgos and Soria, south-east by Guadalajara and Madrid, south-west by Avila, and north-west by Valladolid. Pop. (1920) 167,081; area, 2,635 sq. miles. The greater part consists of an arable tableland (2,500 ft.) producing some of the finest corn in the Peninsula. Along the whole south-eastern boundary the Sierra de Guadarrama rises up suddenly, like a huge barrier, separating Old from New Castile and the basin of the Duero from that of the Tagus. Except the capital, Segovia (*q.v.*), there is no town of more than 5,000 inhabitants. At the foot of the Navacerrada pass lies the royal demesne and summer residence of La Granja (*q.v.*). There are small manufactures of coarse pottery, dyes, paper and alcohol. Segovia is dependent upon its agricultural produce—wheat, rye, barley, peas, hemp, flax, etc.—together with the rearing of sheep, cattle, mules and pigs. There are extensive forests in the sierras, which yield excellent granite, marble and limestone; but the difficulty of transport has prevented any systematic development of these resources.

SEGOVIA, the capital of the Spanish province of Segovia; on the railway from Madrid to Valladolid and Zamora. Pop. (1920) 16,013. Segovia is built upon a narrow ridge of rock which rises in the valley of the Eresma, where this river is joined by the Clamores. It is an episcopal see in the archbishopric of Valladolid. The place has many records and monuments of the vicissitudes of fortune through which it has passed, foremost among the latter being the ancient alcázar or citadel, the cathedral and the aqueduct of Trajan.

The alcázar is perched upon the western tip of the long tongue of rock upon which the city is built. Of the original mediaeval fortress but little remains save the noble façade. The 16th-century cathedral (1521–1577), the work of Juan Gil de Ontañon and his son Rodrigo, is a well-proportioned and delicate piece of Late Gothic—the latest of its kind in Spain—and contains some very fine stained glass. The most remarkable of the many other churches are those of La Vera Cruz (Knights Templar, Romanesque of the early 13th century), San Millan and San Juan (both Romanesque of the second half of the 13th), El Parral (Gothic of early 16th century), and Corpus Christi, an ancient Jewish sanctuary and an interesting specimen of Moorish work. The



THE SEGOVIA CATHEDRAL, COMPLETED IN A.D. 1577, AN EXAMPLE OF LATE GOTHIC ARCHITECTURE IN SPAIN

towers and external cloistering, or *corredores*, of several of the later churches—especially those of San Esteban and San Martin—are fine. The great aqueduct, however, called El Puente del Diablo, usually ranks as the glory of Segovia. It dates probably from the time of Trajan (*c.* A.D. 53–117), and is now in working order, bringing the waters of the Rio Frio down from the Sierra Fuenfria, 10 m. S. The bridge portion striding across the valley into the city is 847 yd. long, and consists of a double tier of superimposed arches, built of rough-hewn granite blocks, laid without lime or cement. (For illustration, *see* AQUEDUCT.) The royal artillery school of Spain is established here.

SÉGUIER, PIERRE (1588–1672), chancellor of France, was born in Paris on May 28, 1588, of a famous Quercy legal family. Pierre was brought up by his uncle, Antoine Séguier, *président à mortier* in the parlement, and became master of requests in 1620. From 1621 to 1624 he was intendant of Guienne, where he became closely allied with the duc d'Épernon. In 1624 he succeeded to his uncle's charge in the parlement, which he filled for nine years. In this capacity he showed great independence with regard to the royal authority; but when in 1633 he became keeper of the seals under Richelieu, he proceeded to bully and humiliate the parlement in his turn.

Séguier became allied with the cardinal's family by the marriage of his daughter Marie with Richelieu's nephew, César du Cambout, marquis de Coislin, and in December 1635 he became chancellor of France. In 1637 Séguier was sent to examine the papers of the queen, Anne of Austria, at Val de Grâce. According to Anquetil, the chancellor saved her by warning her of the projected inquisition. In 1639 Séguier was sent to punish the Normans for the insurrection of the Nu-Pieds, the military chief of the expedition, Gassion, being placed under his orders. He put down pillage with a strong hand, and was sufficiently disinterested to refuse a gift of confiscated Norman lands. He was the submissive tool of Richelieu in the prosecutions of Cinq-Mars and François Auguste de Thou in 1642.

His authority survived the changes following on the successive deaths of Richelieu and Louis XIII., and he was the faithful servant of Anne of Austria and of Mazarin. His resolute attitude towards the parlement of Paris made the chancellor one of the chief objects of the hatred of the Frondeurs. On Aug. 25, 1648, Séguier was sent to the parlement to regulate its proceedings. On the way he was assailed by rioters on the Pont-Neuf, and sought refuge in the house of Louis Charles d'Albert, duc de Luynes. In the course of the concessions made to the Fronde in 1650, Séguier was dismissed from his office of keeper of the seals. He spent part of his retirement at Rosny, with his second daughter Charlotte and her husband, the duke of Sully. He was recalled in April 1651, but six months later, on the king's attaining his majority, Séguier was again disgraced, and the seals were given to President Mathieu Molé, who held them with a short interval till his death in 1656, when they were returned to Séguier. Séguier lived for some time in extreme retirement in Paris, devoting himself to the affairs of the academy. When Paris was occupied by the princes in 1652, he was for a short time a member of their council, but he joined the king at Pontoise in August, and became president of the royal council.

After Mazarin's death in 1661 Séguier retained but a shadow of his former authority. He showed a great violence in his conduct of the case against Fouquet (*q.v.*), voting for the death of the prisoner. In 1666 he was placed at the head of a commission called to simplify the police organization, especially that of Paris; and the consequent ordinances of 1667 and 1670 for the better administration of justice were drawn up by him. He died at St. Germain on Jan. 28, 1672.

Séguier succeeded Richelieu as official "protector" of the Academy, which from that time (1642) until his death held its sessions in his house.

See F. Duchesne, *Hist. des chanceliers de France* (fol. 1680); for the affair of Val de Grâce, *Catalogue de documents historiques . . . relatifs au règne de Louis XIII.* (Paris, 1847); also R. Kerviler, *Le Chancelier P. Séguier* (Paris, 1874). Great part of his correspondence is preserved in the Bibliothèque Nationale, Paris.

SÉGUR, the name of a French family, the first member of which to attain distinction was FRANÇOIS DE SÉGUR, better known as the seigneur de Sainte-Aulaye (d. *c.* 1605), who professed the reformed religion, and was closely associated with Henry IV., becoming in 1576 president of his council. Jean-Isaac, marquis de Ségur (d. 1707), fought in most of the campaigns of the France of his time, and remained loyal throughout the troubles of the Fronde. His son, HENRI JOSEPH, marquis de Ségur (1661–1737), was lieutenant-general of Champagne and Brie, governor of Foix. In his youth he was the hero of an episode of gallantry with Anne of Beauvilliers, abbess of La Joye, which led to the suggestion that she was none other than the Portuguese nun of

the famous Letters. (But *see* ALCOFORADO, MARIANNA.) His son, HENRI FRANÇOIS, comte de Ségur (1689–1751), was colonel at seventeen, when he succeeded to the command of the Ségur regiment, which his father had raised. In 1718 he began a thirty years' tenure of the lieutenant-generalship of Champagne and Brie. He had married in that year Angélique de Froissy, a natural daughter of the regent, Philip of Orleans, but the death of his father-in-law a few years later prevented his reaping special advancement from his marriage, though Mme. de Ségur belonged to the inner circle of Louis XV.'s intimates.

Ségur served in Italy during the war of the Polish Succession under Marshal Villars, and became, in 1736, inspector-general of cavalry. In 1738 he was sent to Nancy as lieutenant-general under Marshal Belle-Isle, and to Bohemia in 1741 with the French troops allied with the Bavarians. But in September 1741 he was compelled by the imperial troops to surrender at Linz. In 1744 he was again sent to Bavaria, and defeated the Austrians at Lichtenau on Jan. 28, 1745. He served throughout the Flemish campaigns of 1746 and 1747, and was commandant of Metz at the time of his death (June 18, 1751).

OCTAVE-HENRI GABRIEL DE SÉGUR (1778–1818), elder son of Louis Philippe de Ségur (*q.v.*), served in the later Napoleonic campaigns, and remained in the army under the Restoration. He threw himself into the Seine on Aug. 15, 1818. The domestic unhappiness that led to his suicide is retailed by the comtesse de Boigne in her *Mémoires* (vol. i., 1907). His eldest son, EUGÈNE, comte de Ségur, succeeded his grandfather in the peerage in 1830. He married Sophie Rostopchine (1799–1894), daughter of Count Feodor Rostopchine, governor of Moscow. The countess of Ségur wrote some famous books for children, the most familiar of which are perhaps the *Malheurs de Sophie* and the *Mémoires d'un âne*, and many tales in the *Bibliothèque rose*. Her letters to her daughter and son-in-law, the count and countess de Simard de Petray, were published in 1891, and those to her grandson in 1898.

RAYMOND JOSEPH PAUL, comte de Ségur d'Aguesseau (1803–1889), third son of Octave de Ségur, took his mother's family name in addition to his own. He studied law at Aix and Paris. As *procureur général* of Amiens he gave in March 1830 a decision on the question of the electoral lists which pleased the liberal party, but late in the year, as substitute in the royal court of Paris, he ordered the suppression of certain liberal journals, and in other civil appointments was accused of reactionary administration. He gave his adhesion to Prince Louis Napoleon, and became a member of the consultative commission in 1851, and of the senate in 1852. After the fall of the empire he retired into private life.

PIERRE MARIE MAURICE HENRI, marquis de Ségur (1853–1916), wrote a life in 1895 of the marshal de Ségur, which was crowned by the French Academy. His book on Madame Geoffrin, *Le Royaume de la rue Saint-Honoré* (1897), also received a prize. His principal work is the three volumes devoted to Marshàl Luxembourg—*La Jeunesse du maréchal de Luxembourg, 1628–1668* (1900); *Le Maréchal de Luxembourg et le prince d'Orange, 1668–1678* (1902); *Le Tapissier de Notre-Dame. Dernières années du maréchal de Luxembourg, 1678–1695* (1904); *Julie de Lespinasse* (1905), English Transl., 1907; and *Au couchant de la monarchie Louis XVI. et Turgot, 1774–1776* (Paris, 1910). He was elected to the French Academy in 1907.

There is much general information on the family of Ségur in A. de Ségur's *Le Maréchal de Ségur, 1724–1801* (Paris, 1895), and in L. P. de Ségur's *Recueil de famille* (1826).

SÉGUR, PHILIPPE HENRI, MARQUIS DE (1724–1801), marshal of France, son of Henri François, comte de Ségur, served under his father in command of an infantry regiment in Italy and Bohemia. He lost an arm at Lauffeld in 1747. In 1748 he succeeded his father as lieutenant-general of Champagne and Brie; he also received in 1753 the governorship of the county of Foix. He fought in the Seven Years' War and in 1760 he was taken prisoner at Kloster-campen. As minister of war (1780–87) under Necker he created in 1783 the permanent general staff, and made admirable regulations with regard to barracks and military hospitals. In 1783 he became a marshal of France. During the Terror he was imprisoned in La Force, and after his release was reduced to considerable straits until in 1800 he received a pension from Napoleon. He died in Paris on Oct. 3, 1801.

See A. de Ségur, *Le Maréchal de Ségur, 1724–1801* (1895).

SÉGUR, PHILIPPE PAUL, COMTE DE (1780–1873), French general and historian, son of Louis Philippe, comte de Ségur, was born in Paris on Nov. 4, 1780. He served with General Macdonald in the Grisons in 1800–1801, and published an account of the campaign in 1802. By the influence of Colonel Duroc (afterwards duc de Frioul) he was attached to the personal staff of Napoleon. He served through most of the important campaigns of the first empire, and was frequently employed on diplomatic missions. He remained in the army at the Restoration, but, having accepted a command from Napoleon during the Hundred Days, he was retired until 1818, and took no further active part in affairs until the revolution of 1830.

During his retirement Ségur wrote his *Histoire de Napoléon et de la grande armée pendant l'année 1812* (Paris, 2 vols., 1824), which ran through numerous editions, and was translated into several languages. The unfavourable portrait of Napoleon given in this book provoked representations from General Gourgaud, and eventually a duel, in which Ségur was wounded. On the establishment of the July monarchy he received, in 1831, the grade of lieutenant-general and a peerage. In 1830 he was admitted to the French Academy, receiving the grand cross of the Legion of Honour in 1847. After the revolution of 1848 he lived in retirement. He died in Paris on Feb. 25, 1873. His works include: *Histoire de Russie et de Pierre le Grand* (1829); *Histoire de Charles VIII.* (2 vols., 1834–1842), in continuation of the history of France begun by his father; and the posthumous *Histoire et mémoires* (8 vols., 1873).

See *Un Aide-de-camp de Napoléon (1800–1812), mémoires du général comte de Ségur*, new edition by his grandson Louis de Ségur (3 vols., 1894–1895), of which an abridged English version was published in 1895.

SEGUSIO (mod. *Susa, q.v.*), an ancient town in north Liguria, the capital of the Cottii (*see* COTTII REGNUM). Here the son of King Donnus, Cottius—who held the rank of imperial praefect over the 14 tribes over which his father had ruled as king—erected a triumphal arch in honour of Augustus in 9–8 B.C., which is still standing. Claudius restored the royal titles to the family; but, after the death of its last member, Nero made the district into a province. It was strongly fortified and garrisoned, and remains of its walls, including those of a double-arched gate, exist. Constantine captured the town, which offered some resistance to him, on his march against Maxentius.

SEHESTED, HANNIBAL (1609–1666), Danish statesman, born at Arensborg Castle on Ösel, was educated abroad, returned to Denmark in 1632 and was attached to the court of Christian IV. Two or three years later he was sent to Wismar to negotiate a treaty with the Swedish chancellor, Axel Oxenstjerna, and, if possible, bring about a match between Christian's son Frederick and Gustavus Adolphus's daughter Christina. Though failing in both particulars, he retained the favour of the king, who betrothed him to his daughter Christine, then in her tenth year, whom he married in 1642. In May 1640 Sehested became a member of the *Rigsraad*. In 1642 he was appointed viceroy of Norway (April 1642). He sought to develop Norway's material resources, and reorganize her armaments and fiscal system; and he aimed at giving her a more independent position as regards Denmark. During Christian IV.'s second war with Sweden (1643–1645), Sehested, as viceroy of Norway, assisted his father-in-law materially. He invaded Sweden four times; successfully defended Norway from attack; and he won an engagement at Nysaker in 1644. After the war he renewed his reforming efforts, and during the years 1646–1647 he succeeded with the help of Christian IV. in creating a separate defensive fleet for Norway and giving her partial control of her own finances. Sehested's success, and still more his accumulation of money and honours aroused the distrust of the *Rigsraad* and the envy of his rivals.

Charges of embezzlement and peculation were brought against him, and he surrendered his private property in Norway to the

Crown. From 1651 to 1660 he lived abroad. In the summer of 1657 he returned to Denmark, but Frederick III. refused to receive him, and he hastily quitted Copenhagen. During the crisis of the war of 1658 he was at the headquarters of Charles X. of Sweden. In seeking the help and protection of the worst enemy of his country, Sehested approached the very verge of treason, but, as soon as he was assured that the case of Denmark was not hopeless, he began to work in her interests in Sweden. In 1660 Frederick III. allowed him to return to Copenhagen, and finally made him plenipotentiary to negotiate with the Swedes. The treaty of Copenhagen, which saved the honour of Denmark, was very largely Sehested's work. He was one of the willing abettors of Frederick III. at the revolution of 1660, when he re-entered the Danish service as lord treasurer and councillor of state. As a diplomatist he, in some respects, anticipated the views of Griffenfeldt, supporting the policy of friendship with Sweden and a French alliance. He died suddenly on Sept. 23, 1666 at Paris, where he was conducting important negotiations. His "political testament" is perhaps the best testimony to his liberal and statesmanlike views.

See Thyra Sehested, *Hannibal Sehested* (Copenhagen, 1886); Julius Albert Fridericia, *Aldelsvaeldens sidste Dage* (Copenhagen, 1894).

SEHORE, a British station in Central India, within the state of Bhopal, 24 m. E. from Bhopal. Pop. (1921) 10,183. It is the headquarters of the political agent for Bhopal, and a British military cantonment. For many years it was also the headquarters of the Bhopal contingent, which was in 1903 incorporated in the Indian army.

SEICHE, an irregular fluctuation of the water level of lakes, first observed in Switzerland. *See* Lake and Geneva, Lake of.

SEIGNIORAGE. The due levied by the authority that possesses the right of coining on the metal that it manufactures into coin. The term "brassage" has been used to describe this due, when confined to the mere cost of the process, the wider term "seigniorage" being employed when the charge is so raised as to become a profit to the imposer. The exercise of the right of seigniorage has been the instrument by which most of the debasements of currency have been carried out. Under feudalism, especially in France, the chief nobles had this prerogative. In the modern state it is reserved for the sovereign authority. Most countries adopt a moderate seigniorage charge. Thus the fundamental currency law of France (1803) provides that "only the expense of coining" shall be charged. The limitation on the coinage of silver in practically all countries has made the seigniorage on that metal very heavy. The policy of England in respect to gold has been peculiar. Since 1664 it has been freed from any charge though the delay in returning the coined gold causes a small loss of interest.

The theory of the effects that a seigniorage produces have been discussed at length. The definitive results obtained may be briefly stated as follows:—(1) A seigniorage charge is the same as a debasement, but its evil effect may be avoided by limiting the amount of coin issued. (2) Seigniorage operates as a tax on the metal subject to it, and this tax tends ultimately to fall on the producers, or rather on the rent obtained through the production. (*See* Money.)

SEIGNOBOS, CHARLES (1854–), French historian, was born Sept. 10, 1854, at Lamastre (Ardèche). Educated at the Lycée de Tournon, he passed to the École Normale Supérieure. Entrusted with an independent course of historical instruction in 1879 at Dijon, he was appointed to the Sorbonne, first as unattached professor in 1883 and later as special lecturer in 1890. In 1897 appeared his *Histoire politique de l'Europe contemporaine*, which was crowned by the Académie française. His work is distinguished by a broad-minded and often democratic tone, and a grasp of social science which place him in the forefront of modern historical writers.

His other published works include: *Histoire de la civilisation* (1886); *Histoire des anciens peuples de l'Orient* (1890); *La méthode historique appliquée aux sciences sociales* (1901); and in *L'Histoire de France Contemporaine* of E. Lavisse, *La Révolution de 1848* (1921); *Le Second Empire* (1921); *Le Déclin de l'Empire et l'Établissement de la IIIe République* (1921).

SEIGNORY or SEIGNIORY, in English law, the lordship remaining to a grantor after the grant of an estate in fee-simple. There is no land in England without its lord: "Nulle terre sans seigneur" is the old feudal maxim (*see* Tenure, Feudal). Where no other lord can be discovered the Crown is lord as lord paramount. The principal incidents of a seignory were an oath of fealty; a "quit" or "chief" rent; a "relief" of one year's quit rent, and the right of escheat. In return for these privileges the lord was liable to forfeit his rights if he neglected to protect and defend the tenant or did anything injurious to the feudal relation. Every seignory now existing must have been created before the Statute of *Quia Emptores* (1290), which forbade the future creation of estates in fee-simple by subinfeudation. The only seignories of any importance at present are the lordships of manors (*see* Copyholds). They are regarded as incorporeal hereditaments, and are either appendant or in gross. A seignory appendant passes with the grant of the manor; a seignory in gross—*i.e.*, a seignory which has been severed from the demesne lands of the manor to which it was originally appendant—must be specially conveyed by deed of grant.

As to seignorial tenures in the Channel Islands *see* W. Burge, *Commentaries on Colonial and Foreign Laws*, vol. iv. pt. 1, p. 1,018; and as to Quebec, see *ib.* p. 1,028.

SEINE, the department of northern France which has Paris as its chief town, formed in 1790 of part of the province of Ile-de-France. It is entirely surrounded by the department of Seine-et-Oise, from which it is separated at certain parts by the Seine, the Marne and the Bièvre. The area of the department is only 185 sq.m., and of this surface about a sixth is occupied by Paris; the suburban towns also are close together and very populous. The population in 1926 was 4,628,637, of which number 2,871,429 were in the city of Paris. Flowing from south-east to north-west through the department, the Seine forms three loops; on the right it receives above Paris the Marne, below Paris the Rouillon, and on the left the Bièvre within the city. The left bank, higher than the right, consists of the Villejuif and Châtillon plateaux separated by the Bièvre; the highest point (560 ft.) is above Châtillon and the lowest (105) at the exit of the Seine.

Market gardening is the chief agricultural industry, and by means of irrigation and manuring the soil is made to yield from ten to eleven crops per annum. Below Paris the plain of Gennevilliers, fertilized by sewage water, yields large quantities of vegetables. Milch cows are reared in large numbers. The principal woods (Boulogne and Vincennes) belong to Paris. It is partly owing to the number of quarries in the district that Paris owes its origin: Châtillon and Montrouge in the south yield freestone, and Bagneux and Clamart in the south and Montreuil and Romainville in the east possess the richest plaster quarries in France. Within the circuit of Paris are certain old quarries now forming the catacombs. Most of the industrial establishments in the department are situated in Paris or at St. Denis (*qq.v.*). The department is traversed by all the railway lines which converge in Paris, and also contains the inner circuit railway (Chemin de Fer de Ceinture) and part of the outer circuit. There are many canals. The department forms the archiepiscopal diocese of Paris, falls within the jurisdiction of the Paris court of appeal and the académie (educational division) of Paris, and is divided between the II., III., IV., V. and VI. *corps d'armée*. Apart from Paris (*q.v.*) the department includes the arrondissements of St. Denis and Sceaux with 22 cantons between them. The 20 arrondissements of Paris are ranked as cantons for certain purposes. The chief places besides Paris are St. Denis, Asnières, Aubervilliers, Boulogne-sur-Seine, Clichy-sur-Seine, Courbevoie, Levallois-Perret, Neuilly-sur-Seine, Pantin, St. Ouen, Colombes, Charenton, Ivry-sur-Seine, Montreuil-sous-Bois, Nanterre, Nogent-sur-Marne, Vincennes and Arcueil.

SEINE, one of the chief rivers of France, rising on the eastern slope of the plateau of Langres, 18 m. N.W. of Dijon. It flows north-westward throughout its entire course, but has numerous windings: between its source and its mouth in the English Channel the direct distance is only 250 m., but that actually traversed by the river is 482 m.

Rising at 1,545 ft. above sea-level, the Seine is at first such an insignificant streamlet that it is often dry in summer as far as Châtillon (705 ft.) some 31 m. from its source. It next passes Méry, and at Marcilly receives the Aube (right), at which point the Haute-Seine Canal from Troyes and Bar terminates and the river itself is canalized. Here it is deflected south-west by the heights of the Brie, the base of which it skirts past Nogent and Montereau. At the latter point it receives the Yonne (left), and is deepened from 5 ft. 3 in. to 6 ft. 6 in. It resumes its north-west direction, receives the Loing (left) at Moret, passes Melun, is joined at Corbeil by the Essonne (left), and just above Paris by the Marne (right). From this point to the sea its channel has been deepened so that vessels of 9 to 10 ft. draught can reach the capital. The river then meanders through a pleasant champaign country past St. Cloud, St. Denis, Argenteuil, St. Germain, Conflans where it is joined by the Oise (right) and then passes Poissy, Mantes and Les Andelys. From the Oise to the sea the river flows over Cretaceous strata. At Poses the river becomes tidal. It next receives the Eure (left), and passes Pont de l'Arche, Elbeuf and Rouen, where sea navigation commences.

The river is dyked below Rouen so as to admit vessels of 20 ft. draught, and large areas have thus been reclaimed for cultivation. At every tide there is a "bore" ranging usually from 8 to 9 ft. Below Quilleboeuf, where it receives the Risle (left) the estuary begins, set with extensive sandbanks, between which flows a narrow navigable channel. Tancarville (right) is the starting-point of a canal to enable river boats for Havre to avoid the sea passage. The river enters the English Channel between Honfleur (left) and Havre (right). The low elevation of the surrounding hills has rendered it comparatively easy to connect the Seine and its affluents with adjoining river basins by means of canals; and it is so connected with the Somme, the Scheldt, the Sambre, the Meuse, the Rhine, the Saône and the Loire.

SEINE-ET-MARNE, a department of northern France, formed in 1790 of almost the entire district of Brie (half of which belonged to Champagne and half to Ile-de-France) and a portion of Gâtinais (from Ile-de-France and Orléanais). Pop. (1926) 380,017. Area, 2,275 sq.m. The department belongs to the Seine basin, and is drained partly by that river and partly by its tributaries the Yonne and the Loing from the left, and from the right the Voulzie, the Yères and the Marne, with its affluents the Ourcq, the Petit Morin and the Grand Morin, at the last-named of which the German advance in Sept. 1914 was stayed.

The oats and wheat of Brie are very good; potatoes, sugar beet, mangel-wurzel and green forage are important crops, and market gardening flourishes. Provins and other places are well-known for their roses. The cider and honey of the department are of good quality. Brie cheeses are well known, and large numbers of calves, sheep and poultry are reared. There are large forests covering a fifth of the surface. Most important is the forest of Fontainebleau. Large areas are devoted to game-preserves. Excellent freestone is quarried in the department, notably at Château-Landon and Nemours, mill-stones at La Ferté-sous-Jouarre; the Fontainebleau sandstone is used for pavements, and the white sand which is found along with it is in great request for the manufacture of glass. Along the Marne are numerous gypsum quarries; lime-kilns occur throughout the department; and peat is found in the valleys of the Ourcq and the Voulzie. Beds of common clay and porcelain clay supply the potteries of Fontainebleau and Montereau. Paris is the chief outlet for the industrial and agricultural products of the department.

The Seine, the Yonne, the Marne, and the Grand Morin are navigable, and, with the canals of the Loing and the Ourcq and those of Chalifert, Cornillon and Chelles, which cut off the windings of the Marne, form a total waterway of over 200 m. Seine-et-Marne has 3 arrondissements (Melun, Meaux and Provins), 29 cantons and 534 communes. It forms the diocese of Meaux (archiepiscopal province of Paris), and part of the region of the V. army corps and of the *académie* (educational division) of Paris, where is its court of appeal. Melun, the capital, Meaux, Fontainebleau, Coulommiers, Provins, Nemours and Montereau (*qq.v.*), are the chief towns. Lagny (pop. 6,398), has an abbey-church of the 13th century; Brie-Comte Robert has a church of the early 13th century; Ferrières, a 13th century church; Moret-sur-Loing preserves 15th century fortifications including two remarkable gateways; St. Loup-de-Naud a church of the early 12th century; Jouarre a church of the 15th century, built over a 10th century crypt; and Vaux-le-Vicomte has the famous *château* built by Fouquet, minister of Louis XIV.

SEINE-ET-OISE, a department of France, formed in 1790 of part of the old province of Ile-de-France, and traversed from south-east to north-west by the Seine, which is joined by the Oise. Pop. (1926) 1,137,524. Area, 2,184 sq. miles. It is bounded by the departments of Seine-et-Marne on the east, Loiret on the south, Eure-et-Loir on the west, Eure on the north-west and Oise on the north. It encloses the department of Seine, and with it forms the centre of the Paris basin. The Epte on the north-west is almost the only natural boundary of the department. The streams (all belonging to the basin of the Seine) are: (right) Yères, Marne, Oise and Epte; (left) Essonne (joined by the Juine, which passes Étampes), Orge, Bièvre and Mauldre. Seine-et-Oise belongs in part to the Pliocene tableland of Beauce in the south and to that of Brie in the east. In the centre are the wooded hills of the Hurepoix which make the charm of Versailles, Marly and St. Germain. In the north-west, in the Vexin, the culminating point (690 ft.) is reached, while the lowest point, where the Seine leaves the department, is little more than 40 ft. above the sea.

Seine-et-Oise is a flourishing agricultural and horticultural department. Wheat, oats, potatoes and sugar-beet are important crops. Versailles, Rambouillet, Argenteuil are among the many market-gardening and horticultural centres, and wine is grown at Argenteuil and elsewhere. Forests occupy about 190,000 ac., the largest being that of Rambouillet (about 32,000 acres). There are mineral springs at Enghien and Forges-les-Bains. Important industrial establishments are the national porcelain factory at Sèvres; and the government powder-mills of Sevran and Bouchet.

The railways of all the great companies of France (except the Midi) traverse the department. The Seine and the Oise, and the canals of Ourcq and Chelles provide about 120 m. of waterway. Seine-et-Oise is divided into four arrondissements (Versailles, Corbeil, Pontoise, Rambouillet) with 40 cantons and 692 communes. It forms the diocese of Versailles under the archbishop of Paris, and part of the educational division (académie) of Paris and is under the command of the military government of Paris, where is its court of appeal.

The chief towns are Versailles, the capital, Corbeil, Sèvres, Étampes, Mantes, Pontoise, Rambouillet, Argenteuil, Poissy, St. Cloud, St. Cyr, St. Germain-en-Laye, Meudon, Montmorency, Rueil and Marly-le-Roi (*qq.v.*). Montfort-l'Amaury has a Renaissance church, a 16th century gateway and a ruined château once the seat of the family of Montfort; Montlhéry preserves the keep (13th century) and other ruins of a fortress which commanded the road from Paris to Orléans; Roche-Guyon, seat of the family of that name, has two châteaux, one a feudal stronghold, the other also mediaeval but altered in the 18th century; Vigny has a Gothic 15th century château; Ecouen, a château of the 16th century once the property of the Condé family; Dampierre has a 17th century château once the property of Charles, cardinal of Lorraine; Maisons-Laffitte, a château of the same period once belonging to the family of Longueil. The château of Malmaison (18th century) is famous as the residence of the Empress Joséphine.

Of the many churches the most interesting are those of Jouy-le Moutier (11th and 12th centuries); Beaumont-sur-Oise (13th century); Taverny (12th and 13th centuries); Longpont (remains of an abbey-church dating from the 11th to the 13th centuries). Near Cernay-la-Ville are remains of a Cistercian abbey and near Lévy-St.-Nom those of the abbey of Notre-Dame de la Roche, including a church (13th century) with stalls which are among the oldest in France and the tombs of the Lévis-Mirepoix family.

SEINE-INFÉRIEURE, a department of the north of France, formed in 1790 of four districts (Vexin normand, Bray,

Caux and Roumois) belonging to the province of Normandy. Pop. (1926), 885,299. Area, 2,448 sq.m. Seine-Inférieure is bounded north-west and north by the English channel for a distance of 80 m., north-east by Somme, from which it is separated by the Bresle, east by Oise, south by Eure and the estuary of the Seine, which separates it from Calvados. The department consists of a portion (Pays de Caux) of the chalk plateau of western France, through which the Seine has sawn its way near the southern boundary. From the slopes of the plateau many small streams drain seawards, the most important being the Arques, emerging at Dieppe, and the Bresle at Le Tréport on the north-eastern boundary. In the comparatively regular outline of the coast there are a few breaks, as at Le Tréport, Dieppe, St. Valery-en-Caux, Fécamp and Havre, the Cap de la Hève, which commands this last port, and Cape Antifer, 12 or 13 m. farther north. Le Tréport, Dieppe, Veules, St. Valery, Veulettes, Fécamp, Yport, Étretat and Ste. Adresse (to mention only the more important) are fashionable watering-places. Forges-les-Eaux (in the east of the department) has cold chalybeate springs.

In general the department is fertile and well cultivated. Along the Seine fine meadow-land has been reclaimed by dyking; and sandy and barren districts have been planted with trees, mostly oaks and beeches, at their finest in the forest of Arques and along the railway from Rouen to Dieppe. The forest of Eu covers 36 sq.m. in the north-east. Wheat and oats are the principal arable crops, rye, flax, colza, sugar beet and potatoes being also important. Milch cows are kept in great numbers especially in the Bray district, and Gournay butter and Gournay and Neufchâtel cheese are in repute. The farms of the Caux plateau are each surrounded by an earthen dyke, on which are planted forest trees, generally beech and oak. Apples and pears are grown, and much cider is produced. A little peat is cut, and there is a number of quarries. Rouen is the chief centre of the cotton trade, which comprises spinning and the weaving of *rouenneries, indiennes* (cotton prints), cretonnes and other cotton goods. Elbeuf is the centre of woollen manufacture. The dyeing and printing of fabrics and other accessory industries also employ many hands. Engineering works, foundries and iron ship-building yards are found at Havre and Rouen. Wooden ships are also built at Havre, Rouen, Dieppe and Fécamp. Other establishments of importance are the national tobacco-factory at Dieppe, sugar-refineries, distilleries, glass-works, potteries, paper-works, soap-works, chemical-works, flour-mills, oil-factories, leather-works, etc. Fisheries are important. Fécamp, which plays a very important part at the Newfoundland fisheries, sends large quantities of cod, herring, mackerel, etc., into the market; Dieppe supplies Paris with fresh fish; St. Valery sends boats as far as Iceland. The principal ports for foreign trade are Havre, Rouen and Dieppe.

Seine-Inférieure is served by the Ouest-État railway, but the Northern railway also has several lines there. The Seine and other rivers provide 85 m. of navigable waterway. The canal of Tancarville from Quilleboeuf to Havre is about 15 m. long, that from Eu to Tréport about 2 m. The department is divided into three arrondissements (Rouen, Dieppe and Havre), 55 cantons and 759 communes. It forms the diocese of the archbishopric of Rouen and part of the region of the III. army corps and of the *académie* (educational division) of Caen. Its court of appeal is at Rouen, the capital.

Rouen, Havre and Dieppe and in a lesser degree, Elbeuf, Fécamp, Harfleur, Lillebonne, Yvetot, Eu, Le Tréport, Aumale, Étretat, Bolbec, Barentin (*qq.v.*) and Caudebec-en-Caux are the chief towns. St. Martin-de-Boscherville has remains of an important abbey, with a fine church in the 12th century Romanesque style, and a Gothic chapter-house of the latter half of the 12th century; Valmont has fine ruins (16th century) of the choir of a Cistercian abbey-church; Varengeville is well known for the manor (16th century) of Jacques Ango (*see* DIEPPE); Graville-Ste. Honorine has a Romanesque church and other remains of an ancient abbey; Montivilliers has a fine abbey-church of the 11th, 12th and 16th centuries; and Arques, Boos, Martainville, Mesnières and Tancarville have old châteaux of various periods.

SEINING, NETTING AND TRAWLING. From remote antiquity fish have been taken by spear, line, trap and net. At the present day nets are by far the most important fishing implements employed, although certain deep water fish (for instance halibut) are still taken mainly by long lines. Fishing nets, although of innumerable kinds, fall naturally into two main groups, namely, stationary nets and nets used in motion. The former group contains the most primitive nets, though nets of great complexity are now included in it; and the simplest fixed nets, themselves derived probably from dams of rushes or stones so placed as to lead fish in to a "pound" or enclosure, may with some confidence be considered as the ancestors of the great otter trawls now shot and towed daily from powerful steamers on fishing grounds more than a thousand miles from the market they work to supply. The more primitive fixed nets are of far less importance than movable nets (except in the capture of certain particular species), owing to the fact that they are necessarily confined to very shallow water. The main types of movable nets may therefore be treated first.

All nets are constructed in accordance with what is known of the habits of the fish they are designed to capture; and as fishes may be roughly divided into those spending at least the greater part of their lives on or near the sea-bottom and those spending a great portion of their lives near the surface, two lines have been followed in the development of nets, some being designed to work on the bottom, others to work near the surface. The most important nets used in the capture of "demersal" or bottom-living fishes are trawls; the most important pelagic nets are drift-nets. The word trawling was at one time applied to more than one method of fishing, but has, at all events in Europe, now become restricted to the operation of a flattened conical net or trawl, dragged along the sea-bottom. There are two trawls in common use, the beam-trawl and the otter-trawl. They differ in the method adopted for extending the mouth of the net. The original form is the beam-trawl.

The beam-trawl may be described as a flattened conical net whose mouth is kept open when in use by a long beam preferably of elm supported at the ends by iron runners, the trawl-heads. Trawl-heads are of various shapes, but usually take the form of a loop, the curve being in front and ending in straight bars which meet at a point behind. One of these bars, the "shoe" lies along the sea-bed when the trawl is in use, and is usually of double thickness, in order to withstand wear. A square socket is bolted to the top of the head, to receive the beam, and ring-bolts are fitted at the front of the curve and in the angle of the "heel" for attaching the towing ropes and the "ground rope" to which the lower lip of the net is lashed.

The Net.—The top lip of the net is lashed along the beam, but the ground rope, being much longer than the beam, when the trawl is towed forms a deep curve between the trawl-heads, the centre or "bosom" thus being considerably behind the beam. Accordingly, when the fish on the sea-bed are disturbed by the travelling ground rope, the roof of the trawl is above them, and the way of escape has already passed and is moving steadily on: a great number of them therefore ultimately pass over the ground rope into the net. The net narrows gradually until the last few feet are reached: this terminal portion is cylindrical and is called the "cod-end." It is closed by a line rove through the terminal meshes, the "cod-line." The fish taken mostly collect in the cod-end, and as their weight increases friction with the bottom, it is protected by pieces of old netting laced across its under side. The fish not taken from the cod-end are found in the "pockets" the pockets are made by lacing together the upper and under sides of the net. They are wedge shaped, the points lying at the sides of the net, at about the level of the bosom, the broad ends at that of the entrance to the cod-end. At this level the lumen of the net thus is divided into three: a fish enters by the central passage, which is furnished with a valve-like curtain, the "flapper," and then either stays in the cod-end or works back along the sides into the pockets. Some species, particularly soles, are frequently found in the pockets.

Dimensions.—A full-sized beam trawl has a beam from 45 to

50 ft. long, and its own length is nearly twice as great: the heads hold the beam from $3\frac{1}{2}$ to $4\frac{1}{2}$ ft. from the bottom. There are, however, wide local differences in size and pattern: and the proportions of the various parts of the net and the sizes of the mesh depend also on the species sought. A North Sea trawl has a cod-end of about 12 ft., out of a total length of 75 ft.: its meshes are 3 in. in size in the front part of the net, lessening to $1\frac{1}{2}$ in. in the cod-end. Small pocketless trawls of 15 ft. beam are used for shrimping from open boats. Shank-nets, whose mouths are kept open by wooden rectangles, with the lower lip a few inches from the ground are also used in shrimping.

Working the Net.—The large beam-trawl is towed a little faster than the tide, and in the same direction. It is drawn along by two ropes ("bridles") of 15 fathoms, one attached to each trawl-head and which are shackled to a 6 in. manila rope or warp. The length of warp run out is rather over 3 times the depth of the ground. Successful shooting of the trawl is an art which has to meet and overcome innumerable difficulties caused by the various combinations of wind, tide, ground and weather, and space does not permit of its discussion here. Essentially, it proceeds in the following stages. The beam and heads are put over the side and the net paid out after them: the fore bridle is run out until the beam is at right angles to the ship's side: both bridles and the warp are then run out: a rope ("guy") is however attached to the warp when nearly out and made fast in the bow, in such a manner that if the net "comes fast" on an obstruction the guy takes the strain and brings the ship head to wind, where she can lie until a change of tide enables her to free her gear. The towing generally lasts one tide (6 hours) and the hauling of the nets is now usually effected by a small steam capstan ("steam man"), whose compact engine is housed under a cover on the capstan top. When the trawl-heads are made fast the net is hauled in by hand until the cod-end is reached, when a bight of rope is put round it, passed over a "tackle" (pulley block) and the cod-end heaved in by the capstan, when the cod-line is loosed and the fish fall on deck.

Replacement of Beam- by Otter-trawl.—Although a very old net, the beam-trawl reached its highest importance in the nineteenth century. In that century the sailing trawlers which employed it increased greatly in numbers and tonnage and improved in equipment and efficiency: and they brought the whole North Sea under the trawl. Its closing decades however witnessed the beginning of the rise of the otter-trawl and of the use of steam in fishing vessels: and saw also the decay of beam-trawling and the decline of sailing trawlers. Thus in England and Wales there were over 2,000 first class sailing trawlers in 1893, over 900 in 1900, 817 in 1913 and 272 in 1928: in the same period the average tonnage fell from 57 to 33. In the first stages of the change the fact that the otter could not be worked with confidence from a sailing vessel no doubt accelerated the adoption of steam power, since the efficiency of the otter rendered its use inevitable; while on the other hand the power of steam favoured the development of larger nets and enabled more distant grounds to be explored and worked, and the otter, having no rigid beam, was capable of manufacture in a large size and of yielding, on an abundantly stocked ground, the large catches necessary to pay the expenses of long voyages. It is probable that the low working expenses of sailing beam trawlers may ensure their continuance on grounds near ports in close touch with good markets, especially when the fish on the ground are of the more valuable kinds ("prime"), although even on these grounds the motor otter trawler is increasing in importance; but in the present phase of fisheries it is clearly the great steam trawler that bears the main burden of the supply of demersal fish. In 1928 steam trawlers landed in England and Wales 415,000 tons of these fish; sailing (beam) trawlers less than 7,000 tons.

The Otter-trawl.—The essential feature of the otter-trawl is that its mouth is kept open not by a rigid structure but by two large boards, the otter-boards or "doors" acting like kites working horizontally instead of vertically. The device was employed by yachts since its invention by Hearder in 1860, and later by Danish plaice seiners, but the boards now used were first patented in 1894 and 1895 by Scott of Granton and Nielsen, a Dane, respectively.

The otter-boards resemble massive wooden doors, liberally strengthened by iron bands: they are about 8 ft. high, 9 ft. long and 3 in. thick. The net is fastened to shackles placed at the top and bottom of the after-end of the board. Like the beam-trawl, the otter has many types, the proportions of the parts varying with the species sought. Headlines may be as much as 120 ft. in length: the fore and aft length of the actual net is rather less than that of the head rope, and as has been said that of the ground rope greater: the cod-end is usually about 14–18 ft. Much research has been devoted to determining the actual spread of the net when towed: and it appears probable that a 90 ft. headline gives a spread of rather over 50 ft.

Working the Net.—The operation of shooting is carried out fundamentally as in the beam-trawl—*i.e.*, the trawl is brought at right angles to the ship by running out the fore warp sufficiently, before both warps are lowered. The fore warp is then drawn to the quarter of the vessel, where it is shackled with the after warp during towing. Towing takes place at varying speeds, round about $2\frac{1}{2}$ knots, or in herring trawling $3\frac{1}{2}$ knots. Hauls vary in duration with the abundance of the fish: a common duration, seldom exceeded, is 3 hours. When about to haul the fore warp is released from the aft and the ship steered in a curve to bring them both at right angles to the side and so clear of the propellers. The warps are then rapidly wound in, and the net and cod-end brought on board as in the beam-trawl. The trawler carries her fish iced to port.

Seines.—The movable nets most resembling trawls are seines. This net consists essentially of a long strip of netting with a buoyed headline and a weighted ground rope. It is taken out in a boat to some distance from shore, paid out in a curve concave to the beach, and the lines attached to the net being brought ashore, the net is hauled to land. This simple seine is used for the capture of smelts and other small fish, but most seines have developed into more complex forms, usually by changes involving the formation of a bunt, or a true cod-end in the middle of the net: and several forms are worked completely away from shore.

Thus the *Danish plaice-seine* is now worked by a small steamer or motor vessel. It is a net some 180 ft. long, with a 50 ft. cod-end, and to each wing over a mile of warp is attached. One end of a warp is buoyed, and the ship moves in a great oval, paying out warp, net and second warp, and then returning to the buoy, when both warps and the net are hauled by special winding engines. The net gives excellent results with plaice or, properly modified, with haddock on clean level sand at moderate depths, but has hardly fulfilled expectations for general fishing far from land.

This net is the last development of the Danish seines. A simpler form is the *eel drag-seine,* which is worked from a boat in shallow water. It is somewhat smaller (140 ft. long) tapering at the wings and with a bag of 30 ft., the wings are attached to spars and drawn on board by warps. The *drift eel-seine* is an interesting development. It is similar but smaller, and drifts with the boat, the ends of the net being kept apart by a floating spar or, latterly, by small trawl boards. The bag is valved by a funnel of netting.

The Mediterranean *filet de boeuf* may be here included, as a net having affinities with both trawl and seine. It is worked between two boats, and has a very long cod-end.

Pilchard-seines are shot about a shoal of these fish by boats guided by the signals of watchers ("huers") on shore. They are shot in a nearly complete circle, which is then closed by a short "stop" net, when lines from the ends of the main net are taken ashore and the whole hauled to the shallows. The fish are then removed by a "tuck net," a small seine through whose lowest meshes a line is rove, so that by hauling this line the net changes from a wall of netting to a shallow basin. The main seine is about 200 fathoms long: as in the trawl, the meshes decrease in size towards the cod-end or purse.

The Purse-seine, much used in the United States and in Japan, is in principle a tuck-net. The mackerel or other shoal is

surrounded by a long wall of netting whose ground-rope bears rings through which is rove the line which on hauling converts the circle into a saucer. The slack of the net is then taken up gradually until the area is small and the fish are reached. In Japan the fish are guided into the purse by a long line of net which acts as a leader.

Drift-nets.—The nets of most importance after the otter-trawl are the drift-nets employed for the capture of herring, mackerel and other fish which pass much of their life near the surface of the sea. Although both herring and, in less degree mackerel are now trawled, the main fishery for these important fish is carried out by the drifters.

Drift-nets as employed in Great Britain are of fine cotton, the rougher nets being used now only by continental nations. The size of net varies with the locality and the fish to be taken, as does the mesh; but a common length is 30 yds. The mesh measures in rows of knots to the yard vary from over 60 for sprat, 29 to 36 for herring, and from 25 to 36 for mackerel. The nets are shot end to end on the same long warp, which may extend for as much as 3 miles, all headlines are buoyed by cork, the ground-ropes weighted, and in addition the warp is buoyed at intervals by buoys called bowls, the net being attached to the buoy ropes also. Some small nets are used with their headline at the surface, but usually they are sunk, except for mackerel. The warp is sometimes worked above the net, sometimes a fathom or more below it, the former are known as "sunk" nets, and French and Dutch drifters follow this plan; the others are called "swum" nets. When riding at nets the strain of the warp is taken by a chain or rope called the "tissot" which joins the warp near the net. The warp is of 3½ in. manila. The evolutions of shooting and hauling cannot be here described. The former is done so as to ensure the nets drifting free of the ship, the latter with the vessels head up wind.

Steam has replaced sail in drift vessels, and even more completely, such sailing drifters as remain being aided by auxiliary motor engines. An interesting development is the success of small vessels capable both of working drift-nets and at other seasons a small otter-trawl.

Stationary Nets.—Stationary nets, except for a few fish are relatively unimportant and can receive little more than a mention. They are of four main kinds. *Stake-nets* are gill nets usually set up between tide marks and supported by stakes. Occasionally the net between pairs of stakes is occupied by a simple bag, as in Germany. If the stake-net acts as a "leader" into a circular enclosure of netting the net is a pound- or kettle-net. The bag-net and fly-net for the capture of the salmon are merely elaborated forms of this type. The pound is roofed by netting, in the fly-net, and in the bag-net, which is floated—not staked—floored also. It is wedge shaped, narrowing gradually from the entrance end and divided incompletely by oblique internal walls or valves of netting into side compartments.

The stow-net is used in the Wash, Thames and Solent for the capture of sprats. It is a pyramidal net, about 200 ft. long, whose nearly square mouth is kept open by 20 ft. "balks" of timber, the bottom one weighted. Four bridles lead from the ends of the balks to the chain by which the vessel employing the net is anchored, always in a tideway. The sprats are carried by the tide into the net, which on the slackening of the tide is hauled after it has been closed by raising the bottom balk up to lie against the top one. A small stow-net is used also for taking "whitebait."

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SEIPEL, IGNAZ (1876–), Austrian statesman and Roman Catholic priest, was born in Vienna July 19, 1876. As professor at Salzburg (1909–12) he saw much of Heinrich Lammasch (*q.v.*), with whom he worked until 1917 in the preparation of an edition of the writings of Hugo Grotius on international law.

Seipel was appointed to Vienna University in 1917 and his work, *Nation and State*, dealing with the supernational state, such as the Austro-Hungarian Monarchy, as a higher type of State compared with the national State, and thus viewing Austria-Hungary's future optimistically, at the same time favouring a reasonable pacificism, caused the Emperor Charles to include him in the circle of those men who were to prepare the way for peace through unofficial negotiations abroad. At the same time, the German parties in the Austrian Parliament summoned him as scientific expert to the consultations on the reform of the constitution now recognised as overdue, and in these Seipel supported moderate federalism on a national basis. But the downfall of the Austro-Hungarian Monarchy could not be prevented either by reform of the constitution or by the peace policy of the Lammasch Ministry, which took office at the eleventh hour, in Oct. 1918, and included Joseph Redlich and Seipel as peace exponents.

After the collapse, Seipel succeeded in preventing the threatened split of the strongest Conservative party in the country, the Christian Socialist, into a Monarchist and a Republican party. This and the necessity of getting new men into Parliament under the new conditions caused his election in 1919 to the National Constituent assembly by the electoral division for central Vienna, and later to the National Council. During the first coalition Government, Seipel worked against too close an alliance of the Christian Socialists with the Social Democrats; in particular he prevented the execution of far-reaching schemes for the socialisation of means of production. After the elections of 1920, which returned the Christian Socialists at the head of the poll, Seipel was undisputed leader of his party. Under his influence Austrian policy gradually veered to the right, and after the resignation of Dr. Schober (*q.v.*), Seipel created a firm Anti-Socialist majority by concluding a parliamentary pact with the Pan-Germans. He then took office as Chancellor (May 31, 1922). At that time the universal misery had reached its climax owing to the policy of inflation. Seipel, together with his Ministers of Finance, August Ségur and Victor Kienböck, put an end to inflation by the creation of a new note bank independent of the Government and prepared for his negotiations with the League of Nations in the autumn of 1922 by his political journeys to Prague, Berlin and Verona, by which he obtained the guarantee of a foreign loan by a number of States and eventually the loan itself. Seipel succeeded by hard fighting in carrying through Parliament the acceptance of the Geneva Protocol and of the foreign controller of Austrian finances appointed by the League of Nations, and led Austrian policy to the re-establishment of almost complete financial equilibrium, and his majority and position were confirmed by the elections of October 1923. In the autumn of 1924, however, when he had hardly recovered from a wound inflicted in an attempt on his life, he resigned office on account of opposition encountered from that wing of his own party which represented local interests in the provinces. Seipel took office again on Oct. 20, 1926, at the head of a Christian-Socialist–Pan-German coalition, which he managed skilfully, discouraging open *Anschluss* propaganda and insisting on the maintenance of treaties, but stressing every opportunity for co-operation with Germany. Proper control of the budget was assured as a safeguard against the repetition of scandals. The elections of April 1927 continued Dr. Seipel's mandate; but his term of office witnessed dangerous growth of hostility between the Socialist and Anti-Socialist elements. On May 4, 1929, Dr. Seipel retired, and was succeeded as chancellor by Ernst Streerowetz.

SEISIN, the possession of such an estate in land as was anciently thought worthy to be held by a free man. Seisin is of two kinds, in law and in deed. Seisin in law is where lands descend and the heir has not actually entered upon them; by entry he converts his seisin in law into seisin in deed. Seisin is now confined to possession of the freehold, though at one time it appears to have been used for simple possession without regard to

the estate of the possessor. Its importance is considerably less than it was at one time, owing to the old form of conveyance by feoffment with livery of seisin having been superseded by a deed of grant (*see* FEOFFMENT), and the old rule of descent from the person last seised having been abolished in favour of descent from the purchaser (*q.v.*). At one time the right of the wife to dower (*q.v.*) and of the husband to an estate by curtesy (*q.v.*) depended upon the doctrine of seisin.

Primer seisin was a feudal burden at one time incident to the king's tenants *in capite,* whether by knight service or in socage. It was the right of the Crown to receive of the heir, after the death of a tenant *in capite,* one year's profits of lands in possession and half a year's profits of lands in reversion. This was ended by the act abolishing feudal tenures (12 Car. II. c. 24, 1660).

See F. W. Maitland, "Seisin of Chattels," *Law Quarterly Review,* vol. i., p. 324 and "The Mystery of Seisin," *Law Q.R.* ii. 481; Pollock and Maitland, *Hist. Eng. Law,* vol. ii. 29 *seq.*

SEISMOMETER. The term *seismometer* (from σεισμός, an earthquake, and μετρόν, a measure) was invented by David Milne (afterwards Milne Home) in 1841 to denote an instrument for recording and measuring the movements of the ground during an earthquake. It is our earliest seismological term. A few years later, the name *seismograph* (γραφη, a writing) was given to an instrument erected in 1855 by L. Palmieri in the (then) new observatory on Vesuvius. A much simpler type of instrument is included under the heading of *seismoscope* and aims at little more than the announcement of the fact that a shaking has occurred, or the record of its time or direction.

Early Instruments.—The first seismometer deserving of the name was one invented in 1841 by J. D. Forbes for "measuring earthquake shocks and other concussions." The scientific principles underlying the construction of seismographs were realized in 1880 by some of the British teachers in Japan—J. A. Ewing, T. Gray and J. Milne—and the instruments erected by them in Tokyo and elsewhere, threw much light on the nature of the earthquake-motion. In 1881–82, the attempt of G. H. and H. Darwin at Cambridge to measure the lunar disturbance of gravity led to the construction, in 1893, of H. Darwin's bifilar pendulum and of Rebeur-Paschwitz's horizontal pendulum (1887).

Seismoscopes.—The earliest instrument of the kind known to us may be classed as a seismoscope. The invention of a Chinese scholar Chang Hêng, it dates as far back as the year A.D. 132. It consisted of a column so suspended that it could move in one of eight directions. A ball was held lightly along each of these lines and, when thrown down by the rod, was caught in a cup below and so revealed the direction of the motion.

Later seismoscopes were frequently designed to give the time of occurrence of a shock. They consisted as a rule of a horizontal rod lightly pivoted at one end and provided with teeth below so that, when the rod fell, the teeth caught a pin projecting from the pendulum of a clock.

Modern Types.—The essential feature of a seismometer is that some point or line within it shall remain at rest, or very nearly so, during the complicated movements of the ground in an earthquake. Various methods of obtaining such steady points have been proposed, but the instruments in general use are various forms of pendulums, either *common* pendulums, in which a heavy mass is suspended by a wire or rod from a fixed point above, or *inverted* pendulums, which consist of a vertical rod with its lower end pointed and working in a conical cavity and carrying a heavy mass at its upper end, or *horizontal* pendulums in which a horizontal rod carrying a heavy mass is suspended from two points in various ways. A few instruments are a combination of two forms of pendulum—the Ewing duplex pendulum seismometer of common and inverted pendulums, and the instrument used by the Darwins of common and horizontal pendulums. Two methods of registration are now used—the one mechanical, a fine point tracing the movement on smooth paper covered with a thin layer of smoke, the other photographic, the beam of light either passing through a hole at the end of the pendulum or, more generally, reflected from a mirror connected with it.

An important point to remember about all pendulums is that they tend to oscillate with their own proper period. If the period of vibration of an earthquake should approach that of the pendulum, such vibrations will then be unduly magnified in the record. The tendency is met, and the record corrected, by some form of damping, such as the resistance of a liquid (as in the Darwin bifilar pendulum), or a confined air-space (as in the Wiechert pendulum), or electro-magnetic reactions (as in the Galitzin and Milne-Shaw seismographs).

Common Pendulums.—Seismometers based on the common pendulum were in early use. One was erected near Comrie in Perthshire in 1840. It was 39 inches long and the bob carried at its lower end a pointer that traced the movement of the pendulum in a thin layer of sand below it. Instruments of this class have always been favoured in Italy, and many records of distant earthquakes have been obtained by them. They agree closely in their methods of recording the movements on smoked paper wrapped round a revolving drum. A thin rod, projecting downwards from the bob of the pendulum, works in slits in the short arms of two horizontal levers. The short arms are at right angles to one another, so that the pointed ends of the long arms record two perpendicular components of the motion. One of the levers is straight and the other is bent at right angles, or both are bent at an angle of 45°, and the pointed ends rest near one another on the smoked paper in motion below. The instruments differ chiefly in the length of the pendulum and the weight of the bob.

Inverted Pendulums.—The oldest form of inverted pendulum seismometer, indeed the oldest seismometer of any kind, was that designed by Prof. J. D. Forbes in 1841 and erected in the same year at several places near Comrie. Its essential features are shown in fig. 1. The heavy ball C is carried on a vertical metal rod AB, on which it can be adjusted at any height desired. The rod ends below in a cylindrical steel wire D fixed to the base of the instrument, which can be made more or less stiff by altering its free length. As this wire is cylindrical, the direction of the displacement is indicated by the plane of vibration of the pendulum. The self-registering part of the instrument consists of a spherical segment E of copper lined with paper, against which a pencil F, in the top of the pendulum rod, is pressed by a spring.

The most widely used form of inverted pendulum is that designed by Prof. E. Wiechert. In one, the heavy mass consists of iron plates, weighing a little more than a ton. This is carried on a stout iron rod, supported at the lower end on springs which enable it to turn freely in any direction and yet, after disturbance, restore it to its vertical position of equilibrium. The displacements of the pendulum are magnified by two levers ending in fine glass rods which inscribe the records of their movements on a sheet of moving smoked paper. By means of air-damping cylinders, the pendulum can be made as nearly aperiodic as is desired. The movements of the ground are magnified about 500 times. In a still more sensitive form of the instrument, the iron plates forming the heavy mass are replaced by a cylinder that can be filled with the heavy mineral barytes. The weight is thus increased to nearly 17 tons, while the movements are magnified 2,200 times.

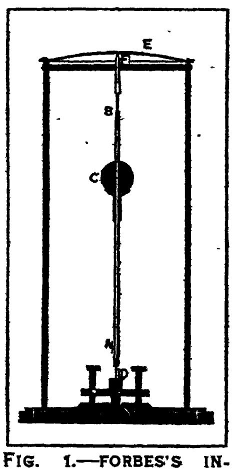


FIG. 1.—FORBES'S INVERTED PENDULUM

Horizontal Pendulums.—The horizontal pendulum in its simplest form consists of a metal rod or frame rotating about a nearly vertical axis, and carrying a heavy mass near one end or the middle. It may be (a) supported on two conical steel points, or (b) one end of the rod may be pointed and rest in a conical hole in the frame while the other is supported by a wire, or (c) the rod may be supported by two wires, the weight being either between or outside the two points of attachment of the wires. Whatever the mode of suspension, however, it is essential that the horizontal distance between the points of support shall be very small compared with the vertical distance between them, that is, that the line joining

the two points of support shall be inclined at a very small angle to the vertical. In each case, it is clear that, if the pendulum when at rest is directed east and west, it is only movements which are wholly or partly in the north-south direction that disturb the instrument. For a complete representation of the horizontal motion, it is therefore necessary to have two similar instruments placed side by side at right angles.

The Rebeur-Paschwitz horizontal pendulum is of interest as the first instrument erected by which records of distant earthquakes were regularly made. It is notable for its lightness and small size, its weight being only 1½ ounces and its length less than

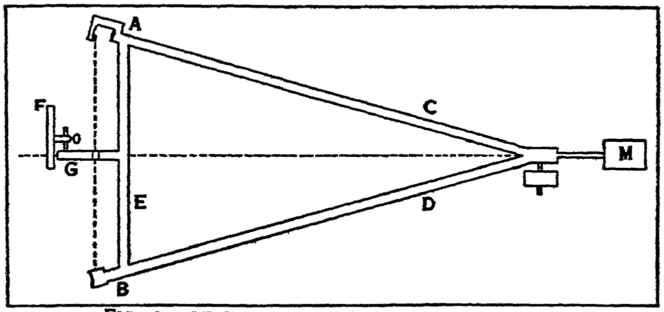
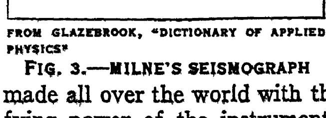


FIG. 2.—REBEUR-PASCHWITZ HORIZONTAL PENDULUM

8 inches. It consists (fig. 2) of three thin brass tubes, C, D, E, in the form of an isosceles triangle, carrying a small mass M. The two equal tubes are prolonged at A and B and end in small spherical agate cups. These rest against steel points fixed to the frame of the instrument. The rod G projects at right angles to the tube E, and to it is attached the mirror F, which passes through the frame of the support. The photographic method of registration is used.

The Milne seismograph (fig. 3) was used by Prof. Milne in Japan for the registration of distant earthquakes and, with improvements in detail, became for many years the standard instrument at the observatories under the care of the British Association Seismological Committee. The boom of the pendulum BD is an aluminium rod about 39 inches long. The bob M consists of two brass balls, each about half a pound in weight and attached to the ends of a short bar crossing the boom at right angles. At the end B of the boom there is a small agate cup that rests on a steel point in the cast-iron column AB, which is about 20 inches in height. The boom is further supported by a silk thread CA, which passes over a small pulley at the top of the column. It ends at D in a small aluminium plate, in which there is a narrow slit. In the top of the case containing the recording part of the instrument a similar plate is fixed in the direction at right angles to the other. A ray of light from an adjacent lamp is reflected by a mirror so as to pass through both slits and form a small spot of light on a sheet of bromide paper wrapped round the brass cylindrical drum P. The drum is 39 inches in circumference, rotates once in four hours, and, with every revolution, advances one-quarter of an inch in the direction of its axis. Close to the end D, a small shutter attached to the long hand of a watch cuts off the light once every hour, thus providing the scale of time.

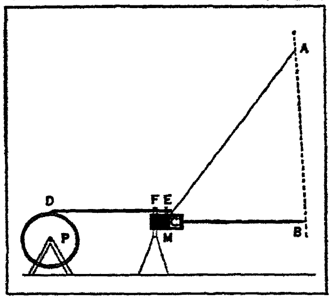


FROM GLAZEBROOK, "DICTIONARY OF APPLIED PHYSICS"

FIG. 3.—MILNE'S SEISMOGRAPH

It would be difficult to overestimate the value of the records made all over the world with the Milne seismograph. The magnifying power of the instrument is, however, low (about 7 or 8 times), and it is unprovided with any form of damping. Both of these defects have been removed by Mr. J. J. Shaw, and, since 1915, the Milne-Shaw seismograph has been gradually replacing the earlier form. In this, a boom, 16 inches long, carries a heavy mass weighing one pound, and also a damping vane which moves in a magnetic field so strong that the pendulum is brought to rest after each oscillation. The beam of light is reflected by a mirror which rotates in an agate setting and is coupled to the free end of the boom. This gives a magnifying power of 300. After passing through two cylindrical lenses at right angles to one another, the beam of light converges to so fine a point on the paper that waves with a period of two or three seconds are clearly shown on paper moving at the rate of about 20 inches an hour.

The Omori horizontal pendulum (fig. 4) belongs to the same type as the Milne seismograph, the chief difference being that the record is made on smoked paper, thus allowing a much more open diagram. The boom BC is an iron rod about 40 inches long and the bob M is a cylinder filled with lead and weighing about 30 pounds. The pointed end B rests in a conical socket fixed to the iron supporting column, the other support being a wire CA that passes over a pulley at the top of the column. The recording lever DE is a light aluminium rod which turns about an axle F connected with the ground. The short arm FE of the lever ends a horizontal fork, the branches of which pass round a vertical steel axle connected with the mass M. This axle turns with great freedom, so that there is very little friction between it and the lever. The other end D of the lever is a light aluminium pointer which rests lightly on a sheet of thinly smoked paper wrapped round the rotating drum P. The drum is about 36 inches in circumference, rotates once an hour, and advances parallel to its axle one-sixth of an inch with every revolution. Once every minute, time-marks are made on the paper by a small pointer (not shown in fig. 4) connected with a clock. The chief advantage of the Omori pendulum is the open diagram that it provides, but, being undamped, the oscillations of the pendulum lessen the value of the record. The Omori pendulum is also made in other forms. In the portable form, the mass weighs about 6¾ pounds and the length of the rod is nearly 30 inches. For recording local shocks, two other forms are used. In one, the mass weighs 110 pounds, the length of the rod is nearly 8 inches, and the movements of the ground are magnified 20 times; in the other, the corresponding figures are 33 pounds, 2½ inches and 70 times. A somewhat similar instrument is the Bosch-Omori horizontal pendulum, one form of which records mechanically and the other photographically.



FROM DAVISON, "A MANUAL OF SEISMOLOGY"

FIG. 4.—OMORI'S HORIZONTAL PENDULUM

The Darwin bifilar pendulum (fig. 5) is a modification of the instrument used by G. H. and H. Darwin in their experiments on the lunar disturbance of gravity. In this instrument, the mirror M itself is the bob of the pendulum. It is carried by a fine silver wire, passing through two hooks C, D, in the rim of the mirror and attached to two points of support at a very small distance apart horizontally. The instrument is damped by being entirely immersed in oil, and its movements are recorded by light reflected from the mirror to a sheet of bromide paper wrapped round a revolving drum. Though many earthquakes have been recorded by the bifilar pendulum, it does not, owing to its immersion in oil, respond to the preliminary tremors of short period. The instrument is, however, extremely sensitive to small tilts of the ground, and it has been found possible to measure a tilt of $\frac{1}{300}$ of a second, which is equal to the angle formed by lifting through an inch the end of a line one thousand miles in length.

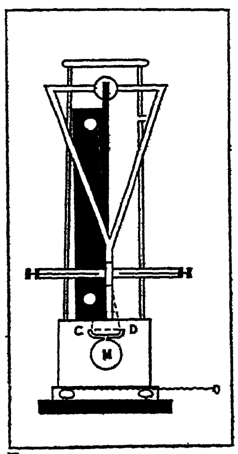
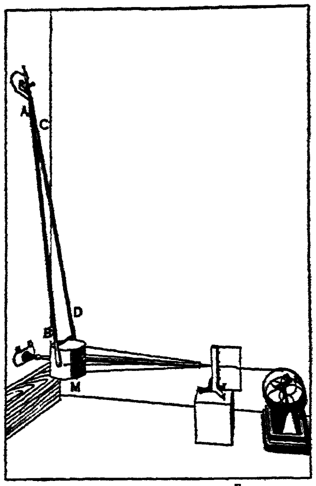


FIG. 5.—DARWIN'S BIFILAR PENDULUM

The Galitzin seismograph, like the Darwin pendulum, belongs to the third type of horizontal pendulum. The arrangement of the mass M and the supporting wires AB, CD are as shown in fig. 6. The weight of the mass is about 110 kg. At one end of the

beam, a copper plate is attached horizontally and placed between a pair of powerful horseshoe magnets. When the pendulum is displaced, currents are induced in the copper plate, and the attraction between them and the magnets damps the swing. By adjusting the distance between the magnets, the pendulum can be rendered absolutely aperiodic. Close to the copper plate, coils of fine wire are also attached to the beam and placed between another pair of horseshoe magnets. When the beam moves, an electric current is generated in the coils, and is transmitted to a sensitive d'Arsonval galvanometer, the movements of which are registered by a ray of light reflected by the galvanometer mirror on to photographic paper wrapped round a revolving drum. This current is proportional, not to the displacement of the beam, but to its velocity. Thus, the record does not correspond to the actual movements of the ground, but it gives with great accuracy the epochs of the various phases of an earthquake. Though not without disadvantages, the instrument possesses many compensations. It can be accurately damped, it can be arranged so as to magnify the movements of the ground 1,000 times or more, owing to its suspension by wires the beam moves without friction, and the recording apparatus can be placed at some distance from the pendulum, if desired.

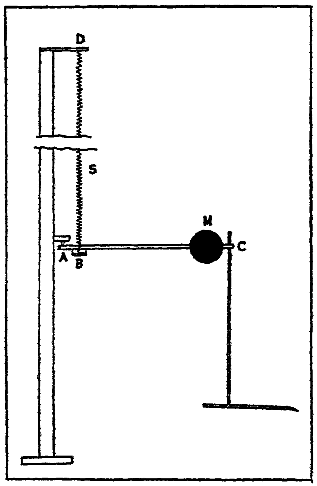


FROM GALITZIN "VORLESUNGEN ÜBER SEISMOMETRIE"

FIG. 6.—GALITZIN'S HORIZONTAL PENDULUM

A pendulum suspended in the same manner, with a small concave mirror attached to the rod at the centre of rotation, has recently (1927) been erected by Mr. M. Ishimoto at Tokyo and other places in order to measure very small tilts of the ground.

Vertical Motion Seismograph.—All the instruments described above are designed to record the horizontal component or components of the earthquake motion. Instruments intended for recording the vertical component depend as a rule on a principle first recognised by Prof. T. Gray in 1881. Gray's vertical motion seismograph, with improvements suggested by Sir J. A. Ewing, is represented in fig. 7. In this instrument, AC is a horizontal metal beam, carrying near one end the cylindrical heavy mass M. The beam turns about a fulcrum at the end A, which consists of two steel points fixed to a projection from the frame and pressing into a hole and knife-edge at the end of the beam. It is supported by two long springs S, adjustable at the upper end D, while their lower ends are attached to a hanging cross-bar B, in the middle of which a point presses against the lower side of the beam. The length of the springs S is adjusted so that the moments about the fulcrum of the weight of the pendulum and the upward pull of the springs are approximately equal. When the fulcrum A is displaced in the vertical direction, the line that remains steady lies within the mass M on the side of its centre away from the fulcrum, and the movements of the ground are magnified by a lever projecting downwards from the free end of the arm. In Galitzin's vertical motion seismograph, which is a compact form of the above, the weight of the beam and mass is about 54 pounds and the length of the beam 30 inches. At the end of the beam are attached a copper plate and coils of wire placed between magnets, the one for damping the instrument and the other for recording the velocity of the beam, as in the horizontal motion seismograph.



FROM DAVISON, "A MANUAL OF SEISMOLOGY"

FIG. 7.—GRAY'S AND EWING'S VERTICAL MOTION SEISMOGRAPH

BIBLIOGRAPHY.—The literature of seismometry is very extensive, and it is only possible here to refer to a few of the works in which the theory and construction of different instruments are described—R. Ehlert (*Beit. zur Geoph.*, vol. 3, 1896–98, pp. 350–474); J. A. Ewing, *Earthquake Measurement* (Tokyo Imp. Univ., Mem. Sci. Dept., no. 9, 1883, pp. 1–92); Prince B. Galitzin, *Vorlesungen über Seismometrie* (1914, pp. 1–538, German trans. edited by O. Hecker); C. G. Knott, *The Physics of Earthquake Phenomena* (1908, pp. 48–89); H. F. Reid, *Theory of the Seismograph* (Californian Earthquake of 1906, vol. 2, 1910, pp. 143–190) and *On the Choice of a Seismograph* (Amer. Seis. Soc. Bull., vol. 2, 1912, pp. 8–30); G. W. Walker, *Modern Seismology* (1913, pp. 1–36); and E. Wiechert, *Theorie der automatischen Seismographen* (Abhand. der kön. Gesell. Wissen. zu Göttingen, Math. Phys. Kl., vol. 2, 1903, pp. 1–128). Brief descriptions of several instruments specially adapted for recording near earthquakes, such as Ewing's three component seismograph, the Gray-Milne seismograph, and Ewing's duplex pendulum seismometer, will be found in C. Davison's *Manual of Seismology* (1921, pp. 17–22).

SEISTAN, the ancient *Sakastane* ("land of the *Sakae*"), an extensive border district between Persia and Afghanistan, situated in most part between 29° 0′ and 32° 0′ N., and 61° 0′ and 62° 30′ E. Its area, some 100 m. in extreme length and breadth, covers about 7,000 sq.m. about two-fifths of which lies in Persia and three-fifths in Afghanistan. The total population was estimated at 205,000 in 1906.

A physical feature of this region of Asia is that none of the rivers flow to the sea, but discharge into great inland depressions—the Seistan depression being one—of which the general level is about 1,400–1,700 ft. above the sea. Regarded as a whole the Seistan depression, or Hamun, into which the rivers here discharge themselves, consists of two extensive lagoons, formed respectively by the Harud Rud and the Farah Rud (both coming from the north), and by the Helmund river and Khash Rud (coming respectively from the south and east). South of these lagoons extends a tract of country covered with reeds called the Naizar. When the rivers are in flood the two lagoons become united and the inundation covers the Naizar also. A further tract then also becomes overflowed, so that a great lake is formed which, lastly, discharges its redundant waters, through a course called the Shela (or Shelag), into a depression called the Gawd i Zarih.

The population consists chiefly of Tajiks, but Baluchis and Qainis, descendants of the ancient rulers of the land, have also established themselves; and Nadir Shah forced some nomad tribes of Shiraz to emigrate to Seistan.

Politically, Seistan is divided between Persia and Afghanistan by a theoretical boundary line fixed by Commissions appointed to examine the question in 1872 and 1903–5. This line runs from the Kuh i Malik Siyah mountain, on the Perso-Afghan frontier, roughly north-east to Band i Seistan on the Helmund, thence northward to the Naizar reed beds on the Hamun shore, whence it turns westward to Siyah Kuh. The part falling to Persia west of this line is usually known as "Seistan Proper" and that on the east as "Outer Seistan."

The original chief town of Persian Seistan, Sihkuna, has been supplanted by Nasratabad (formerly Nasirabad), founded by the Amir of Qain about 1870, and locally known as Shahr-i-Seistan. Quain (*q.v.*) and Seistan together form a hereditary governorship, practically independent of the governor-general of Khurasan.

The trade outlets from Seistan proper are: (a) from Nasratabad southward to Duzdab (135 m.) and thence by rail to Nushki and Quetta; (b) from Nasratabad to Birjand, where the route joins the Meshed-Duzdab motor road. Both roads are unmetalled but are passable for light motor traffic; transport by caravan on the first takes 7–8 days to Duzdab, and on the second 14–15 days to Birjand. A project was under consideration in 1927 for a light railway from Duzdab to Seistan, for the transport of the wheat which is the special product of the district, to the Indian market.

Afghan Seistan comprises the land east of the frontier described above, and includes the Hamun i Puza (the more eastern of the two northern lagoons) up to Juwaim in the north; the tract extends southward to the frontier of Persian Baluchistan, in which country lies the Gawd i Zarih lagoon. The capital is Khakansur,

a small settlement on the Khash Rud, about 30 m. north-east of Nasratabad.

History.—The ancient *Drangiana*, or land of the *Drangai*, received the name of Sakastane after the country was conquered by the Sakae (Scythians) about 128 B.C. Certain references in the Avesta lead to the supposition that Seistan, in antiquity, was a principal seat of the Zoroastrian religion. In ancient and mediaeval times the name Sakastane denoted a larger area than the name now implies and possibly even included a great area towards the east up to Kandahar. Ardashir, the founder of the Sasanian dynasty, subjugated Sakastane, but during the Sasanian epoch the Sakae appear rather as allies than subjects.

The Arab conquest of Seistan began in 683–4, but the hold of the country by some of the caliphs was precarious and uncertain. The only time Seistan played an important part in mediaeval history was during the reign of the Safavid dynasty—founded by Yaqub b. Layth, himself a Seistani—during which period it was naturally the central land of the dynasty. After the downfall of the Safavids, Seistan belonged successively to the empire of the Samanids and Ghaznawids, but the land had its own *maliks*, or native rulers, under the suzerainty of the greater dynasties.

The early ravages of the Mongols reached the frontiers of Seistan and after their departure its history becomes confused and several persons strove for the supremacy. In 1300–1 Seistan suffered from an invasion of the Chagatai and then, again, sustained fearful damages from the Mongols at the hands of Timur, who destroyed Zaranj, the capital situated near the Sanarud canal, took prisoner the *malik*, Qutb ud Din Kayam (1383) and destroyed the canal system of the land.

Thenceforward Seistan had its own rulers until Shah Ismail conquered the country in 1508–9. The native princes of Seistan remained vassals of the Persian empire till the Afghan invasion of Mir Mohammed (1722), when the *malik*, Kayani Mohammed, by means of a disloyal treaty with the Afghans, secured for himself the possession of Seistan and Khurasan. He was slain by Nadir Quli Khan, the general of Shah Tahmasp who, afterwards, as Nadir Shah, retained Seistan as part of his Persian dominions. After Nadir's death (1736) Seistan came under the suzerainty of Ahmad Shah, the Durrani ruler of Afghanistan but, on his death (1773), the land became a bone of contention not so much between Persians and Afghans as between Herat and Kandahar.

Eventually the internal dissensions of Afghanistan gave Persia her opportunity—the Sarbandi chief, Ali Khan, allied himself with the Persian government, hoisted the Persian flag on the fortress of Sihkuha, the capital town, and sent his sons as hostages to the Shah at Meshed (1853). The Shah's army finally took possession of Seistan in 1865, and two years later it was placed under a Persian governor with the title of *Hashmat ul Mulk*. Complications between Persia and Afghanistan during this period led to British arbitration and the delimitation of the border by the Seistan Commission of 1872, under the leadership of Sir F. J. Goldsmid. In accordance with the award, the Persian forces evacuated that part of Seistan lying on the right bank of the Helmund. The work of delimitation was finally completed by the MacMahon Mission in 1903–5.

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(P. Z. C.)

SEITZ, KARL (1869–), Austrian politician, was born at Vienna on Sept. 4, 1869, the son of a wood merchant. Originally inclined to the German National party, he joined in 1888 the Social Democratic party. He organized the Social Democratic teachers of Vienna, and in the diet of Lower Austria waged a fierce fight against Burgomaster Lueger and the dominant Christian Socialist party. Elected to the Austrian *Reichsrat* in 1901 he became after the death of Pernerstorfer, its vice-president down to its dissolution. After the revolution of 1918 he was president of the German-Austrian National Assembly, and subsequently of the national parliament (*Nationalrat*) until the new elections in Oct. 1920, and acting federal president until Nov. 1920. He was in 1921 chairman of the committee of the Social Democratic party and of the parliamentary party, and vice-president of the *Nationalrat*. In 1924 he was elected burgomaster of Vienna.

SEJANUS, LUCIUS AELIUS, favourite and minister of the emperor Tiberius. He was the son of Seïus Strabo, prefect of the praetorians, and was adopted into the Aelian gens. When his father became governor of Egypt, Sejanus was made prefect in his stead, with the support of the praetorians, whom he concentrated in a camp on the Viminal hill. He became virtually ruler of Rome. In pursuit of a still higher ambition, he poisoned Drusus, whose death was followed by those of Agrippina and her sons, Drusus and Nero, all under suspicious circumstances. He then induced Tiberius to return to Capreae. Tiberius caused Sejanus to be put to death (A.D. 31).

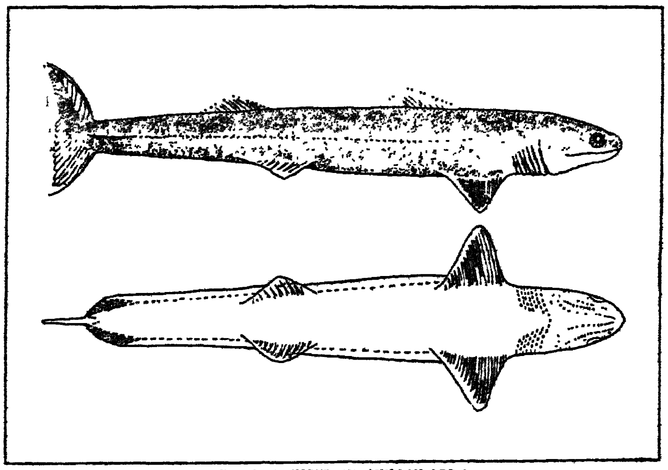
See Tacitus, *Annals*, iv. 1, 2, 3, 8, 39–59, 74, v. 6–9; Suetonius, *Tiberius*, 62; Dio Cassius, lvii., lviii.; Juvenal, x. 65–86; J. Jülg, *Vita Aelii Sejani* (1882), with notes giving full references to authorities; J. C. Tarver, *Tiberius the Tyrant*, chap. xvii. (London, 1902).

SEKONDI, a town on the Gold Coast, British West Africa, in 4° 57′ N., 1° 42′ W., and 167 m. by rail S. by W. of Kumasi. Pop. (1921) 9,500 natives and about 300 Europeans. Sekondi is one of the old trading stations on the Guinea coast, and Fort Orange was built here by the Dutch about 1640, the English later on building another fort near by. In 1694 the Dutch fort was plundered by the Ahanta, who in 1698 burnt the English fort. It was not rebuilt, and it was not until 1872 that the place became definitely British. The town was of little account until it was chosen as the sea terminus of the railway serving the gold-mining districts and Ashanti. The railway reached the Tarkwa goldfields in 1901 and the Obuassi mines in 1902. Although it had no sheltered harbour (ships had to anchor in the roadstead half a mile from the shore). Sekondi then became the chief port of the Gold Coast colony. But after the opening in 1928 of the deep water harbour a few miles west at Takoradi (*q.v.*) Sekondi declined as a port. It continued, however, to be a business centre, with excellent rail and road connections with Takoradi.

SELACHIANS, a group of fish-like vertebrates that includes the sharks and rays. They are often ranked as a sub-class of the Pisces, but differ so fundamentally from the bony fishes that it is best to recognize them as a distinct class, Selachii, which may be thus defined:—Craniate vertebrates with jaws, and with branchial arches supporting the gills. Nasal organs, paired blind sacs, with incompletely divided external apertures. Skin with denticles structurally similar to teeth; no dermal ossifications. Internal skeleton cartilaginous. Median and paired fins with horny rays, and with skeleton typically of a series of cartilaginous rods. Vertebral column of the notochord and its sheath, neural and haemal arches, and intermuscular ribs; no supra-neural arches or pleural ribs. No air-bladder.

Most living sharks are more or less spindle-shaped, with transverse or crescentic mouth, generally on the under side of the head, and with a series of five to seven gill-openings on each side in front of or partly above the pectoral fins. The end of the tail is provided with a fin above and below the upper and lower lobes of the caudal fin. Generally the end of the tail is upturned and the lower caudal lobe is more developed than the upper (heterocercal tail); in swift pelagic sharks with pointed fins the end of the tail

is strongly upturned, the upper lobe is greatly reduced and the lower is correspondingly developed, but in the slower bottom-living forms with rounded fins the end of the tail is but little upturned and the caudal lobes are more nearly equal. The rays are bottom-living forms with flattened head and body, ventral gill-openings and large pectoral fins. The Chimaeroids live on the bottom, and have a long tapering tail and large paddle-like pectoral fins. From the correspondence between habits and form of the fins in living selachians, it is certain that the Palaeozoic *Cladoselachus* and *Acanthodes,* with broad-based, pointed fins and strongly heterocercal tail, were pelagic, but that *Pleuracanthus,* with long tapering tail and paddle-like paired fins, lived at the bottom. (For a general account of the principal living forms, and their habits, *see* SHARK, RAY.)



FROM MIVART, "CAMBRIDGE NATURAL HISTORY" (MACMILLAN LTD.)

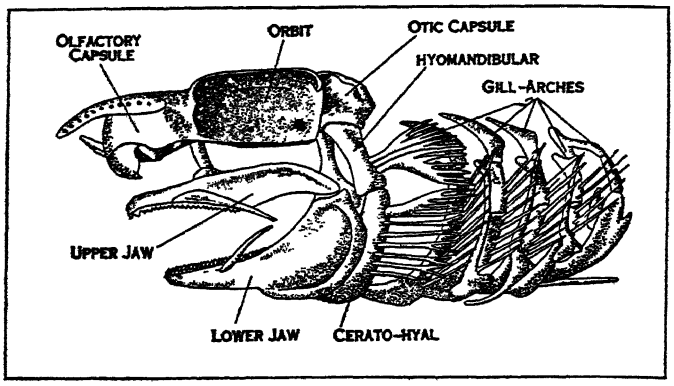
FIG. 1.—CLADOSELACHUS, A PRIMITIVE PALAEOZOIC SHARK

ANATOMY

Gill-arches and Jaws.—Selachians are of special interest in that they are in many respects the most primitive of the vertebrates, and a study of their structure and development throws light on the origin of jaws, teeth and limbs. They differ from the Cyclostomata in their method of breathing, water being taken into the pharynx and expelled through the gill-clefts by the expansion and contraction of the pharynx. The gills are series of parallel strap-like projections from the anterior and posterior walls of the gill-clefts, which are separated by thin septa; the inner ends of the septa are supported by cartilaginous arches that nearly encircle the pharynx, and are divided on each side into four segments; the principal elements of these arches, epi-branchials above and cerato-branchials below, are directed backwards and meet at an angle when the pharynx is contracted; above the epi-branchials are the pharyngo-branchials, and below the cerato-branchials the hypo-branchials join a median series of basi-branchials. The jaws of Selachians clearly represent the epi- and cerato-elements of an anterior gill-arch, enlarged and covered with teeth. In modern sharks and rays the jaws are supported by the enlarged epi-element, or hyomandibular, of the arch behind it, or hyoid arch, which articulates with the otic region of the skull, but in the Chimaeroids the upper jaw, or pterygo-quadrate, is fused with the skull, and the hyoid arch is not modified for suspension.

Teeth.—In having the body covered with denticles formed of dentine the Selachians resemble the most primitive Agnatha, the Silurian and Devonian Coelolepidae (*see* CYCLOSTOMATA). Similar, but smaller denticles, may occur in the mouth and pharynx, and the true teeth are to be regarded as homologous structures. The teeth are attached to the membrane covering the jaws, which is continually moving outwards, so that the worn teeth drop off and are replaced; behind the series in use can be seen a number of series in reserve.

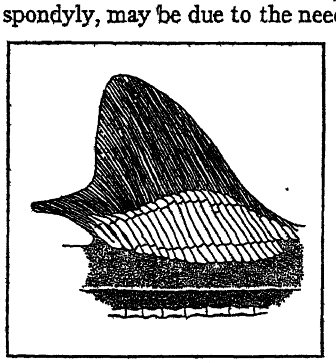
Fins.—In the Selachians both median and paired fins are keel-like outgrowths of the body strengthened by horny fin-rays; their skeleton primarily consists of a series of cartilaginous rods segmented into two principal pieces, basals within the body and radials in the fin; each of the rods has a muscle on each side. A study of the development shows that all the fins begin as longitudinal folds of the epidermis, at the base of which a mesenchyme plate develops; next a double series of buds from the body muscles migrate into the fins, and later the cartilaginous skeleton differentiates out of the mesenchyme plate. From their similar structure and development the conclusion is drawn that the median and paired fins have a similar origin, and that they originated as outgrowths of the body. The limb-girdles, pectoral arch and pelvis are formed by fusion of the anterior basals, and sharks in which there is no pelvis (*Cladoselachus*) are the most primitive.



BY COURTESY OF THE ZOOLOGICAL SOCIETY OF LONDON

FIG. 2.—SCYLIORHINUS SKULL SHOWING JAWS AND GILL ARCHES

Vertebral Column.—In Selachians the vertebral column consists of the notochord and its cartilaginous sheath, and of dorsal and ventral series of paired cartilaginous plates; the dorsal plates may meet above the spinal cord, or the arch may be completed by a median series of cartilages, but the whole is below the longitudinal elastic ligament; there are no paired elements meeting above the ligament and carrying a series of spines, as in the Pisces, and their ventral counterparts, the pleural ribs and haemal spines, are also absent. The cartilaginous sheath of the notochord may be calcified, and segmented into centra. Each vertebra has a neural plate, or basi-dorsal cartilage, perforated or notched behind for the exit of the ventral root of a spinal nerve, and another, inter-dorsal, perforated or notched for a dorsal root. In the caudal region of the Euselachii the vertebrae are twice as numerous as the muscle segments, so that every other pair of basidorsals and interdorsals has no nerve exits; this condition, known as diplospondyly, may be due to the need for greater flexibility of the tail. The tail of the Chimaeroids is polyspondylic; *i.e.,* the vertebrae are more than twice as numerous as the myotomes. In musculature, visceral anatomy, etc., the Selachians have a general resemblance to the more primitive bony fishes; thus the intestine has a spiral valve and the heart has a conus with several series of valves; the brain is characterized by the large divergent olfactory lobes.



FROM MIVART, "CAMBRIDGE NATURAL HISTORY" (MACMILLAN LTD.)

FIG. 3.—SKELETON OF THE FIRST DORSAL FIN OF MUSTELUS ANTARCTICUS

Development.—In all living Selachians fertilization is internal, the males being provided with paired intromittent organs, mixopterygia, which are appendages of the pelvic fins, with a cartilaginous internal skeleton and with a groove or canal along the whole length of each, which is the duct of a glandular sac at its base. The eggs are large, heavily yolked, and enclosed in horny cases; in many sharks and rays the eggs are not laid, the cases are absorbed, and development proceeds within the body of the mother; some of these viviparous forms (e.g., *Mustelus*) have a yolk-sac placenta, and in certain rays (e.g., *Pteroplatea*) long

uterine villi pass into the spiracles of the young and furnish a nutritive secretion.

CLASSIFICATION

The following classification is modified from that of Regan (1906).

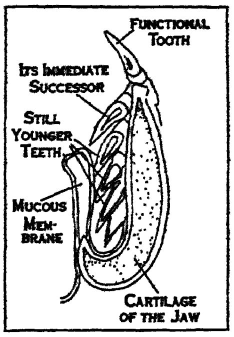
Class *Selachii*

Sub-class 1. *Pleuropterygii.* Palaeozoic sharks with broad-based, paired fins, the pelvics without any fusion of the basalia, the pectorals scarcely more advanced in structure. *Cladoselachus, Cladodus, Symmorium, Cratoselache.*

Sub-class 2. *Acanthodii.* Palaeozoic sharks with a strong spine at the anterior edge of each fin. As in the Pleuropterygii, the paired fins were broad-based, and mixopterygia appear not to have been developed. *Acanthodes,* etc.

Sub-class 3. *Ichthyotomi.* Palaeozoic sharks in which the pectoral basalia form the segmented axis of a biserial fin like that of *Ceratodus* (lung fish); males with mixopterygia. *Pleuracanthus.*

Sub-class 4. *Euselachii* (modern sharks and rays). Pectoral fin with metapterygium (fused basalia), and with propterygium and mesopterygium, formed by union of proximal segments of anterior radials; pelvic fins with pelvis and basipterygium; males with mixopterygia. Pterygoquadrate free from skull. Hyomandibular articulating with skull and supporting jaws. Gill-clefts with separate external openings.



FROM RIDWOOD, "CAMBRIDGE NATURAL HISTORY" (MACMILLAN LTD.)
FIG. 4.—TRANSVERSE SECTION THROUGH THE JAW OF A SHARK

Order 1. *Pleurotremi* (sharks)

Pectoral fins free from head; gill-openings lateral. Hyomandibular with cartilaginous rays supporting the first half-gill. Two halves of pectoral arch well separated above.

Sub-order 1. *Notidanoidea.* Six or seven gill-openings. A single dorsal fin above the anal. Rostrum simple.

Family 1. Chlamydoselachidae (*Chlamydoselachus*).

Family 2. Hexanchidae (*Hexanchus, Heptanchus*).

Sub-order 2. *Galeoidea.* Five gill-openings. Two dorsal fins and an anal; no fin-spines. Rostrum triradiate.

Family 1. Odontaspididae (*Odontaspis, Scapanorhynchus*).

Family 2. Lamnidae (*Lamna, Carcharodon, Alopias, Cetorhinus*).

Family 3. Orectolobidae (*Orectolobus, Chiloscyllium, Stegostonea, Ginglymostoma, Rhinodon*).

Family 4. Scyliorhinidae (*Scyliorhinus, Pseudotriacis*).

Family 5. Carchariidae (*Carcharias, Sphyrna, Galeus, Mustelus*).

Sub-order 3. *Squaloidea.* Five or six gill-openings. Two dorsal fins, each typically preceded by a spine, but if these are wanting the anal fin is also absent. Rostrum simple.

Family 1. Hybodontidae (Mesozoic).

Family 2. Heterodontidae (*Heterodontus, Gyropleurodus*).

Family 3. Protospinacidae (Jurassic).

Family 4. Pristiophoridae (*Pristiophorus, Pliotrema*).

Family 5. Squalidae (*Squalus, Spinax, Centrophorus, Somniosus*).

Family 6. Squatinidae (*Squatina*).

Order 2. *Hypotremi* (rays)

Pectoral fins produced forwards and joined to head; gill-openings ventral. Hyomandibular purely suspensory.

Sub-order 1. *Narcobatoidea.* Large electric organs between pectoral fins and head. Suprascapulae united above vertebral column.

Family 1. Torpedinidae (*Torpedo, Narcine,* etc.).

Sub-order 2. *Batoidae.* No large electric organs. Suprascapulae united to vertebral column.

Family 1. Rhinobatidae (*Rhinobatus, Discobatus*).

Family 2. Pristidae (*Sclerorhynchus, Pristis*).

Family 3. Raiidae (*Raia, Psammobatis,* etc.).

Family 4. Trygonidae (*Trygon, Myliobatis, Rhinoptera, Mobula,* etc.).

Sub-class 5. *Holocephali.* Males with mixopterygia. Pterygoquadrate fused with skull. Lower jaw with one pair of tooth-plates, upper with two pairs. Hyoid arch complete, with pharyngohyal. Gill-clefts opening into a chamber with one external opening.

Family 1. Squaloraiidae (Mesozoic).

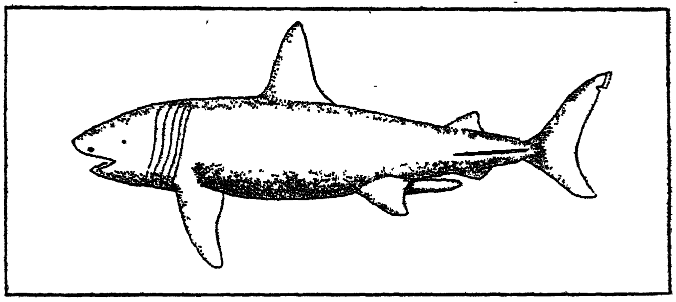
Family 2. Myriacanthidae (Mesozoic).

Family 3. Chimaeridae (*Chimaera, Callorhynchus, Harriotia, Rhinochimaera*).

The three sub-classes distinguished by the presence of mixopterygia are evidently derived from a common ancestor, which was not hyostylic, for the presence of a complete hyoid arch in the Holocephali, with a pharyngo-hyal above the epi-hyal or hyomandibular, shows that they are not derived from a form in which the hyomandibular articulated with the skull and supported the jaws. In the Palaeozoic sub-classes the pterygo-quadrate appears to have articulated with the otic region of the skull; such an articulation occurs in the Hexanchidae and Hybodontidae of the Euselachii, but whether it is primitive or secondary in these is uncertain. Some authors consider the Holocephali to be related to the Squaloid sharks, but their tooth-plates appear to be formed by fusion, not enlargement, and are therefore not comparable with the enlarged lateral teeth of *Heterodontus,* and the dorsal fin spine is not an enlarged denticle as in the Squaloids, but is formed by concrescence of horny rays; moreover, the structure of the hyoid arch, and the separate pelves, preclude the derivation of the Holocephali from the Euselachii. For further details of the anatomical characters of the orders and families of the Euselachii Regan (1906) may be consulted.

Geographical Distribution.—Many families of Euselachii are restricted to tropical and subtropical seas, the principal exceptions being the Scyliorhinidae, Squalidae, Squatinidae and Raiidae, nearly all of which are bottom-living forms; to these four families belong the species that can be reckoned as British, except summer migrants and occasional visitors. *Squatina* is found mainly north and south of the Tropics, as is *Squalus,* but *Scyliorhinus* and *Raia* are large, nearly cosmopolitan genera. A few sharks enter rivers, and two species of *Carcharias* are believed to live only in fresh water, one in Lake Nicaragua, the other in the Zambezi. Of the rays, *Pristis* and *Trygon* may ascend rivers, and there are a few fresh water Trygonidae in South America.

Palaeontology.—Many living genera of Euselachii are of considerable antiquity; all the recent families except the Carchariidae and Trygonidae have genera living to-day that are found fossil in Cretaceous strata, and such specialized forms as *Squatina* and *Rhinobatus* occur in the Jurassic, together with

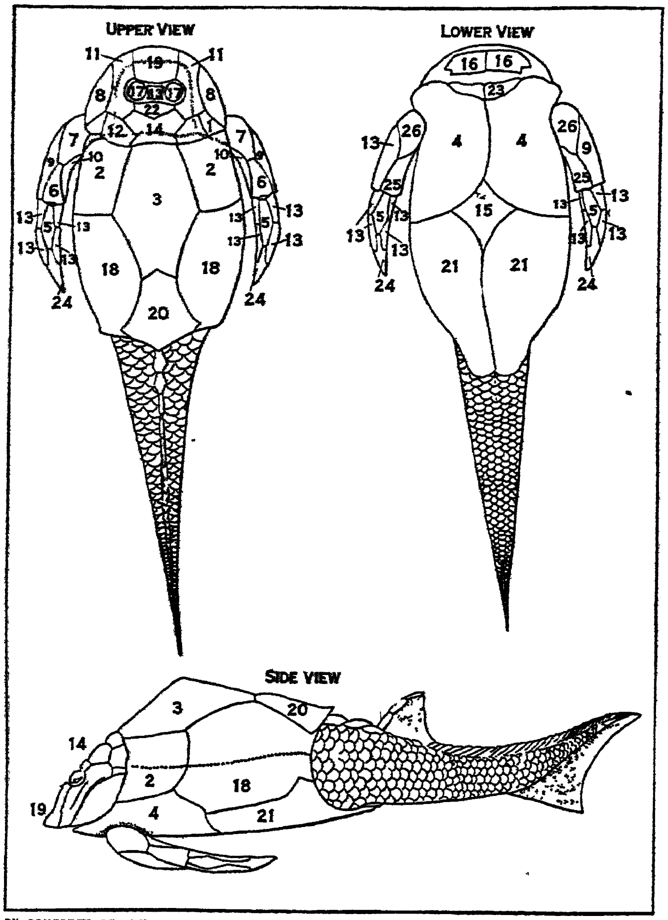

FROM GOOD AND BEAN, "CAMBRIDGE NATURAL HISTORY" (MACMILLAN LTD.)
FIG. 5.—THE BASKING SHARK (CETORHINUS MAXIMUS)

Heterodontus, Pristiurus and *Hexanchus.* The curious *Scapanorhynchus,* with long shovel-like snout, was discovered in 1898 living in deep water off Japan, but had long been known from Cretaceous rocks. *Protospinax,* a recently described Jurassic shark, appears to stand in the same relationship to *Pristiophorus* that *Rhinobatus* does to *Pristis.* The saw-shark (*Pristiophorus*) has the snout produced into a long blade with a series of teeth on each side, and in this resembles the saw-ray (*Pristis*); but *Pristis* is evidently a modified *Rhinobatus,* and the discovery of *Protospinax* (Woodward, 1918), a shark with the snout produced and

flattened as in *Rhinobatus,* but except for the more primitive median fins otherwise similar to *Pristiophorus,* is of some interest.

The Euselachii are not certainly known before the Trias, for the Carboniferous and Permian Orodontidae, Cochiliodontidae, Petalodontidae and Psammodontidae, generally assigned to this sub-class, are mainly known from teeth. The Holocephali also date back to the Trias. Of the Palaeozoic sub-classes only the Pleuropterygii can be regarded as ancestral, the Devonian *Cladoselachus* being the most primitive shark known.

The Placodermi.—The researches of Stensio (1925) have revealed the relationship to the Selachii of the Arthrodira, a group



BY COURTESY OF THE PALAEONTOGRAPHICAL SOCIETY

FIG. 6.—PTERICHTHYS, AN ANCIENT TYPE WITHOUT LIVING RELATIVES

of Palaeozoic fish-like vertebrates in which the head is covered by a shield of bony plates, movably articulated with a bony carapace that protects the anterior part of the body. Below the head-shield Stensio has found a cartilaginous cranium wholly or partly invested inside and out by a thin layer of bone; this cranium is of typical Selachian form, with prominent olfactory capsules; there are no dermal bones (parasphenoid, vomers) below it. It is clear that the Arthrodira are not Pisces, but are an independent offshoot of the Selachii. It is, perhaps, best to place them in a separate class, Placodermi, which will include also the similarly armoured Palaeozoic Asterolepida (*Pterichthys,* etc.).

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(C. T. R.)

SELAGINELLA, a genus of plants of the club-mosses or Lycopodiales (see *Pteridophyta*), allied to the ferns. There are about 700 species, chiefly tropical in distribution, with a much-branched, usually creeping stem, bearing roots on the lower, and leaves on the upper side, with terminal sporangia. The leaves are arranged spirally or in four rows, the latter the more common method. *S. selaginoides* occurs on boggy hill-sides in Great Britain and also in North America from New Hampshire to Colorado and northward to Greenland. Some 35 other species occur in the United States, chiefly in the southern and western States.

SELBORNE, ROUNDELL PALMER, 1ST EARL OF (1812–1895), English lawyer and statesman, was born at Mixbury, in the county of Oxford, on Nov. 27, 1812; his father was rector of the parish. He was educated at Rugby and Winchester, and at Trinity College, Oxford. He was called to the bar on June 7, 1837, and soon had a good chancery practice. In addition he wrote for *The Times* and the *British Critic,* and took an active interest in Church affairs.

In 1847, and again in 1853, Palmer was returned as M.P. for Plymouth, as a Peelite, and in the House of Commons he took an active and independent part. He advocated the admission of Jews to parliament; he opposed Lord John Russell's measure to repel the so-called papal aggression; he opposed the admission of Dissenters into the university of Oxford; and he was hostile to the action of the government in the Crimean War, and the second opium war with China. This attitude was disapproved of by his constituency, and he gave up his seat at the election of 1857. In 1848 he married Lady Laura Waldegrave, and in 1849 he became a Q.C. In July 1861 he accepted from Lord Palmerston the office of solicitor-general, a knighthood, and a safe seat for the borough of Richmond in Yorkshire; in Sept. 1863 he became attorney-general, and, as such, was adviser of the ministry, in the courts, and in the House, in the questions which arose in respect of the "Trent" and the "Peterhoff," the cruisers "Alabama" and "Florida" and the "Alexandra," during the American Civil War. In 1866 he advocated making household suffrage the basis of representation, an expression of opinion which probably influenced the Reform Bill of the following year—in the discussions on which Palmer took a prominent part, and especially in opposition to the so-called "fancy franchises" originally proposed by its authors. In April 1868 he refused to support Gladstone's measures for the disestablishment of the Irish Church, and after the election of that year he declined Gladstone's offer of the office of lord chancellor.

The treaty of Washington cast a great duty upon Palmer. After the conclusion of the Civil War in America very large claims were preferred against Great Britain for alleged breaches of her duty as a neutral power; and after long negotiations, England and the United States agreed to arbitration.

In Sept. 1872 Gladstone again offered him the great seal, and he accepted it, with the title of Lord Selborne. In the following year Lord Selborne carried through Parliament the Judicature Act. The result of this act was to effect a fundamental change in the judicature system. By the operation of the Judicature Act one supreme court with several divisions was constituted; each division could administer the whole law; the conflict of divergent systems of law was largely overcome by declaring that when they were at variance, the principles of equity should prevail over the doctrines of the common law. The details of this great change were embodied in a code of general rules prepared by a committee of judges, over which Lord Selborne for two years presided week by week. "If," wrote Lord Selborne in his memoirs, speaking of the Judicature Act of 1873, "I leave any monument behind me which will bear the test of time, it may be this." This unification of the courts was more or less contemporary with the construction of a single building to house them; in 1882 Queen Victoria personally presided in the new Law Courts, and handed them over formally to Lord Selborne. On this occasion he received an earldom. In 1885 he definitely broke with Gladstone over Home Rule and disestablishment. But though he never held office again, he continued to sit in the House of Lords both to hear appeals and in the ordinary business.

In 1886, in answer to a pronouncement of Gladstone's, Lord Selborne published *A Defence of the Church of England,* on a historical basis, with an introductory letter addressed to Gladstone. In 1888 he published a second work on the Church question, entitled *Ancient Facts and Fallacies concerning Churches and Tithes,* in which he examined more critically than in his earlier book the developments of early ecclesiastical institutions, both on the continent of Europe and in Anglo-Saxon England, which resulted in the formation of the modern parochial system and its general endowment with tithes. He died on May 4, 1895, at his seat in Hampshire after an attack of influenza.

Among Lord Selborne's other interests were university and legal education: he made an attempt, before the time was ripe, to establish a school of law in London in 1867.

See his *Memorials* (ed. by Lady Sophia Palmer, 4 vols. 1896–98).

SELBORNE, WILLIAM WALDEGRAVE PALMER, 2ND EARL OF (1859–), son of the preceding, was educated at Winchester and University College, Oxford, where he took a first class in history. In 1883, being then Viscount Wolmer, he married Lady Beatrix Cecil, 3rd daughter of the 3rd marquess of Salisbury. From 1895 to 1900 he was under-secretary for the colonies, under Chamberlain as his chief. He sat in the House of Commons for East Hants (1885–92), and for West Edinburgh (1892–95). In 1900 he entered the cabinet as first lord of the admiralty, and in 1905 he succeeded Lord Milner as high commissioner for South Africa and governor of the Transvaal and Orange River colonies. He assumed office at Pretoria in May of that year. He had gone out with the intention of guiding the destinies of South Africa during a period when the ex-Boer republics would be in a transitional state between crown colony government and self-government, and letters patent were issued granting the Transvaal representative institutions. But the Liberal party came into office in England in the December following, before the new constitution had been actually established, and the decision was now taken to give both the Transvaal and Orange River colonies self-government without delay. Lord Selborne loyally accepted the changed situation, and his moderation and good sense helped to make the new régime a success. He left South Africa in May 1910, on the eve of the establishment of the Union of South Africa which he had done so much to promote. On his return to England, Selborne took an active share in defending the House against liberal attack, and was one of the leading "diehards" who maintained an uncompromising resistance to the Parliament bill. During the World War he joined the first Coalition ministry in May 1915, as minister of agriculture. He appointed an expert agricultural committee under the chairmanship of Lord Milner, to report on the means of maintaining and increasing food production in England and Wales; but he and the government rejected their recommendation to guarantee farmers a minimum price of 45s. a quarter for four years. In June 1916 he resigned his office because he disapproved of the Irish policy of compromise accepted by Asquith's government. He did not join Lloyd George's ministry. After the war he promoted the movement of self-government in the Church which culminated in the Church Enabling Act of 1919. He also identified himself strongly with the policy of reforming the House of Lords and reconsidering the relations between the two Houses under the Parliament Act.

SELBORNE, a village of Hampshire, England. It is celebrated as the birthplace and scene of the work of Gilbert White the naturalist; his house is in the village, and his memorial and grave are in the ancient church.

SELBY, WILLIAM COURT GULLY, 1ST VISCOUNT (1835–1909), Speaker of the British House of Commons, was born on Aug. 29, 1835, the son of Dr. James Manby Gully of Malvern. He was educated at Trinity College, Cambridge, where he was president of the Union. He was called to the bar in 1860, went the northern circuit, and took silk in 1877. In 1880 and 1885 he unsuccessfully contested Whitehaven as a Liberal, but was elected for Carlisle in 1886, and continued to represent that constituency until his elevation to the peerage. In April 1895 he was elected Speaker by a majority of eleven votes over Sir Matthew White Ridley (cr. Viscount Ridley, 1900), the Unionist nominee. In 1905 he resigned and was raised to the peerage with the title of Viscount Selby. He died on Nov. 6, 1909.

SELBY, an urban district in the West Riding of Yorkshire, England, 13½ m. S. of York on the L.M.S. and L.N.E. railways. Pop. (1931) 10,064. It is situated in the low-lying vale of York on the Yorkshire Ouse by which communication is afforded with the Humber. It is connected by canal with the Aire and Calder navigation, and has shops for building river craft.

The church of St. Mary and St. German belonged to a Benedictine abbey founded under a grant from William the Conqueror in 1069 and raised to the dignity of a mitred abbey by Pope Alexander II. The monastic buildings have almost disappeared. The nave of the church passes from Norman to Early English in the course of its eight bays from east to west and also in the arcade through the triforium to the clerestory. The choir and Lady chapel belong to the Decorated period. In 1906 a fire broke out in the Latham chapel adjoining the north choir aisle and soon involved the whole building. The oak-grained roof and rich fittings of the choir were wholly destroyed, but the finely-moulded arches and the magnificent tracery of the east window survived in great part. Much damage was done to the tower and the roof of the nave perished, though the stonework of the nave suffered comparatively little. Tradition indicates Selby as the birthplace of Henry I., and this accounts for the high privileges conferred upon the abbey. The town played a considerable part in the operations of the Civil Wars, being held at the outset by the Parliamentarians, captured by the Royalists in 1644, but soon retaken by Sir Thomas Fairfax.

SELDEN, JOHN (1584–1654), English jurist, legal antiquary and oriental scholar, was born on Dec. 16, 1584, at Salvington, in the parish of West Tarring, Sussex. His father, also John Selden, held a small farm. Selden was educated at Chichester grammar school and Hart hall, Oxford. In 1603 he entered Clifford's Inn, London, and in 1604 migrated to the Inner Temple, and in 1612 he was called to the bar. His practice was mostly conveyancing, and he rarely went into court.

Selden's early works were: *Analecton Anglo-Britannicon* (1615); *England's Epinomis* and *Janus Anglorum; Facies Altera* (1610), which dealt with the progress of English law down to Henry II.; *Titles of Honour* (1614), which, in spite of some obvious defects and omissions, has remained to the present day the most comprehensive and trustworthy work of its kind that we possess; and *De diis Syriis* (1617), which immediately established his fame as an oriental scholar among the learned in all parts of Europe. For his *History of Tithes* (1618), Selden was summoned before the privy council and compelled to retract his opinions, or at any rate what were held to be his opinions. Moreover, his work was suppressed and himself forbidden to reply to any of the controversialists who had come or might come forward to answer it.

This seems to have introduced Selden to the practical side of political affairs. It was pretty certain that, although he was not in parliament, he was the instigator and perhaps the draftsman of the memorable protestation on the rights and privileges of the House affirmed by the Commons on Dec. 18, 1621. For this he was committed to the Tower, and he occupied himself in preparing an edition of Eadmer's *History,* which he published two years afterwards. In 1623 he was returned to the House of Commons for the borough of Lancaster, and sat with Coke, Noy and Pym on Sergeant Glanville's election committee. In Charles's second parliament (1626) he was elected for Great Bedwin in Wiltshire, and took a prominent part in the impeachment of George Villiers, duke of Buckingham. In the following year, in the "benevolence" case, he was counsel for Sir Edmund Hampden in the court of king's bench. In 1628 he was returned to the third parliament of Charles for Ludgershall in Wiltshire, and had a large share in drawing up and carrying the Petition of Right.

In the session of 1629 he was one of the members mainly responsible for the tumultuous passage in the House of Commons of the resolution against the illegal levy of tonnage and poundage, and, along with Eliot, Holles, Long, Valentine, Strode, and the rest, he was sent once more to the Tower. He was released by the intervention of Laud. In 1628 at the suggestion of Sir Robert

Cotton he had compiled, with the assistance of two learned coadjutors, Patrick Young and Richard James, a catalogue of the Arundel marbles. He employed his leisure at Wrest, to which he now retired, in writing. About this period he seems to have inclined towards the court rather than the popular party, and even to have secured the personal favour of the king. To him in 1635 he dedicated his *Mare clausum*, and under the royal patronage it was put forth as a kind of State paper. It had been written 16 or 17 years before; but James I. had prohibited its publication for political reasons; hence it appeared a quarter of a century after Grotius's *Mare liberum*, to which it was intended to be a rejoinder. He was returned to the Long Parliament without opposition for the University of Oxford.

Selden joined in the protestation of the Commons for the maintenance of the Protestant religion according to the doctrines of the Church of England, the authority of the Crown, and the liberty of the subject. In 1643 he participated in the discussions of the assembly of divines at Westminster, and was appointed shortly afterwards keeper of the rolls and records in the Tower. In 1646 he subscribed the Solemn League and Covenant, and in 1647 was voted £5,000 by the parliament as compensation for his sufferings under the monarchy. He published in 1642 *Privileges of the Baronage of England when they sit in Parliament* and *Discourse concerning the Rights and Privileges of the Subject*; in 1644, *Dissertatio de anno civili et calendario reipublicae Judaicae*; in 1646 his treatise on marriage and divorce among the Jews entitled *Uxor Ebraica*; and in 1647 the earliest printed edition of the old English law-book *Fleta*. In 1650 Selden passed the first part of *De synedriis et prefecturis iuridicis veterum Ebraeorum* through the press, the second and third parts being severally published in 1653 and 1655, and in 1652 he wrote a preface and collated some of the manuscripts for Sir Roger Twysden's *Historiae Anglicae scriptores decem*. His last publication was a vindication of himself from certain charges advanced against him and his *Mare clausum* in 1653 by Theodore Graswinckel, a Dutch jurist.

After the death of the earl of Kent in 1639 Selden lived permanently under the same roof with his widow. It is believed that he was married to her, although their marriage does not seem to have ever been publicly acknowledged. He died at Friary House in Whitefriars on Nov. 30, 1654, and was buried in the Temple church, London. Of all the members of the Antiquarian Society, the centre of historical research of the 17th century, Selden was the acknowledged master.

See Wood, *Athenae Oxonienses* (ed. Bliss, 1817, 4 vols.); Aikin, *Lives of John Selden and Archbishop Usher* (1812); Johnson, *Memoirs of John Selden*, etc. (1835); Singer, *Table Talk of John Selden* (1847); and Wilkins, *Johannis Seldeni opera omnia*, etc. (1725).

SELECTION, the term applied in biology to the picking out of some variants in preference to others from a population of animals or plants. Human or artificial selection has been the chief instrument in establishing the breeds of domestic animals; natural selection has been the main agency in bringing about evolution in nature; and sexual selection has helped in producing the adornments used by animals in courtship (*see* VARIATION; EVOLUTION; BREEDS AND BREEDING). (X.)

ARTIFICIAL SELECTION

Artificial selection is definable as the methodical or unconscious choice by man of certain individual animals or plants as parents of the next generation. It is made possible by the facts that related individuals maintained under the same conditions exhibit dissimilarities, and that certain of these dissimilarities are hereditary. Man cannot as yet produce new hereditary characters at will, but as and when these appear he can, by appropriate breeding practices, incorporate or eliminate them from his stock. When a conspicuous and advantageous new inherited character appears, selection is reduced to the preservation of the individual or individuals exhibiting it and to the use of these for further breeding. But in most instances a new desirable character is at first only faintly pronounced; it is a slight difference in the degree of expression of a character already existing in the stock, a slightly finer quality of wool, or a slightly increased quantity or improved quality of milk, and then patience, the finest powers of discrimination and the soundest of judgments must be exercised during many years if this improvement is to be maintained. For such selection there must always be a clearly predetermined object in view, the breeder must be able to define his aim and to discriminate between slight differences. In the absence of any precise method of assessing the kind and degree of improvement, judgment can be acquired only by long experience.

Unconscious selection is the practice of preserving the more valued and of eliminating the less valued individuals without any thought of altering the general characterization of the stock. Methodical selection is the conscious and deliberate practice of modifying the general characterization of a stock according to some predetermined standard through the careful choice of certain individuals as the parents of the next generation and through the control of the matings of these individuals. Save that in one case man acts deliberately and purposefully and in the other unintentionally, there is little difference between the two kinds of artificial selection: each blends into the other. In both cases man preserves those individuals which promise to be most useful or attractive to him, and neglects the others.

In methodical selection the choice of the individual for further breeding is determined by (1) its appearance, (2) the record of its ancestry (pedigree) and (3) the record of its progeny (the progeny test).

Remarkable results have been secured by this mass selection—the choice for breeding of all or many of those individuals exhibiting variation in the desired direction. This is the method of the grower of corn who, at harvest time, selects the best ears from the whole yield and from these rears his next year's crop. This selection, on the basis of appearance, though slow and uncertain, has produced the improved varieties of plants and animals. It is effective because most of the characters upon which it is employed are dependent on a large number of hereditary factors, which can be sorted out and accumulated by selection of this kind. The most rapid and permanent results of such selection are those which take the form of the sorting out of pure lines from a mixed population of self-fertilized plants, for in this case a single selection separates the inherited differences at once. This accomplishes immediately all that is possible, for selection within a pure line is ineffective. (*See* PURE LINE.) In animals the nearest approach to a pure line is a closely inbred strain comparatively homozygous for the characters for which selection is practised. It is abundantly demonstrated that appearance alone is not a reliable guide to breeding ability. Individuals which look alike may possess different breeding records, and the only real tests for breeding ability are the performances of their relatives (pedigree) and more especially the records of their progeny (the progeny test).

Many domestic animals and plants afford striking proofs of the power of artificial selection. Thus from a wolf-like ancestor have arisen the greyhound and the bull-dog, the Pekinese and the great dane. Similarly, artificial selection has been the means of perfecting the thoroughbred, the Shetland, and the shire horse. Amongst plants, most, if not all, cultivated species have been more or less transformed by selection, roses and hyacinths affording notable instances. (*See* ANIMAL BREEDING, MENDELISM, PURE LINE, and HEREDITY.) (F. A. E. C.)

NATURAL SELECTION (MATHEMATICAL THEORY)

Pearson developed a theory of the effects of natural selection on continuously varying characters which was based on the law of ancestral heredity, enunciated by Galton and modified by himself. He produced very strong evidence that natural selection is occurring in men. The theory is complicated, and somewhat incomplete. Intense selection for a character is effective, being nearly complete in three or four generations, but two points remain uncertain, namely (*a*) whether the population can ever be brought quite to the level selected for, and (*b*) whether it will regress indefinitely towards its original state when selection ceases. It is at least clear that such regression would be slow. The doubt depends on the uncertainty of the coefficients of correlation between

DRAWN FOR THE ENCYCLOPÆDIA BRITANNICA BY H. GRONVOLD

MALE BIRDS OF PARADISE

1. Princess Stephania's bird of paradise (*Astrapia stephaniae*)
2. King bird of paradise (*Cicinnurus regius*), second view showing bird with plumage spread
3. Superb bird of paradise (*Lophorina superba*)
4. Hunstein's bird of paradise (*Diphyllodes magnificus*)
5. Great bird of paradise (*Paradisea apoda*)
6. Crown Prince Rudolph's bird of paradise (*Paradisornis rudolphi*) (blue bird of paradise), hanging by feet to display plumage
7. Bare-headed bird of paradise (*Schlegelia wilsoni*)

a character in an individual and his remote ancestors.

Haldane and Norton developed a theory of selection in populations exhibiting Mendelian inheritance. (*See* HEREDITY.) A population mating at random and only partly possessing an autosomal gene A is in equilibrium in the absence of selection when the three genotypes are in the ratio $u^2AA:2uAa:1aa$. If u_n is the value of the ratio in the nth generation, and selection occurs so that the population breeds in the ratios $(1-K)u_n^2:2u_nAa:(1-k)aa$,

$$u_{n+1}=\frac{(1-K)u_n^2+u_n}{u_n+1-k}.$$

If K and k, which are called coefficients of selection, are both positive, the population reaches an equilibrium with $u_\infty=\frac{k}{K}$. Otherwise either the gene A or a disappears. If $K=0$, *i.e.*, dominance is complete, we have, if $u_0=1$

$$\therefore n=-\int_1^{u_n}\frac{(2u+1)du}{u(u+1)\log_e\left[1-\frac{k(2u+1)}{(u+1)^2}\right]}$$

$$+\frac{k}{12}\left[\frac{2u_n+1}{(u_n+1)^2}-\frac{9}{4}\right]+\frac{k^2}{24}\left[\frac{(2u_n+1)^2}{(u_n+1)^4}-\frac{81}{16}\right]+\cdots$$

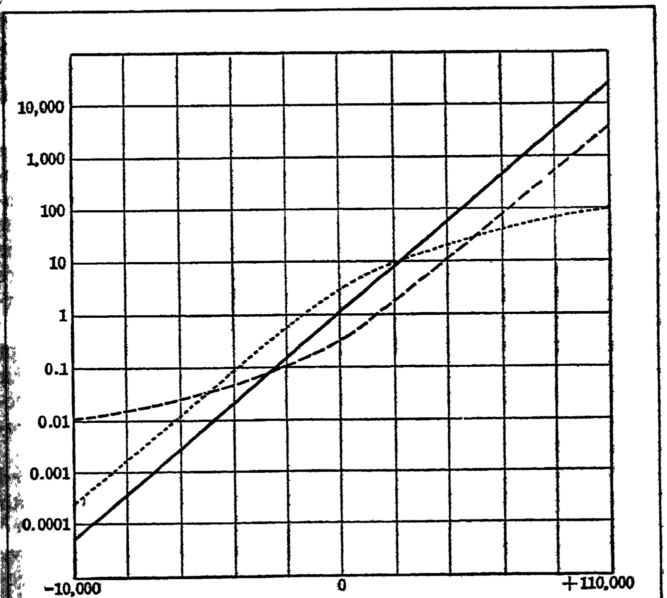
The series appears to be an asymptotic expansion.

When k is small

$$\frac{du_n}{dn}=\frac{ku^u}{1+u_n}\therefore kn=u_n+\log_e u_n-1 \text{ approximately.}$$

In the case of sex-linked inheritance, where the proportions of the male sex are $u_nA:1a$, of the female $u_n^2AA:2u_nAa:1a$, and selection occurs in both sexes with equal intensity, we have

$$kn=\log_e u_n+2\log_e\left(\frac{u_n+3}{4}\right), \text{ when selection is slow.}$$



PROCEEDINGS OF THE CAMBRIDGE PHILOSOPHICAL SOCIETY BY COURTESY OF THE CAMBRIDGE UNIVERSITY PRESS

FIG. 1

Effect of selection on an autosomal mendelian character. Abscissa=number of generations. Ordinates=percentage of population with the favoured character. ——— = Self-Fertilization. ------ = Random mating, dominants favoured. ...... = Random mating, recessives favoured

These equations can be generalized in various ways. The generations may be supposed to overlap, as in man. In this case we must know for each genotype the probability of a member of it producing an offspring between the ages x and $x+\delta x$ (dead as well as living members being included in the calculation). If this probability is $K(x)\delta x$ for a dominant, $[K(x)-k(x)]\delta x$ for a recessive, then when selection is slow the equations for selection are similar to the above, provided we put

$$k=\frac{\int_0^\infty k(x)\delta x}{\int_0^\infty xK(x)\delta x}.$$

Similarly we may obtain formulae for the effects of differential selection in the two sexes, and of competition limited to members of the same family.

When the two competing types do not mate, owing to self-fertilization or incompatibility, or when inheritance is wholly maternal, we find $kn=\log_e u_n$, where u_n is the ratio of the types. Fig. 1 shows the very different rates at which the population would change according to the type of inheritance of the character selected. In each case $k=\cdot 001$, *i.e.*, 1,000 of the favoured type survive for every 999 of the other. In all cases the reverse series of changes occurs if the sign of k be changed. It is clear that in the case of an autosomal gene selection is somewhat ineffective so long as the recessive is rare. This is due to the fact that kn is not entirely a sum of logarithmic functions of u_n. When, however, dominance is incomplete, recessives, however rare, will increase at a relatively rapid rate.

If there is a moderate degree of self-fertilization, inbreeding or assortative mating, the population assumes different equilibria in the absence of selection and the rate of change under selection may be altered. Thus if a proportion l of the population be self-fertilized or mated to sibs we have

$$kn=\log_e u_n+\frac{2}{l}\log_e\left(\frac{2-l+lu_n}{2}\right)$$

or

$$kn=\log_e u_n+\frac{4(1-l)}{l}\log_e\left(\frac{4-3l+lu_n}{4-2l}\right)$$

respectively, so that selection is not very greatly slowed down even when recessives are rare. On the other hand assortative mating does not have this effect.

Selection and Mutation.—The effect of selection may be balanced or even over-ridden by that of mutation, if the latter is sufficiently frequent. This is the case if the probability of a gene mutating to its allelomorph in the course of a generation is greater than k, the coefficient of selection. On the other hand a single mutant gene in a large population is usually extinguished by mere misfortune. If it is recessive it has a negligible chance of spreading through the population, if dominant its chance of doing so is approximately 2k, where k is the coefficient of selection in its favour.

When a character is determined by the coexistence of a number of genes, whether dominant or recessive, selection proceeds somewhat more slowly, but on the same general lines as above. Thus if a character is produced by m recessive genes, and carries a disadvantage measured by k, the proportion y_n of the population carrying it after n generations is given by eliminating s between

$$y_n=\prod_{r=1}^{m}(1-a_r s)^2 \text{ and } kn=\int\frac{ds}{sy_n}$$

where the values of a_r depend on initial conditions.

Linkage between two selected genes is irrelevant, provided that the probability of crossing over between them is greater than k. An autotetraploid population mating at random is acted on by selection more slowly than a diploid.

It will be clear that in order to obtain any idea of the effect of selection on a relatively rare character in a population in which inbreeding is not intense, it is necessary to know its mode of inheritance. If it is a recessive, or determined by a number of dominant genes, selection, whether favourable or the reverse, will only cause slow changes in the number of individuals which manifest it. On the other hand selection acts rapidly on rare dominants, and on all characters in a highly inbred population.

If a character while valuable to the community of which an individual is a member diminishes the probable number of offspring left by that individual (as is the case with some social instincts) it will not spread through the population unless this consists of small endogamous groups. If, however, as in social insects, most of the individuals are neuters, a socially valuable character,

even though tending to shorten their lives, will, in general, spread. Similarly, except in insect societies, a socially disadvantageous character increasing the probable number of offspring left by its bearers will spread through the species.

Fisher investigated the equilibrium which would be reached in a population in which very numerous Mendelian differences existed, under the influence of mutation, random survival and selection. When a gene has great selective value it will rapidly spread all through a population if ever present in appreciable numbers. Thus genetic differences (and hence variation in natural populations), must mainly be due to genes of little survival value, or to those which are most beneficial in the heterozygous condition. If u represents, as above, the ratio of dominant to recessive genes in any character, then for a large number of different characters the distribution of $z_z = \log_e u$, is given by the expression $df \propto \frac{1}{2\pi} \operatorname{sech} \tfrac{1}{2}z dz$, f being the frequency for a given value of z, no selection occurs, but mutation is balanced by random extinction. This is a symmetrical function of z, the most frequent value of u being unity. Even in the absence of mutation, the variability of a population is only diminished with extreme slowness by random extinction. In the more important case where the genes are dominants acted upon by selection, a balance is struck between the increase of variance by mutation and its diminution by selection and to a less extent by random extinction. Here $df \propto \frac{dz}{\sqrt{(e^{-2} \operatorname{sech}^2 \frac{1}{2}z + k^2 \cosh^2 \frac{1}{2}z)}}$, where k is a small quantity depending on the size of the population and the intensity of selection. This is an asymmetrical function of z and the most frequent value of u is large, *i.e.*, the variation in the population is mainly due to more recessives. The observed values of correlations between relatives for continuously varying characters can be predicted with great accuracy if these characters are due to numerous genes whose distribution in the population is determined according to this law. Thus, while Haldane's work relates to the hitherto almost unobserved process of evolution, that of Fisher explains observed facts concerning heredity.

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SEXUAL SELECTION

Charles Darwin, after propounding the revolutionary and far-reaching theory of natural selection (*q.v.*) to account for the evolutionary origin of adaptive characters, set himself to see whether the conception was all-embracing. He came to the conclusion that the bulk of the large group of secondary sexual characters, such as the deer's antlers, the peacock's train, the lark's song, etc., could not be accounted for by the operation of natural selection, but that another type of selective mechanism, which he called sexual selection, here came into operation.

He argued that whenever any character possessed only by males conferred upon its possessor no direct advantages in the struggle for existence, but served merely to confer advantages upon one male in its struggle with other males to secure a mate, then we could not speak of natural selection, but of sexual selection. In some cases, as in polygamous birds, the two forms of selection might be in opposition, the gorgeous but cumbrous plumes favoured by sexual selection being definitely disadvantageous in the struggle for existence.

Although much attacked, the theory survives, if in a somewhat altered form, and the evidence now available makes it clear that sexual selection has undoubtedly played a considerable part in moulding the form and behaviour of higher animals.

The most important types of character which have presumably thus originated are as follows:—(1) for pursuit and capture of one sex by the other; (2) offensive and defensive weapons employed by members of one sex in fighting for the other; (3) means for making known the presence of one sex to the other; (4) characters employed in stimulating sexual emotion in the other sex; *i.e.*, organs employed in courtship of animals (*q.v.*).

As examples of these various types may be cited (1) the enlarged prehensile antennae of various small Crustacea (*Moina;* many Copepods) or the enlarged limbs (*gnathopods*) with which male gammarid Crustacea seize and grip the female; (2) (*a*) offensive—the antlers of stags, the enlarged canines of boars and stallions; (*b*) defensive—the mane of the lion or of certain male baboons; (3) the chirping of male crickets and the croaking of male frogs, the drumming of certain woodpeckers, the flashing of fireflies; (4) the train of the peacock, the crest (present in both sexes) of the Crested Grebe, the bower of bower-birds.

Naturally these different categories grade into each other; courtship characters grade into recognition marks; weapons may serve also as adornments, and the same character, *e.g.*, great strength, may serve both to fight enemies and to capture mates.

It has been suggested with some plausibility that prominent weapons may secure advantage by deterring other males from attempting combat; there seems no doubt that young stags with poorly-developed antlers avoid battle with large-antlered males. There are a number of prominent secondary sexual characters to which no function can yet be assigned; *e.g.*, the enormous horns of the males of the Goliath and other beetles.

The fact that organs for capturing the female may grade insensibly into copulatory organs, and organs for stimulating the emotions into those facilitating the meeting of the sexes, suggests a valid criticism of the pure neo-Darwinian doctrine which maintains that sexual selection is something altogether apart from natural selection.

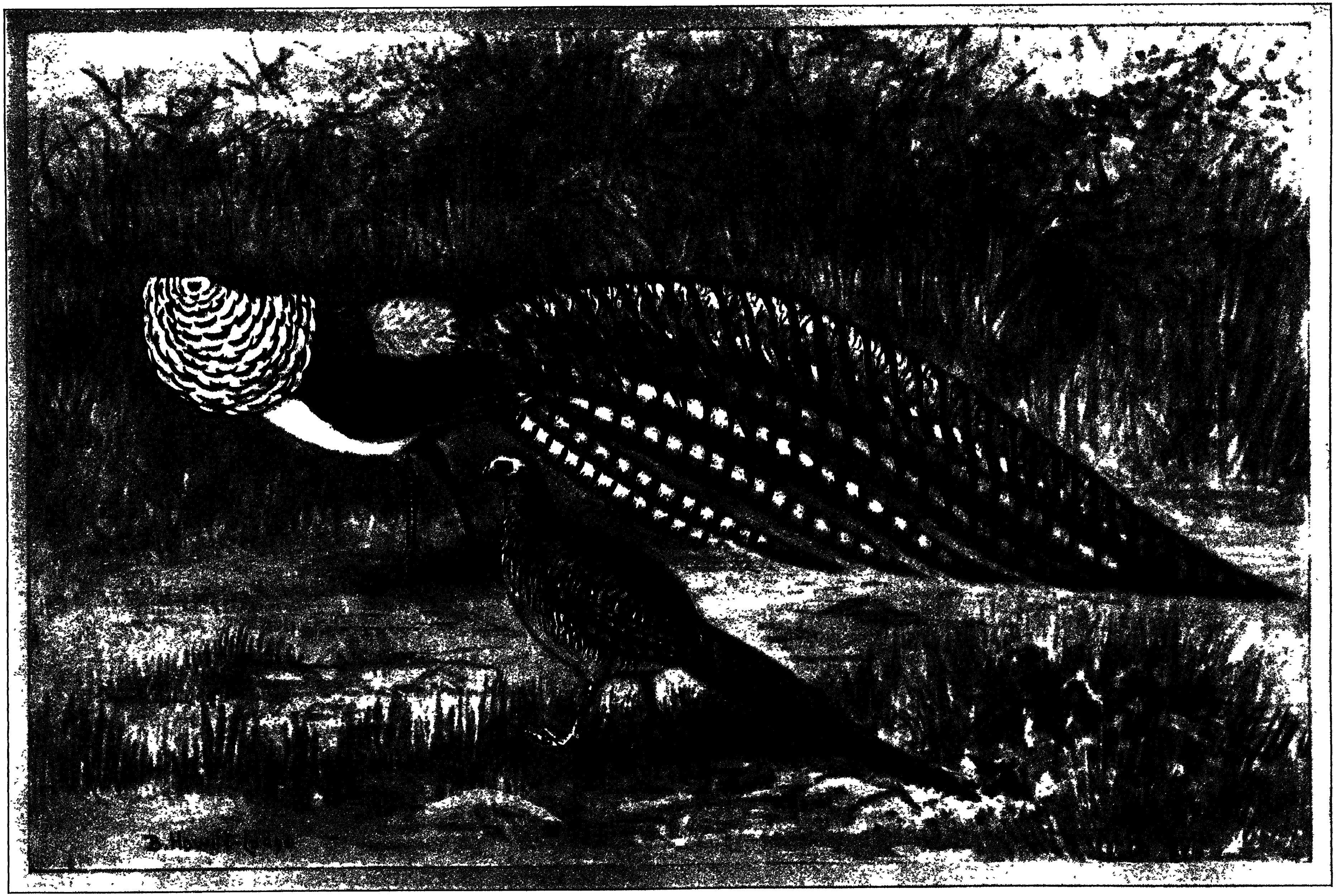
Certain organs and instincts are obviously necessary to a sexually-reproducing species if the race is to continue; and in so far as selection has contributed to their origin, it will, as Darwin himself pointed out, have been natural selection.

Devices for securing efficient mating and fertilization will eventually become more elaborate as we ascend the animal scale, as internal supplants external fertilization, as locomotion becomes more rapid, as the brain becomes more complex. The two chief ways to secure mating will be material force (pursuit and capture; or fighting for possession), or stimulation of the opposite sex (advertisement of a "sexual situation" by means of recognitional sounds, colours, actions or scents; or by emotionally stimulating display). In all these cases, while natural selection will see to it that the devices are reasonably efficient, there may and usually will also exist Darwinian sexual selection, as a result of competition between males, and this may intensify and exaggerate the characters. Since it will usually be impossible to disentangle the shares of natural and of Darwinian sexual selection, and since they both tend to produce characters of the same type, it is perhaps better to re-define sexual selection. If, instead of making competition between members of one sex the criterion, we adopt selection with reference to successful and efficient mating as our definition, the situation clears up considerably. For sexual selection in the original sense we may then substitute the term ***intra-sexual selection.***

In all recognitional and courtship characters selection is exerted *via* the brain and mind of the opposite sex, and may thus, with Lloyd Morgan, be called *psychical sexual selection* (as opposed to psychical selection of a non-sexual nature, such as must have operated in the genesis of conspicuous flowers by psychical selection *via* insects).

Sexual selection is usually unisexual, acting only upon one sex. In many cases, however (courtship decorations in herons, grebes, etc.), it is mutual and affects both sexes similarly. Rarely, as in phalaropes, the male broods and cares for the young, and the female does most of the courting. We may here speak of reversed sexual selection, falling mainly upon the females, which are accordingly the more brightly coloured.

A. R. Wallace wished to discard the whole sexual selection theory, and to ascribe the development of male weapons and display characters to the hypothetical action of "male vigour." This view as it stands is undoubtedly erroneous. However, it will often be true that greater prowess in battle and greater efficiency in song or display will be associated with high vigour; and in this way sexual selection will have, as an important by-product, the



PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA BY B. HOWITT-LODGE

MALE AND FEMALE LADY AMHERST PHEASANT AT MATING TIME

The Lady Amherst Pheasant (*Chrysolophus amherstiae*) is an inhabitant of western and southern China and eastern Tibet. The male is one of the most gorgeous of all pheasants. One of his attitudes towards the female at the mating season is shown here. His body and long gaudy tail are tilted towards the hen-bird and the cape-like ruff of erectile feathers on the back of his head and neck is widely spread on the side towards her

selection, as fathers of the next generation, of males above the average in vigour.

The new definition above given obviates one great difficulty in the theory as originally stated. It was difficult to see how intra-sexual selection could be very effective without a preponderance of males, or polygamy; and in the great majority of animals there is no polygamy, and the proportion of the sexes is nearly equal. (*See*, however, Darwin, *Descent of Man*, 2nd ed., p. 329; and E. Howard, *Territory in Bird Life*, p. 35.) If, however, sexual selection is primarily designed for securing efficient and speedy mating, this difficulty is removed.

The other objection which is commonly raised, that the theory of sexual selection ascribed too much taste and conscious discrimination to the female, rests upon a pure misconception. So long as the courtship display stimulates the female, a selective result will be obtained, whether she exercise taste and judgment or be stimulated in the most automatic way.

A few examples will go to show how entangled are natural and intra-sexual selection.

In the courtship of the little fly *Drosophila*, the male approaches the female while waving his wings in a peculiar manner. Sturtevant made up three series of bottles. In each of series A was placed a normal male and female; in B a female with a male whose wings had been cut off; and in C a female with one normal and one wing-clipped male. Successful mating was accomplished by the wing-clipped males in series B, but in a much longer average time than in series A; *i.e.*, the wing-waving courtship apparently has the effect of stimulating the female to sexual response more quickly than does the mere presence of a male. In series C, the average time of mating was only a trifle longer than in series A; but the wing-clipped males were almost as successful as their normal rivals. This can only be explained as meaning that, once the courtship has excited and stimulated the female, she will be ready to accept any male. Courtship is, in this case, almost entirely an affair of natural selection; like a copulatory organ, it renders fertilization more certain, and so benefits the race, and is of little benefit to one male in competition with another.

The same appears definitely to hold good in newts, in which courtship is the preliminary to the male's depositing his sperm in a packet on the pond-bottom. Even should two or more males be courting simultaneously, and should the courtship of one be more effective than that of the rest, it would be impossible that the female should pick up his sperm packet in preference to another. In certain polygamous birds, on the other hand, although the display of the males presumably has some function in merely securing fertilization, yet intra-sexual selection of one male in preference to others is predominant. This occurs in birds where there are special assembly-places for the males' display in the breeding season: the females visit these places only for the purpose of mating, and the males take no share in caring for eggs and young. Black grouse, certain birds of paradise, and the ruff are examples from different orders. Owing to the unique variability of male ruffs in the breeding-plumage, every male on a "hill" (as the ruff's assembly places are called) can be individually recognized. Edmund Selous took advantage of this fact. He made observations on one "hill" throughout several weeks of the breeding season, and was able to establish the fact that whereas some of the cocks never succeeded in mating at all while he was watching, and others but rarely, one or two secured a large number of mates. Not only that, but the most successful cock had an exceptionally well-developed ruff, and one that to our eyes at least was very striking in its colour contrasts. In this species, then, by no means every male secures a mate, and courtship-display is concerned with the securing of mates. There is a real "struggle for reproduction" among males, with resultant intra-sexual selection.

In man it is obvious that sexual selection plays, and has played an important rôle, but in a more complex way than in most species, since not only does some degree of mutual sexual selection exist, but also some degree of intra-sexual selection in both sexes separately. Sexual selection has undoubtedly helped to diversify as well as to improve human appearance.

Sexual selection has exercised a considerable secondary effect in evolution, through characters which have arisen in one sex under the influence of sexual selection, being often partially or completely transferred to the other sex under the influence of heredity. A good example is afforded by the finch family (*Fringillidae*). In general, male finches are brighter-coloured than the females, but their characteristic patterns are usually reproduced in duller colours in the females. It is probable that the bright colours originated in the males through sexual selection; but their partial transference to the females (though of no functional significance in them) has resulted in the females of the different species being more different from each other than they otherwise would have been.

When, *e.g.*, the females nest in holes, bright colours can be transferred to them more completely without endangering their safety; this is so, for instance, in the European robin and the tits. When, however, as in most pheasants, the female nests in exposed situations, natural selection inhibits the transference.

Admittedly many of these conclusions are based solely on indirect evidence; but in view of the experimental work on Drosophila and newts, and the natural experiment annually staged with ruffs, which decisively point to a stimulating effect of display on the female, the cumulative circumstantial evidence must be presumed correct unless it is actually shown false. (*See* COURTSHIP OF ANIMALS; SELECTION: *Natural Selection; BIRD: Reproductive Habits.*)

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SELENE or **MENE**, the moon-goddess, daughter of Hyperion and Theia, sister of Helios and Eos, mother of Pandia by Zeus. She was also wooed by Pan in the form of a white ram, or she had selected a white ram from his flock as the price of her favours. The most famous of her amours was with Endymion (*q.v.*). Selene was represented as driving a chariot drawn by two horses, or later by cows or oxen, herself mounted on a horse, a bull, a mule, or a ram. Later, she was identified with Artemis, and with Phoebe (*q.v.*). She was worshipped on the days of the new and the full moon. The male moon-god (Mēn) is Asiatic. The Roman goddess of the moon was Luna, who possessed sanctuaries on the Aventine and Palatine hills. She had the title Noctiluca (night-shining) and her Palatine temple was lit up at night.

See W. H. Roscher, *Über Selene und Verwandtes* (1890), with *Nachträge* (1895); Preller, *Griechische Mythologie* (4th ed., 1894), pp. 443–446; A. Legrand, s.v. "Luna" in Daremberg and Saglio, *Dictionnaire des antiquités*; G. Wissowa, *Relig. u. Kultus* (2nd ed.), p. 315 *et seq.*

SELENGA-ORKHON, a river of Central Asia, which rises in two principal headstreams, the Selenga and the Orkhon, on the plateau of north-west Mongolia in 101° E. Both flow east-north-east to their confluence near Kiakhta (*q.v.*) on the border of Mongolia and the Buriat-Mongol A.S.S.R. (*q.v.*). From Kiakhta to its delta on Lake Baikal the Selenga flows down a gently graded slope giving access from Mongolia to the plains of Asiatic Russia. Along the lower part of this trench climbs the Siberian railway which then passes to Chita. The Selenga is frozen from November 22nd to May 9th at Verkhne-Udinsk and from December 1st to May 8th at Novo-Selenginsk. It is navigable in summer from the delta to Kiakhta (210 m.); its total length is 750 m. On the left it receives the Djida and the Temnik and on the right the Tola, Khara-gol, Chikoi, Khilok and Uda. For a description of its former trading importance *see* KIAKHTA. Near the upper Orkhon was the permanent camp of Karakorum, from the 8th century down to the end of the 13th the centre of the Mongol power, especially under the sway of Jenghiz Khan and his son Ogotai or Ogdai in the 12th and 13th centuries. For an interpretation of the inscriptions discovered here in the 19th century *see* V. Thomsen, *Inscriptions de l'Orkhon* (Helsingfors, 1900).

SELENIUM, a chemical element closely allied in physical and chemical properties with sulphur (symbol Se, atomic number

34, atomic weight 79·20). It is a complex element having six isotopes (*q.v.*) with atomic weights ranging from 74 to 80. It was discovered in 1817 by J. J. Berzelius who called it selenium (Greek σελήνη, the moon) because of the close analogy between the new element and the recently discovered tellurium (Latin, *tellus*, the earth).

Distribution.—Selenium is widely distributed throughout the world, although in small quantities, being the 40th element in order of plentifulness, between bismuth and gold. It is present in meteoric iron. It rarely occurs native; occasionally it accompanies native sulphur, but is usually found in combination with the heavy metals to form selenides, such as clausthalite, PbSe (29% Se); eucairite, $(Ag,Cu)_2Se$; crookesite $(CuAgTl)_2Se$; naumannite, Ag_2Se; and zorgite (a complex selenide with 31% Se). It occurs also in various pyrites and galenas. Whenever any of the foregoing seleniferous minerals are subjected to manufacturing operations, the selenium appears as a by-product.

In the U.S.A. selenium is obtained in considerable quantities together with some tellurium from the anode slime of the copper refineries. This material is fused with sodium nitrate and sand or oxidised with nitric acid. In either case the aqueous extract is treated with hydrochloric acid and sulphur dioxide to set free the selenium.

Physical Properties.—Selenium exists in several allotropic forms (*see* ALLOTROPY), four of which are definitely crystalline.

Crystalline Red Selenium α and β are two varieties separating in monoclinic crystals obtained from solutions of amorphous or vitreous selenium in hot carbon disulphide. At 110–120° C the α-form, which is isomorphous with monoclinic sulphur, changes into grey metallic selenium, while with the β-form the transformation temperature is 125–130° C. By rapid heating the melting points of α and β forms have been found to be about 180° C. The density of crystalline red selenium is 4·45.

Crystalline Grey Selenium A is obtained by warming vitreous selenium to 175° C. It is only sparingly soluble in hot carbon disulphide, is a bad conductor of the electric current, and is metastable, changing into the following second grey variety.

Crystalline Grey Selenium B (*Metallic Selenium*), formed by warming the other modifications to 200° C, has a metallic lustre, is malleable and, unlike variety A, is in certain circumstances a good electrical conductor. This metallic selenium (m.p. 220·2° C, sp.gr. 4·8) crystallises in rhombohedral crystals of the hexagonal system and is isomorphous with tellurium. Metallic selenium is a non-conductor in the dark, but on exposure to light its electrical conductivity is proportional to the intensity of the light falling upon it. This remarkable property has led to the selenium cell, the basic principle of which depends on coating with a thin film of selenium a conducting metal such as copper, brass, platinum, silver or gold. This metal is either in the form of plates insulated from each other by mica or other insulating material, or two metallic wires wound closely on a cylinder of glass or other non-conductor and covered with selenium. As it is only metallic selenium (variety B) which is sensitive to light, the cell contents after coating with the element must be carefully annealed at 200° C to insure that the selenium has been transformed into the photo-sensitive modification.

APPLICATIONS

United States Production.—The output of selenium in the United States has increased very considerably in recent years. In 1914 22,867 lb. were produced, whereas in 1924 the production reached 130,000 lb., the average price being about $2.10 per pound. This supply goes chiefly to the glass industry, the makers having displaced manganese by selenium as a glass decolorizer, the pink tint produced by this element being complementary to the objectionable green shade arising from the presence of iron in the glass. Moreover, the addition of further quantities of selenium, either as such or as sodium selenite, Na_2SeO_3, imparts to glass a clear red colour useful in railway work. Selenium is used in the ceramic industries for the production of red enamels and red enamelled steelwares. The use of 1–3% of selenium in vulcanised india rubber articles increases their resistance to abrasion by 50%.

Uses as a Solvent, etc.—Selenium oxychloride was shown by V. Lenher to be a liquid having many valuable properties. It is a solvent for natural and synthetic resins, fish oils, etc.; it assists in distinguishing between saturated and unsaturated hydrocarbons, attacking the latter but not the former. In a mixture of benzene and heptane, it dissolves the former whereas the latter floats unchanged. That this liquid is now a commercial product is largely due to Lenher, who established a research school at Wisconsin University for the study of selenium and tellurium.

The remarkable electrical properties of metallic selenium have led to the development of the selenium cell, whereby one can over the telephone "hear a ray of light falling upon a metallic plate." The following electrical contrivances are rendered possible by this selenium cell: (i.) phototelegraph for transmitting photographs or sketches along a wire; (ii.) photographophone for making synchronous records of sounds with moving pictures; (iii.) optophone, invented by E. E. Fournier d'Albe in 1914, for enabling the blind to read ordinary type by ear; (iv.) self-lighting buoys, whereby buoys and beacons in inaccessible spots may light and extinguish themselves automatically, depending only on sunlight; (v.) photometry; (vi.) military uses in wireless telephony and in locating enemy batteries by light.

The fire-proofing of cables with selenium has proved successful. Diethyl selenide has been recommended as a warning stench for introduction into inodorous poisonous commercial gases such as carbon monoxide.

Chemical Properties.—*Hydrogen selenide* (seleniuretted hydrogen) is a colourless gas with repulsive odour, which when liquefied boils at −41° C/760 mm. and melts at −68° C (Olzewski). It burns with a blue flame giving either red selenium or white selenium dioxide depending on the amount of oxygen present. Its solubility in water is somewhat greater than that of hydrogen sulphide. It is obtained by the action of hydrochloric acid on ferrous selenide, but is better prepared by dropping water on aluminium selenide produced by the direct combination of selenium and powdered aluminium.

Metallic Selenides are produced by direct combination of the metals with selenium or, in the case of selenides insoluble in water, by precipitation of solutions of metallic salts by hydrogen selenide. The alkali selenides are colourless but become red on taking up more selenium to form polyselenides such as Na_2Se_2.

Selenium tetrafluoride, SeF_4, was obtained in a state of purity (1928) by E. B. R. Prideaux and C. B. Cox by the interaction of selenium tetrachloride and silver fluoride as a colourless liquid boiling at 93° C (m.p. −13·2° C) and having density 2·77. It attacks glass and is completely hydrolysed by water to selenious and hydrofluoric acids.

Diselenium dichloride, Se_2Cl_2, a brownish-yellow liquid with pungent odour, is decomposed by water into hydrochloric and selenious acids with elimination of red selenium. *Selenium tetrachloride*, a colourless crystalline mass, which vaporises without melting, is produced by burning selenium in chlorine. *Selenium oxychloride*, $SeOCl_2$, a pale yellow liquid boiling at 177·2° C (m.p. 8·5° C), is prepared by mixing the tetrachloride with selenious oxide under carbon tetrachloride, or by partially hydrolysing the tetrachloride.

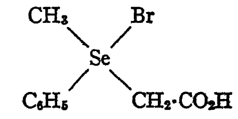
Selenium forms two oxides: The long-known *dioxide*, SeO_2, crystallising in colourless, lustrous needles, obtained by burning selenium in oxygen, readily sublimes but under pressure it melts at 340° C; it dissolves in water to form selenious acid. *Selenium trioxide*, recently described by R. R. Worsley and H. B. Baker (1923) as a solid substance resulting from the action of ozone on selenium dissolved in dry selenium oxychloride, dissolves in water to give selenic acid. This acid, the analogue of sulphuric acid, is usually seen as a syrupy liquid, but has been obtained solid (m.p. 58° C); it has the noteworthy property of dissolving gold.

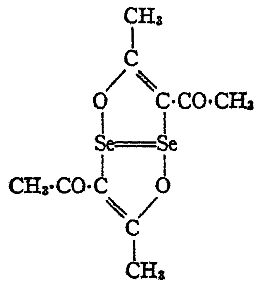
ORGANIC SELENIUM COMPOUNDS

Derivatives of Bivalent Selenium.—Ethylselenomercaptan, C_2H_5SeH, a liquid of repulsive odour (b.p. 57° C), is obtained by

distilling an alkali hydroselenide with an alkali ethylsulphate. Diethyl selenide (b.p. 108° C) and diethyl diselenide (b.p. 186° C) are prepared from potassium ethyl sulphate and potassium mono- and di-selenide respectively. These three liquids are also obtained by treating phosphorus pentaselenide with potassium ethyl sulphate and caustic potash.

Derivatives of Quadrivalent Selenium.—The dialkyl selenides are unsaturated compounds and combine further with alkyl iodides, dimethyl selenide and methyl iodide yielding trimethylselenonium iodide, $(CH_3)_3SeI$, a crystalline salt which is transformed by moist silver oxide into the basic trimethylselenonium hydroxide, $(CH_3)_3Se{\cdot}OH$. From sodium selenophenoxide, $NaSe{\cdot}C_6H_5$, and methyl iodide, phenyl methyl selenide, $C_6H_5{\cdot}Se{\cdot}CH_3$, is produced, and this substance combines with bromoacetic acid to form phenylmethylselenetine bromide (I.) a salt containing

(I.) 

 (II.)

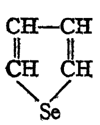
an asymmetric selenium atom; this substance has been resolved by W. J. Pope and Neville (1902) into two optically active isomerides. (*See* STEREOCHEMISTRY.) By the interaction of selenium tetrachloride and acetylacetone, G. T. Morgan and H. D. K. Drew (1920) obtained chloroacetylacetone and bimeric selenium acetylacetone (II.) in yellow plates melting at 175° C. The interaction of this organic derivative with sulphurous acid or alkali bisulphites affords an elegant method of preparing either selenodithionic acid, $Se(SO_3H)_2$, or its alkali salts:

$$(C_5H_6O_2Se)_2 + 4H_2SO_3 \text{ (or } 4KHSO_3) = 2C_5H_8O_2 + 2Se(SO_3H)_2 \text{ [or } 2Se(SO_3K)_2]$$

Phenol condensed with selenium oxychloride gives rise to two isomeric trihydroxytriphenylselenonium chlorides, $(HO{\cdot}C_6H_4)_3$-SeCl; with selenious acid it yields dihydroxydiphenyl selenide $(HO{\cdot}C_6H_4)_2Se$ (M. Takamatru, 1928). Ortho- and para-cresols also give rise to both types of selenium compound, whereas β-naphthol furnishes only di-β-hydroxydinaphthyl selenide (G. T. Morgan and F. Burstall, 1928).

Derivatives of Sexavalent Selenium.—The aromatic selenonic acids are obtained by (1) direct action of selenic acid on benzene and its homologues, or (2) permanganate oxidation of the aryl selenious acids or aryl diselenides. Benzeneselenonic acid, $C_6H_5{\cdot}SeO_3H$, is a hygroscopic syrup which in contact with moisture forms a crystalline hydrate. Diphenylselenone, $(C_6H_5)_2SeO_2$, a colourless crystalline substance melting at 155° C, is produced by oxidation from diphenylselenoxide, $(C_6H_5)_2SeO$, the latter being obtained from diphenylselenide dibromide.

Cyclic Selenium Derivatives.—Selenium takes part in the formation of various heterocyclic compounds. Selenophen (I.), the analogue of thiophen, has been prepared by H. V. A. Briscoe and J. B. Peel (1928) from the interaction of selenium and acetylene at 400° C; it is a colourless liquid boiling at 110°/752 mm.



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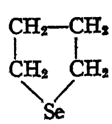

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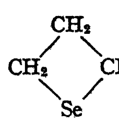

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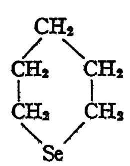

(IV.)

The following saturated selenohydrocarbons have been prepared by the interaction of sodium selenide and the appropriate alkylene dibromide: (i.) *cyclo*selenopropane (III.), from trimethylene dibromide, is a colourless liquid boiling at 80–81° C/40 mm. and giving a crystalline mercurichloride; *cyclo*selenobutane (tetrahydroselenophene) (II.), from tetramethylene dibromide, is a colourless liquid boiling at 135–6°/770 mm.; (iii.) *cyclo*selenopentane (IV.), from pentamethylene dibromide, is a colourless liquid boiling at 158–161° C/760 mm. and having a disagreeable odour; it forms crystalline derivatives with the halogens and with mercuric chloride (Morgan and Burstall, 1929).

Detection and Estimation of Selenium.—Selenium is precipitated from its inorganic compounds by hydrogen sulphide, and is redissolved by ammonium sulphide. The elimination of red selenium from its soluble compounds on reduction with sulphur dioxide, hydrazine, hydroxylamine, etc., is a characteristic test. The gravimetric estimation is made by weighing this precipitate on a tarred filter after boiling until the red selenium has turned black, the latter form being more easily filtered. Selenium may be estimated iodometrically, and selenious acid may be oxidised to selenic acid by standard permanganate.

BIBLIOGRAPHY.—R. Abegg, Fr. Auerbach and I. Koppel, *Handbuch der Anorganischen Chemie,* vol. iv. (1927), with a special chapter on the colloid chemistry of selenium; B. Smith Hopkins, *Chemistry of the Rarer Elements* (1923); G. A. Roush, *The Mineral Industry;* these annual volumes give an epitome of the industrial developments of selenium in the U.S.A.; E. E. Fournier D'Albe, *The Moon Element —an Introduction to the Wonders of Selenium* (1924), a treatise on selenium cells and their uses. (G. T. M.)

SELENIUM CELLS. The light-sensitive property of selenium was discovered in 1873 by Willoughby Smith, who, as a pioneer of submarine telegraphy, had selected that substance for some experiments requiring the use of a high electrical resistance. It is interesting to notice that 56 years had elapsed since the isolation of selenium by Berzelius, and that Riess, throughout his work upon its electrical conductivity had missed, in 1845, the important fact that light is capable of modifying the actual effect he was studying. In 1875 Siemens suggested the use of selenium in photometry and, from that time till the present day, many other proposals relating to the subject have been forthcoming. Thus in 1880 Ayrton and Perry describe what they called "electric vision" and in the following year Shelford Bidwell constructed several improved selenium cells.

Prof. Minchin, in 1891, used selenium for measuring the light from the stars and a few years later Giltay showed that Röntgen rays also changed the electrical resistance of selenium just as light does. Work on the electrical transmission of pictures was carried out during 1902 by Korn, who, five years later, succeeded in thus sending a picture from Munich to Berlin. Dr. Fournier d'Albe invented the "optophone" in 1912 and Graham Bell had made the first "photophone" some 32 years earlier. A greatly improved photophone, however, was designed by Prof. A. O. Rankine in 1916 and is referred to more in detail later.

It will be understood, from what has preceded, that these cells or bridges depend for their action on the change in electrical resistance of selenium when illuminated. A variety of forms of them have been devised but in practically all the aim is similar, namely to arrange two or more conductors so that they are separated by and in close contact with crystalline selenium. The great interest attaching to the subject arises from the fact that no completely satisfactory explanation of the action of light on selenium has been discovered.

The Construction of Selenium Cells.—The earliest systematic experiments relating to the action of light upon selenium were made by melting a platinum wire into the opposite ends of a short rod and noting the change of electrical resistance under various conditions of illumination, temperature, etc. Since the amorphous form of selenium, in which it is sold by dealers, is so poor a conductor of electricity that it may be classed as an insulator, it is necessary when preparing light-sensitive cells to convert this into one of the grey crystalline forms, which conduct comparatively well.

The simplest cells can be made by winding two thin copper wires side by side and one mm. apart upon a strip of mica, say 3″ long by 1″ wide. The strip should then be placed on a hot plate and a thin layer of selenium melted over the wires. On

removal from the plate, cooling and reheating, the black-looking lustrous selenium will rapidly become dull and finally grey. In that state it will be found to be sensitive to light and a fair conductor of electricity. With two adjacent ends of the wires separated and a potential difference of 50 volts applied to the others, a current of perhaps 50 to 100 micro-amperes may be passed through such a cell in the dark, and in the ordinary light of a room this current should immediately rise to 300 micro-amperes or even more. In a modification due to Dr. Pfund, a piece of glass 1 cm. wide and 3 cm. long is coated with selenium which is smoothed out by a hot glass rod. Four strands of bare copper wire are then wound round the whole so that the selenium surface is covered. After fixing the ends of the wires, the first and third strands are unwound and removed so as to leave a gap between the second and fourth and the bridge is reheated and annealed to grey.

Dr. Fournier d'Albe recommends preparing selenium cells by coating slate with graphite and then scratching away a zig-zag line as shown in fig. 1, so that a potential difference applied at the regions A and B would tend to cause a current to flow across the scratch. Owing to the high insulation of the slate, however, no current can pass until selenium is melted over it and allowed to turn grey. In practice it is found necessary to grind the slate surface as smooth as possible by means of pumice powder and subsequently to rub in the graphite very thoroughly to ensure a sufficiently conducting surface.

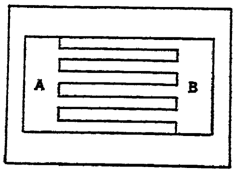

FIG. 1

One of the most successful modern cells is that devised by Prof. Thirring of Vienna. In this type the bridges are built up on what is called the "condenser" plan, and consist of a number of thin strips of brass and mica arranged alternately, and so cut that the mica is slightly narrower than the brass. If such a pack of strips be clamped together and stood on its edge upon a flat surface the brass will stand slightly higher than the mica, and selenium melted over the surface, sinks into the tiny channels between the upper part of the brass strips and thus forms a series of bridges. The selenium is then carefully annealed and finally ground off so as to expose an extremely thin layer to the action of light. The alternate brass strips are connected together in two groups after the manner of an electrical condenser.

A thin layer of selenium is now generally admitted to be essential where sensitivity and greater reliability are desired. It should also be pointed out that for many years the necessity of excluding damp air from selenium cells has been realised, and an important contribution to the subject, recently made by Prof. Rankine (*Proceedings* of the Physical Society of London, v. 39, Part 3, April 15th 1927) and Mr. Avery, shows conclusively that the variable behaviour of selenium bridges is to a large extent attributable to the presence of moisture. Polarization occurs and causes irregularities and inability to reproduce readings. It is therefore important to dry and effectively seal up all selenium bridges required for experiment. This may be partially done by coating them with paraffin wax, shellac, resin, etc., but the best plan is to seal the cells into glass tubes after thorough drying by exposure to P_2O_5. All forms of selenium appear to absorb moisture slightly.

Selenium melts at 217° C and when cooled rapidly remains amorphous. On reheating to 180° C it changes to one of the grey varieties, all of which are more or less sensitive to light. Close examination discloses a mass of minute crystals. Their shapes are largely influenced by the temperature at which they are formed. A thin layer of selenium for instance, which appears deep red by transmitted light, will gradually develop a crop of light-sensitive spherical crystals, the growth of which can be observed on the stage of a microscope if the temperature is maintained at about 100° C (fig. 2). At temperatures in the neighbourhood of 260° C a transparent highly hydroscopic type of crystal is produced which is practically insensitive to light. This and other forms of selenium crystals, excepting the spherical type, may most conveniently be obtained by condensation. A flat brass plate is placed upon a tripod and heated till selenium, rubbed over the central area of it, melts easily. This should then be smoothed off with the edge of a glass strip and a separating ring of mica laid on the molten selenium. A sheet of glass is then placed over and in contact with the mica, and the vapour rising from the selenium condenses on its under surface. At first a red deposit appears which a lens shows to consist of minute beads of transparent amorphous selenium. After a few minutes of continued heating however, the colour changes to grey and with experience, crops of very beautiful crystals can be obtained (*see* fig. 3). An exposure of twelve hours, with the plate held an inch above the molten selenium will, under suitable conditions, produce quantities of needle-like crystals 2 or 3 mm. long. If this be replaced by a slate tablet or gold coated plate on which a line, as previously described, has been cut, the selenium is soon deposited in sufficient quantity to constitute a light-sensitive layer. It is comparatively easy, in half an hour, to prepare a selenium cell in this way that will carry 5,000 micro-amperes with an illumination of 100 candle-feet and a potential difference of 50 volts.

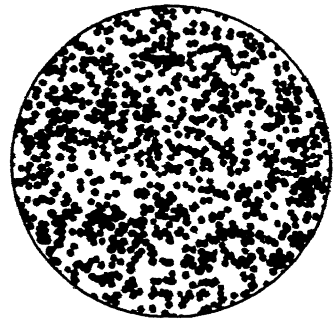
FIG. 2.—SPHERICAL CRYSTALS OF SELENIUM

The sensitivity of a selenium bridge is often expressed by stating the ratio of the "dark current" to that which passes when the cell is illuminated by a light of 100 candle-feet. In the case of a well-made cell this ratio may be 1 to 100.

The value of the current should, on shutting off the light, return to within 5% of its initial value in one second. If a longer time-lag is observed it is generally believed to be due to secondary effects. The time-lag is frequently spoken of as "inertia." Although the above conditions have been actually realised, the usual practice is to work with a 1 to 6 or 1 to 10 ratio for the dark to light current, and to be satisfied with a return to within 5% of zero within five seconds.

It will be found that selenium melted on to ordinary glass will not always adhere well on conversion to the grey or metallic variety and cooling. By using finely ground glass however, and heating the selenium till it freely fumes, it may be stroked with a mica spatula to a smooth surface as it cools, and will then adhere to the base sufficiently well for most practical purposes.

Soapstone, biscuit porcelain and a variety of insulating substances have also been tried as bases. On the other hand the process known as fuming and already described as suitable for the formation of crystals, generally gives an adherent layer even upon polished glass. The presence of oil improves the contact. In this way experiments may be made on the light sensitivity of a single crystal.

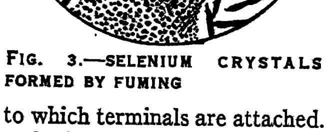
FIG. 3.—SELENIUM CRYSTALS FORMED BY FUMING

Cylindrical bridges made by placing alternate discs of brass and mica upon an insulating rod are useful for certain purposes. The discs are clamped by tightening a nut on the rod and the brass plates are alternately connected together into two groups to which terminals are attached. The whole is heated and selenium melted over the outer edges of the discs, the usual precaution being taken to convert it into the grey light-sensitive variety. Two conducting plates immersed in various liquids, so as to constitute a voltaic battery, one plate being coated with grey selenium and exposed to light, have also been found to be effective as a light-sensitive device. Bridges made with pairs of dissimilar metals separated by thin mica and coated with selenium give an electric current on illumination. Whether a cell will have a high or low electrical resistance when finished depends upon the temperature

and time taken in its preparation. It is not uncommon to find bridges designed to be operated for long periods on 200 volts.

Theoretical.—The process by which light causes the electrical resistance of selenium to vary is not known precisely.

It was formerly held that impurities were necessary but Marc has definitely proved that view to be incorrect. He showed that the presence of traces of silver, etc., affect the behaviour of the cells but proved that the fundamental action of light upon *pure* selenium is indeed a fact. He supported these ideas by various experiments, but failed to devise any really decisive proof of the correctness of his conclusions. The more modern view is, of course, based upon the existence of electrons and seems to adequately explain many of the experimental results. According to the electron theory, selenium becomes ionised by light, and the time-lag is accounted for by supposing the recombination of the ions to take place more slowly than in the case of a gas. That is of course a difficulty, but the electron theory also requires that the resistance of selenium bridges should vary as the square root of the intensity of light falling upon them, and this is found to be the case. On the other hand the sensitive crystals are surprisingly opaque to light and it appears that light waves are only able to penetrate them to a depth of ·0014 cm. In addition there is the fact that surface conditions can vary widely without affecting the sensitivity, and it therefore seems that if electrons are produced or liberated by the light, the process must be one occurring within the crystal itself. It may be generally stated that selenium does not show any selective action towards the colour of the light impinging upon it: the chief factor appears to be the energy conveyed by the beam. In most sources of light the greatest energy is carried by the longer wave lengths and it was therefore formerly thought that selenium is most sensitive to red light. As a matter of fact, for coloured lights with equal energy, selenium is usually somewhat more sensitive to blue light. It also responds to ultra violet light and X-rays as well as to the gamma rays from radium. Experiments upon the sensitivity of selenium to light of various wave lengths have shown that the temperature treatment of the bridge appreciably influences the result.

A wide range of variation is possible by different times of heating and cooling. On the whole it looks as if two chief types of crystals are generally produced viz. one more sensitive to red and one to blue light.

Prof. F. C. Brown has shown, that when using a single crystal of selenium 1 cm. long, the maximum change in resistance across its base occurred when the extreme tip only was illuminated. The crystals may be bent or flattened but still even after heavy pressure retain their sensitivity to light. A block of grey or metallic selenium is sensitive to pressure, and filing or scraping also definitely increases its resistance. If the light falls upon a block of selenium having wire gauze electrodes, the change of resistance is greater in the direction of the current than at right angles to it.

The presence of mercury may cause a selenium cell to be "light negative" *i.e.*, to show an *increased* resistance in light. There is general agreement that a selenium bridge improves up to a certain point by keeping.

Practical Applications.—The comparatively large currents carried by selenium, combined with the simplicity of accessory apparatus, render it particularly suitable for operating a relay by which other actions may be stopped or started. A beam of light can be made to undo a lock, or give an alarm, either by its sudden appearance or by its cessation.

Selenium cells are in use for talking films, where the light through the margin of the film is suitably modified by varying photographic density, so that the current carried through the bridge to a loud-speaker is correspondingly varied and speech reproduced.

To Dr. Fournier d'Albe is due the credit of applying the use of selenium cells for the assistance of blind people. By means of a clockwork device, to interrupt the current through a selenium cell sufficiently rapidly, a musical sound can be heard in a telephone and the intensity of the note made to serve as a guide to the direction and proximity of a light. Dr. Fournier d'Albe has designed a small portable apparatus by which on pointing it in various directions towards a light, the loudness of the note heard in a telephone indicates brightness. Totally blind persons can find a window in a room or learn to guide themselves about a house by this means. A more important development in this direction however, is his invention of the optophone, an instrument which enables a blind person to read ordinary print by means of sound. This apparatus depends for its action on a selenium cell. It is clear that the pitch of the note, heard in a telephone in circuit with a selenium bridge, can be altered by varying the speed at which perforations in a revolving disc allow light to reach the cell. Different notes may in fact be given out by a loud-speaker connected with a bridge, and a sort of musical instrument evolved. Similar developments have taken place in America.

Sunshine, fog or moonlight recorders have been made with selenium, and recently in America, the result of a horse race was established by the leading horse intercepting a beam of light and thereby affecting a selenium cell, which actuated a relay, and marked the exact moment of the horse's arrival at the winning post. The variations of light intensity during an eclipse of the sun have also been recorded by means of selenium.

For photometric work however, for television or all applications where great precision is required, the photo-electric cell with thermionic valve is more reliable at present.

The far greater sensitivity of selenium, and the comparatively large currents it is able to carry, at the same time offers very strong inducement to physicists to continue the study of its remarkable properties, quite apart from the intrinsic scientific interest attaching to the subject.

An ingenious device invented during the War by Prof. A. O. Rankine, and called the "photophone," enables light reflected from a mirror attached to the needle-holder of a gramophone diaphragm to affect a distant selenium cell and so transmit speech.

Some of the latest applications have been evolved in the laboratories of Messrs. The Radiovisor Parent Ltd., where a system of street lamp control has been perfected so that lamps may be automatically lighted at dusk and extinguished at dawn. This has now been in use in the urban district of Barnes, London, since March, 1928. A similar method has already been employed in Germany for lighting and extinguishing harbour buoys, etc. Amongst other applications which have been developed in this laboratory are a system of railway control and a burglar alarm.

A device whereby the smoke density in the smoke stacks of destroyers may be registered on an indicator has been experimented with both in the British and in the U.S.A. Navy. Selenium enables this to be done by recording changes of electrical resistance when light projected across the lower part of the stack is more or less obscured by the smoke. During the War it was shown to be practicable to regulate the movements of a ship, to fire guns or explode mines by means of selenium bridges controlled by a searchlight beam.

Two forms of selenium fire alarms have also been invented. Selenium bridges have also been used to increase the speed of telegraphic signalling.

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SELENIUM COMPASS. The increasing use of steel in aeroplane structure and equipment has led to the need for a compass that may be fixed in a part of the ship unaffected by magnetic disturbances. The problem, simple in principle, offers difficulties in practice. The selenium compass presents an avenue of escape, though at the expense of additional weight and complication. Selenium possesses the curious property of changing its electric resistance when light strikes upon it. In the selenium compass, two diametrically opposed lamps, fitted in the bottom of the compass bowl, provide two beams of light which strike upon two selenium cells incorporated in a bridge fixed on the top of the compass bowl. The magnetic system carries a diaphragm which, in

one orientation of the bowl and bridge with respect to the magnetic system, will hide both beams of light from the selenium cells. If, however, the bowl be turned, the electric resistances of the two selenium cells become unequal, a condition which can be determined in the usual manner by means of a galvanometer fitted on the dashboard. The compass is operated in the following manner: An instrument fitted in the cockpit has a dial marked in degrees, like an ordinary compass card. By turning a handle, the pilot or navigator can move a pointer over the dial to any desired compass course, at the same time rotating through gearing the compass bowl and bridge in the tail of the aircraft. If, for example, the handle be turned until the pointer indicates a south-east direction, then the bowl will automatically be turned so that only on this course will the diaphragm on the magnetic system equally shield the selenium cells. The pilot has thus simply to turn the aircraft until the galvanometer reading is zero; any departure from the course will be indicated by a deflection of the galvanometer. The selenium compass has been successfully operated in flight, but, since it employs a null method of reading, it cannot be used to indicate bearings.

SÉLESTAT or **SCHLETTSTADT,** a town of France, capital of an arrondissement, in the department of Bas-Rhin, on the Ill, 26 m. S. of Strasbourg by the railway to Basle. It was a royal residence in Carolingian times and became a free town of the Empire in the 13th century. In the 15th century it was the seat of a celebrated academy, founded by Rodolphus Agricola, which contributed to the revival of learning in this region. Erasmus of Rotterdam was one of its students. In 1634 it passed to France and was afterwards fortified by Vauban. It offered little resistance, however, to the Germans in 1870, and the fortifications have since been razed. The Hoh-Königsburg, a great castle standing at an elevation of 2,475 ft., was presented to the emperor William II. by the town of Schlettstadt in 1899, and was completely restored in 1908. The site is first mentioned as bearing a castle in the 8th century.

SELEUCIA, the name of several Hellenistic cities named after the founder of the Seleucid dynasty, Seleucus Nicator. The most important are:

1. **Seleucia on the Tigris.**—This city lay on the right bank at the mouth of the Nahr-al-Malik (the royal canal). The city was founded by Seleucus Nicator in 312 B.C., and marks the definite shift of the centre of power in Mesopotamia from the Euphrates to the Tigris. Throughout the period of Sumerian times the principal city of the region had been on the Euphrates, first Kish (*q.v.*), and when the Euphrates shifted its course, Babylon. Alexander followed the ancient precedent. Seleucia however marks the definite end of Babylon and is closely associated with Hellenistic culture in Mesopotamia. During the Persian domination Ctesiphon on the opposite bank succeeded Seleucia.

Seleucia is said to have been founded with the definite object of destroying Babylon. It was peopled with Macedonians and Greeks, and admitted Jews and Syrians to citizenship, *i.e.*, it was definitely a cosmopolitan city, characteristic of the Hellenistic age. Pliny gives the population at 600,000. During the Parthian domination the city continued to be the foremost city of the east in position and trade. It was always in sympathy with the west rather than the east, and was definitely opposed to and at times in open rebellion against the Parthians. The Arsacids founded the rival city of Ctesiphon. Seleucia, however, continued to survive, and eventually was burnt by Avidius Cassius in A.D. 164, at which time it is said to have had 300,000 inhabitants. The destruction of the city marks the end of Hellenism in Mesopotamia.

2. **Seleucia Pieria,** in Syria, a port and frontier fortress on the Cilician border. The city lay four miles north of the mouth of the Orontes in 36° N. and 36° E. and was the port of Antioch, with which city and Apamea and Laodicea it formed the Syrian tetrapolis. The town appears to have been of considerable size and the great road to the sea, a deep cutting through the rock still survives. Walls, temples and amphitheatre can also be traced. The city was of considerable military importance during the wars between the Ptolemies and the Seleucids and was recognized as an independent city later by the Romans (in A.D. 70). It had practically disappeared by the fifth century.

3. **Seleucia Tracheotis** (modern Selefke), also called Trachea, a city in Cilicia in 36° N. 34° E. It lay on the Calycadnus (modern Gok Su), a few miles from the mouth of the river, doubtless as a protection against attacks from the sea. There are the ruins of a castle on the Acropolis and other considerable remains. The city was at one time a port with a large trade. It was built near an old site (Oldia) in 300 B.C. by Seleucus Nicator. During the third Crusade Frederick Barbarossa was drowned in crossing the river (A.D. 1190). The city was captured by the Turks in the thirteenth century. It still remains the capital of a district.

Several other towns also bore the name of Seleucia, as (4) Seleucia in Mesopotamia, modern Birijik (*q.v.*), (5) in the Persian Margiana, which received its name from Antiochus I. of Syria, having been previously called Alexandria, after its original founder; (6) in Pisidia; (7) in Pamphylia; (8) on the Belus in Syria; and (9) Tralles (*q.v.*). (L. H. D. B.)

SELEUCID DYNASTY, a line of kings who reigned in Nearer Asia from 312 to 65 B.C.

Seleucus.—The founder SELEUCUS (surnamed for later generations Nicator) was a Macedonian, the son of Antiochus, one of Philip's generals. Seleucus, as a young man of about twenty-three, accompanied Alexander into Asia in 333, and won distinction in the Indian campaign of 326. When the Macedonian empire was divided in 323 (the "Partition of Babylon") Seleucus was made *chiliarch* (practically=vizier) to the regent Perdiccas. Seleucus himself had a hand in the murder of Perdiccas in 321. At the second partition, at Triparadisus (321), Seleucus was given the government of the Babylonian satrapy. In 316, when Antigonus had made himself master of the eastern provinces, Seleucus fled to Egypt. In the war which followed between Antigonus and the other Macedonian chiefs, Seleucus actively co-operated with Ptolemy and commanded Egyptian squadrons in the Aegean. The victory won by Ptolemy at Gaza in 312 opened the way for Seleucus to return to the east.

His return to Babylon in that year was afterwards officially regarded as the beginning of the Seleucid empire. Master of Babylonia, Seleucus at once proceeded to wrest the neighbouring provinces of Persis, Susiana and Media from the nominees of Antigonus. A raid into Babylonia conducted in 311 by Demetrius, son of Antigonus, did not seriously check Seleucus's progress. Whilst Antigonus was occupied in the west, Seleucus during nine years (311–302) brought under his authority the whole eastern part of Alexander's empire as far as the Jaxartes and Indus. In 305, after the extinction of the old royal line of Macedonia, Seleucus, like the other four principal Macedonian chiefs, assumed the style of king. He attempted to recover Alexander's conquests in India, but with Antigonus threatening in the west he made peace with Chandragupta in 302, ceding him territory in Afghanistan for 500 elephants. In 301 he and Lysimachus defeated Antigonus at Ipsus in Asia Minor. A new partition of the empire followed, by which Seleucus added to his kingdom Syria, and perhaps some regions of Asia Minor. The possession of Syria gave him an opening to the Mediterranean, and he founded here his new capital, Antioch, on the Orontes. Seleucia continued to be the capital for the eastern satrapies. About 293 he installed his son Antiochus there as viceroy. Demetrius fell in 285, and an invitation by Ptolemy Ceraunus gave him a chance to remove his last rival, Lysimachus, who was defeated and killed at Corupedion in Lydia (281). Seleucus now had the whole of Alexander's empire but Egypt in his hands. He left Asia to Antiochus, and crossed over to take possession of Macedonia. He reached the Chersonese to be murdered by Ptolemy near Lysimachia (281).

Antiochus I. Soter (324 or 323–262) was half a Persian, his mother Apame being one of those eastern princesses whom Alexander had given as wives to his generals in 324. On the assassination of his father (281), the task of holding together the empire was a formidable one, and a revolt in Syria broke out almost immediately. With his father's murderer, Ptolemy, Antiochus was soon compelled to make peace, abandoning apparently Macedonia and Thrace. In Asia Minor he was unable to reduce

Bithynia or the Persian dynasties which ruled in Cappadocia. In 278 the Gauls broke into Asia Minor, and a victory which Antiochus won over them is said to have been the origin of his title of *Soter* (Gr. for "saviour"). At the end of 275 the question of Palestine, which had been open between the houses of Seleucus and Ptolemy since the partition of 301, led to hostilities (the "First Syrian War"). About 262 Antiochus tried to break the growing power of Pergamum, but suffered defeat near Sardis and died soon afterwards (262).

261–223 B.C.—He was succeeded (261) by his second son ANTIOCHUS II. THEOS (286–246), whose mother was the Macedonian princess Stratonice, daughter of Demetrius Poliorcetes. War with Egypt still went on along the coasts of Asia Minor (the "Second Syrian War"). Antiochus also made some attempt to get a footing in Thrace. About 250 peace was concluded between Antiochus and Ptolemy II., Antiochus repudiating his wife Laodice and marrying Ptolemy's daughter Berenice, but by 246 Antiochus had left Berenice and her infant son in Antioch to live again with Laodice in Asia Minor. Laodice poisoned him and proclaimed her son SELEUCUS II. CALLINICUS (reigned 246–227) king, whilst her partisans at Antioch made away with Berenice and her son. Berenice's brother, Ptolemy III., who had just succeeded to the Egyptian throne, at once invaded the Seleucid realm and annexed the eastern provinces, whilst his fleets swept the coasts of Asia Minor. In the interior of Asia Minor Seleucus maintained himself, and when Ptolemy returned to Egypt he recovered Northern Syria and the nearer provinces of Iran. At Ancyra (about 235?) Seleucus was defeated by his younger brother Antiochus Hierax, supported by Laodice, and left the country beyond the Taurus to his brother and the other powers of the peninsula. Of these Pergamum now rose to greatness under Attalus I., and Antiochus Hierax perished as a fugitive in Thrace in 228/7. A year later Seleucus was killed by a fall from his horse. His elder son, SELEUCUS III. Soter (reigned 227–223), took up the task of reconquering Asia Minor from Attalus, but fell by a conspiracy in his own camp.

Antiochus III. the Great (223–187).—Callinicus's younger son, a youth of about eighteen, now succeeded to a disorganized kingdom (223). Not only was Asia Minor detached, but the further eastern provinces had broken away, Bactria under the Greek Diodotus (*q.v.*), and Parthia under the nomad chieftain Arsaces. Soon after Antiochus's accession, Media and Persis revolted under their governors, the brothers Molon and Alexander. The young king was in the hands of the bad minister Hermeias, and was induced to make an attack on Palestine instead of going in person to face the rebels. The attack on Palestine was a fiasco, and the generals sent against Molon and Alexander met with disaster. Only in Asia Minor, where the Seleucid cause was represented by the king's cousin, the able Achaeus, was its prestige restored and the Pergamene power driven back to its earlier limits. In 221 Antiochus at last went east, and the rebellion of Molon and Alexander collapsed. The submission of Lesser Media, which had asserted its independence under Artabazanes, followed. Antiochus rid himself of Hermeias by assassination and returned to Syria (220). Meanwhile Achaeus himself had revolted and assumed the title of king in Asia Minor. Antiochus considered that he might leave Achaeus for the present and renew his attempt on Palestine. The campaigns of 219 and 218 carried the Seleucid arms almost to the confines of Egypt, but in 217 Ptolemy IV. defeated Antiochus at Raphia and compelled him to withdraw north of the Lebanon. In 216 Antiochus went north to deal with Achaeus, and had by 214 driven him into Sardis. Antiochus contrived to capture Achaeus (*see* POLYBIUS), but the citadel held out till 213.

Having thus recovered the central part of Asia Minor—for the dynasties in Pergamum, Bithynia and Cappadocia the Seleucid government was obliged to tolerate—Antiochus turned to recover the outlying provinces of the north and east. Xerxes of Armenia was brought to acknowledge his supremacy in 212. In 209 Antiochus invaded Parthia, occupied the capital Hecatompylus and pushed forward into Hyrcania. The Parthian king was apparently granted peace on his submission. In 209 Antiochus was in Bactria, where the original rebel had been supplanted by another Greek Euthydemus. (*See* further BACTRIA and articles on the separate rulers.) The issue was again favourable to Antiochus. After sustaining a famous siege in his capital Bactra (Balkh), Euthydemus obtained an honourable peace. Antiochus next, following in the steps of Alexander, crossed into the Kabul valley, received the homage of the Indian king Sophagasenus and returned west by way of Seistan and Kerman (206/5). From Seleucia on the Tigris he led a short expedition down the Persian Gulf against the Gerrhaeans of the Arabian coast (205/4). Antiochus seemed to have restored the Seleucid empire in the east, and the achievement brought him the title of "the Great King." In 205/4 the infant Ptolemy V. Epiphanes succeeded to the Egyptian throne, and Antiochus concluded a secret pact with Philip of Macedonia for the partition of the Ptolemaic possessions. Once more Antiochus attacked Palestine, and by 199 he seems to have had possession of it. Scopas recovered Palestine for Ptolemy, but was defeated at the Panium, near the sources of the Jordan, in 198. In 197 Antiochus moved to Asia Minor to secure the coast towns which had acknowledged Ptolemy and the independent Greek cities. This enterprise brought him into antagonism with Rome, since Smyrna and Lampsacus appealed to the republic of the west, and the tension became greater after Antiochus had in 196 established a footing in Thrace. The evacuation of Greece by the Romans gave Antiochus his opportunity, and he now had the fugitive Hannibal at his court to urge him on. In 192 Antiochus invaded Greece, but in 191 he was routed at Thermopylae by the Romans under M. Acilius Glabrio, and obliged to withdraw to Asia. The Romans followed up their success by attacking Antiochus in Asia Minor, and the decisive victory of L. Cornelius Scipio at Magnesia and Sipylum (190), following on the defeat of Hannibal at sea off Side, gave Asia Minor into their hands. By the peace of Apamea (188) the Seleucid king abandoned all the country north of the Taurus, which was distributed among the friends of Rome. As a consequence of this blow to the Seleucid power, the outlying provinces of the empire, recovered by Antiochus, reasserted their independence. Antiochus perished in a fresh expedition to the east in Luristan (187).

187–164 B.C.—The Seleucid kingdom as Antiochus left it to his son, SELEUCUS IV. PHILOPATOR (reigned 187–176), consisted of Syria (now including Cilicia and Palestine), Mesopotamia, Babylonia and Nearer Iran (Media and Persis). Seleucus IV. was compelled by financial necessities, created in part by the heavy war-indemnity exacted by Rome, to pursue an unambitious policy, and was assassinated by his minister Heliodorus. The true heir, Demetrius, son of Seleucus, being now retained in Rome as a hostage, the kingdom was seized by the younger brother of Seleucus, ANTIOCHUS IV. EPIPHANES, who reigned 176–164. In 170, Egypt, governed by regents for the boy Ptolemy Philometor, attempted to reconquer Palestine; Antiochus not only defeated this attempt but invaded and occupied Egypt, and left Philometor as his ally installed at Memphis. When Philometor joined Ptolemy Eurgetes, Antiochus again invaded Egypt (168), but was compelled to retire by the Roman envoy C. Popillius Laenas (consul 172), after the scene in which the Roman drew a circle in the sand about the king and demanded his answer before he stepped out of it. Antiochus had resided at Rome as a hostage, and afterwards for his pleasure at Athens, and had brought to his kingdom an admiration for republican institutions and an enthusiasm for Hellenic culture—or, at any rate, for its externals. There is evidence that the forms of Greek political life were more fully adopted under his sway by many of the Syrian cities. He spent lavishly on public buildings. It is his contact with the Jews which has chiefly interested later ages, and he is doubtless the monarch described in the pseudo-prophetic chapters of Daniel (*q.v.*). Jerusalem, near the Egyptian frontier, was an important point, and in one of its internal revolutions Antiochus saw, perhaps not without reason, a defection to the Egyptian side. His chastisement of the city, including as it did the spoliation of the temple, served the additional purpose of relieving his financial necessities. It was a measure of a very different kind when, a year or two later (after 168), Antiochus tried to suppress the

practices of Judaism by force, and it was this which provoked the Maccabaean rebellion. (*See* MACCABEES.) In 166 Antiochus left Syria to attempt the reconquest of the further provinces. He seems to have been signally successful. Armenia returned to allegiance, the capital of Media was recolonized as Epiphanea, and Antiochus was pursuing his plans in the east when he died at Tabae in Persis, after exhibiting some sort of mental derangement (winter 164/3).

164–145 B.C.—He left a son of nine years, ANTIOCHUS V. EUPATOR (reigned 164–162), in whose name the kingdom was administered by a camarilla. Their government was feeble and corrupt. The attempt to check the Jewish rebellion ended in a weak compromise. In 162 Demetrius, the son of Seleucus IV., escaped from Rome and was received in Syria as the true king. Antiochus Eupator was put to death. DEMETRIUS I. SOTER (reigned 162–150) was a strong and ambitious ruler. He crushed the rebellion of Timarchus in Media and reduced Judaea to new subjection. But he was unpopular at Antioch, and fell before a coalition of the three kings of Egypt, Pergamum and Cappadocia. An impostor, who claimed to be a son of Antiochus Epiphanes, ALEXANDER BALAS (reigned 150–145), was installed as king by Ptolemy Philometor and given Ptolemy's daughter Cleopatra to wife, but Alexander proved to be dissolute and incapable, and when Demetrius, the son of Demetrius I., was brought back to Syria by Cretan *condottieri*, Ptolemy transferred his support and Cleopatra to the rightful heir. Alexander was defeated by Ptolemy at the battle of the Oenoparas near Antioch and murdered during his flight. Ptolemy himself died of his wounds.

The Later Seleucids.—DEMETRIUS II. NICATOR (first reign 145–140) was a mere boy, and the misgovernment of his Cretan supporters led to the infant son of Alexander Balas, ANTIOCHUS VI. DIONYSUS being set up against him (145) by Tryphon, a magnate of the kingdom. Demetrius was driven from Antioch and fixed his court in the neighbouring Seleucia. In 143 Tryphon murdered the young Antiochus and assumed the diadem himself. Three years later Demetrius set off to reconquer the eastern provinces from the Parthians, leaving Queen Cleopatra to maintain his cause in Syria. When Demetrius was taken prisoner by the Parthians, his younger brother ANTIOCHUS VII. SIDETES (164–129) appeared in Syria, married Cleopatra and crushed Tryphon. Antiochus VII. was the last strong ruler of the dynasty (138–129). He took Jerusalem and once more brought the Jews, who had won their independence under the Hasmonaean family, to subjection. (*See* MACCABEES.) He led a new expedition against the Parthians in 130, but, after signal successes, fell fighting in 129. (*See* also PERSIA: *History.*) Demetrius (second reign 129–126), who had been allowed by the Parthians to escape, now returned to Syria, but was soon again driven from Antioch by a pretender, ALEXANDER ZABINAS, who had the support of the king of Egypt. Demetrius was murdered at the instigation of his wife Cleopatra in 126. The remaining history of the dynasty is a wretched story of the struggle of different claimants, while the different factors of the kingdom, the cities and barbarian races, more and more assert their independence. Both Demetrius II. and Antiochus VII. left children by Cleopatra, who form rival branches of the royal house.

To the line of Demetrius belong his son SELEUCUS V. (126), assassinated by his mother Cleopatra, ANTIOCHUS VIII. GRYPUS (141–96), who succeeded in 126 the younger brother of Seleucus V., the sons of Grypus, SELEUCUS VI. EPIPHANES NICATOR (reigned 96–95), ANTIOCHUS XI. EPIPHANES PHILADELPHUS (reigned during 95), PHILIP I. (reigned 95–83), DEMETRIUS III. EUKAIROS (reigned 95–88), and ANTIOCHUS XII. DIONYSUS EPIPHANES (reigned 86?–85?), and lastly PHILIP II., the son of Philip I., who appears momentarily on the stage in the last days of confusion. To the line of Antiochus VII. belong his son ANTIOCHUS IX. CYZICENUS (reigned 116–95), the son of Cyzicenus, ANTIOCHUS X. EUSEBES (reigned 95–83?), and the son of Eusebes, ANTIOCHUS XIII. ASIATICUS (reigned 69–65). In 83 Tigranes, the king of Armenia, invaded Syria, and by 69 his conquest had reached as far as Ptolemais, when he was obliged to evacuate Syria to defend his own kingdom from the Romans. When Pompey appeared in Syria in 64, Antiochus XIII. begged to be restored to his ancestral kingdom or what shred was left of it. Pompey refused and made Syria a Roman province. Antiochus Grypus had given his daughter in marriage to Mithradates (*q.v.*), a king of Commagene, and the subsequent kings of Commagene (*see* under ANTIOCHUS) claimed in consequence still to represent the Seleucid house after it had become extinct in the male line, and adopted Antiochus as the dynastic name. The kingdom was extinguished by Rome in 72. The son of the last king, Gaius Iulius Antiochus Epiphanes Philopappus, was Roman consul for A.D. 100.

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SELF-BINDER: *see* HARVESTING MACHINERY.

SELF-DETERMINATION is a term which, since the World War, has been commonly used to denote the right of every people to choose freely such form of government and of political and cultural institutions as it thinks will best correspond to its needs. As a war-time slogan it was chiefly used by Allied propagandists who represented it as part of the Allied programme to liberate certain subject nationalities of eastern, central, and south-eastern Europe and of the Middle East. President Wilson was one of its chief advocates, and included it in his famous Fourteen Points (*q.v.*) enunciated in 1918. (*See* EUROPE; PLEBISCITE; also the articles on the various European countries; *e.g*, POLAND; RUMANIA.)

SELF-HEAL (*Prunella vulgaris*), a cosmopolitan herb with a creeping rootstock and purple two-lipped flowers. The stems are short and branching, the leaves oblong or lanceolate. The plant belongs to the family Labiatae and was formerly used for cuts, wounds, etc., whence the common name.

SELF-HETERODYNE RECEPTION, a system of heterodyne reception through the use of a device which is both an oscillator and a detector. Heterodyne reception is the process of receiving radio waves by combining the received current with locally generated alternating current.

SELFRIDGE, HARRY GORDON (1864–), American business man, was born at Ripon (Wis.), U.S.A., on Jan. 11, 1864. He entered the firm of Marshall Field and Co., of Chicago, from which he retired in 1904. In 1906 he went to London and organized the firm of Selfridge and Co., Ltd., wholesale and retail merchants, which opened in 1909 with extensive premises in Oxford street. These became known throughout the country, and the firm developed into one of the most successful business enterprises of its kind in the world. Selfridge wrote a book, *The Romance of Commerce* (1918), in which he recorded the growth of commerce from earliest times until the present day.

SELIM, the name of three sultans of Turkey.

SELIM I. (1465–1521) succeeded in 1512 his father Bayezid II., whom he dethroned, and whose death, following immediately afterwards, gave rise to suspicions which Selim's character certainly justified. A bigoted Sunni, he resolved on putting down the Shi'ite heresy, which had gained many adherents in Turkey; the number of these was estimated as high as 40,000. Selim determined on war with Persia, where the heresy was the prevalent religion, and in order that the Shi'ites in Turkey should give no trouble during the war, "measures were taken," as the Turkish historian states, which proved fully efficacious. The campaign which followed was a triumph for Selim, whose firmness and courage overcame the pusillanimity and insubordination of the Janissaries. Syria and Egypt next fell before him; he became master of the holy cities of Islam; and he induced the last Caliph of the Abbasid dynasty formally to surrender the title of caliph

(*q.v.*) as well as its outward emblems, viz. the holy standard, the sword and the mantle of the prophet. After his return from his Egyptian campaign, he was preparing an expedition against Rhodes when he was overtaken by sickness and died, on Sept. 22, 1521, in the ninth year of his reign, near the very spot where he had attacked his father's troops, not far from Adrianople. He was about fifty-five years of age. He was bigoted, bloodthirsty and relentless; and at one time he was with difficulty dissuaded from ordering the complete extirpation of all the Christians in Turkey.

Selim II. (1524–1574) was a son of Suleiman I. and his favourite Roxelana, and succeeded his father in 1566. An able grand vizier, Mahommed Sokolli, succeeded in concluding at Constantinople an honourable treaty (1568) with the emperor Maximilian II., whereby the emperor agreed to pay to Turkey an annual "present" of 30,000 ducats. Against Russia he was less fortunate. A plan had been elaborated at Constantinople for uniting the Volga and Don by a canal, and in the summer of 1569 a large force of Janissaries and cavalry were sent to lay siege to Astrakhan and begin the canal works, while an Ottoman fleet besieged Azov. But a sortie of the garrison of Astrakhan drove back the besiegers; 15,000 Russians, under Knes Serebianov, attacked and scattered the workmen and the Tatar force sent for their protection; and, finally, the Ottoman fleet was destroyed by a storm. Early in 1570 the ambassadors of Ivan the Terrible concluded at Constantinople a treaty which restored friendly relations between the sultan and the tsar. Expeditions in the Hejaz and Yemen were more successful, and the conquest of Cyprus in 1571, which provided Selim with his favourite vintage, led to the calamitous naval defeat of Lepanto in the same year, which freed the Mediterranean from the corsairs by whom it was infested. Sokolli was preparing for a fresh attack on Venice, when the sultan's death on Dec. 12, 1574, cut short his plans. Selim was dissolute and idle, and took no part in the wars of his reign.

Selim III. (1762–1808) was a son of Sultan Mustafa III. and succeeded his uncle Abd-ul-Hamid I. in 1789. He was thoroughly persuaded of the necessity of reforming his state. But Austria and Russia gave him no time for anything but defence, and it was not until the peace of Jassy (1792) that a breathing space was allowed him in Europe, and Bonaparte's invasion of Egypt and Syria shattered the old-standing French alliance. Selim profited by the respite to abolish the military tenure of fiefs; he introduced salutary reforms into the administration, especially in the fiscal department, sought to extend education, and engaged foreign officers as instructors, by whom a small corps of new troops called *nizam-i-jedid* were collected and drilled. These troops were able to hold their own against rebellious Janissaries in the European provinces, where disaffected governors made no scruple of attempting to use them against the reforming sultan.

Emboldened by this success, Selim issued an order that in future picked men should be taken annually from the Janissaries to serve in their ranks. Hereupon the Janissaries and other enemies of progress rose at Adrianople, and the reforms had to be abandoned. Serbia, Egypt and the principalities were successively the scene of hostilities in which Turkey gained no successes, and in 1807 a British fleet appeared at Constantinople, to insist on Turkey's yielding to Russia's demands and on the dismissal of the ambassador of Napoleon I. Selim was, however, thoroughly under the influence of this ambassador, Sebastiani, and the fleet retired without effecting its purpose. The Janissaries rose once more in revolt, induced the Sheikh-ul-Islam to grant a fetva against the reforms, dethroned and imprisoned Selim (1807), who was strangled in the seraglio, and placed his nephew Mustafa on the throne.

For authorities *see* Turkey: *History*.

SELINUS, an ancient city on the south coast of Sicily (Σελινοῦς), 27 m. S.E. direct from Lilybaeum (the modern Marsala) and 8 m. S.E. of Castel Vetrano, which is 74 m. S.S.W. of Palermo by rail. It was founded, in 651 or in 628 B.C., by colonists from Megara Hyblaea, and from the parent city of Megara (*see* Sicily: *History*). The name, which belonged both to the city and to the river on the west of it, was derived from the wild celery which grows there abundantly, and which appears on some of its coins (*see* Numismatics, *Greek*, § "Sicily"). We hear of boundary disputes with Segesta as early as 580 B.C. Selinus soon grew in importance, and extended its borders from the Mazarus to the Halycus. Its government was at first oligarchical, but about 510 B.C. a short-lived despotism was maintained by Peithagoras and, after him, Euryleon. In 480 B.C. Selinus took the Carthaginian side. Thucydides speaks of its wealth and of the treasures in its temples, and the city had a treasury of its own at Olympia.

A dispute between Selinus and Segesta was one of the causes of the Athenian expedition of 415 B.C. At its close the former seemed to have the latter at its mercy, but an appeal to Carthage was responded to, and an overwhelming force under Hannibal took and destroyed the city in 409 B.C.; the walls were razed to the ground and only 2,600 inhabitants escaped to Agrigentum (Acragas). In 408 Hermocrates, returning from exile, occupied Selinus and rebuilt the walls; and it is to him that the fine fort on the neck of the acropolis must be attributed. He fell, however, in 407 in an attempt to enter Syracuse, and, as a result of the treaty of 405 B.C., Selinus became absolutely subject to Carthage, and remained a mere village until its inhabitants were transferred to Lilybaeum (250 B.C.). It was never afterwards rebuilt, and Strabo mentions it as one of the extinct cities of Sicily. There are traces of habitation in the early Middle Ages, and during the Islamic period there was a village there: but an earthquake in the 10th or 11th century ruined it completely, and it has been covered by shifting sand.

The ancient city occupied a sand-hill running north and south; the south portion, overlooking the sea, which was the acropolis, is surrounded by fine walls of masonry of rectangular blocks of stone, which show traces of the reconstruction of 408 B.C. It is traversed by two main streets, running north and south and east and west, from which others diverged at right angles. There are, however, some traces of earlier buildings at a different orientation. Only the south-east portion of the acropolis, which contains several temples, has been excavated: in the rest private houses seem to predominate. The deities to whom the temples were dedicated not being known, they are indicated by letters. In all the large temples the cella is divided into two parts, the smaller and inner of which (the *adytum*) was intended for the cult image. The opisthodomus is sometimes omitted. From the disposition of the drums of the columns, it is impossible to suppose that their fall was due to any other cause than an earthquake. Temple C is the earliest of those on the acropolis. It had six columns at each end (a double row in the front) and seventeen on each long side. Twelve of those on the north have been reerected. From it came the three archaic metopes now in the museum at Palermo. Portions of the coloured terra-cotta slabs which decorated the cornice and other architectural members have also been discovered, including the fragments of an enormous Gorgon mask, over 8 ft. high, from the centre of one of its pediments. In front of it stood a large altar over 60 ft. long. Next to it on the north lies temple D, both having been included in one *temenos*, with other buildings of less importance: to the east of D is a large altar. B is a small temple of comparatively late date; while A and O lie on the south side of the main street from east to west in another *peribolos*.

At the north end of the acropolis are extensive remains of the fortifications of Hermocrates across the narrow neck connecting it with the rest of the hill. In front of the wall lies a deep trench, into which several passages descend, as at the nearly contemporary fort of Euryelus above Syracuse (*q.v.*). Outside this again lies a projecting semicircular bastion, which commands the entrance from the exterior of the city on the east, a winding trench approached by a pair of double gateways, which are not vaulted but covered by the gradual projection of the upper courses. Capitals and triglyphs from earlier buildings destroyed to make room for them have been used in the construction of these fortifications: from their small size they may be mostly attributed to private houses, but a small temple was also destroyed, fragments of five metopes of which are at the museum at Palermo (*c.* 500 B.C.). A way across the curving trench leads to an open space, where the

Table of the Measurements of the Temples (in feet)

	A	B	C	O	D	E	F	G
Length, excluding steps	132	31½	209¼	..	183¾	222½	203	362
Breadth, excluding steps	53¼	18⅓	78½	..	77½	83	80¼	164⅓
Length of cella	94¼	..	136⅓	..	129	163⅓	(?)	226½ (?)
Breadth of cella	28⅓	..	34½	..	32¾	46⅔	30¼	69
Height of columns with capitals	23½	..	28¾	..	27¼	..	..	33¼
Diameter of columns at bottom	4½	..	6⅓	..	6	6⅔	5¾	8⅔ (11½)
Number of columns in peristasis	36	4	42	36 (?)	34	38	36	46
Class	Peripteros-hexastylos	Prostylos-tetrastylos	Peripteros-hexastylos	..	Peripteros-hexastylos	Peripteros-hexastylos	Peripteros-hexastylos	Pseudo-dipteros-octostylos
Approximate date	480 B.C.	After 240 B.C.	581 B.C.	480 B.C.	570–554 B.C.	Soon after 480 B.C.	570–554 B.C.	..

Agora may have been situated: beyond it lay the town, the remains of which are scanty, though the line of the walls can be traced.

Outside the ancient city, on the west of the river Selinus, lie the ruins of a temple of Demeter Malophoros, with a propylon leading to the sacred enclosure: the temple itself has a cella with a narrow door and without columns; outside and in front of it was a large altar 52 ft. long. A large number of votive terra-cotta figures, vases and lamps were found in the course of the excavations. The earliest temple must have been erected soon after the foundation of the city, while the later building which superseded it dates from shortly after 600 B.C. The propylon, on the other hand, may date from after 409 B.C.

On the hill east of Selinus, separated from it by a small flat valley, lies a group of three huge temples. No other remains have been found round them, though it seems improbable that they stood alone and unprotected. It is likely that they were outside the town, but stood in a sacred enclosure. All of them have fallen, undoubtedly owing to an earthquake. The oldest of the three is F. A peculiarity of the construction of this temple is that all the intercolumniations were closed by stone screens. In it were found the lower parts of two metopes. Next in date comes the huge temple G, which, as an inscription proves, was dedicated to Apollo; though it was never entirely completed (many of the columns still remain unfluted), it was in use. The plan is a curious one: despite the comparative narrowness of the cella, it had two rows of ten columns in it, in line with the front angles of the inner shrine. The blocks of stone were quarried from the Cave di Cusa, 8 m. to the north-west, where similar blocks intended for it may still be seen in the quarry. The third temple, E, has been proved by the discovery of an inscription to have been dedicated to Hera. Its fine metopes now in the museum at Palermo belong to the beginning of the 5th century B.C. The cemeteries lay east of the acropolis, north of the city, and west of the temple of Demeter.

See W. B. Dinsmoor, *The Architecture of Greece* (London, 1927, 79 *sqq.*, 193 *sqq.*).

SELJŪKS, the name of several Turkish dynasties which reigned over large parts of Asia in the 11th, 12th and 13th centuries. The history of these rulers forms the first part of the history of the Turkish empire. Proceeding from the deserts of Turkestan, the Seljūks inherited the traditions and at the same time the power of the Arabian caliphate, of which, when they made their appearance, only the shadow remained in the person of the Abbāsid caliph of Baghdād. It is their merit from a Mohammedan point of view to have re-established the power of orthodox Islam and delivered the Muslim world from the subversive influence of the ultra-Shiite tenets, which constituted a serious danger to the duration of Islam itself.

The first Seljūk rulers were Toghrul Beg, Chakir Beg and Ibrahīm Niyāl, the son of Mikail, the son of Seljūk, the son of Tukāk, or Tuqāq (also styled Timūryālik, "iron bow"). They belonged to the Turkish tribe of the Ghuzz, which traced its lineage to Oghuz, the famous eponymic hero not only of this but of all Turkish tribes.

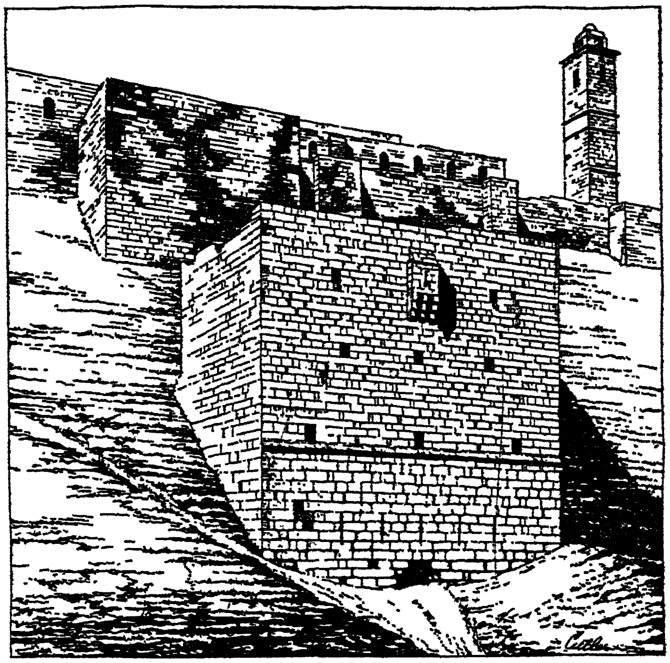
At the beginning of the 11th century the Ghuzz were settled in Transoxiana, and became a serious danger to the adjoining Mohammedan provinces. Under the leadership of Pīgu Arslān Israil, they crossed the Oxus and spread over the eastern provinces of Persia, everywhere plundering and destroying. After a decisive battle near Merv (1040), Persia lay open to the victors, who proclaimed themselves independent at Merv (which became from that time the official capital of the principal branch of the Seljūks), and acknowledged Toghrul Beg as chief of the whole family. After this victory the three princes Toghrul Beg, Chakir Beg and Ibrahīm Niyāl separated in different directions and conquered the Mohammedan provinces east of the Tigris; the last named, after conquering Hamadān and the province of Jebel (Irak i Ajami), penetrated as early as 1048 into Armenia and reached Manzikert, Erzerūm and Trebizond. This excited the jealousy of Toghrul Beg, who summoned him to give up Hamadān and the fortresses of Jebel; but Ibrahīm refused, and the progress of the Seljūkian arms was for some time checked by internal discord. Ibrahīm was, however, compelled to submit.

The Empire of Rūm.—At this time the power of Qaim, the Abbāsid caliph of Baghdād (*see* CALIPHATE), was reduced to a mere shadow, as the Shiite dynasty of the Būyids and afterwards his more formidable Fātimite rivals had left him almost wholly destitute of authority. The real ruler at Baghdād was a Turk named Basāsīrī, lieutenant of the last Būyid, Malik-ar-Rahīm. Nothing could, therefore, be more acceptable to the caliph than the protection of the orthodox Toghrul Beg, whose name was read in the official prayer (*khotba*) as early as 1050. At the end of the same year (1055) the Seljūks entered the city and seized the person of Malik-ar-Rahīm. Basāsīrī, after acknowledging the right of the Fātimites, gathered fresh troops, incited Ibrahīm Niyāl to rebel again, and re-entered Baghdād at the close of 1058. The next year, however, Toghrul Beg got rid of both his antagonists, and re-entered Baghdād. He re-established the caliph, and was betrothed to his daughter, but died before the consummation of the nuptials (Sept. 1063). Alp Arslān, the son of Chakir Beg, succeeded his uncle and extended the rule of his family beyond the former frontiers. He made himself master, *e.g.*, of the important city of Aleppo; and during his reign a Turkish amir, Atsiz, wrested Palestine and Syria from the hands of the Fātimites. He made successful expeditions against the Greeks, especially that of 1071, in which the Greek emperor Romanus Diogenes was taken prisoner (*see* ROMAN EMPIRE, LATER). The foundation of the Seljūk empire of Rūm (*q.v.*) was the immediate result of this great victory.

Malik Shāh, the son and successor of Alp Arslān, intervened in the affairs of Asia Minor and Syria, conceding the latter province as an hereditary fief to his brother Tutush, who established himself at Damascus. He, however, like his father Alp Arslān, was indebted for his greatest fame to the wise and salutary measures of their vizier, Nizām ul-Mulk. This extraordinary man was a renowned author and statesman, and immortalized his name by the foundation of several universities (the Nizāmiyah at Baghdād), observatories, mosques, hospitals and other public institutions. At his instigation the calendar was revised, and a new era, dating from the reign of Malik Shāh and known as the

Jelalian, was introduced. Not quite 40 days before the death of his master this great man was murdered by the Assassins. He had fallen into disfavour because of his unwillingness to join in the intrigues of the princess Turkān Khātūn, who wished to secure the succession to the throne for her infant son Maḥmūd at the expense of the elder sons of Malik Shāh.

Despite the intrigues of Turkān Khātūn, Malik Shāh was suc-



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

THE CITADEL OF THE SYRIAN CITY, ALEPPO, SITUATED ON A HILL IN THE NORTHWESTERN PART SURROUNDED BY A DEEP MOAT

ceeded by his elder son Barkiyāroq (1092–1104), whose short reign was a series of rebellions and strange adventures such as one may imagine in the story of a youth who is by turns a powerful prince and a miserable fugitive. His brother Mohammed (1104–18) successfully rebelled against him, and his most dangerous enemies were the Isma'īlites, who had succeeded in taking the fortress of Alamut (north of Kazvīn) and become a formidable political power by the organization of bands of *fedais,* who were always ready, even at the sacrifice of their own lives, to murder any one whom they were commanded to slay.

Mohammed had been successful by the aid of his brother Sinjar, who from the year 1097 held the province of Khorāsan with the capital Merv. After the death of Mohammed, Sinjar became the real head of the family, though 'Iraq acknowledged Maḥmūd, the son of Mohammed. Thus there originated a separate dynasty of Irak with its capital at Hamadān (Ecbatana); but Sinjar during his long reign often interfered in the affairs of the new dynasty, and every occupant of the throne had to acknowledge his supremacy. In 1117 he led an expedition against Ghazni and bestowed the throne upon Bahrām Shāh, who was also obliged to mention Sinjar's name first in the official prayer at the Ghaznavid capital—a prerogative that neither Alp Arslān nor Malik Shāh had attained. In 1134 Bahrām Shāh failed in this obligation and brought on himself a fresh invasion by Sinjar in the midst of winter; a third one took place in 1152, caused by the doings of the Ghorids (Hosain Jihānsūz or "world-burner"). Other expeditions were undertaken by him against Khwārizm and Turkestan; the government of the former had been given by Barkiyāroq to Mohammed b. Anushtagīn, who was succeeded in 1128 by his son Atsiz, and against him Sinjar marched in 1138. Though victorious in this war, Sinjar could not hinder Atsiz from afterwards joining the *gurkhan* (great khān) of the then rapidly rising empire of the Karakitai, at whose hands the Seljūk suffered a terrible defeat at Samarkand in 1141. By the invasion of these hordes several Turkish tribes, the Ghuzz and others, were driven beyond the Oxus, where they killed the Seljūk governor of Balkh, though they professed to be loyal to Sinjar. Sinjar resolved to punish this crime; but his troops deserted and he himself was taken prisoner by the Ghuzz, who kept him in strict confinement for two years (1153–55), though treating him with all outward marks of respect. In the meantime they plundered and destroyed the flourishing cities of Merv and Nishāpūr; and when Sinjar, after his escape from captivity, revisited the site of his capital he fell sick of sorrow and grief and died soon afterwards (1157). His empire fell to the Karakitai and afterwards to the shāh Khwārizm.

The province of Kermān was one of the first conquests of the Seljūks, and became the hereditary fief of Kāvurd, the son of Chakir Beg. His descendants remained in possession of their ancestor's dominions; and till 1170 Kermān, to which belonged also the opposite coast of Omān, enjoyed a well-ordered government, except for a short interruption caused by the deposition of Irān Shāh, who had embraced the tenets of the Isma'īlites, and was put to death (1101). But after the death of Toghrul Shāh (1170) his three sons disputed with each other for the possession of the throne, and implored foreign assistance, till the country became utterly devastated and fell an easy prey to some bands of Ghuzz, who, under the leadership of Malik Dinār (1185), marched into Kermān after harassing Sinjar's dominions. Afterwards the shāhs of Khwārizm took this province. The Seljūkian dynasty of Syria came to an end after three generations, and its later history is interwoven with that of the crusaders (*see* CRUSADES).

Invasion of Asia Minor.—After the great victory of Alp Arslān in which the Greek emperor was taken prisoner (1071), Asia Minor lay open to the inroads of the Turks. Hence it was easy for Suleimān, the son of Kutulmish, the son of Arslān Pigu (Israil), to penetrate as far as the Hellespont. But the possession of Asia Minor was insecure to the Seljūks as long as the important city of Antioch belonged to the Greeks, so that we may date the real foundation of this Seljūk empire from the taking of that city by the treason of its commander Philaretus in 1084, who afterwards became a vassal of the Seljūks. The conquest involved Suleimān in war with the neighbouring Mohammedan princes, and he met his death soon afterwards (1086), near Shaizar, in a battle against Tutush. Owing to these family discords the decision of Malik Shāh was necessary to settle the affairs of Asia Minor and Syria; he kept the sons of Suleimān in captivity, and committed the war against the unbelieving Greeks to his generals Bursuḳ (Προσουχ) and Buzān (Πουζανος). Barkiyāroq, however, on his accession (1092), allowed Kilij Arslān, the son of Suleimān, to return to the dominions of his father. Acknowledged by the Turkish amirs of Asia Minor, he took up his residence in Nicaea, and defeated the first bands of crusaders under Walter the Penniless and others (1096); but, on the arrival of Godfrey of Bouillon and his companions, he was prudent enough to leave his capital in order to attack them as they were beseiging Nicaea. He suffered, however, two defeats in the vicinity, and Nicaea surrendered on June 23, 1097. As the crusaders marched by way of Dorylaeum and Iconium towards Antioch, the Greeks subdued the Turkish amirs residing at Smyrna, Ephesus, Sardis, Philadelphia, Laodicea, Lampes and Polybotus; and Kilij Arslān, with his Turks, retired to the north-eastern parts of Asia Minor, to act with the Turkish amirs of Sivās (Sebaste), known under the name of the Danishmand.

Afterwards there arose a natural rivalry between the Seljūks and the Danishmand, which ended with the extinction of the latter about 1175. Kilij Arslān took possession of Mosul in 1107, and declared himself independent of the Seljūks of 'Iraq; but in the same year he was drowned in the Khaboras through the treachery of his own amirs, and the dynasty seemed again destined to decay, as his sons were in the power of his enemies. The sultan Mohammed, however, set at liberty his eldest son Malik Shāh, who was succeeded by his brother Masūd, who established himself at Konia (Iconium), from that time the residence of the Seljūks of Rūm. During his reign—he died in 1155—the Greek emperors undertook various expeditions in Asia Minor and Armenia; but the Seljūk was cunning enough to profess himself their ally and to direct them against his own enemies. Nevertheless the Sel-

jūkian dominion did not rise to significance till his son and successor, Kilij Arslān II., had subdued the Danishmands and appropriated their possessions, though he thereby risked the wrath of the powerful atabeg of Syria, Nureddin, and afterwards that of Saladin. But as the sultan grew old his numerous sons, each of whom held the command of a city of the empire, embittered his old age by their mutual rivalry, and the eldest, Kutb ed-dīn, tyrannized over his father in his own capital, exactly at the time that Frederick I. (Barbarossa) entered his dominions on his way to the Holy Sepulchre (1190). Konia itself was taken and the sultan forced to provide guides and provisions for the crusaders. Kilij Arslān lived two years longer, finally under the protection of his youngest son, Kaikhosrau, who held the capital after him (till 1199) until his elder brother, Rukneddin Suleimān, having vanquished his other brothers, ascended the throne and obliged Kaikhosrau to seek refuge at the Greek emperor's court. This valiant prince who died in 1204 saved the empire from destruction and conquered Erzerūm, which had been ruled during a considerable time by a separate dynasty, and was now given in fief to his brother, Mughīt ud-dīn Toghrul Shāh. His son, Kilij Arslān III., was soon deposed with Greek assistance by Kaikhosrau. After the establishment of the Latin empire of Constantinople the Turks were the natural allies of the Greeks and the enemies of the crusaders and their allies, the Armenians. Kaikhosrau, therefore, took in 1207 from the Italian Aldobrandini the important harbour of Attalia (Adalia); but in 1211 perished in battle with Theodore Lascaris, emperor of Nicaea. His son and successor, Kaikāūs, made peace with Lascaris and extended his frontiers to the Black sea by the conquest of Sinope (1214). On this occasion he took prisoner the Comnenian prince (Alexius) who ruled the independent empire of Trebizond, and compelled him to acknowledge the supremacy of the Seljūks, to pay tribute, and to serve in the armies of the sultan. Elated by this great success and by his victories over the Armenians, Kaikāūs attempted the capture of Aleppo, at this time governed by the descendants of Saladin; but the affair miscarried.

Advance of the Mongols.—Soon afterwards the sultan died (1219) and was succeeded by his brother, Alā ud-dīn Kaikobād I., the most powerful and illustrious prince of this branch of the Seljūks, renowned not only for his successful wars but also for his magnificent structures at Konia, Alaja, Sivās and elsewhere, which belong to the best specimens of Saracenic architecture. The town of Alaja was his creation. He extended his rule as far as Seleucia, and desisted from further conquest only on condition that the Armenian princes would enter into the same kind of relation to the Seljūks as had been imposed on the Comnenians of Trebizond. But his greatest military fame was won by a war which, however glorious, was to prove fatal to the Seljūk empire in the future: in conjunction with his ally, the Ayyubite prince Ashraf, he defeated the Khwārizm shāh Jalāl ud-dīn near Erzingān (1230). This victory removed the only barrier that checked the progress of the Mongols. During this war Kaikobād put an end to the collateral dynasty of the Seljūks of Erzerūm and annexed its possessions. He also gained the city of Khelāt with dependencies that in former times had belonged to the Shāh-i-Armen, but shortly before had been taken by Jalāl ud-dīn; this aggression was the cause of the war just mentioned. The acquisition of Khelāt led, however, to a new war, as Kaikobād's ally, the Ayyubite prince, envied him this conquest. Sixteen Mohammedan princes, mostly Ayyubite, of Syria and Mesopotamia, under the leadership of Malik al-Kāmil, prince of Egypt, marched with considerable forces into Asia Minor against him. Happily for Kaikobād, the princes mistrusted the power of the Egyptian, and it proved a difficult task to penetrate through the mountainous, well-fortified accesses to the interior of Asia Minor, so that the advantage rested with Kaikobād, who took Kharput, and for some time even held Ḥarrān, Ar-Roha and Rakka (1232). The latter conquests were, however, soon lost, and Kaikobād himself died in 1234 of poison administered to him by his son and successor, Ghiyāss ed-dīn Kaikhosrau II., leaving an empire embracing almost all Asia Minor, with the exception of the countries governed by Vatatzes (Vataces) and the Christian princes of Trebizond and Lesser Armenia, who, however, were bound to pay tribute and to serve in his armies. It was an empire containing Christian as well as Mohammedan elements, for the sultan relied in war mainly upon his Christian troops, and granted extensive privileges to Christian merchants. In appearance it was so strong that the Mongols hesitated to invade it, although standing at its frontiers. Their attack was deferred until 1243, but in that year Kaikhosrau was defeated at Kuzadāg (between Erzingān and Sivās), and forced to purchase peace by the promise of a heavy tribute. The independence of the Seljūks was now for ever lost. The Mongols retired for some years; but, Kaikhosrau II. dying in 1245, the joint government of his three sons gave occasion to fresh inroads, till one of them died and Hulagu divided the empire between the other two, Izz ed-dīn (Kaikaus II.) ruling the districts west of the Halys, and Rukneddin (Kilij Arslān IV.) the eastern provinces (1259). But Izz ed-dīn, intriguing with the Mameluke sultans of Egypt to expel his brother and gain his independence, was defeated by a Mongol army and obliged to flee to the imperial court. Here he was imprisoned, but afterwards released by the Tatars of the Crimea, who took him with them to Sarai, where he died. Rukneddin was only a nominal ruler, the real power being in the hands of his minister, Muīn ed-dīn Suleimān, who in 1267 procured an order of the Mongol Khān Abaka for his execution. The minister raised his infant son, Ghīyāss ed-dīn Kaikhosrau III., to the throne, and governed the country for ten years longer, till he was entangled in a conspiracy of several amirs, who proposed to expel the Mongols with the aid of the Mameluke sultan of Egypt, Bibars (Beibars or Beybars). The latter marched into Asia Minor and defeated the Mongols in the bloody battle of Ablastān, the modern Albistan (1277); but, when he advanced farther to Caesarea, Muīn ed-dīn Suleimān retired, hesitating to join him at the very moment of action. Bibars, therefore, in his turn fell back, leaving Suleimān to the vengeance of the khān, who soon discovered his treason and ordered a barbarous execution. Kaikhosrau III. continued to reign in name till 1284, though the country was in reality governed by a Mongol viceroy. Masūd, the son of Izz ed-dīn, who on the death of his father had fled from the Crimea to the Mongol khān and had received from him the government of Sivās, Erzingān and Erzerūm during the lifetime of Kaikhosrau III., ascended the Seljūk throne on his death. But his authority was scarcely respected in his own residence, for several Turkish amirs assumed independence and could only be subdued by Mongol aid, when they retired to the mountains, to reappear as soon as the Mongols were gone. Masūd fell, probably about 1295, a victim to the vengeance of one of the amirs, whose father he had ordered to be put to death. After him Kaikobād, son of his brother Farāmarz, entered Konia as sultan in 1298, but his reign is so obscure that its very length is uncertain. With him ended the dynasty of the Seljūks; but the Turkish empire founded by them continued to exist under the rising dynasty of the Ottomans. (*See* Turkey.)

Bibliography.—The best, though insufficient, account of the Seljūks is still de Guignes, *Histoire générale des Huns*, bks. x.–xii., from whom Gibbon borrowed his dates. Among translations from original sources (of which the most trustworthy are yet unedited), *see* Mirkhond, *Geschichte der Seldschuken* (ed. Vullers, Giessen, 1838); *Tarikh-ī-Guzideh*, French translation by Defrémery in the *Journal asiatique*, 1848, i. 417 *sqq.*, ii. 259., *sqq.*, 334 *sqq.* Information respecting certain periods is given incidentally in the works of von Hammer and d'Ohsson (*see* bibliography to Turkey: *History*), and in S. Lane Poole, *Mahommedan Dynasties* (1894). (M. T. H.; F. M. S.)

SELKIRK (or SELCRAIG), ALEXANDER (1676–1721), Scottish sailor, the prototype of "Robinson Crusoe," seventh son of John Selcraig, shoemaker and tanner of Largo, Fifeshire, was born in 1676. Having been summoned on Aug. 27, 1695, before the kirk-session for indecent behaviour in church, he "did not compear, being gone away to the seas." In May 1703 he joined Dampier in a privateering expedition to the South Seas, as sailing master on the "Cinque Ports" galley. In September 1704 the "Cinque Ports" put in at Juan Fernandez Island, west of Valparaiso; here Selkirk had a dispute with his captain, Thomas Stradling, and at his own request was put ashore with a few ordinary necessaries. Before the ship left he begged to be

readmitted, but this was refused, and Selkirk remained alone in Juan Fernandez over four years, till on Jan. 31, 1709, he was found, and on Feb. 12, taken off, by Captain Woodes Rogers, commander of the "Duke" privateer (with Dampier as pilot), who made him his mate and afterwards gave him command of one of his prizes, "The Increase" (March 29th). Selkirk returned to the Thames on Oct. 14, 1711; he was back at Largo in 1712; in 1717 he was again at sea, and in 1721 he died as master's mate of H.M.S. "Weymouth" (Dec. 12th).

See Woodes Rogers, *Cruising Voyage round the World* (1712), and Edward Cooke, *Voyage in the South Sea and round the World* (1712), the earliest descriptions of Selkirk's adventures; also *Providence Displayed, or a Surprising Account of one Alexander Selkirk . . . written by his own Hand* (reprinted in *Harl. Miscell.* for 1810, v. 429); and Funnell's *Voyage round the World* (1707). Steele made Selkirk's acquaintance, and gave a sketch of the adventurer and his story in the *Englishman* (Dec. 3, 1713). In 1719, shortly after a second edition of Rogers' *Voyage* had appeared (1718), Defoe published *Robinson Crusoe*, the idea of which is plainly derived from Selkirk's story.

The best modern biography is the *Life and Adventures of Alexander Selkirk* by John Howell (1829). In 1868 a tablet was put up on Juan Fernandez at a point on the hill road called "Selkirk's Look-out."

SELKIRK, THOMAS DOUGLAS, 5TH EARL OF (1771–1820), was born at St. Mary's Isle, Kirkcudbrightshire, on June 20, 1771. He succeeded his father in 1799, his six elder brothers having predeceased him. At this time the Highlands of Scotland were being changed into grazing land and deer forests. Selkirk took deep interest in the evicted peasants, and tried to organize emigration to the British colonies. In 1803–1804 he founded a large and prosperous settlement in Prince Edward Island, and at about the same time a smaller one at Baldoon in Upper Canada. He later turned his attention to the Canadian west, and gradually acquired control of the Hudson's Bay Company. In May 1811 an immense tract was granted to him in the Red River valley, and he at once proceeded to send out settlers; but the hostility of the North-West Fur Company, with its headquarters at Montreal, eventually ruined the colony (*see* RED RIVER SETTLEMENT), and the influence of his rivals led to the defeat of Selkirk in various legal proceedings. On April 8, 1820 he died broken-hearted at Pau.

Copies of his papers, most of which are unpublished, are in the Canadian Archives Department at Ottawa.

SELKIRK, a royal and police burgh, parish and county town of Selkirkshire, Scotland. Pop. (1931) 5,667. It lies on a hill on the right bank of Ettrick Water, 6¼ m. south of Galashiels by the L.N.E. railway company's branch line, of which it is the terminus. There are statues of Sir Walter Scott in his sheriff's robes, of Mungo Park, the African explorer, who was educated at the grammar school, and a memorial of Flodden Field. Woollen manufactures and wool-spinning are the principal industry, and the town is an agricultural centre. Immediately south of the town are the beautiful grounds of the Haining.

As its early name (Scheleschyrche) indicates, Selkirk originally consisted of a number of *shiels* (huts), in the forest beside which a church had been planted by the Culdees of Old Melrose. David I., while prince of Cumbria, founded in 1113 the abbey, which was removed fifteen years afterwards to Kelso, and also erected a castle. Captured by Edward I., by whom it was enlarged and strengthened, the fortress was retaken by Wallace in 1297, and remained in the hands of the Scots till the battle of Halidon Hill (1333), when it was delivered to the English. It was probably destroyed in 1417 when Sir Robert Umfraville, governor of Berwick, set fire to the town, and nothing remains of it save some green mounds and the name Peel Hill. The charter granted by David I. was renewed by James V. in 1533.

After the battle of Philiphaugh (1645), David Leslie, the Covenanters' general, had some prisoners confined in the tolbooth of Selkirk and afterwards massacred in the market-place. From an early period the souters (shoemakers) were a flourishing craft, and in the rebellions of 1715 and 1746 were required to furnish the Jacobites with several thousand pairs of shoes. Though shoemaking is extinct, "the souters of Selkirk" is still a nickname for the inhabitants.

SELKIRK MOUNTAINS, a range in the S.E. of British Columbia, Canada, extending N. for about 200 m. from the American frontier with a breadth of about 80 m. and bounded E., W. and N. by the Columbia river. Though often spoken of as part of the Rocky Mountain system, they are really distinct, and belong to an older geological epoch, and their outline too is rounder and less serrated than that of the Rockies.

On the S.E. is the Purcell range, with the main chain of the Rockies still farther E., and on the W. the Gold range, prolonged northward as the Cariboo Mountains. They do not rise much above 10,000 ft.

The scenery is wild and magnificent; below the snow-line, especially on the western side, the slopes are densely wooded, and enormous glaciers fill the upper valleys; of these the most celebrated is that of the Illecillewaet, near Glacier House, on the Canadian Pacific railway. The Selkirks are crossed by the railway at Rogers Pass, discovered in 1883. The engineering difficulties overcome are very great and the grades in places very steep. A magnificent series of caverns, called the Nakimu Caves, occur in the Glacier Park Reserve not far from Glacier.

SELKIRKSHIRE, southern county, Scotland, bounded north by Peeblesshire and Midlothian, east and south-east by Roxburghshire, south and south-west by Dumfriesshire and west by Peeblesshire. Its area is 170,793 acres (excluding water). Almost the whole is hilly, the only low ground occurring in the larger valleys; the rocks are Silurian and Ordovician, much folded. The highest hills are in the west and south-west. On the confines of Peeblesshire the chief height is Broad Law (2,723 ft.), and on the Dumfriesshire border, Ettrick Pen (2,269). A great deal of boulder-clay covers the older rocks; the ice-borne material travelled from west to east, and many of the hills show steep and bare slopes towards the west, but have gentle slopes covered with glacial deposits on the eastern side. The principal rivers are the Ettrick (32 m.) and its left-hand affluent the Yarrow (14 m.), but for a few miles the Tweed traverses the north of the county. Gala Water (21 m.), though it joins the Tweed a little below Galashiels, belongs rather to Midlothian, since it rises in the Moorfoot Hills and for most of its course flows in that shire. St. Mary's Loch and its adjunct, the Loch of the Lornes, are the chief lakes, and there are numerous small lakes in the south-east. The vales of Tweed and Yarrow and Ettrickdale are the principal valleys.

History and Antiquities.—There are no Roman remains in Selkirkshire, the natives probably being held in check from the station at Newstead near the Eildons. The Standing Stone near Yarrow church bearing a Latin inscription is ascribed to the 5th or 6th century and is only a quasi-Roman relic. No so-called British camps have been found on the upper and middle waters of the Ettrick and Yarrow, and of the few situated in the lower valleys of these streams the most important is the large work on Rink Hill in the parish of Galashiels, the district containing various interesting prehistoric remains. At Torwoodlee, 2 m. north-west of Galashiels, are the ruins of the only example of a *broch* (round tower) in the Border counties. The barrier known as the Catrail, or Picts' Work, starts near Torwoodlee, whence it runs southwards to Rink Hill. There it sweeps round to the south-west as far as Yarrow church, from which it again takes a due south direction to the valley of the Rankle, where it passes into Roxburghshire. The history of the shire for six centuries following the retreat of the Romans is that of the whole of south-eastern Scotland. The country formed part, first, of the British kingdom of Strathclyde, then of the Saxon kingdom of Northumbria, and finally, about 1020, was annexed to Scotland. The first sheriff of whom there is record was Andrew de Synton, appointed by William the Lion (d. 1214).

To the north of Hangingshaw in the country between the Yarrow and Tweed William Wallace constructed an earthwork in 1297, still called Wallace's Trench, 1,000 ft. long, and terminating on the top of a hill in a large square enclosure. Here he lay till his plans were completed and at last departed, his forces including a body of Selkirk archers, for a raid into the north of England. During the prolonged strife that followed the death of Robert Bruce (1329) the foresters were constantly fighting, and the county suffered more heavily at Flodden (1513) than any

other district. The lawlessness of the Borderers was at length put down by James V. with a strong hand. He parcelled out the forest in districts, and to each appointed a keeper to enforce order and protect property. In 1529 the ringleaders, including William Cockburn of Henderland, Adam Scott of Tushielaw and the notorious Johnnie Armstrong. were arrested and promptly executed. This severity gradually had the desired effect, though after the union of the crowns in 1603 the freebooters and moss-troopers again threatened to be troublesome, until James VI.'s lieutenants ruthlessly stamped out disaffection. The Covenanters held many conventicles in the uplands, and their general, David Leslie, routed the marquis of Montrose at Philiphaugh in 1645.

Agriculture.—As the soil is mostly thin, over a subsoil of clayey till, agriculture is carried on at a disadvantage. About one-sixth of the surface is under cultivation; oats, turnips and a little barley are grown. Live stock is pursued more profitably, the sheep walks carrying heavy stocks; cheviots are the principal breed. Over half the holdings are over 100 acres, and the average size is 126 acres. More than one-third of the county (upwards of 60,000 acres) belongs to the duke of Buccleuch. The land between the Ettrick and the Tweed was formerly covered with forest to such an extent that the sheriffdom was described as Ettrick Forest, and became the hunting-ground of the Stuarts. James V., however, to increase his revenues, let the domain for grazing, and it was soon converted into pasture for sheep.

Woollen manufactures (tweeds, tartans, yarn and hosiery) are the predominant industry at Galashiels and Selkirk. Tanning is carried on at Galashiels.

The only railway communication is in the north, where there is a branch line from Galashiels to Selkirk, besides part of the track of the Waverley route from Edinburgh to the south and the line from Galashiels to Peebles.

Population and Administration.—In 1931 the population was 22,608; 61 persons spoke Gaelic and English and one Gaelic only. Selkirk (pop. 5,667) is the county town and only royal burgh. Galashiels (pop. 13,102) is the largest town and the only other burgh. Selkirkshire combines with Roxburgh to return a member to Parliament, and the shires of Selkirk, Roxburgh and Berwick form a sheriffdom, with a resident sheriff-substitute at Selkirk. The county is under school board jurisdiction, and there are high schools at Selkirk and Galashiels.

SELLA, QUINTINO (1827–1884), Italian statesman and financier, was born at Mosso, near Biella, on July 7, 1827. After studying engineering at Turin and Paris he became a professor at Turin. Entering the Chamber of Deputies in 1860 he became secretary-general of public instruction, and in 1862 received from Rattazzi the portfolio of finance. The Rattazzi cabinet fell before Sella could efficaciously provide for the deficit of £17,500,000 with which he was confronted; but in 1864 he returned to the ministry of finance in the La Marmora cabinet, and dealt energetically with the deficit of £8,000,000 then existing. A vote of the chamber compelled him to resign before his preparations for financial restoration were complete; but in 1869 he returned to the ministry of finance in a cabinet formed by himself, but of which he made over the premiership to Giovanni Lanza. By means of the grist tax (which he had proposed in 1865, but which the Menabrea cabinet had passed in 1868), and by other fiscal expedients, he succeeded, before his fall from power in 1873, in placing Italian finance upon a sound footing. In 1870 his influence turned the scale against interference in favour of France against Prussia, and in favour of an immediate occupation of Rome. He retired from politics in 1881, and died on March 14, 1884.

His *Discorsi parlamentari* were published (5 vols., 1887–1890) by order of the Chamber of Deputies. An account of his life and his scientific labours was given by A. Cossa in the *Proceedings of the Accademia dei Lincei* (1884–1885).

SELMA, a city of Alabama, U.S.A., the county seat of Dallas county; on the north bank of the Alabama river, 50 m. W. of Montgomery. It is on Federal highway 80, and is served by the Louisville and Nashville, the Southern and the Western of Alabama railways, and by river steamers and barges. Pop. 15,589 in 1920 (53% negroes); and 18,012 in 1930 by the Federal census, to which adjacent suburbs add more than 5,000. It is the metropolis of a large territory in the "black soil belt" of Alabama, raising especially cotton, live stock, pecans and diversified farm products; is an important dairy and lumber centre; and has extensive railroad shops, cotton mills with 25,000 spindles, a large bag factory, cottonseed-oil mills, and various other manufacturing industries. The aggregate factory output for 1927 was valued at $6,430,233. The wholesale trade is estimated at $20,000,000 annually. About 1815 a settlement was established here, called Moore's Landing or Moore's Bluff. In 1820 a town was laid out and incorporated by a company under the leadership of William Rufus King (vice president of the United States in 1853), who chose the name because of his admiration for the Ossianic legend. The city was chartered in 1852. During the Civil War it was the seat of arsenals, ship-yards and military factories, and was one of the last strongholds of the Confederacy to fall, surrendering on April 12, 1865, when Gen. Wilson entered the city and burned most of it.

SELMECZBANYA (BAŇSKA ŠTIAVNICA), old mining town on terraced slopes of a ravine in the Slovakian highlands, Czechoslovakia, and encircled by high mountains including the peak of Calvarienberg on the south-west, crowned by a castle and a church. It was colonized in the 12th century by German miners who later embraced the Reformation. The German element was driven out during the 18th century as a result of the counter-Reformation and its place taken by Slovaks. The mines were of great importance and quantities of gold and silver were raised but they have declined and now five silver mines are the chief relics of this former greatness. The activities are supplemented by the work of local potteries but the population has considerably decreased in the last twenty-five years. Pop. (1921), 13,264.

About 7 m. to the south-west and west lie Vihnye and Szkleno, two small spas with iron, lime and sulphur springs.

SELOUS, FREDERICK COURTNEY (1851–1917), British explorer and hunter, was born in London on Dec. 31, 1851, and was educated at Rugby and in Germany. He went out to South Africa when he was 19, travelled from the Cape to Matabeleland, reached early in 1872, and was granted permission by Lobengula to shoot game anywhere in his dominions. From that date until 1890, with a few brief intervals spent in England, Selous hunted and explored over the then little-known regions north of the Transvaal and south of the Congo basin, shooting elephants and collecting specimens of all kinds for museums and private collections. His travels added largely to the knowledge of Rhodesia. In 1890 he entered the service of the British South Africa company, acting as guide to the pioneer expedition to Mashonaland. Over 400 m. of road were constructed through a country of forest, mountain and swamp, and in two and a half months Selous took the column safely to its destination. He then went east to Manica, concluding arrangements there which brought the country under British control. He gave a summary of his travels in "Twenty Years in Zambesia" (*Geo. Journ.* vol. i., 1893). He returned to Africa to take part in the first Matabele War (1893), being wounded during the advance on Bulawayo. In March 1896 he settled with his wife on an estate in Matabeleland. He published an account of the Matabele campaign, entitled *Sunshine and Storm in Rhodesia* (1896). On the restoration of peace Selous settled in England. He continued, however, to make shooting and hunting expeditions—visiting Asia Minor, Newfoundland, the Canadian Rockies and other parts of the world. He wrote several books and many articles.

During the World War he served in the East African campaign in the legion of frontiersmen (25th Royal Fusiliers). He was killed in action at Beho Beho on Jan. 4, 1917. His collection of trophies was given by his widow to the Natural History Museum, London, where in June 1920 a national memorial to him was unveiled. A Selous scholarship was also founded at his old school, Rugby.

See J. G. Millais, *Life of Frederick Courtney Selous* (1918).

SELWYN, GEORGE AUGUSTUS (1719–1791), English wit, son of Colonel John Selwyn (d. 1751), of Matson, Gloucestershire, was born on Aug. 11, 1719. Educated at Eton and Oxford,

he became member of parliament for the family borough of Ludgershall in 1747, and from 1754, three years after he inherited Matson, to 1780 he represented Gloucester. He obtained two or three lucrative sinecures. In society he was very popular and won a great reputation as a wit. He is said to have been very fond of seeing corpses, criminals and executions, and Horace Walpole says he loved "nothing upon earth so well as a criminal, except the execution of him." He died in London on Jan. 25, 1791. Like the eccentric duke of Queensberry Selwyn claimed to be the father of Maria Fagniani, who became the wife of Francis Charles Seymour, 3rd marquess of Hertford.

See J. H. Jesse, *George Selwyn and his Contemporaries* (1843–44; new ed., 1882); and S. P. Kerr, *George Selwyn and the Wits* (1909).

SELWYN, GEORGE AUGUSTUS (1809–1878), English bishop, second son of William Selwyn (1775–1855), a distinguished legal writer, was born at Hampstead, London, on April 5, 1809. He was educated at Eton and at St. John's college, Cambridge, where he graduated in 1831. He returned to Eton as private tutor, was ordained deacon in 1833, and in 1841 was appointed first bishop to New Zealand, then just beginning to be colonized. He studied navigation and the Maori language on the voyage out and on his arrival gave himself up to a life of continual hardship. He spent days and sometimes nights in the saddle, swam broad rivers and provided himself with a sailing vessel. Unfortunately, just when he had gained the confidence of the natives, his ascendancy was rudely shaken by the first Maori war. Selwyn endeavoured to mediate, but incurred the hostility of both parties.

In 1854 he returned to England for a short furlough. He returned to New Zealand with a band of able associates, including J. C. Patteson, and began to divide his large diocese into sees of more manageable proportions. The colonists came to respect his uprightness, and the Maoris learned to regard him as their father. In 1868, while he was in England to attend the first pan-Anglican synod, the bishopric of Lichfield became vacant, and after some hesitation he accepted it. On his death, on April 11, 1878, his great work for the church was celebrated by a remarkable memorial, Selwyn college, Cambridge, being erected by public subscription and incorporated in 1882.

See *Lives* by H. W. Tucker (2 vols. 1879) and G. H. Curteis (1889).

His son, John Richardson Selwyn (1844–1898), bishop of Melanesia, was born in New Zealand on May 20, 1844. He was educated at Eton and at Trinity college, Cambridge, and was ordained deacon in 1869. The martyrdom of John Coleridge Patteson, bishop of Melanesia, led him to volunteer for service in the Australasian Archipelago. After three years' service, during which the bishopric remained vacant, he was nominated as Patteson's successor (1877). He returned to England in 1890 and became master of Selwyn college, where he died on Feb. 12, 1898.

SEMANG, a negrito tribe (*see* Races of Man, and Further Asia) of the Malay peninsula and of Siam. The Semang live in caves or leaf-shelters formed between branches. A waistcloth for men, made of bark hammered out with a wooden mallet from the cortex of a species of wild bread-fruit tree, and a short petticoat of the same for women, is the only dress worn; many go naked. Scarification is practised, by drawing the serrated edge of a sugar-cane leaf across the skin and rubbing in charcoal powder. They have bamboo musical instruments, the Jews' harp and a nose flute. On festive occasions they sing and dance, decorating themselves with leaves. The Semang bury their dead simply placing food and drink in the grave. The Semang of Patalung, called Ngo by the Siamese, are probably mixed with pre-Dravidian stock. They use the blow-gun (*q.v.*) as well as the bow and spears. They have a woman chief.

See Skeat and Blagden, *Pagan Tribes of the Malay Peninsula*, (1906); P. Schebesta, *Among the Forest Dwarfs of Malaya* (1929).

(J. H. H.)

SEMANTICS, the study of the changes in the meaning of words in the way of specialisation or generalisation, etc. *See* R. C. Trench, *The Study of Words* (1888, etc.).

SEMAPHORE, an apparatus for signalling by means of flags, lights or arms. Previous to the invention of the telegraph, semaphore signalling was used for transmitting messages between distant points, and is yet employed in the navies of many nations for intercourse between ships. The most familiar semaphore is that used in railway signalling for transmitting information to enginemen. (From Gr. σῆμα, sign, and φορά, carrying.)

SEMARANG, a residency of Java, Dutch East Indies, occupying a good deal of the north-eastern portion of the island; area about 11,300 sq.m. (Rembang residency was divided almost equally between Semarang and Surabaya residencies in 1928). Semarang is bounded on the west by Pekalongan, east by Surabaya, south by Kedu, Surakarta and Madiun, and on the north by the Java sea. Its western half is flat along by the coast, sloping gradually to high hills some distance inland, and culminating in mountains, especially where the residency cuts, tooth-like, into Surakarta, and the Merbabu complex of mountains. This half is abundantly watered by rivers, the most important of which are the Lusi and the Tuntang, and is a great sugar and kapok producing region (having a sugar experimental station), also a coffee-growing centre. The eastern half has a strip of flat land by the coast (Juwana and Japara plains), then limestone hills, and, in the west, the isolated mountain mass of Muria, and the fertile valley of the Lusi, running between the hills and the mountains of central Java on the southern edge of the residency. This half is noted for its teak forests and its extensive petroleum deposits, Chepu, on the eastern border, being a great refining centre; iodide of copper is also found. Population of the residency, before the Rembang addition, 2,786,921, almost entirely Javanese. The capital is Semarang (*q.v.*), in the west, and the next most important town is Rembang, in the east, on the coast, pop. 13,618. Other towns of note are Kendal, on the coast, and Ambarawa, Salatiga, Gundih, Demak, the "Mecca of Java" (*see* Java), Purwadadi and Blora. The railway from Semarang to Surakarta runs through the residency as far as Gundih, and the steam tramway from Cheribon to Surabaya traverses the coast from the western boundary very near Kendal to Semarang, thence across country to a short distance beyond Rembang, and from that place south-eastwards to the eastern boundary. Semarang was subject to Dutch rule, under a governor (the governor of the north-east coast, as he was styled), from 1748 onwards, his headquarters being at the town of Semarang. (E. E. L.)

SEMARANG, one of the chief towns and ports of Java, Dutch East Indies. It is situated, almost centrally, on the north coast 250 m. E. of Batavia, and is the capital of the residency of Semarang. It has a population of 146,509 (14,849 Europeans and Eurasians, and 19,429 foreign Asiatics, including Chinese), is on the banks of the Semarang river, and is connected by railway with Surakarta, Jokjakarta, Madiun and Surabaya, and by steam tramway with Cheribon, where connection is made with the railway to Bandung and Batavia. Semarang, like Batavia, is divided into two parts, the old native town near the coast, thickly housed, with narrow streets, but with some good shops, hotels, European business houses, and two churches (in former times it was surrounded by a moat, with forts), and a newer town, further inland, where are situated the residence of the resident, various Government and public buildings, including a military hospital, and also a club, the head offices of the Netherlands Indian railway (the workshops of this railway are also in Semarang), hotels, restaurants, and, in the large town square, *aloon*, the residence of the regent, and a mosque; the square also has recreation grounds. The two districts are connected by the fine Bojong road. South of Bojong road there is a beautiful residential hill suburb (Chandi), 500 ft. above the sea. Of interest in the vicinity of Semarang are Demak and Salatiga (*see* Java). Although Semarang is the third port in Java (exports, in 1926, 103,212,057 guilders, mainly sugar and kapok; imports 105,300,820), it is only an open roadstead, and the boisterous north-west monsoon may even cause suspension of work. Vessels anchor about 3 m. out, and, for the protection of the lighters into which they discharge their cargo, there is a harbour, the western pier-head of which extends some 1,600 metres into the sea, to prevent the mouth from silting up and to retain a sufficient depth of water. This harbour has a broad front, branching to the shore in two cus-

toms-house basins, and a fishing vessel harbour, whilst there are godowns, bonded stores and storage sheds, with two stationary steam cranes, and a small dry dock. The port is connected by rail and road with the hinterland; and by cable with Batavia, Surabaya and Balik Papan, in Borneo. The river between the town and the sea is canalized for traffic. There is a proposal (1928) to construct a deep sea harbour at a cost of, approximately, 15 million guilders. Various Dutch and other European liners and vessels of the Royal Packet Navigation company call regularly at Semarang. (E. E. L.)

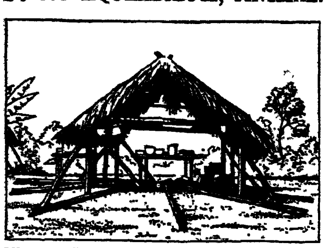
SEMBAT, MARCEL (1862–1922), French politician, was born Oct. 19, 1862, at Bonnières (Seine-et-Oise), and educated at the Collège Stanislas. In 1893 he became Socialist deputy for the 18th *arrondissement* of Paris, and attached himself to the Blanquist faction of the party headed by Edouard Vaillant. On the constitution of the United Socialist party, however, in 1905, under Jaurès, Sembat became one of a brilliant body of extremist debaters which made the Radical-Socialist party the strongest political force in France. On the outbreak of the World War, Sembat became minister of public works in the Ministry of National Defence in Aug. 1914. He died at Chamonix on Sept. 5, 1922. Among his published works are *Matisse et son oeuvre* (1920) and *La victoire en déroute* (Eng. tr. 1925).

SEMBRICH, MARCELLA (1858–), operatic singer, was born at Wiesniewczyk, near Lemberg, Austria, on Feb. 15, 1858. Discarding her own name, Praxede Marcelline Kochanska, she took her mother's maiden name for her operatic career. On June 3, 1877, she made her début at Athens as Elvira in *Puritani*. She was engaged for the Dresden opera house in 1878 appearing in the title part in *Lucia di Lammermoor*, also her first rôle at Covent Garden, June 12, 1880, and at the Metropolitan Opera House, Oct. 24, 1883. After five seasons at Covent Garden she reappeared at the Metropolitan Opera House in 1898, remaining until 1909. Since retiring from the concert stage in 1916 she has made a world-wide reputation as a teacher of singers.

SEMELE, in Greek mythology, daughter of Cadmus and Harmonia, and mother of Dionysus by Zeus. *See* DIONYSUS.

SEMICIRCULAR CANALS: *see* EQUILIBRIUM, ANIMAL.

SEMINOLE, an American Indian tribe, formed in the 18th century by splitting away from the Creek (*q.v.*). The name means "seceders." They occupied the territory of the destroyed Apalachi in northern Florida and fought the United States bitterly in 1817–18 and under Osceola in 1835–42. They number some 2,000 in Oklahoma and 300 in southern Florida, both bodies much mixed with negro blood. (*See* MacCauley, *Bur. Am. Ethn. Rep.* V., 1887.)



BY COURTESY OF THE HEYE FOUNDATION
A SEMINOLE OPEN THATCHED HOUSE IN FLORIDA

SEMIPALATINSK, (1) formerly a province of the general-governorship of the Steppes, now included in the Kazakstan A.S.S.R. (*q.v.*); (2) a town of Asiatic Russia in the Kazakstan A.S.S.R. in lat. 50° 28′ N., 80° 13′ E., on the Irtysh river, in a sandy waste at an altitude of 686 ft. Pop. (1926) 56,411. Its position on the Irtysh, with steamer routes to Omsk and Lake Zaisan made it a Kirghiz centre for trade in livestock, wool and tallow. It has a dock, wharves and repairing shops. The river is 250 yd. wide and is frozen from Nov. 26 to April 30. The opening in 1915 of the railway line from Novo-Sibirsk to Semipalatinsk greatly increased its prosperity; active work is going forward (1928) to continue the line southwards to link up with the railway systems of the Russian Central Asiatic Republics. The town has breweries, leather works, flourmills and a sheepskin factory and is the centre of a district of the same name.

SEMĪRAMIS (*c.* 800 B.C.), a famous Assyrian princess, round whose personality a mass of legend has accumulated. It was not until 1910 that the researches of Professor Lehmann-Haupt of Berlin restored her to her rightful place in Babylonian-Assyrian history. The legends derived by Diodorus Siculus, Justin and others from Ctesias of Cnidus were completely disproved, and Semīramis had come to be treated as a purely legendary figure. The legends ran as follows: Semīramis was the daughter of the fish-goddess Atargatis (*q.v.*) of Ascalon in Syria, and was miraculously preserved by doves, who fed her until she was found and brought up by Simmas, the royal shepherd. Afterwards she married Onnes, one of the generals of Ninus, who was so struck by her bravery at the capture of Bactra that he married her, after Onnes had committed suicide. Ninus died, and Semīramis, succeeding to his power, traversed all parts of the empire, erecting great cities (especially Babylon) and stupendous monuments, or opening roads through savage mountains. She was unsuccessful only in an attack on India. At length, after a reign of forty-two years, she delivered up the kingdom to her son Ninyas, and disappeared, or, according to what seems to be the original form of the story, was turned into a dove and was thenceforth worshipped as a deity.

The name of Semīramis came to be applied to various monuments in Western Asia, the origin of which was forgotten or unknown. (*See* Strabo xvi. 1. 2.) Ultimately every stupendous work of antiquity by the Euphrates or in Iran seems to have been ascribed to her—even the Behistun inscriptions of Darius (Diod. Sic. ii. 3). Semīramis appears as a goddess, the daughter of the fish-goddess Atargatis, and herself connected with the doves of Ishtar or Astartē. The same association of the fish and dove is found at Hierapolis (Bambyce, Mabbog), the great temple which, according to one legend, was founded by Semīramis (Lucian, *De dea Syria*, 14), and where her statue was shown with a golden dove on her head (33, 39). The irresistible charms of Semīramis, her sexual excesses (which, however, belong only to the legends: there is no historical groundwork), and other features of the legend, all bear out the view that she is primarily a form of Astartē, and so fittingly conceived as the great queen of Assyria.

Professor Lehmann-Haupt, by putting together the results of archaeological discoveries, has arrived at the following conclusions. Semīramis is the Greek form of Sammuramat. She was probably a Babylonian (for it was she who imposed the Babylonian cult of Nebo or Nabu upon the Assyrian religion). A column discovered in 1909 describes her as "a woman of the palace of Samsi-Adad, King of the World, King of Assyria, . . . King of the Four Quarters of the World." Ninus was her son. The dedication of this column shows that Semīramis occupied a position of unique influence, lasting probably for more than one reign. She waged war against the Indo-Germanic Medes and the Chaldaeans. The legends probably have a Median origin. A popular etymology, which connected the name with the Assyrian *summat*, "dove," seems to have first started the identification of the historical Semīramis with the goddess Ishtar and her doves.

See F. Lenormant, *La Légende de Sémiramis* (1873); A. H. Sayce, "The Legend of Semīramis," in *Hist. Rev.* (January, 1888).

SEMITIC LANGUAGES. The "Semitic" or "Shemitic" languages, so named in 1781 by Schlözer because most of those who spoke them were descended from Shem (Gen. x.–xi.), were spoken in Arabia, Mesopotamia, Syria and Palestine, whence they spread into Abyssinia, Egypt, northern Africa and elsewhere. All are closely related in structure and vocabulary (*cf.* Ass.-Bab. *bîtu*, Hebr. *bayith*, Aram. *baythâ*, Mand. *bîth*, Arab. *baitu*, and Eth. *bēt* "house"); yet cognate forms and words have not infrequently in the course of history acquired a different connotation (*e.g.*, Hebr. *'eleph*, "one thousand," but Eth. *'elf*, "ten thousand"). Each language also contains much that cannot be referred to the common stock.

Originally, the Semitic languages were less clearly defined. Early Aramaic like Assyro-Babylonian prefixed the precative *l-* to the imperfect and like Hebrew used "*wāw-* consecutive," but later dropped both constructions. Philologically they developed with varying rapidity; thus classical Arabic and Babylonian retained the case-endings of the primitive speech, while classical Hebrew and Aramaic used the accusative for all plural cases, exhibiting the same decay as modern Arabic. They can hardly be classified chronologically. Geographically, they fall into four

groups: eastern (Assyro-Babylonian or Accadian), central ("Amorite," Aramaic, Syriac), western (Canaanite, Moabite, Hebrew, Phoenician), and southern (Arabic, Ethiopic). Assyrian gave rise to "Cappadocian" in Asia Minor. Phoenician, which developed into Punic in the Mediterranean islands and northern Africa, reached Marseilles. Hebrew under Judaism passed into "Mishnaic" Hebrew and the modern vernacular and literary dialects of the East, especially Palestine, and various European countries. From Aramaic sprang Samaritan after the schism at Samaria, Palmyrene at Palmyra and Nabataean in Syria and northern Arabia, the Syriac of the Church, which missionaries carried into China and India, and the gnostic "Mandaean" of Babylonia. The modern dialects of Aramaic near Damascus and of Syriac in parts of Kurdistan have devised a definite article, enriched the tense-system, and admitted many contractions and other phonetic changes, thereby substituting an unexpected euphony for the *stridentia anhelantiaque verba* (Jerome) of the ancient speech.

In Arabia the "proto-Arabic" dialects, Sabaean ("Ḥimyaritic"), Minaean (which like Ass.-Bab. sometimes preferred *s* to *h*), and Liḥyānī (or Thamudean), preceded Arabic; this was carried far and wide by Islam and now counts some 40 dialects. Of these Socotrī (which changes *s* into *h*) and Mahrī, are spoken in Shihr and Mahra respectively. Others are the Maghribī dialects of northern Africa, which have been contaminated by Berber influence, and that (now extinct) of Sicily; they affix to the first person plural *-u*, which otherwise marks only the second and third person, and prefix to the first person singular *n-*, which otherwise marks only the first person plural. Maltese, also of the Maghribī family, but alone confined to Christians and generally written in European characters, has been for some 900 years separated from Arabic, while exposed to Italian influence. Ethiopic or *Geʿez*, originally the speech of the kingdom of Aksūm and afterwards of the Church and literature of Ethiopia, yielded to the southern and largely non-Semitic Amharic (or Abyssinian) as the language of the court; this developed into the northern Tigrē and southern Tigrai or Tigriña. Hararī at Harar, an island close to eastern, and Guraguē in southern, Shoa, are distant offshoots of Amharic.

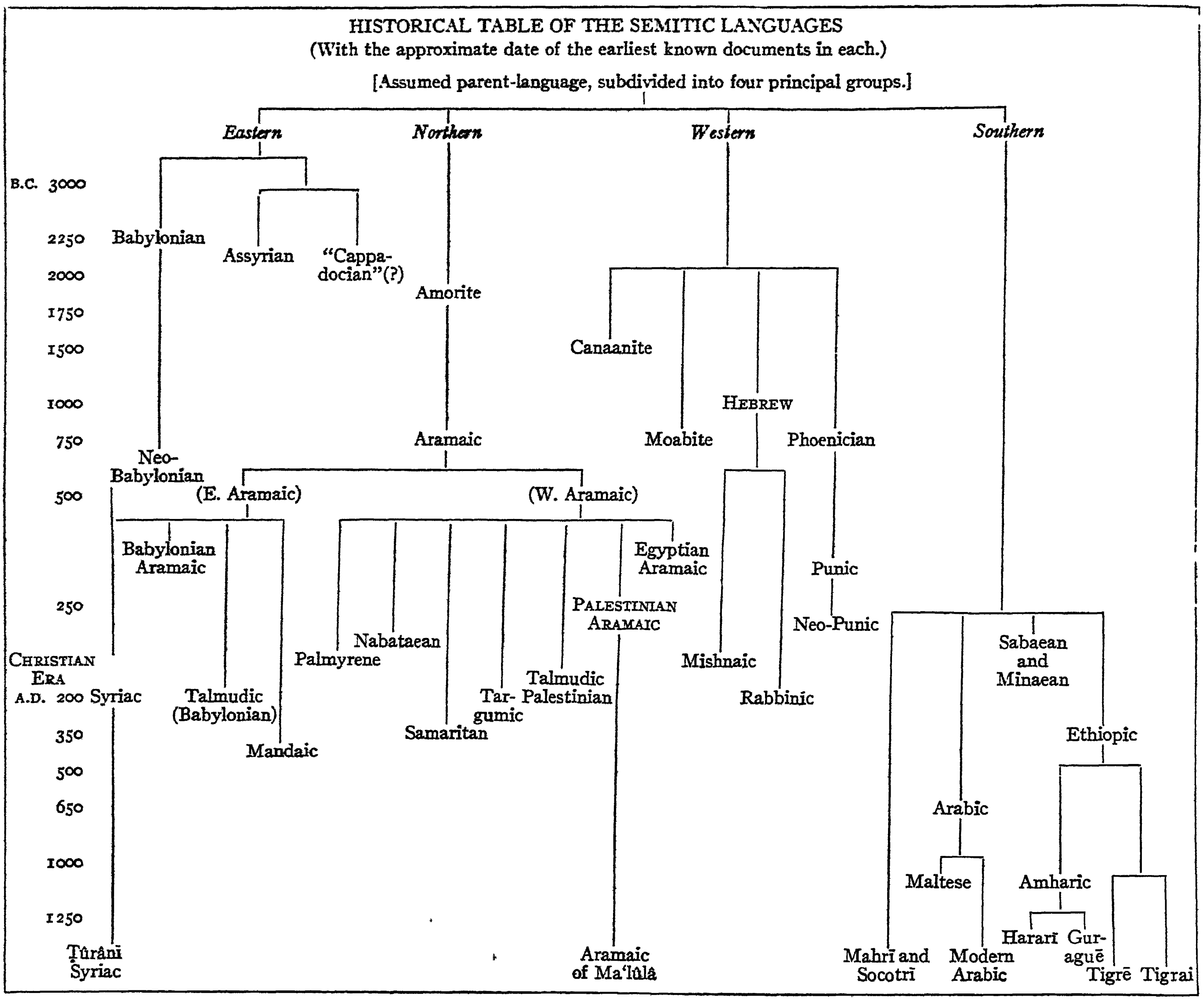
In settling the connection between the various languages it is easy to be misled by isolated peculiarities in vocabulary or grammar. Each of the older languages agreed in grammatical points with some other to which generally it bore no close resemblance, while more nearly related dialects exhibited different formations; each also possessed features peculiar to itself. For instance, on the one hand, Hebrew with Phoenician and Liḥyānī prefixed *ha-*, Nabataean and Arabic *'al-*, and Tigrē *la-*, as a definite article; yet the etymological connection between these forms is obscure. Aramaic suffixed *-â* and the other southern Arabic dialects *-n* to express determination. On the other hand, Arabic attached *-n* and the southern Arabic dialects *-m* to indicate indetermination. This *-m* was regularly used in Babylonian, where it had lost all force, even in the earliest documents, and has survived sporadically in adverbs in Hebrew and Abyssinian, a single instance of it being known in Phoenician.

Here several languages have each independently lost something which the tongues most akin to them have preserved. Similarly, the strengthening of the pronoun of the third person by *-t* or *-tū* was customary only in Ethiopic, Sabaean and Phoenician, though perhaps found also in certain Arabic particles. Aramaic alone had no reflexive with prefixed *n-* and Hebrew no causative theme with prefixed *sha-*. Several languages originally had a passive formed by internal vowel-change; Arabic alone exhibits the complete system; there are some traces of it in Hebrew and Aramaic, very few in the modern Arabic, and virtually none in Ass.-Bab., or, when it became literary, in Ethiopic. Again, phonetic resemblances occasionally indicated no kinship but were due to later growth. For instance, the masculine plural ending was in Hebrew *-îm* but in Aramaic, as in modern Arabic, *-în*; yet Aramaic originally had *-m*, whereas classical Arabic had *a* after the *-n* (in *-ûna* and *-îna*), where the change of *m* into *n* between two vowels is very improbable. These endings, therefore, may originally have been distinct. Great caution, too, must be exercised in drawing conclusions from points of agreement between the vocabularies of the various languages. For instance, Assyrian, Hebrew and Ethiopic had the same word for many objects which the other Semites called by different names; and the same might be said of Hebrew and Sabaean. Finally Moabite, which was otherwise indistinguishable from Hebrew (although, if the vocalization were known, its pronunciation might be found to have differed considerably), shared one striking peculiarity with Ass.-Bab. and the southern group, viz., a derived verbal theme formed by infixing *t* (*cf.* Moab. *'ltḥm*, "fought," and Arab. *iltaḥam*, "was hotly contested," with Hebr. *nilḥam*, "fought"). But to build any theory on such facts is hazardous, since the words or forms so cited are either found, though with a changed *nuance*, in at least one cognate language or actually occur with the same sense exceptionally or in poetical or archaic texts.

Certainly Arabic (with Sabaean, Mahrī and Socotrī) and Ethiopic were closely related and formed a distinct group over against the Hebraeo-Phoenician, Aramaic and Ass.-Bab. groups. Only in these southern languages are found the peculiar "inner plurals," consisting in the employment of certain forms denoting abstracts for the plural. They agree in inserting *â* between the first two consonants to enable a verb to take a direct instead of an indirect object (*e.g.*, Arab. *kâtaba*, "corresponded with," and *takâtaba*, "corresponded together," from *kataba*, "wrote"), and in using *a* between the last two consonants of the perfect in every active theme (*cf.* Eth. *'aṣdaqa* with Hebr. *hiṣdîq*, "justified"). Yet Hebrew has isolated examples of both peculiarities (e.g., *lôshēn*, "slandered," with *ô* for *â*, and *qiddash*; "sanctified," if the vocalization is correct). This is not disproved by such exceptions nor violated by the fact that the aspirated dentals *th, dh, ẓ* in Arabic are replaced in Ethiopic, as in Hebrew and Ass.-Bab., by the pure sibilants *s* (or *sh* in the latter language), *z, ṣ*, but in Aramaic by the simple dentals *t, d, ṭ*, which seem closer to the Arabic sounds. Even after the separation of the northern and southern groups all must have possessed these sounds, like Arabic, but have afterwards simplified them in one direction or another; hence accidental similarities resulted. Ethiopic kept *ḍ*, the most peculiar of them, distinct from *ṣ*, whereas Aramaic confused it with the guttural ʿ (*ʿayin*) and Ass.-Bab. and Hebrew with *ṣ*; all therefore once possessed this as a distinct sound. The sibilant *ś* (*sîn*) occurred only in Hebrew, Phoenician and old Aramaic; it must have closely resembled *sh* (*shîn*) with which Ass.-Bab. confused it, since it was represented by the same sign, and in later times was changed into an ordinary *s*. The division of the Semitic languages, therefore, into northern and southern is justifiable. It must, however, be remembered that such a division was not an instantaneous occurrence but that even after it, intercourse was maintained between tribes speaking kindred dialects and that intermediate dialects between the groups once existed. Further, Hebraeo-Phoenician and indeed Aramaic stand apart from Ass.-Bab. in more things than in the script; *e.g.*, in the preservation of the gutturals and the absence of verbal themes with *-tan-* infixed. The simplest classification is perhaps the following; A. Ass.-Bab. B. (i.) Hebraeo-Phoenician and Aramaic; (ii.) Arabic and Ethiopic.

Their connection with the Hamitic languages is disputed. They clearly, however, influenced Egyptian, which has pronouns (*cf.* Egt. *'nky* with Hebr. *'ānôkî*, "I") and pronominal affixes (*cf.* Egt. *-ty* with Hebr. *-tā*, "thou," and Egt. *-ty* with Ass.-Bab. *-at*, "she") resembling the Semitic forms, a pseudo-participle like the Accadian "permansive," certain verbal stems analogous to the Semitic themes, and many similar words (*cf.* Egt. *myw* and Ass.-Bab. *mû*, "water"). The Berber languages show similar but less frequent resemblances. Similarities, however, between Semitic and Indo-European words are either superficial (*cf.* Skt. *shash* and Hebr. *shēsh*, "six," whose root proves them unconnected) or due to borrowing (*cf.* Gk. χρυσός, which was borrowed from the Phoen. *ḥārûṣ*, "gold").

The script in all except Ass.-Bab. is derived from Phoenician and the writing runs from right to left in all except Ass.-Bab. and Ethiopic; only in a few Sabaean and early Ethiopic inscriptions is it alternate. Accadian alone had a script, borrowed from Sumerian, which primitively represented vowels, while Ethiopic very soon added them to an originally consonantal script; in both



the signs represent syllables and not letters. In the others vowel-signs, which were never regularly used, were added above and below the line, first by the Syrians in imitation of the Greek vowels and afterwards by the Hebrews and Arabs. Special numerical signs were invented or borrowed (for the so-called "Arabic numerals" are Indian) by all except the later Jews, who used letters of the alphabet for the purpose. No syllable might begin with a vowel, a breathing (*'aleph* or *hamzah*), written ', being used to support an initial vowel; there were also five gutturals of varying hardness, viz., *h, ḥ, ḫ,* '(*'ayin*) and *ġ* (*ġayin*). Arabic alone had all six gutturals; Mandaean confused all and Ass.-Bab. merged all except *ḫ*, and sometimes ' and *h* in vowels. There were also 12 sibilants and dentals as well as the ordinary consonants, which interchanged in the various languages according to definite rules; there were usually only two labials, *b* and *p* or *f*, although Hebrew had an aspirated *b* and *p* and Ethiopic two forms of *p*. The stress lay on the consonants, perhaps most of all in Syriac, and the vowels (originally only *a, i* and *u*) might be freely modified, especially through proximity to gutturals (*cf.* Ass.-Bab. *sibi* and Heb. *shebha'*, "seven").

Roots.—Almost all words go back to triconsonantal roots, although the theory which refers them utimately to biconsonantal roots is not improbable; for certain primitive words, like *dm*, "blood," are biconsonantal, and two consonants seem to run through many common roots, like *KS* through those denoting "to cut" or "strike." But the language, as now known, has passed this stage, and the parent speech, if ever there was one, is irretrievably lost. From the simple root diverse parts of speech are formed by modifying the vowels or by adding prefixes or affixes; thus from the root *qdsh* are formed the Bab. *qadishtu*, "hierodule"; Heb. *qōdhesh*, "holiness," *qādhôsh*, "holy," and *miqdāsh*, "sanctuary"; Mishn. Heb. *qiddûsh*, "betrothal"; Syr. *mqaddshûthâ*, "sanctification," and *qadhîshā'îth*, "holily"; Arab. *qaddîs*, "priest"; Eth. *qedsenā*, "holiness" and so on. This facility outweighed the rarity of compound substantives; but compound propositions and adverbs became ever more frequent.

Genders and Plurals.—The only genders are masculine and feminine, which sometimes serves for the neuter; *e.g.*, Heb. *ṭôbhāh* (fem. sing.), "good" = "goodness" and Heb. *nĕkhōḥôth* (fem. plur.), "honest things" = "honesty." The cases took terminations (sing. nom. *-u*, acc. *-a*, gen. *-i*; du. nom. *-â*, acc.-gen. *-ai* or *-ê*; pl. nom. *-û*, acc.-gen. *-î*). Classical Babylonian and Arabic exhibit all; the later languages confused them. Thus Hebrew, Aramaic and modern Arabic use *-î* (*-îm* or *-în*) and Assyrian *-ā* (*-āni*) as the universal plural ending; Hebrew and Ethiopic retain traces of the singular endings, but Aramaic and modern Arabic have discarded them. To the singular endings Arabic added *-n*, when the noun was indeterminate, and Babylonian *-m*, of which the force is obscure; to the plural Aramaic, Arabic and sometimes Ethiopic added *-n*, Hebrew and Phoenician *-m*. The feminine singular ending was *-(a)t(h)*, which became *-āh* in Hebrew and *-ah* in modern Arabic, and the plural ending *-āt(h)* or, in Hebrew and Phoenician, *-ôth;* the case-endings, when retained, followed this *-t*. There are traces of a primitive plural, formed (as in Sumerian)

by reduplication (*cf.* Ass.-Bab. *māmi* beside; *mê* from *mû*, "water"), to which the Hebrews through misunderstanding sometimes added the regular *-ôth* (*cf.* Heb. *piphiyôth* beside; *piyôth* from *peh*, "mouth"). The remarkable "inner plurals," characteristic of Arabic and less so of Ethiopic, are formed by modifying the vowels and sometimes adding preformative or afformative syllables; *e.g.*, Arab. *'awlâd* from *walad* and Eth. *welūd* from *weled*, "boy." The attempt to take a collective noun like *zākhûr*, "male(s)" as the "inner plural" of the adjective *zākhār*, "male," in Hebrew is hardly justified.

The States.—Determination and indetermination were expressed by the "states." Primarily the "absolute state," which took no termination, denoted the indeterminate, the "emphatic state" the determinate noun, as in Bibl.-Aram. *ḥēlem* (absol.), "a dream," but *ḥelmâ* (emph.), "the dream"; in Ass.-Bab. the absolute state was practically confined to the predicate, as in *sinnishtum* (emph.) *shî ûl ashshat* (absol.), "that woman (is) not a wife." In time these forms too were confused or dropped (*cf.* classical Arab. *malikun*, "a king," and *al-maliku*, "the king," with modern Arab. *malik*, "a king," and *al-malik*, "the king"). Thirdly, the "construct state," used before the genitive case, was the lightest form of the noun, dropping the afformative *-m* or *-n* (and often the singular case-ending in Ass.-Bab.) and dispensing (if there was one) with the article (*cf.* Ass.-Bab. *ashshat awēlim*, "the wife of the man"). This construction runs through the whole group, but various periphrases with prepositions or words denoting "owner" or "property" and so on are not uncommon, especially in Assyrian, Syriac and modern Arabic. Only Hebrew, Nabataean and Arabic had a definitive article (viz., *ha-*, *l-* and *al-* respectively); Ass.-Bab., like late Aramaic, did not feel the need, early Aramaic used the emphatic ending *-â*, and the south-Arabian dialects suffixed *-n* for the purpose; Ethiopic did not determine nouns, while Abyssinian used the suffix "his" (cf. *be'sī*, "man," and *be'sīhū*, "his man" = "the man"). Similarly the modern Aramaic of the *Ṭûru-'l-'Abdîn* has met the difficulty by coining the forms *ū-*, *ī-*, *āu*, "the," from the demonstrative pronoun.

Numerals.—The numerals exhibit one peculiarity not yet satisfactorily explained but characteristic of the whole group: masculine nouns take feminine numerals and *vice versa* from three to ten.

Pronouns.—Pronouns are singularly numerous. From the primary element *ha* many, containing usually the elements *d(h)*, *z*, *k*, *l* or *m* (for the remoter object) and *n* (for the nearer object) are built up; but other varieties occur, especially in the later languages. The personal pronouns, which are less numerous, rest on a common scheme: *k* or sometimes *t* for the first, *t* for the second, and *h* (or *sh* in Ass.-Bab.) for the third person. To express a possessive pronoun or the pronominal object, elements of these pronouns are suffixed to the noun or verb; *e.g.*, Ass.-Bab. *shumshu* =Hebr. *shĕmô* (for *shĕmēhû*), "his name"; or Syr. *qatleh*=Arab. *qatalahu*, "he killed him." These suffixes never denote the indirect object, except in Ethiopic and very rarely in Hebrew; only early Babylonian uses a special form in *-m* for the dative (e.g., *iddinushu*, "they gave it," but *iddinushum*, "they gave to him"). As a relative pronoun either the word used to introduce the genitive case *shā* in Ass.-Bab. and *zî* (*dî*) in Aramaic, or an originally demonstrative pronoun, *'allādhî* (*cf.* Heb. *hallāzeh* "this"), in Arabic and *za* (*cf.* Eth. *ze*, "this") in Ethiopic, is used. Hebrew employed *'ăsher*, the construct state of an old noun, meaning "the place of," "where" (*cf.* Ass.-Bab. *ashru*, "place," and *ashar*, "where") for the purpose; but *she-* was used dialectically and in late Hebrew.

Verbs.—As with nouns, so with verbs, modifications of meaning were expressed by changes in the vocalization or the addition of prefixes. Thus from the common root *q-t(ṭ)-l* Arabic formed *qatala*, "killed"; *qattala*, "massacred"; *qâtala*, "fought with"; *'aqtala*, "exposed to death"; *taqattala*, "was busied with killing"; *taqâtala*, "fought together"; *inqatala*, "was killed"; *istaqatala*, "killed himself (through over-exertion)." Assyrian had 12, Hebrew and Aramaic seven, Arabic 11, and each one or more rarer, themes; Ethiopic had altogether 23 themes. Classical Arabic alone has a passive formed from each theme by substituting *u-i-a* for *a-a-a*, as in *qutila*, "was killed," and so on; Hebrew exhibits such a passive in the intensive and causative themes, such as *quddash*, "was sanctified," from *qiddash*, "sanctified." Elsewhere, however, only the passive participle (*e.g.*, Heb. *yālûdh*, Aram. *yĕlīdh* and Eth. *welūd*, "born") has normally survived. Canaanite, like Ass.-Bab., used the "permansive" tense in both senses, though with different vowels (e.g., *laqiḥu* "they were taken," and *laqaḥu*, "they took"); but this died out, and everywhere except in the eastern group the reflexive was more and more used as a passive; *e.g.*, Heb. *nilqaḥ* beside *luqqaḥ*, "was taken," from *lāqaḥ*, "took" (*cf.* Ass.-Bab. *liqi*, "was taken," and "took") and Syr. *ethmlî*, "was filled," from *mlâ*, "filled."

The basic form was the third person singular unaugmented by prefix or affix, originally a nominal form denoting a timeless state, neither active nor passive; for example, Ass.-Bab. *nadin*, "given," whether "has given" or "has been given." Ass.-Bab. used it generally but not exclusively as intransitive or passive, although this led to ambiguity; for *kasap nadin* meant either "the money has been given" or "he gave the money." The Eastern group, assigning both uses to this form (called "permansive" as expressing a more or less permanent state), removed the ambiguity by employing case-endings; the Western dispensed with them, since it marked the transitive by *a* and the intransitive by *i* under the second consonant. A third form with *u* (*e.g.*, Ass.-Bab. *maruṣ*, "was ill," or Heb. *qāṭōn*, "was small") had always only a "stative" force. Occasionally the other groups confused the *i-* and *a-* forms (*cf.* Heb. *mālē'* and Eth. *mal'a* = Ass.-Bab. *mali*, "is full" or "has filled") but generally distinguished them (*cf.* Arab. *mali'a*, "was full," and *mala'a*, "filled"); although usually different roots were preferred (*e.g.*, Heb. *hākham*, "was wise," and *shāphaṭ*, "judged," (*cf.* Arab. *ḥakuma*, "was wise," and *ḥakama*, "judged").

The pronominal subject was affixed to the permansive tense, as being properly nominal: thus *kabit attâ*, "honourable (art) thou," gave rise to *kabtâtâ*, "thou-art-honourable"; this tense denoted a state, viz., what was complete in past time. A new tense, describing incomplete action in present or future time, was obtained by prefixing the pronominal element: thus *ta-* (from *attâ*), "thou," and *zakir* coalesced into *tazakar* (with *a* for *i* under *k*, as the sense is active), "thou dost" or "wilt remember." Finally, a tense describing incomplete action in past time was devised by modifying the vowels of the present, giving rise to *tazkur*, "thou wast remembering," which came to serve for the pure preterite "thou didst remember." The cognate languages, through using the permansive as a proper preterite, required only an imperfect for incomplete action, past, present or future, for which they adopted a form resembling the Ass.-Bab. preterite (*e.g.*, Heb. *tizkōr*, "thou wast remembering," "dost" or "wilt remember," but *zākhartā*, "thou hast remembered"). Why a form corresponding with the Ass.-Bab. *izakar*, "he does" or "will remember," was not adopted, is not clear; it may have been to avoid confusion with the preterite in certain derived themes. In some Aramaic dialects, especially Syriac and Mandaic, *l-* or *n-* was prefixed to the third person. In prohibitions, not the imperative but a tense resembling the preterite-imperfect (probably derived independently from the imperative) is used; *cf.* Ass.-Bab. *zukur* and Heb. *zĕkhōr*, "remember," but Ass.-Bab. *ē tazkur* and Heb. *'al tizkōr*, "do not remember."

Much skill was shown in circumventing the inadequacy of these tenses, notably by means of "*wāw*-consecutive" in Hebrew (*q.v.*) and the active participle in all the languages. But the need of compound tenses was soon felt. Phoenician, Aramaic and Syriac formed with the verb "to be" a true present, a pluperfect, and other tenses; modern Arabic uses it as well as *rāyiḥ*, "going," *'ammâl*, "doing," and so on, for a similar purpose, and prefixes *bi-*, "in," to the imperfect to make a present (e.g., *yiktub*, "he writes," and *byiktub*, "he is writing"). Mishnaic Hebrew formed a present by combining the participle with the pronominal subject (e.g., *'ômĕrani*, "I say," formed from *'ômēr 'ănî*, "I [am] saying"). The modern Syriac of Kurdistan has entirely discarded the old in favour of new tenses like this participial present and the participle with the verb "to be" and other formative elements.

All, especially Hebrew, being relatively deficient in compound

nouns and adjectives, use numerous circumlocutions for them; *e.g.*, Arab. *qillat ṣabr*, "littleness of patience—impatience"; all again, especially Arabic, frequently use apposition or a genitive case for an adjective; *e.g.*, Arab. *issâ'at addahab*, "the watch, the gold," or *sâ'at addahab*, "the watch of gold." Arabic alone has a special form for the comparative and superlative of adjectives, of which Hebrew preserves traces; all use a partitive preposition to express comparison; *e.g.*, Heb. "small from my brothers" = E. "smaller than my brothers." Most, but especially Hebrew and Arabic, lack adverbs, which they replace by the adverbial accusative and prepositional phrases. The syntax of all is very alike: but the Eastern languages when influenced by Sumerian tend to throw the verb to the end, the Western to the beginning of the sentence. All employ nominal clauses owing to difficulties about the verb "to be" and the absence (except in Assyrian) of a verb "to have" (*e.g.*, Arab. "with me money" = E. "I have money"). Equally common is the circumstantial clause, viz., a clause added, often asyndetically, to describe the circumstances (*e.g.*, Heb. "a tower and its head in Heaven" = E. "a tower whose top may reach unto Heaven"). Arabic is peculiar in putting the predicate in such a clause and after several verbs, notably the substantive, in the accusative case (*e.g.*, Arab. "he went out, his father [nom.] sitting" [acc.] = E. "while his father was seated"). The verb, especially in Hebrew and Arabic, when at the beginning of the sentence, often stands in the third person masculine singular (*cf.* Gk. *schēma Pindaricum*). Co-ordinating and to a greater degree sub-ordinating conjunctions, especially in Hebrew, were rare; Syriac, however, by borrowing largely from Greek (*e.g.*, Syr. *ger* = Gk. γάρ, "for") obtained a more flowing construction of sentences. Otherwise λέξις εἰρομένη, "speech strung together," chiefly with the conjunction "and," is characteristic of Semitic idiom (*e.g.*, Arab. "he was forced and did it" = E. "forced to do it"). This conjunction frequently also introduces the apodosis (*e.g.*, Heb. "if I find and I will spare" = E. "then I will spare"). So Ass.-Bab. used "and let" for "that" (*e.g.*, Capp. "see and let thy instructions come" = E. "that thy instructions come"). Subordinate clauses were not generally distinguished; but Ass.-Bab. marked verbs in them by the ending *-u* or sometimes *-a* and Arabic by *-a*. Ethiopic alone had a special form, using *yezaker*, "he remembers," as an imperfect and *yezker*, "let him remember," as a subjunctive. The corresponding form in Hebrew, though an imperfect, served also, if possible, in a shortened form, as a jussive (*e.g.*, Heb. *yizkōr*, "let him remember") and in Ass.-Bab. though a preterite, with *lû*, "let," as a precative (*e.g.*, Ass.-Bab. *lizkur*, "let him remember"). The infinitive in the accusative case, sometimes with an epithet, was often added to strengthen the verbal idea, especially in Arabic; in Babylonian a primarily exclamatory infinitive in the nominative case served the same purpose (*e.g.*, Ass.-Bab. *tabālum tatbal*, "a taking away! hast thou taken away?" = E. "hast thou indeed taken away?"). Hebrew uses constructions apparently similar to both.

The Semitic languages, therefore, shared many common characteristics; but each, although all stand more closely together than any modern languages, developed peculiarities, which appear sporadically in the others. Thus Ass.-Bab. shared some words or idioms with Hebrew, others with Syriac; Hebrew in some things resembled Phoenician or Moabite, in others Aramaic; Aramaic here touched Phoenician, there Arabic; Arabic had much in common with Ethiopic, which in some points approached Accadian and Hebrew rather than any other language. *See* ASSYRIAN; HEBREW; ARAMAIC; SYRIAC; ETHIOPIC; AMHARIC; ARABIC; YIDDISH.

(G. R. D.)

SEMLER, JOHANN SALOMO (1725–1791), German church historian and biblical critic, was born at Saalfeld in Thuringia on Dec. 18, 1725, the son of a clergyman in poor circumstances. He grew up amidst pietistic surroundings, which powerfully influenced him his life through, though he never became a Pietist. In his seventeenth year he entered the university of Halle, where he became the disciple, afterwards the assistant, and at last the literary executor of the orthodox rationalistic professor S. J. Baumgarten (1706–1757). In 1749 he became editor, with the title of professor, of the Coburg official *Gazette.* But in 1751 he was invited to Altdorf as professor of philology and history, and in 1752 he became a professor of theology in Halle. After the death of Baumgarten (1757) Semler became the head of the theological faculty of his university, and the fierce opposition which his writings and lectures provoked only helped to increase his fame as a professor. His popularity continued undiminished for more than 20 years, until 1779. In that year he came forward with a reply (*Beantwortung der Fragmente eines Ungenannten*) to the *Wolfenbüttel Fragmente* (*see* REIMARUS) and to K. F. Bahrdt's confession of faith, a step which was interpreted by the extreme rationalists as a revocation of his own rationalistic position. Even the Prussian Government, which favoured Bahrdt, made Semler painfully feel its displeasure at this new but really not inconsistent aspect of his position. But, though Semler was really not inconsistent with himself in attacking the views of Reimarus and Bahrdt, his popularity began from that year to decline, and towards the end of his life he felt the necessity of emphasizing the apologetic and conservative value of true historical inquiry. He died at Halle on March 14, 1791, worn out and disappointed at the issue of his work.

Semler was a pioneer in the criticism of the traditional canon of Scripture, in the search for the origins of the books of the New Testament, and in Church history.

Tholuck gives 171 as the number of Semler's works, of which only two reached a second edition, and none is now read for its own sake. For estimates of Semler's labours, *see* W. Gass, *Gesch. der prot. Dogmatik* (Berlin, 1854–1867); Isaak Dorner, *Gesch. der prot. Theol.* (Munich, 1867); the art. in Herzog's *Realencyklopädie;* Adolf Hilgenfeld, *Einleitung in das Neue Test.* (Leipzig, 1875); F. C. Baur, *Epochen der kirchlichen Geschichtsschreibung* (1852); and Albrecht Ritschl, *Gesch. des Pietismus* (Bonn, 1880–84).

SEMMELWEISS, IGNAZ PHILIPP (1818–1865), Hungarian physician, was born at Buda on July 1, 1818, and was educated at the universities of Pest and Vienna, where he attracted the attention of Joseph Skoda and Carl Rokitansky. He graduated M.D. at Vienna in 1844, and was then appointed assistant professor in the maternity department, under Johann Klein. In Klein's time the deaths in this department from what was then known as "puerperal fever" became portentous. The death of a colleague from a dissection wound suggested to Semmelweiss an identity with the fatal puerperal cases, and the beginning of a scientific pathology of septicaemia was made. The students often came to the lying-in wards from the dissecting-room, their hands cleansed with soap and water only. In May 1847 Semmelweiss prescribed ablutions with chlorinated lime water; in that month the mortality stood at 12·24%, before the end of the year it had fallen to 3·04%, and in the second year to 1·27%. Skoda and other physicians were convinced by these results. Klein, however, apparently blinded by jealousy and vanity, supported by other reactionary teachers, and aided by the disasters which then befell the Hungarian nation, drove Semmelweiss from Vienna in 1849. Fortunately, in the following year Semmelweiss was appointed obstetric physician at Pest in the maternity department, then as terribly afflicted as Klein's clinic had been; and during his six years' tenure of office he succeeded, by antiseptic methods, in reducing the mortality to 0·85%. He died on Aug. 17, 1865, from a disastrous wound of the right hand, a victim of the very disease for the relief of which he had already sacrificed health and fortune.

His chief publication was *Die Ätiologie der Begriff und die Prophylaxis des Kindbettfiebers* (1861). There are biographies by Hegar (1882), Bruck (1887), Duka (Hertford, 1882), Grosse (1898) and Schürer von Waldheim (1905). For the relations in the order of discovery of Semmelweiss to Lister, *see* LISTER.

SEMMERING PASS, the lowest of all the great passes across the Alps. The hospice, near the summit, was founded about 1160, but the pass was certainly used at a much earlier date. Between 1848 and 1854 a railway line (the first in any sense to cross the Alps) was constructed, but passes 282 ft. below the summit of the pass (3,225 ft.) by a tunnel about 1 m. long. The line runs from Wiener Neustadt (30½ m. from Vienna) past Bruck to Graz (139 m. from Vienna), whence it is 227 m. by rail to Trieste.

SEMMES, RAPHAEL (1809–1877), American naval officer, was born in Charles county, Md., on Sept. 27, 1809. He was

appointed midshipman in the navy in 1826, and while waiting for orders studied law and in 1834 was admitted to the bar. Semmes served in the war with Mexico; was active in superintending the landing of Gen. Scott's troops at Vera Cruz in March, 1847, and later, as volunteer aid to Gen. Worth, took an active part in the battles of the Valley of Mexico. These experiences are interestingly told in his books *Service Afloat and Ashore During the Mexican War* (1851) and *Campaign of Gen. Scott in the Valley of Mexico* (1852). In 1855 he was promoted to commander and afterwards was made naval secretary of the Lighthouse Board at Washington, in which service he was when the Civil War broke out. When Alabama, his adopted State, seceded, he resigned his commission and received an appointment of the same rank in the Confederate navy. He fitted out the packet "Sumter," in which he captured as many as 17 Northern merchant vessels, chiefly along the South American coast. Later he commanded the more famous "Alabama," a 1,016 ton ship built in England for the Confederacy, with which he made a series of daring and successful cruises lasting two years. Finally, he met the Northern ship "Kearsarge" in the English channel, and after a long seven-hour battle was forced to surrender. Twenty minutes later the "Alabama" sank and Semmes was rescued by an English yacht. When he returned home he was commissioned rear-admiral and assigned to the Confederate fleet in the James river. When Richmond was captured he blew up his ships and, with his men, joined the army of Gen. Johnston. When Johnston surrendered Semmes returned to his home in Mobile and opened a law office, to which practice he devoted the greater part of the rest of his life. He died on Aug. 30, 1877.

In addition to his books on the Mexican War he wrote *The Cruise of the Alabama and Sumter* (1864) and *Memoirs of Service Afloat* (1869).

SEMNAN, a town in Persia and administrative headquarters of the province hitherto known as "Semnan wa Damghan." It is bounded north by Astarabad and Shahrud, west by Mazanderan, Tehran and Qum, east by Khurasan and south by Yezd. The revenue of the province of Semnan and Damghan together amounted to 284,477 krans in 1926–27 (£ St. = 45 krans).

The town of Semnan is situated 145 m. E. of Tehran on the high road to Meshed, in 35° 34′ N. and 53° 22′ E., at an elevation of 3,740 ft. The water supply comes from the streams that run down from the Elburz and the principal crop of the surrounding plain is tobacco. The population was estimated by Curzon in 1890 at under 16,000 and a later estimate, 1900, gives 20,000.

Semnan is a place of great antiquity, mentioned by Ptolemy as *Samina* and cited by the oriental geographers as worthy of note for the many rivulets of water running through the streets, for the making of soft stuffs of cotton for handkerchiefs, etc., and specially for its sweet paste made from almonds and figs. The dialect of Semnan, commonly called Simnuni, has the reputation in Persia of being particularly unintelligible.

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SEMOIS (also spelt Semoy and Semoys), a river less than 120m. long rising near Arlon on the Belgium-Luxembourg frontier and flowing in a sinuous course across the lower Devonian strata of the southern Ardennes. The last 20m. of its course are in France where at Monthermé it joins the Meuse on its right bank. Bouillon is the only town on its banks; it is not navigable.

SEMOLINA, the principal material used in the manufacture of macaroni, vermicelli, spaghetti and other alimentary pastes. In English speaking countries the article sold as semolina is the wholly granular product used for making semolina puddings. The *New English Dictionary* gives a quotation showing that so long ago as 1797 semolina was used in this way. It is obtained from hard wheats, generally those of the race *Triticum Durum*, and consequently possesses certain distinctive characteristics, notably a certain toughness when it is made into a dough, and an intensely yellow colour. This toughness is essential for the manufacture of the best macaroni.

(*See* also Flour and Flour Manufacture; Middlings.)

(A. E. Hu.)

SEMON, SIR FELIX (1849–1921), English laryngologist, was born at Danzig on Dec. 8, 1849, and studied medicine at Heidelberg. He served in the Prussian Guard during the Franco-German war, afterwards continuing his medical studies in Vienna, Paris and London. After some years on the staff of the hospital for throat diseases, Golden square, London, he was appointed head of the throat department of St. Thomas's hospital, where he quickly gained a wide reputation. The *Internationales Centralblatt für Laryngologie und Rhinologie* was founded by him in 1884, and he continued to edit it until 1909. In 1885 he was elected F.R.C.P. In 1888 he obtained an appointment as laryngologist to the National hospital for the paralysed and epileptic, where he was associated with Sir Victor Horsley in researches which led to the formulation of "Semon's law," "that in all progressive organic lesions of the centres and trunks of the motor laryngeal nerves, the abductors of the vocal chords succumb much earlier than the adductors." From 1894 to 1896 he was president of the Laryngological Society of London, which he helped to found in 1893. He was knighted in 1897 and became a naturalized British subject in 1901. He retired in 1911, and died near Great Missenden on March 1, 1921. His researches led to the thyroid treatment of myxoedema, and his early diagnosis of cancer of the larynx enabled him to perform many successful operations by laryngo-fissure.

SEMO SANCUS DIUS FIDIUS, an obscure Roman deity; a god Fisios or Fisovios Sancios was also worshipped in Umbria, and appears to be the same. He had a temple at Rome on the Quirinal, in which was an ancient statue of a woman, said to be Gaia Caecilia, or Tanaquil, wife of Tarquinius Priscus. His functions are very obscure. The four parts of his name seem to be connected respectively with seed (*semen, cf.* the Semunes invoked by the *Fratres Arvales*), purity or holiness (*sancus* and *sanctus* are from the same root), Jupiter (or simply brightness, or celestial nature; Dius, root *Div*), and faith (*fides*). Hence perhaps "the spirit of sowing (or seed), pure, Jovian (or bright, or celestial), faithful." Of his ritual we know only that oaths by him were taken in the open air, the formula being *medius fidius, cf. mehercule*, "by Hercules"; that there was an opening in the roof of his temple; and that certain discs of metal were kept in the temple. The first two facts perhaps suggest a sky-god, but we know that certain deities undoubtedly not celestial (for example, Terminus, the spirit of boundaries) had similar ritual. The discs might possibly be solar symbols. On the whole, the balance of the very scanty evidence is rather in favour of supposing him to be a god of the sky, perhaps connected, as Wissowa supposes, with Jupiter, who had power to influence seed-corn (by sending rain in season?) and, being able to see what went on in the world, was a natural witness to solemn oaths. The ancients, wrongly supposing the last two members of his name to signify "son of Zeus," identified him with Hercules, a blunder which some moderns (as Preller) have fallen into.

See Wissowa in Roscher's *Lexikon, s.v.*, and *Religion und Kultus*, 2nd ed., p. 129.

SEMPACH, a small town in the Swiss canton of Lucerne, built above the eastern shore of the lake of the same name, and about 1½ m. by road north of the Sempach railway station (9 m. N.W. of Lucerne). In 1920 it had 1,180 inhabitants, German-speaking and Roman Catholics. About half an hour distant to the north-east is the site of the famous battle of Sempach (9th July, 1386), in which the Swiss defeated the Austrians, whose leader, Duke Leopold, lost his life. The legendary deed of Arnold of Winkelried (*q.v.*) is associated with this victory. The spot is now marked by an ancient and picturesque battle-chapel (restored in 1886). Some miles north of Sempach is the quaint village of Münster or *Beromünster*, where the first dated book was printed (1470) in Switzerland. For the battle of Sempach *see* Swiss Wars.

See Th. von Liebenau, *Die Schlacht bei Sempach* (Lucerne, 1886).

SEMPILL, the name of a Scottish family long seated in Renfrewshire. An early member, Sir Thomas Sempill (d. 1488), was killed whilst fighting for James III. at the battle of Sauchie-

burn, and his son John (d. 1513), who was made a lord of parliament about 1489, fell at Flodden. John's grandson, Robert, 3rd Lord Sempill (*c.* 1505–72), assisted the Scottish regent, Mary of Lorraine, in her struggle with the lords of the congregation, and was afterwards one of the partisans of Mary, queen of Scots; about 1566, however, he deserted the queen, against whom he fought at Carberry Hill and at Langside. Hugh, 12th Lord Sempill (d. 1746), fought in Spain and in Flanders, and held a command in the English army at Culloden; in 1747 he was made colonel of the Black Watch. The title passed into the Forbes family (Forbes-Sempill) in 1836.

SEMPILL, ROBERT (the elder) (*c.* 1530–1595), Scottish ballad-writer, was in all probability a cadet of illegitimate birth of the noble house of Sempill or Semple. He was probably a soldier, and must have held some office at the Scottish court, as his name appears in the lord treasurer's books in February 1567–1568, and his writings show him to have had an intimate knowledge of court affairs. He was a bitter opponent of Queen Mary and of the Catholic Church. Sempill was present at the siege of Leith (1559–1560), was in Paris in 1572, but was driven away by the massacre of St. Bartholomew. He was probably present at the siege of Edinburgh Castle (1573), serving with the army of James Douglas, earl of Morton. He died in 1595. His chief works are: "The Ballat maid vpoun Margret Fleming callit the Flemyng bark"; "The defence of Crissell Sandelandis"; "The Claith Merchant or Ballat of Jonet Reid, ane Violet and Ane Quhyt," all three in the Bannatyne ms. They are characterized by extreme coarseness, and are probably among his earlier works. His chief political poems are "The Regentis Tragedie," a broadside of 1570; "The Sege of the Castel of Edinburgh" (1573), interesting from an historical point of view; "Ane Complaint vpon fortoun . . ." (1581), and "The Legend of the Bischop of St. Androis Lyfe callit Mr. Patrik Adamsone" (1583).

See *Chronicle of Scottish Poetry* (ed. James Sibbald, Edinburgh, 1802); and "Essays on the Poets of Renfrewshire," by William Motherwell, in *The Harp of Renfrewshire* (Paisley, 1819; reprinted 1872). Modern editions of Sempill are: "Sege of the Castel of Edinburgh," a facsimile reprint with introduction by David Constable (1813); *The Sempill Ballates* (T. G. Stevenson, Edinburgh, 1872) containing all the poems; *Satirical poems of the Reformation* (ed. James Cranstoun, Scottish Text Soc., 2 vols., 1889–1893), with a memoir of Sempill and a bibliography of his poems.

SEMUR-EN-AUXOIS, a town of eastern France, capital of an arrondissement in the department of Côte-d'Or, 45 m. W.N.W. of Dijon on the P.L.M. railway. Pop. (1926) 2,787. Semur (*Sinemurum*) was a Gallic fortress in the dark ages and in feudal times a castle of the dukes of Burgundy. In the 11th century it became capital of Auxois. Its communal charter dates from 1276. The incorporation of Burgundy with France was resisted by the town, which was taken by the royal troops in 1478. During the wars of religion in the 16th century it served as refuge for the Leaguers, and though it submitted to Henry IV. at his accession its fortifications were destroyed in 1602. Semur occupies one of the finest sites in France, on the extremity of a plateau above the river Armançon, which surrounds the town on three sides. There are remains of the old encircling ramparts. The castle (13th and 14th centuries) consists of a rectangular keep flanked by four towers. Portions of it are still in use. Semur possesses a sub-prefecture. It is an important market centre for the Auxois and Morvan. Cement, leather, oil and chemical manures are among its industrial products.

SENAC DE MEILHAN, GABRIEL (1736–1803), French writer, son of Jean Sénac, physician to Louis XV., was born in Paris in 1736. He entered the civil service in 1762; two years later he bought the office of master of requests. He was successively intendant of La Rochelle, of Aix and of Valenciennes. In 1776 he became intendant-general for war, but was soon compelled to resign. His first book was the fictitious *Mémoires d'Anne de Gonzague, princesse palatine* (1786), thought by many people at the time to be genuine. In the next year followed the *Considérations sur les richesses et le luxe,* combating the opinions of Necker; and in 1788 the more valuable *Considérations sur l'esprit et les moeurs,* a book which abounds in sententious, but often excessively frank, sayings.

Sénac witnessed the beginnings of the Revolution in Paris, but emigrated in 1790, making his way first to London, and then, in 1791, to Aix-la-Chapelle. In 1793, while his recollections of the Revolution were still fresh, Sénac wrote a novel, *L'Emigré* (Hamburg, 4 vols., 1797; reprint 1904). At the invitation of Catherine II. Sénac went in 1792 to Russia and thence to Hamburg and to Vienna, where he found a friend in the prince de Ligne.

See his *Oeuvres choisies,* edited by M. de Lescure in 1862; *Lettres inédites de Madame de Créqui à Sénac de Meilhan* (1856), edited by Edouard Fournier; Louis Legrand, *Sénac de Meilhan et l'intendance du Hainaut et du Cambrésis* (1868); and the notice by Fernand Caussy prefixed to his edition (1905) of the *Considérations sur l'esprit et les moeurs.*

SÉNANCOUR, ÉTIENNE PIVERT DE (1770–1846), French author, was born in Paris in November 1770. His father desired him to enter the seminary of Saint-Sulpice preparatory to becoming a priest, but Sénancour, to avoid a profession for which he had no vocation, went on a visit to Switzerland in 1789. At Fribourg he married in 1790 a young Frenchwoman, Mademoiselle Daguet, but the marriage was not a happy one. His absence from France at the outbreak of the Revolution was ill interpreted, and his name was included in the list of emigrants. He visited France from time to time by stealth, but he only succeeded in saving the remnants of a considerable fortune. In 1799 he published in Paris his *Rêveries sur la nature primitive de l'homme,* a book containing impassioned descriptive passages which mark him out as a precursor of the romantic movement. His best known work *Obermann* (2 vols., 1804), was to a great extent inspired by Rousseau, was edited and praised successively by Sainte-Beuve and by George Sand, and had a considerable influence both in France and England. It is a series of letters supposed to be written by a solitary and melancholy person, whose headquarters are placed in a lonely valley of the Jura. He returned to France in 1803 and died at St. Cloud on Jan. 10, 1846. He wrote late in life a second novel in letters *Isabelle* (1833).

Sénancour is immortalized for English readers in the *Obermann* of Matthew Arnold. *Obermann* itself was translated into English, with biographical and critical introduction, by A. G. Waite (1903). *See* the preface by Sainte-Beuve to his edition (1833, 2 vols.) of *Obermann,* and two articles *Portraits contemporains* (vol. i.); *Un Précurseur* and *Sénancour* (1867) by J. Levallois, who received much information from Sénancour's daughter, Eulalie de Sénancour, herself a journalist and novelist; and a biographical and critical study *Sénancour,* by J. Merlant (1907).

SENATE, the assembly of old men (Lat. *senatus,* from root, *sen-,* as in *senex,* old), originally the heads of the chief families, and hence the upper council in a governmental system. The Latin word corresponds with the Greek *γερουσία* (*see* GEROUSIA), the name of the council of elders at Sparta. The Athenian Areopagus (q.v.) may in some ways be compared to the Roman senate; the Cleisthenic council (*see* BOULE) at Athens was in all respects a different body. The word, applied primarily to the Roman council (*see* below), is also used to designate the upper chamber in the legislatures of France, Italy, and the United States (q.v.); in the British legislature it is represented by the House of Lords. The title is used for the governing bodies of the universities of Cambridge and London, and also certain American colleges and universities. In the Scottish universities, the governing body is the Senatus Academicus. The College of Cardinals is the Senate of the Holy See.

THE ANCIENT ROMAN SENATE

(A) **History.**—The senate or council of elders formed the most permanent element in the Roman Constitution. The authorities ascribe its origin to Romulus, who chose out 100 of the best of his subjects to form an advisory council. In 509 B.C. it contained 300 members, and a distinction existed within it between *patres maiorum gentium* and *minorum gentium,* the heads of the greater and the lesser families. Throughout the monarchical period the senate consisted entirely of patricians. There is some connexion between the increase in the numbers of the senate and the distinction between two classes of *patres.* Probably the rise in the number of the senators was due to the incorporation of fresh

elements into the patrician community, with an increase of *gentes* (families); and the new clans were the *gentes minores* (lesser families). The appointment of senators depended entirely upon the king. It is possible that a king might change his advisers during his reign, and a new king could certainly abstain from summoning some of those convened by his predecessors. The powers of the senate at this time were very indefinite.

Under the Republic.—The abolition of monarchy and the substitution of two elected consuls did not at first bring any important change in the position of the senate. It was the advisory council of the consuls, meeting only at their pleasure, and owing its appointment to them, and remained a power secondary to the magistrates, as it had been to the king. Tradition ascribes to the first consuls some change in the class from which senators were drawn. Whatever the nature of the change, plebeians were not introduced into the senate at this time. Such a change is utterly improbable after the success of a patrician *coup d'état,* such as the expulsion of the Tarquins; and there is no evidence for the existence of a plebeian senator before the year 401 B.C. In one respect, the substitution of consuls for kings tended to the subordination of the chief magistrates to the senate. The consuls held office only for one year, while the senate was a permanent body; in experience and prestige, its individual members were often superior to the consuls of the year. The magistrate would seldom venture to disregard the advice of the senate, especially as he himself would, in accordance with steadily growing custom, become a senator at the end of his year of office. It was probably in their capacity of ex-magistrates that plebeians first entered the senate; the first plebeian senator mentioned by Livy, P. Licinius Calvus, was also the first plebeian consular tribune. Of the two powers which the senate inherited from the monarchy, the interregnum and the *patrum auctoritas,* the first had become rarer of exercise than before; for if either consul existed, interregnum could not be resorted to. The *patrum auctoritas,* however, developed into a definite right claimed by the senate to give or withhold its consent to any act of the comitia (q.v.). The influence which it had long exercised over foreign policy increased the importance of the senate in a period of constant warfare with the nations of Italy. But in the early republic, the senate remained an advising body, and assumed no definite executive powers.

In the last two centuries of the republic, a great change took place in the position of the senate. It became a self-existent, automatically constituted body, independent of the annual magistrates, a recognized factor in the Constitution, with extensive powers. Its self-existence was effected by entrusting the selection to the censors. The censorship (q.v.) was instituted in 443 B.C., and some time before the year 311 it was placed in charge of the *lectio senatus.* Conditions of selection had been imposed by 311, which made the constitution of the senate practically automatic. Ex-curule magistrates (*see* CURULE) were entitled to admission together with other persons who had done conspicuous public service; and for some time before Sulla's dictatorship little power of choice can really have rested with the censors. Sulla secured an automatic composition for the senate by increasing the number of quaestors, and enacting that all ex-quaestors should pass at once into the senate. This enactment provided for the maintenance of the number of senators, 20 ex-quaestors passing in every year. The senate's powers had now extended beyond its ancient prerogatives of appointing an interrex, and ratifying decisions of the comitia. The first of these powers had fallen into practical disuse, and the second had become a mere form by the last century of the republic. But the senate had acquired more effective control through the observance of certain unwritten rules regulating the relation between senate and magistrates. It was understood that the magistrate should not question the people on any important matter without the senate's consent, nor refuse to do so at its request; that one magistrate should not employ his veto to quash the act of another except at the senate's bidding, nor refuse to do so when directed. The earlier influence upon foreign policy developed into a definite claim put forward by the senate to conduct all negotiations with a foreign power, the terms being submitted to the people for ratification. For the organization of a new Roman province, even this formal ratification was dispensed with, and a commission of senators alone aided the victorious general in the organization of his conquests. The senate also acquired the right to distribute spheres of rule among the various magistrates. The control of finance was in the senate's hands. Three circumstances had combined to bring about this result. The censors, who were only occasional officials, were entrusted with the leasing of the public revenues; the senate directed the arrangements made by them. The details of public expenditure were entrusted to the quaestors, who, when the magistracies were multiplied, occupied an entirely subordinate position; this strengthened the position of the senate as the natural director of young and inexperienced magistrates. Thirdly, the general control exercised by the senate over provincial affairs implied its direction of the income derived from the provinces, which in the later republic formed the chief property of the State. It claimed a right, unchallenged till the time of Tiberius Gracchus, of granting occupation and decreeing alienation of public lands. Every branch of State finance was therefore in its hands. In matters of criminal jurisdiction, the senate claimed the right to set free, by its decree in case of emergency (*decretum ultimum*) the full powers of *coercitio* contained in the imperium of a magistrate, but limited normally in capital cases by laws of appeal. The exercise of this right amounted to a declaration of martial law. It was only resorted to in cases of special urgency, such as the epidemic of poisoning in 331 B.C., and the formidable preponderance of the revolutionary tribune Tiberius Gracchus in 133 B.C. The action of the senate on this last occasion evoked a vigorous protest from the people, and a law of C. Gracchus subsequently forbade any such exercise of capital jurisdiction on the part of a magistrate. The senate continued, however, to make use of this decree, and the question of its right to do so was one of the chief points at issue in the final struggle between the senatorial and democratic parties. The best known instance of this *decretum ultimum* is that of 63 B.C., when Cicero took summary action against the Catilinarians, and justified his action on the plea that the decree had authorized him to do so. The chief feature of the democratic revolution at Rome which occupied the century following the tribunate of T. Gracchus was opposition to the tenure of these extensive powers by the senate. Sulla's enactments in 81 B.C., which aimed at restoring its ascendancy, show how much power it had already lost; and his attempts to reinstate it were short-lived (*see* ROME: *History*). The Gracchi and Caesar alike found themselves obliged to override senatorial prerogative in the interests of progress, and the senate never regained the popular confidence.

Under the Empire.—Caesar's revision of the senatorial list and his increase of the senate to 900 was a return to the practice by which the early magistrates had chosen their own body of councillors. And though the arrangement for the automatic replenishing of the senate was restored, yet the influence exercised by Caesar and his successors over elections secured their control over the personnel of the senate. It was regarded in the early principate as the representative of republican institutions, and Augustus took pains to divide his authority with the senate. In legislation, indeed, the senate was supreme under the principate. The legislative powers of the comitia became very gradually extinct; but long before they had disappeared *senatus consulta* had come to take the place of *leges* in ordinary matters, and with this prerogative the princeps never directly interfered. The senate was left at the head of the ordinary administration of Rome and Italy, together with those provinces which, not requiring any military force nor presenting special administrative difficulties, were left to the care of the Roman people. It also retained control of the public Treasury (*see* AERARIUM), while the princeps administered his own treasury (*fiscus*). It gradually became the electing body for the annual magistracies; and, as entrance to it was still won chiefly through the magistracy, co-optation became practically the principle of admission. On the other hand, it lost all its control of foreign administration, and though occasionally consulted by the princeps, it was entirely subordinate to him in this department.

It was to the advantage of the early Caesars to pay deference to the senate, and so give to their rule an appearance of constitutionalism. Vespasian admitted Italians and provincials into the senate, with a view, no doubt, to increasing its value as a representative council of the empire, but it ceased to have any real control.

(B) **Procedure.**—Senatorial procedure remained comparatively unchanged throughout the republic and the first three centuries of the empire. The right of summoning the senate belonged originally to the consuls, and later to the consuls, praetors, and tribunes of the plebs. In the Ciceronian period, the right belonged to them in the above order of precedence. The magistrate who summoned the senate also presided and brought business before it. He first made statements to the house on important public affairs, and might then at his discretion ask the opinion of the house or invite other senators to speak. He was expected to follow a regular order of precedence in asking for votes or speeches. When the chief senators had expressed their opinion on the motion of the president, or made proposals of their own, the house divided on the motion, or the president put to the house the various proposals made. Under the empire, all the presiding magistrate's rights were extended to the princeps, who enjoyed also the right of giving his opinion as a private senator.

(C) **Insignia.**—The senatorial insignia were not at first distinguished from those of ex-curule magistrates. But by degrees the broad stripe (*latus clavus*) on the tunic and the red shoe (*calceus mulleus*) became distinctive of the senator (hence *laticlavius*, "a senator").

Certain disqualifications were attached to senators in republican times, chief of which was their exclusion from trade; and these were increased under the principate. Failure to observe these disqualifications, or any public disgrace or gross misconduct, was punished by removal from the senate by the censors.

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THE UNITED STATES SENATE

The Senate is the smaller (often spoken of as the upper) of the two chambers of the United States Congress. It is composed of 96 members, two from each of the 48 States. The Constitution decrees that no State, whatever its size or population, may be deprived of such equal representation without its own consent. This is in contrast to the House of Representatives where States are represented in proportion to population and the larger States have a much greater voting power than the smaller States. The Senate represents regions rather than numbers. It is a concession to the theory of the equal sovereignty of States and was necessary as a part of the compromise which made a Federal Government possible (*see* United States, *Constitution and Government* for details of the Federal system). A Senator must be at least 30 years old, an inhabitant of the State for which he is elected and a United States citizen of not less than nine years standing. He is elected directly by the people of his State for a six-year term. One-third of the Senate body is elected every two years so that the change in membership and organization of the Senate is gradual. No State elects both its Senators in the same year unless an emergency vacancy should make it necessary.

Powers.—(1) *Legislative.* The Constitution provides that the legislative powers of the Senate are co-equal with those of the House except for the single provision that measures for raising revenue must originate in the House. With regard to revenue legislation, however, the Senate "may propose or concur with amendments as on other bills" and in practice this privilege enables it to change the character of such legislation as radically as it wishes. At various times one chamber or the other may have the greatest amount of legislative influence because of its better organization or better hold upon public opinion. In case of disagreement between the two houses a conference Committee representing both chambers attempts to reach a compromise.

(2) *Executive.* The two chief fields in which the Senate enters the executive domain are in its powers to reject presidential appointments and in its treaty-making power. The more important appointments of the President, according to the Constitution, must be made with the "advice and consent of the Senate." The vast majority of appointments are accepted by the Senate with little hesitation, yet rejections are by no means uncommon, and at times have been a fruitful cause of discord between the Senate and the President. Theoretically the Senate takes no initiative in the selection of appointees, but in practice the President, if he hopes for harmony with that body, will consider the wishes of members, particularly in making appointments to Federal offices within their own States. By passing the Tenure of Office Act of 1867 the Senate also claimed a share in the President's power of removal. But in the case of *Frank S. Meyers* vs. *United States*, decided by the U.S. Supreme Court in 1926, such pretensions were definitely declared unconstitutional.

The Constitution also declares that before any treaty with a foreign power can be made two-thirds of the Senators must concur. Here also the Senate theoretically takes no initiative, but the President is likely to sound the opinion of Senate leaders before proceeding with negotiations, and may wisely keep in touch with them. The Senate also has the power to amend treaties in which case it becomes necessary to reopen negotiations with the treaty nation. This power of the Senate compels a president to enter treaty negotiations under a handicap and also prevents rapid action, but on the whole it has probably done much to keep the nation free from secret treaties and entanglements and is therefore in accord with the American temper. The Senate has always shown itself very jealous of this power, and a treaty must be favorable to win the necessary two-thirds vote. Before Pres. Wilson's defeat on the League of Nations covenant the Senate had rejected important treaties submitted by Presidents Pierce, Grant, Cleveland, Roosevelt and Taft.

(3) *Judicial.* The Senate has the sole power to try all cases of impeachment, the persons so liable being the "President, Vice-President and all civil officers of the United States." Members of the Senate may be expelled by a two-thirds vote, but cannot be impeached since they are responsible only to their own States. There they may be impeached, if the State constitution so provides. Impeachment proceedings must be initiated by the House. The Senate sets a date for the hearing and on that day sits as a court. The proceedings are public, but after the evidence is taken the Senate retires behind closed doors to reach its verdict. Since impeachments are cumbersome they are rarely resorted to.

Procedure.—By the terms of the Constitution the Vice-President is the Senate's presiding officer. He has no vote except in cases of a tie. The Senate makes its own rules of procedure and in general they are simple and much less restrictive than those of the House. Every bill theoretically receives three readings, but the first two are merely nominal and are given before the bill is referred to its appropriate committee. There it receives intensive study. Friends or opponents may be admitted before the committee to present arguments, and witnesses may be summoned to give testimony. The committee may recommend, amend, delay, report adversely or drop a measure altogether. Debate, if any, upon the bill comes after it has been reported by the committee for its third reading before the Senate. Amendments may then be offered and voted upon. Debate in the Senate is not ordinarily limited as in the House. Since 1917, however, it has been possible for the Senate by a two-thirds vote to restrict each senator to an hour which will bring the debate to a close in a reasonable time. No amendments may be offered during the operative period of this rule of closure unless by unanimous consent. The rule has been used only twice, during the League of Nations debate in 1919 and the World Court debate in 1926. Despite the continued use of dilatory tactics and the prevalency of "filibusters" by minority blocs, the Senate has been slow to impose the closure rule and has jealously resisted further plans for limiting debate.

As intimated, much of the real work of the Senate is done by about thirty standing committees. From time to time select committees may be appointed to deal with specific matters. Of the standing committees those on finance, appropriations, foreign

relations, the judiciary, and interstate commerce are perhaps the most important. Senate committees contain from three to seventeen members, and every senator is assigned to one or more. Selection is made at the beginning of each Congress by special committees designated by the caucus of each party. The senior senator of the party in power is usually made the chairman of a committee. The party in power has a safe numerical margin in every important committee. Senators often stay on the same committee year after year and acquire expert knowledge in its field. In addition to the regular committees there is a "steering" committee, to determine measures warranting precedence.

Most of the Senate's meetings are public but it may vote at any time to go into "executive session" behind closed doors, which it often does in considering treaties or in discussing the confirmation of appointments. In May 1929 the discontinuance of these secret sessions was discussed.

SENEBIER, JEAN (1742–1809), Swiss pastor, was born at Geneva on May 6, 1742. He is remembered on account of his contributions to our knowledge of the influence of light on vegetation. Though Malpighi and Hales had shown that a great part of the substance of plants must be obtained from the atmosphere, no progress was made until bubbles of oxygen were observed on leaves as these were plunged in aerated water. Jan Ingenhousz proved the simultaneous disappearance of carbonic acid; but it was Jean Senebier who demonstrated that this activity was confined to the green parts, and to these only in sunlight, and first gave a connected view of the whole process of vegetable nutrition in strictly chemical terms. He died at Geneva on July 22, 1809.

See Sachs, *Geschichte d. Botanik*, and *Arbeiten*, vol. ii.

SENECA, ANNAEUS (praenomen unknown, called the Elder, *c.* 54 B.C.–A.D. 39), rhetorician, of Corduba in Spain, father, by Helvia, of L. Annaeus Seneca and granduncle of the poet Lucan. His life was mostly passed at Corduba, but on two occasions he spent some time in Rome, where he heard Ovid and Asinius Pollio. The date of his death is approximately inferred from the fact that it occurred before his son, the younger Seneca, was banished by Claudius in A.D. 41 (L. Annaeus Seneca, *Ad Helviam* ii. 4–5). Besides a lost historical work (*cf.* Senec. *De vita patris* fr. 98) he wrote *Controversiae* (ten books) and *Suasoriae* (one book). The *Controversiae* discussed 74 imaginary legal cases, exemplifying the approved method of presenting them, and illustrating various rhetorical devices. The prefaces discussed individual rhetoricians. Books I., II., VI., IX., X. are extant and we have an epitome of the whole (4th or 5th cent.).

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(A. W. MA.)

SENECA, LUCIUS ANNAEUS (*c.* 4 B.C.–A.D. 65), second son of Seneca the elder, statesman and philosopher, was born at Corduba. He studied at Rome under the Stoic Attalus (Senec. *Ep.* 108, "When I listened to Attalus declaiming against the vices, the errors, the evils of life, I often pitied humanity and regarded him as a lofty figure beyond the stature of mankind. He used to say he was a king, but to me he seemed more than a king who could pass judgment upon kings") and Sotion (Senec. *l.c.*, "I shall not be ashamed to confess what love for Pythagoras Sotion inspired in me"). Devoting himself to rhetoric and philosophy he rapidly attained eminence at the bar, and his popularity attracted the attention of Caligula who, "despising the milder and more polished style of oratory," described Seneca's compositions as "mere prize exercises (*commissiones meras*), sand without lime" (Sueton., *Calig.* 53). His career was interrupted when in A.D. 41 Claudius, at the instigation of Messalina, banished him to Corsica. In A.D. 49 Agrippina secured his recall to become tutor to her son Domitius, afterwards the emperor Nero (Tac., *Ann.* xii. 8, Sueton., *Nero* 7), at that time 11 years of age. When Nero came to the throne, Seneca and Afranius Burrus had paramount influence with the youthful emperor (Tac. *Ann.* xiii. 2) and Seneca was probably concerned in the promising manifesto with which Nero inaugurated his reign (Tac. *Ann.* xiii. 4). The death of Burrus (A.D. 62) greatly impaired Seneca's influence (Tac. *Ann.* xiv. 52) *Mors. Burri infregit Senecae potentiam, quia nec bonis artibus idem virium erat altero velut duce amoto, et Nero ad deteriores inclinabat.* His enemies pointed out to Nero the vast and increasing wealth of Seneca, his popularity with the citizens, his rivalry with the emperor in oratory and poetry, which latter art he had cultivated more assiduously since Nero commenced poetry, his disparagement of Nero both as an equestrian and a singer: "How long was everything of distinction in the State to be attributed to the invention of Seneca? Nero surely was no longer a boy but in the flower of adult manhood. Let him doff his pedagogue—in his ancestors he had teachers enough" (Tac. *Ann.* xiv. 52). Seneca requested an interview which was granted. His speech and Nero's reply are given by Tacitus *Ann.* xiv. 53–56. The interview ended amicably, but Seneca practically withdrew into private life and was rarely seen in Rome, "as if detained at home by his weak health and his philosophic studies." (Tac. *l.c.*) Finally, in A.D. 65, on a charge of complicity in the conspiracy of Piso, he was ordered by Nero to end his life (Tac. *Ann.* xv. 61, Sueton. *Nero* 35). When the fatal message reached him, "undismayed he asked for tablets to make his will. When this was refused by the centurion, he turned to his friends and said that, since he was prevented from rewarding their services, he would leave to them the one thing, and yet the best thing, that he had to leave—the pattern of his life. . . . At the same time he reminded his weeping friends of their duty to be strong, now by his conversation, now by sterner rebuke, asking them what had become of the precepts of wisdom, of the philosophy which through so many years they had studied in face of impending evils. . . . Then he embraced his wife and, with a tenderness somewhat in contrast to his fortitude, entreated her to moderate her grief and not nurse it for ever, but in the contemplation of a well-spent life to find honourable consolation for the loss of her husband" (Tac., *Ann.* xv. 62–63).

The most important of Seneca's works are his philosophical writings, a series of essays on practical ethics, or lay sermons, as they might be called, preaching a modified Stoicism. These, with the approximate dates of composition are: *Ad Marciam de consolatione* (A.D. 40–41). *De Ira*, 3 books (41–44); *Ad Helviam de consolatione* (42); *Ad Polybium de consolatione* (43–44); *De brevitate vitae* (49); *De constantia sapientis* (55–56); *De clementia*, 2 books (55–56); *De vita beata* (58–59); *De beneficiis*, 7 books (62–64); *De tranquillitate animi* (62–63); *De otio* (63); *De providentia* (63–64); *Epistulae Morales ad Lucilium* (63–64). Enjoying in his own time an unrivalled popularity as a writer, Seneca, it is abundantly clear, did not maintain his vogue. Quintilian, in his review of Greek and Roman writers suitable for the reading of the student of oratory, defers Seneca to the last on account of the erroneous report that he condemned him utterly.

The remaining works may be dismissed briefly: (1) *Naturales Quaestiones*, 7 books (written about A.D. 63), a popular sketch of astronomy and meteorology; (2) *Ludus de morte Claudii* (*apotheosis, apocolocyntosis*) (written about A.D. 54), a short and not unamusing skit on the deification of the emperor Claudius, introducing, in the manner of the Menippean satire, snatches of verse, both Greek and Latin, in the midst of the prose. (3) Nine tragedies—*Hercules Furens, Thyestes, Phoenissae, Phaedra* (*Hippolytus*), *Oedipus, Troades* (*Hecuba*), *Medea, Agamemnon, Hercules Oetaeus*—modelled on Greek exemplars, show the rhetorical characteristics of his prose and are of small poetic merit. The *Octavia*, the only extant specimen of a *fabula praetexta* (a historical drama on a Roman subject), is proved by internal evidence to be by a later writer. (4) A number of epigrams have come down to us under Seneca's name—nine lamenting his exile in Corsica, after the fashion of Ovid in the *Tristia*, are printed in Haase (Teubner) vol. i., p. 261, *seq.* They possess no special interest or distinction.

The letters of Seneca to St. Paul—which were known to Jerome and Augustine—are universally admitted to be a forgery.

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SENECA, a tribe of North American Indians of Iroquoian stock. They call themselves *Tshoti-nondawaga*, "people of the mountain." The French called them *Tsonnontouan*. Their former range was in western New York state between Seneca lake and the Genesee river. They were one of the Six Nations League of the Iroquois, and eventually became the most important tribe. On the defeat of the Erie and Neuter tribes they occupied the country west of Lake Erie and south along the Allegheny to Pennsylvania. They fought on the English side in the War of Independence. In 1926 there were 2,416 on reservations in New York State, and a few in Oklahoma and on Grand River reservation, Ontario. *See* NORTH AMERICA: *Ethnology.*

For Seneca Cosmology see *21st Ann. Report Bureau Amer. Ethnol.* (1899–1900).

SENECA FALLS, a village of Seneca county, New York, U.S.A., 40 m. W.S.W. of Syracuse, on the Seneca river (connecting Lakes Seneca and Cayuga); served by the Lehigh Valley and the New York Central railways. Pop. (1920) 6,389; and in 1930, 6,443. Hydro-electric power is generated from the 50 ft. falls in the river, and there are important manufacturing industries, making power pumps, lathes, metal letters, woollen and leather goods, folding boxes and various other articles. The village was settled about 1790 and incorporated in 1831. On July 19–20, 1848, it was the scene of the first Woman's Rights convention held in the United States.

SENECIO, a genus of plants of the composite family Compositae, one of the most numerous of all flowering-plant genera, embracing about 1,450 species, widely distributed throughout the world. It includes herbs, shrubs and even trees, a number of which are cultivated for their flowers, foliage or ivy-like habit. The leaves are alternate and sometimes all basal. The flower-heads are single or clustered, variously coloured, and usually with fertile rays, but sometimes rayless. The surrounding bracts (involucre) are usually arranged in a single series, reinforced at the base with calyx-like shorter bracts (bracteoles). The dry fruits (achenes) are crowned with a pappus of soft, whitish, often very numerous, bristles. Nine species are found in Great Britain, including *S. Jacobaea* (ragwort), a showy roadside plant with heads of bright-yellow flowers, and *S. vulgaris* (groundsel), a widespread weed. Upwards of 70 species occur in North America, most numerously in the southern and western parts of the United States. Representative American species are *S. aureus* (golden ragwort), *S. Pseudo-Arnica* (sea-beach groundsel), *S. obovatus* (round-leaved squaw-weed), *S. Balsamitae* (balsam groundsel), and *S. lobatus* (cress-leaved groundsel). Among the more widely-cultivated species are *S. Cineraria* (dusty miller), *S. cruentus* (cineraria), *S. Petasites* (velvet groundsel), and *S. mikanioides* (German ivy), a native of South Africa, now naturalized in California. (*See* CINERARIA: GOLDEN RAGWORT: GROUNDSEL.)

SENEFELDER, ALOIS (1771–1834), German inventor of lithography, was born at Prague on Nov. 6, 1771, his father Peter being an actor at the Theatre Royal. Unable to pay for the engraving of his compositions, he attempted to engrave them himself. He made numerous experiments with little success; tools and skill were alike wanting. Copper-plates were expensive, and the want of a sufficient number entailed the tedious process of grinding and polishing afresh those he had used. But his attention was accidentally directed to a fine piece of Kellheim stone which he had purchased for the purpose of grinding his ink. His first idea was to use it merely for practice in his exercises in writing backwards, the ease with which the stone could be ground and polished afresh being the chief inducement. While he was engaged one day in polishing a stone slab on which to continue his exercises, his mother entered the room and desired him to write her a bill for the washer-woman, who was waiting for the linen. Neither paper nor ink being at hand, the bill was written on the stone he had just polished. The ink used was composed of wax, soap and lamp-black. Some time afterwards, when about to wipe the writing from the stone, the idea all at once struck him to try the effect of biting the stone with aqua fortis. Surrounding the stone with a border of wax, he covered its surface with a mixture of one part of aqua fortis and ten parts of water. The result of the experiment was that at the end of five minutes he found the writing elevated about the tenth part of a line ($\frac{1}{120}$ in.). He then proceeded to apply the printing ink to the stone, using at first a common printer's ball, but soon found that a thin piece of board covered with fine cloth answered better, communicating the ink more equally. He was able to take satisfactory impressions, and, the method of printing being new, he hoped to obtain a patent for it, or even some assistance from the government. For years Senefelder continued his experiments, until the art not only became simplified, but reached a high degree of excellence in his hands. In later years the king of Bavaria settled a handsome pension on Senefelder. He died at Munich in 1834, having lived to see his invention brought to comparative perfection.

SENEGA, the dried root of the *Polygala Senega*, official in the British and United States pharmacopoeias. Senega contains an active principle, saponin, and is used chiefly as a stimulating expectorant in chronic bronchitis. It is occasionally used as a diuretic in renal dropsy. It is a cardiac depressant and having a tendency to upset the digestion, is only used in combination with other drugs in what are termed expectorant mixtures.

SENEGAL, colony of French West Africa (*q.v.*) bounded on the north by Mauritania (*q.v.*), west by the Atlantic, south by Portuguese Guinea and French Guinea, and east by the Faleme, which separates it from the colony of French Sudan (*q.v.*). Wedged into Senegal and surrounded by it save seawards is the British colony of the Gambia. The colony of Senegal has an area of 192,000 square kilometers and a population of 1,318,000 (density 707 per square kilometre) of which 5,000 are Europeans.

Physical Features.—The coast extends from the mouth of the Senegal to Cape Roxo, where the Portuguese frontier begins. The only gulf on the coast is that which lies to the south of Cape Verde and contains the island of Goree (*q.v.*). The coast in the northern part is low, arid, desolate and dune-skirted, its monotony relieved only here and there by cliffs and plateaux. Farther south it becomes marshy, and clothed with luxuriant vegetation. A little to the north of the Gambia the coast-line is much broken by the archipelago of islands formed by the Salum estuary, whilst south of the Gambia is the broad estuary of the Casamance. Between the Senegal and the Gambia and as far east as about 13° W., the country behind the seaboard is a slightly elevated and, for the most part, barren plain. Farther east is a mountainous and fertile region with altitudes of over 4,000 feet. The mountains sink abruptly towards the Niger valley, while southwards they join the Futa Jallon highlands. On the north they extend to the left bank of the Senegal and throw out spurs into the desert beyond. The Senegal (*q.v.*), its tributary the Faleme, and the upper course of the Gambia (*q.v.*) are the chief rivers which drain the country. The Salum, already mentioned, is a river-like estuary which penetrates fully 100 m. and is split into many channels. It is navigable from the sea for 60 miles. The Casamance flows between the Gambia to the north and the Cacheo to the south, and has a drainage area of some 6,000 square miles. Rising in the Futa Jallon, the river has a course of about 212 m., and at Sedhiu, 105 m. from the sea, is 1½ m. broad. The mouth of the river is fully 6 m. wide. Six to seven feet of water cover the bar at low tide, the river being navigable by shallow draught vessels for the greater part of its length.

Geology.—The low region of the seaboard consists of sandstones or clay rocks and loose beds of reddish soil, containing marine shells. At certain points, such as Cape Verde and Cape Roxo (or Rouge), the red sandstones crop out, giving to the latter its name. Clay slates also occur, and at intervals these sedimentary strata are interrupted by basaltic amygdaloid and volcanic rocks. For instance the island of Goree is basaltic. The base of the mountains is formed in certain places of clay slate, but more generally of granite, porphyry, syenite or trachyte. In those districts mica-schists and iron ores occur. Iron and gold are found

in the mountains and the alluvial deposits. Many of the valleys are covered with fertile soils; but the rest of the country is rather arid and sterile.

Climate.—There are two seasons, the dry and the rainy, the latter contemporaneous with the European summer. In the rainy season the wind blows from the sea, in the dry season the harmattan sweeps seaward from the Sahara. Along the seaboard the dry season is cool and agreeable; in the interior it is temperate in the three months which correspond to the European winter, for the rest of the year the heat is excessive. The maximum readings (90° to 100° F), which are exceptional at St. Louis, become almost the rule at Bakel on the upper Senegal. The mean temperature at St. Louis is 68° to 70° F. The rainy season begins at Goree between the 27th of June and the 13th of July. During this period storms are frequent and the Senegal overflows and floods the lowlands.

Flora and Fauna.—The principal tree is the baobab (*Adansonia digitata*), which sometimes at the height of 24 ft. has a diameter of 34 and a circumference of 104 feet. Acacias are numerous, one species, *A. adansonia*, being valuable for shiptimber. Among the palm-trees is the *ronier*, whose wood resists moisture and the attacks of insects; in some places, as in Cayor, it forms magnificent forests. The mampatas grows sometimes 100 ft. high, its branches beginning at a height of about 25 feet. *Landolphia* and other rubber plants, and the oil-palm, grow luxuriantly in the Casamance district. The karite, or shea-butter tree, is common. Wild indigo is abundant, and the cotton plant is indigenous.

The lion of Senegal and the neighbouring countries differs from the Barbary lion; its colour is a deeper and brighter yellow, and its mane is neither so thick nor so long. Other beasts of prey are the leopard, the wild cat, the cheetah, the civet and the hyena. The wild boar is clumsier than the European variety. Antelopes and gazelles occur in large herds; the giraffe is found in the region of the upper Senegal; the elephant is rare; the hippopotamus is gradually disappearing. Crocodiles swarm in the upper Senegal. Monkeys and apes of different species (the chimpanzee, the colobus, the cynocephalus, etc.), the squirrel, rat and mouse abound. The hedgehog, marmot, porcupine, hare, rabbit, etc., are also met with. Among the more noteworthy birds are the ostrich, which migrates to the Sahara; the bustard, found in desert and uncultivated districts; the marabout, a kind of stork, with its beak black in the middle and red at the point, which frequents the moist meadowlands and the lagoons; the brown partridge, the rock partridge and the quail in the plains and on the mountain sides; and the guinea-fowl in the thickets and brushwood. Along the coast are caught the sperm whale, the manatee and the codfish.

Inhabitants.—The inhabitants of Senegal are, mainly, "Moors" and allied Berber races, and Negroids. The Moors, or rather Berbers (Trarzas, Braknas and Duaish), inhabit the right bank of the Senegal. Fula (Peuls) are found in various parts of the country. Negroids, however, form the bulk of the population. The best known of these tribes are the Wolofs and Mandingos, the last-named a wide-spread group of allied peoples bearing many names such as Sarakolés and Bambaras. Mandingos inhabit the basins of the upper Niger and the upper Senegal, and the western slope of the mountains of Futa Jallon. Under the name of Wakore or Wangara they are also found in all the immense tract enclosed in the bend of the Niger. The Berbers, Fula and Mandingos are Moslems. The Wolofs and the Serers inhabit the seaboard from St. Louis to the Gambia, and the left bank of the Senegal from its mouth to Dagana. The Balanta inhabit the left bank of the Casamance; they are allied to the Mandingos. The principal languages spoken are Wolof, Fula, Serer, Mandingo and Arabic. The river Senegal marks the line of separation between Wolof and Arabic. Fula is the language of the Fula and Tukulors (Fula half-breeds); Mandingo comprises several dialects and is widely spoken. (*See* BERBERS, MANDINGA.)

Towns.—The chief towns of Senegal are Dakar (pop. 34,000, of which 1,000 are Europeans), St. Louis (pop. 18,000, of which 1,000 are Europeans), Rufisque (pop. 9,000, of which 400 are Europeans), Goree (pop. 1,000), Zighinkhor (pop. 2,500), Kaolak (pop. 1,500). On the river Senegal are the towns of Richard-toll (Richard's garden), Dagana, Podor and Bakel. Carabane, Zighinchor and Sedhiu are settlements on the Casamance river. Dakar in the peninsula of Cape Verde, capital of French West Africa, where the governor general resides, forms with Goree and several villages a special territory, administered under the direct authority of the governor general. St. Louis, Dakar, Goree and Rufisque are communes, with a franchise exercised by natives and Europeans alike.

Agriculture and trade.—The two great food crops of Senegal are millet and rice. Millet is the staple food of the natives; there are large and small varieties of millet. The mean production exceeds 400,000 tons; the river-valley produces more than half the harvest. Rice is grown farther south, in the Casamance (130,000 tons). The cultivation of ground-nuts is the chief source of wealth of Senegal; it has spread since 1840, pioneered by a French colonist. Its cultivation is important only in the regions with good transport facilities for the crop. Senegal produces more groundnuts (peanuts) than any other country, on an average 350,000 tons per annum. Rearing of cattle is practised chiefly by the Peuhls, the Toucouleurs and the Serers. Senegal, the first of the colonies of French West Africa to be developed, has the greatest trade, which forms two thirds of the total; its ports also serve as outlets for the trade of the French Sudan, the statistics of which are merged in those of the colony. Senegal imports chiefly cotton cloth, coming mostly from Great Britain; food-stuffs, flour, biscuits, rice, sugar, etc., building materials and machines (motorcars), coal and petroleum. The chief exports are ground-nuts (more than 400,000 tons, worth more than 600 million francs); the secondary products are cotton (1,000 tons, coming partly from French Sudan), gum (4,000 tons, coming from Mauritania), and skins. Total trade reaches 1,563 millions of francs (imports 823 millions, exports 740 millions). Of the imports France sends 531 millions, Great Britain 121, the United States 50; of the exports France takes 492 millions, Germany 74, Great Britain 15. The 6 principal ports of Senegal are Dakar (737,000 tons loaded and unloaded), Kaolak (200,000 tons), Rufisque (123,000 tons), Foundiougne (68,000 tons), Zighinkhor (44,000 tons), St. Louis (36,000 tons). One may note the rapid growth of Kaolak, (situated on the Salum, it is the focus of the railway from Thies to Kayes), and the decline of St. Louis.

A railway finished in 1885, 163 m. long, goes from Dakar to St. Louis, from which point the Senegal river is navigable by steamer from August to November, both inclusive, for about 500 m., the navigable reach terminating at Kayes, whence a railway runs to the Niger. Direct communication between Dakar and the Niger is afforded by a railway (667 km.) starting from Thies, a station on the way to St. Louis, and ending at Kayes, where it connects with the railway from Kayes to the Niger; a branch line of 21 km. runs from Guinguines to Kaolak; this line was completed in 1923. Telegraph lines connect the colony with all other parts of French West Africa. Dakar is in direct cable communication with Brest, and another cable connects St. Louis with Cadiz. Steamship communication between Europe and Dakar and Rufisque is maintained by several French, British and German lines. Over 50% of the shipping is French, Great Britain coming second.

(F. R. C.; A. BE.)

HISTORY

The story of the French conquests throughout West Africa is inseparably connected with the history of Senegal. Trading stations were established elsewhere on the coast, but the line of penetration into the interior was, until the last few years of the 19th century, invariably by way of the river Senegal. Hence there is a peculiar interest in the record of the early settlements on this coast. The Portuguese had some establishments on the banks of the Senegal in the 15th century; they penetrated to Bambuk in search of gold, and were for some time masters of that country, but the inhabitants rose and drove them out. Remains of their buildings are still to be seen. The first French settlement was probably made in 1626 by the *Compagnie Normande* at St. Louis

(*q.v.*), near the mouth of the Senegal river. Between 1664, when the French settlements were assigned to Colbert's West India Company, and 1758, when the colony was seized by the British, Senegal had passed under the administration of seven different companies. None attained any great success, though from 1697 to 1724 the administration was in the hands of a really able governor, André Brue, who, however, from 1703 to 1714 directed the affairs of Senegal from Paris. Brue made many exploring expeditions and was on one occasion (1701) captured by the natives, who extorted a heavy ransom. Under his direction the auriferous regions of Bambuk were revisited (1716) and the first map of Senegal drawn (1724). In the meantime (1677) the French had captured from the Dutch Rufisque, Portudal, Joal and Goree and they were confirmed in possession of those places by the treaty of Nijmwegen (1678). In 1717 the French acquired Portendic, a roadstead half way between capes Verde and Blanco. Goree and the district of Cape Verde were captured by the British under Commodore Keppel in 1758, but were surrendered to the French in 1763, and by the treaty of peace in 1783 the whole of Senegal was also restored. The British again captured the colony in the wars of the first empire (Goree 1800, St. Louis 1809) and, though the treaty of Paris authorized a complete restitution, the French authorities did not enter into possession till 1817. At that time the authority of France did not extend beyond the island of Goree and the town of St. Louis, whilst up to 1854 little was effected by the 37 governors who followed each other in rapid succession. Of these governors Captain (afterwards Admiral) Bouët-Willaumez had previously explored the Senegal river as far as Médine and was anxious to increase French influence, but his stay in Senegal (1842–1844) was too brief to permit him to accomplish much.

The appointment of General Faidherbe as governor in 1854 proved the turning-point in the history of Senegal. In the meantime the Niger had been explored, Timbuktu visited by Europeans and the riches of the region were attracting attention. Faidherbe sought to bring these newly opened-up lands under French sway, and dreamed of a French empire stretching across Africa from west to east. In the territory of West Africa he did much to make that dream a reality. On taking up the governorship he set about subduing the Moorish (Berber) tribes of the Trarzas, Braknas and Duaish, who had subjected the French settlers and traders to grievous and arbitrary exactions; he bound them by treaty to confine their authority to the north bank of the Senegal. In 1855 he annexed the country of Walo and, ascending the river beyond Kayes, erected the fort of Médine for the purpose of stemming the advancing tide of Muslim invasion, which under Omar al-Haji (Alegui) threatened the safety of the colony. In 1857 Médine was brilliantly defended by the mulatto Paul Holle against Omar, who with his army of 20,000 men had to retire before the advance of Faidherbe and turn his attention to the conquest of the native states within the bend of the Niger. The conquest of the Senegambian region by the French followed.

Conquest of Niger Regions.—The first French expedition into the heart of the Niger country was undertaken in 1863, when Faidherbe sent Lieut. E. Mage and Dr. Quintin to explore the country east of the Senegal. The two travellers pushed as far as Segu on the Niger, then the capital of the almany Ahmadu, a son of Omar al-Haji. At Segu they were forcibly detained from Feb. 1864 to March 1866. After a pause of some years, chiefly the result of the Franco-Prussian war of 1870–71, Colonel Brière de l'Isle (governor of Senegal, 1876–1881) appointed Captain Joseph S. Gallieni in 1879 to investigate the route for a railway and to reopen communications with the almany Ahmadu. The armed conquest began in 1880, and for more than 15 years was carried on by Borgnis-Desbordes, J. S. Gallieni, H. N. Frey, Louis Archinard, Col. Combes, Tite Pierre Eugéne Bonnier and other officers. Their forces consisted almost entirely of Senegalese troops. In 1881 the Niger was reached; the fort of Bamako on the Niger was built in 1883; a road was made and the building of a railway from the Senegal to the Niger was begun. In 1887 the governor of Senegal took possession of a small uninhabited group of islands, named the Alcatras, lying off the coast of French Guinea. This act had a tragic sequel. By agreement with the governor, a chieftain of the neighbouring mainland sent four of his warriors to the islands to guard the tricolor. These soldiers were, however, like the islands themselves, completely forgotten by the authorities, and, the Alcatras producing nothing but sand, the four men starved to death. In the same year (1887) Ahmadu, who had formerly been anxious to obtain British protection, signed a treaty placing the whole of his country under French protection. Besides Ahmadu the principal opponent of the French was a Malinké (Mandingo) chieftain named Samory, a man of humble origin, born about 1846, who first became prominent as a reformer of Islam, and had by 1880 made himself master of a large area in the upper Niger basin. In 1887, and again in 1889, he was induced to recognize a French protectorate, but peace did not long prevail either with him or with Ahmadu. The struggle was resumed in 1890; Ahmadu lost Segu; Nioro the capital of Kaarta was occupied (1891); Jenné was taken in 1893. Samory proved a veritable thorn in the flesh to his opponents. Wily and elusive, he made and broke promises, tried negotiation, shifted his "empire" to the states of Kong, and after numberless encounters was finally defeated on the Cavalla to the north of Liberia, and taken prisoner in Sept. 1898. He was deported to the Gabun, where he died in 1900. Timbuktu (*q.v.*) was occupied in Dec. 1893, in defiance of orders from the civil authorities. In the meantime France had signed with Great Britain the convention of Aug. 5, 1890, which reserved the country now known as Nigeria to Great Britain.

Contact with the British.—In the following years French expeditions from Senegal penetrated south-east into the hinterland of the British colonies and protectorates on the Guinea coast and descended the Niger (Feb. 1897) as far as Bussa, the limit of navigation from the ocean. These actions brought them into contact with the British outposts in the Gold Coast and Nigeria. A period of tension between the two countries was put an end to by a convention signed on June 14, 1898, whereby the territories in dispute were divided, Great Britain retaining Bussa, while France obtained Mossi and other territories in the Niger bend to which Great Britain had laid claim. This convention removed the last barrier to the linking up of the French colonies on the gulf of Guinea with the hinterland of Senegal, so that henceforth the countries of the middle Niger were free to seek, through French territory, direct access to the sea. In the same year as this convention was signed it was determined to send an expedition to Lake Chad, which should co-operate with other expeditions from Algeria and the Congo. The Senegal expedition was entrusted to Captains Voulet and Chanoine, officers who had served many years in West Africa. They were obviously affected by the climate and were victims of the moral degeneration to which all Europeans, especially those entrusted with great powers, are subject, when long in contact with races of lower standards than their own. Reports of their misconduct and cruelty reaching St. Louis, Lieut.-Colonel Klobb, of the Marines, was sent to supersede them. Colonel Klobb overtook the expedition at a spot east of the Niger on July 14, 1899. Voulet, fearing arrest and punishment, ordered his men to fire on Klobb and his escort, and the colonel was killed. Thereupon Voulet, joined by Chanoine, declared his intention to set up an independent state, and with the majority of his troops marched away, leaving the junior officers with a small remnant. Within a fortnight both Voulet and Chanoine had been killed by their own men, who returned to the French camp. Lieut. Pallier assumed command and led the force to Zinder, reached on July 29. Here, in the November following, they were joined by F. Foureau and Commandant Lamy, who had crossed the Sahara from Algeria. The combined force marched to Lake Chad, and, having been joined by the Congo expedition, met and defeated the forces of Rabah (*q.v.*).

In 1904, in virtue of another convention between Great Britain and France, the Senegal colony obtained a port (Yarbatenda) on the Gambia accessible to sea-going vessels, while the trans-Niger frontier was again modified in favour of France, that country thereby obtaining a fertile tract the whole way from the Niger to Lake Chad. During 1905–1906 the oases of Air and Bilma were brought under French control, notwithstanding a claim by Turkey to Bilma as forming part of the Tripolitan hinterland.

In 1916 the Tibesti highlands, in the central Sahara, were attached politically to French West Africa; they mark its eastern limit.

In the extreme west, in the region which merges into the Sahara the effective area of French control was increased in 1903 when Coppolani, secretary-general of French West Africa, induced the emirs of certain Trarza and Brakna Moors inhabiting a fertile region on the northern bank of the lower Senegal to place their country under the direct supervision of French officials. In the following year these regions were constituted the Territory of Mauretania. In 1905 Coppolani, who was administering this new territory, was murdered by a band of fanatics at an oasis in the Tagant plateau. During 1908–09 a force under Colonel Gouraud, after considerable fighting—the natives receiving help from Morocco—made effective French influence in Adrar Temur. An agreement with Spain concerning Rio de Oro had previously, in 1900, fixed the frontier in this direction, on paper.

Period of Development.—At first the conquered territories were administered either from Senegal or placed under military rule. The ancient kingdoms were no longer recognized; the descendants of former rulers were deprived of all titles indicating sovereignty and ranked as ordinary chiefs. Native customs were respected as far as possible and the chiefs became in effect government agents. The legal status of slavery was abolished in 1901 but no attempt was made to break up violently the system of domestic slavery, which lingered for a good many years. As the various regions occupied developed they were given separate civil establishments; by 1922 the whole of French West Africa had been divided into eight colonies with local autonomy while matters affecting them all were entrusted to a governorship-general (*see* FRENCH WEST AFRICA). Since 1823 natives had been trained as soldiers and the Senegalese furnished France with many thousands of soldiers during the World War. In Dakar Senegal possesses the only first class port in French West-Africa.

Senegal proper, in accordance with the assimilation idea, was the subject of special legislation, its government being modelled on that of a department in France. The inhabitants of "communes with full powers" (*i.e.*, St. Louis, Dakar, Goree and Rufisque) are, without distinction of race or colour, French citizens, and by the law of April 1879 they elect to the French chambers one deputy. In the rest of Senegal the natives are not French citizens and do not possess the franchise. The *circonscription* of Dakar (*i.e.*, Dakar outside the commune) and dependencies form a unit administered by an officer responsible to the governor-general.

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SENEGAL, a river of West Africa, entering the Atlantic about 16° N., some 10 m. below St. Louis, after a course of fully 1,000 m. It is formed by the junction of the Bafing or Black river and the Bakhoy or White river, and its chief affluent is the Faleme. North of the Senegal the Sahara reaches the coast, and for over 1,000 miles no river enters the ocean.

The Bafing rises in the Futa Jallon highlands about 2,400 ft. above sea-level, in 10° 28′ N., 10° 5′ W., its source being within 125 m. of Konakry on the Gulf of Guinea. A little south of 12° N. the Bafing is a large stream 250 yd. wide. The Bafing follows a northward course for about 350 m., during which it descends by a series of rapids till it reaches a level of 360 ft. above the sea. The headstreams of the Bakhoy rise between 11° 30′ and 12° N. and 9° 20′ and 9° 50′ W. on the N.E. versant of the hills which here form a narrow divide between the basin of the Senegal and that of the upper Niger. The Bakhoy, in its upper course much interrupted by rapids, flows N.E., but about 12° 15′ N. turns north-westward. Its principal affluent, the Baule (Red river), and its headstreams rise farther east on the northern slopes of the hills which above Bamako shut in the Niger. The eastern headwaters of the Senegal thus drain a large area adjacent to the upper Niger. The Baule flows north and in a series of loops reaches 14° 20′ N., where it turns westward and in about 13° 30′ N. and 10° W. joins the Bakhoy. After receiving the Baule, the Bakhoy, now a river of fine proportions, flows W. by N. through rocky country in a narrow valley. In 11° 55′ W. and 13° 48′ N. it unites with the Bafing. At the confluence the Bakhoy is 800 ft. wide, the Bafing at this point having a width of 360 ft.

After the junction of the Black and White rivers the united stream is known as the Senegal. The confluence is called Bafulabé, *i.e.*, "meeting of the waters." Below Bafulabé the river flows northwest through a valley bordered on either side by hills which throw out rocky spurs, over which the Senegal descends in a succession of falls, those of Guina (160 ft.) and of Felu (50 or 60 ft.) being the most important. From the south it is joined by the Faleme, a considerable river which rises in hilly country in about 11° 50′ N. and 11° 30′ W. The first rise of the lower Senegal is due to the rains in the source region of the Faleme, the flood water passing down that stream more quickly than down the Bafing owing to its shorter course. A short distance below the Felu Falls is the town of Kayes on the left bank of the river. Between the falls and Bakel (85 m.) there are twenty-seven "narrows," of which several, such as that at Kayes, are difficult. Kayes is the limit of navigability from the sea. From that town a railway connects with the navigable waters of the Middle Niger at Kulikoro.

Below Bakel the river passes through flatter country and presents a series of great reaches. It sends off numbers of divergent channels (called *marigots*) forming several islands, the largest being that of Morfil, 110 m. long. The river attains its most northerly point, 16° 30′ N., in about 15° 10′ W. Thereafter it runs S.W. and finally due S. In the last 10 m. of its course it runs parallel to the sea, from which it is separated by a narrow line of dunes. On an island at the head of this 10 m. is St. Louis, the capital of the colony of Senegal. At this point the right branch of the river is only 500 ft. from the open Atlantic. A marigot, called the Ndiadier or Maringiouins, leaves the river 40 m. above St. Louis, pierces the dunes at flood time and reaches the sea, 50 m. N. of the mouth of the river. The Senegal indeed has what is styled an interior delta, but, with the exception of the marigot named, all the divergent branches rejoin the main stream before the sea is reached.

The comparative scantiness of its sources, the steepness of its upper course and the rapid evaporation which takes place after the short rainy season would make the Senegal an insignificant stream for more than half the year; but natural dams cross the channel at intervals and the water accumulates behind them in deep reaches, which thus act as reservoirs. In the rainy season the barriers are submerged in succession, the reaches are filled and the plains of the lower Senegal are changed into immense marshes. Lake Cayar on the right side of the lower Senegal and Lake Panieful (Guier) on the left constitute reserve basins, receiving the surplus waters of the river during flood and restoring them in the dry season. Owing to these natural "locks," the Senegal never discharges less than 1,700 or 1,800 cu.ft. per second. The lower Senegal forms the boundary between the Sahara and the western Sudan; the line of its inundations is an ethnographic march between the nomadic Berber and the settled Negro.

From July to October the level of the Senegal shows a series of fluctuations, with, however, a general increase till the end of August or beginning of September, when the maximum occurs. Boats drawing from 1 ft. to 2 ft. 6 in. can ascend to Kayes from the beginning of June to the middle of November; steamers drawing 4 ft. 3 in., from July to October inclusive; and ocean steamers, lightened so as to draw 11–13 ft., during August and September. From Mafu to the sea, a distance of 215 m., the Senegal is always navigable by vessels drawing not more than 10 ft.

The existence of the Senegal appears to have been known to the ancients. It is usually regarded as the Chretes or Chremetes of Hanno. The mouth of the Senegal, then called Senaga, was entered in 1445 by the Portuguese navigator Dinas Diaz (who thought it a western arm of the Nile), and in 1455 Cadamosto

ascended the river for some distance. Leo Africanus rightly describes its lower course as "severing by its winding channel the barren and naked soil from the green and fruitful." It was not until 1637 that the explorations of the upper river began, Jannequin, Sieur de Rochefort, in that year ascending the river some 200 m. above St. Louis. In 1697 André Brüe reached the island of Morfil, and in 1698 he penetrated past the Felu Falls. At that period geographers regarded the Senegal as the termination of the Niger, a theory held until Mungo Park's demonstration of the eastward course of that stream. Park himself added much to the knowledge of the upper basin of the Senegal. It was not until 1818 that the source (*i.e.*, of the Bafing) was located, by Gaspard Mollien.

See G. Mollien, *Découverte des sources du Sénégal et de la Gambie* (Paris, ed. 1889), with introduction by L. Ravaisson-Mollien; J. Ancelle, *Les Explorations au Sénégal et dans les contrées voisines* (Paris, 1886); M. Olivier, *Le Sénégal* (Paris, 1908); Captain Fromaget, "L'Hydrographie du fleuve Sénégal," in *B.S.G. Comm. Bordeaux*, xxxii. (1909); Hardél, *Le régime du fleuve Sénégal in B.S.G. de l'Afrique occidentale* (1907).

SENEGAMBIA, a term used to denote the region between the rivers Senegal and Gambia on the west coast of Africa. The country south of the Gambia as far as Sierra Leone was formerly also regarded as part of Senegambia. As a geographical expression Senegambia fell into disuse towards the end of the 19th century. It forms part of French West Africa.

SENESCHAL (sĕn'ĕ-shal), a title equivalent to "steward." The seneschal began presumably as the major-domo of the German princes who settled in the empire, and was predecessor of the mayors of the palace of the Merovingian kings. But the name seneschal became prominent in France under the Capetian dynasty. The seneschal, called in mediaeval Latin the *dapifer,* was the chief of the five great officers of State of the French court between the 11th and the 13th centuries. His functions were described by the term *major regiae domus,* and *regni Franciae procurator*—major-domo of the royal household, and agent of the kingdom of France. The English equivalent was the lord high steward, but the office never attained the same importance in England as in France. Under the earlier Capetian sovereigns the seneschal was the second person in the kingdom. He inherited the position of the mayor of the palace—had a general right of supervision over the king's service, was commander-in-chief of the military forces, was steward of the household and presided in the king's court in the absence of the king. It was the vast possibilities of the office which must have tempted the counts of Anjou of the Plantagenet line to claim the hereditary dapifership of France, and to support their claim by forgeries. At the close of the 11th century the seneschalship was in the hands of the family of Rochefort, and in the early part of the following century it passed from them to the family of Garlande. The power of the office was a temptation to the vassal, and a cause of jealousy to the king. The Garlandes came to conflict with the king, and were suppressed by Louis VI. in 1127. After their fall the seneschalship was conferred only on great feudatories who were the king's kinsmen—on Raoul of Vermandois till 1152, and on Thibaut of Blois till 1191. From that time no seneschal was appointed except to act as steward at the coronation of the king. The name of the seneschal was added with those of the other great officers to the kings in charters, and when the office was not filled the words *dapifero vacante* were written instead. The great vassals had seneschals of their own, and when the great fiefs were regained by the Crown, the office was allowed to survive by the king. In the south of France, Périgord, Quercy, Toulouse, Agenais, Rouergue, Beaucaire and Carcassonne were royal *sénéchaussées.* In Languedoc the landlords' agent and judicial officer, known in the north of France as a *bailli,* was called *sénéchal.* The office and title existed till the Revolution.

SENIGALLIA or **SINIGAGLIA** (anc. *Sena Gallica*), a city and episcopal see of the Marches, Italy, in the province of Ancona, on the coast of the Adriatic, 15 m. by rail N. of Ancona. Pop. (1921) 12,382 (town), 25,327 (commune). It is situated at 14 ft. above sea-level, and presents a modern appearance, with wide streets. The castle, originally built by Cardinal Albornoz (1355), was restored by Baccio Pontelli (*see* OSTIA) in 1492. The church of S. Maria delle Grazie outside the town is also by him. The ancient *Sena Gallica* was a city of Umbria. The name Gallica distinguishes it from Saena (Siena) in Etruria. A colony was founded there by the Romans after their victory over the Senones, about 280 B.C. It was destroyed by Pompey in 82 B.C. Ravaged by Alaric, fortified by the exarch Longinus, and again laid waste by the Lombards in the 8th century and by the Saracens in the 9th, Senigallia was at length brought so low by the Guelph and Ghibelline wars, and especially by the severities of Guido de Montefeltro, that it was chosen by Dante as the typical instance of a ruined city. In the 15th century it was captured and recaptured again and again by the Malatesta and their opponents. Sigismondo Malatesta of Rimini erected strong fortifications round it in 1450–55. Sixtus IV. assigned the lordship of the town to the Della Rovere family. After 1631 it formed part of the legation of Urbino.

SENIOR, NASSAU WILLIAM (1790–1864), English economist, was born at Compton, Berks, on Sept. 26, 1790, the eldest son of the Rev. J. R. Senior, vicar of Durnford, Wilts. He was educated at Eton and Magdalen College, Oxford; took the degree of B.A. in 1811, was called to the bar in 1819, and in 1836, during the chancellorship of Lord Cottenham, was appointed a master in chancery. On the foundation of the Drummond chair of political economy at Oxford in 1825, Senior was elected to fill the post, which he occupied till 1830, and again from 1847 to 1852. In 1830 he was requested by Lord Melbourne to inquire into the state of combinations and strikes, to report on the state of law and to suggest improvements in it. Senior was a member of many royal commissions. He died at Kensington on June 4, 1864.

His writings on economic theory consisted of an article in the *Encyclopaedia Metropolitana,* afterwards separately published as *An Outline of the Science of Political Economy* (1836), and his lectures delivered at Oxford, several of which were separately printed. A collection of them appeared in French under the title of *Principes Fondamentaux d'Économie Politique* (1835). Senior also wrote works on administrative and social questions. His contributions to the reviews were collected in volumes entitled *Essays on Fiction* (1864); *Biographical Sketches* (1865, chiefly of noted lawyers); and *Historical and Philosophical Essays* (1865). In 1859 appeared his *Journal kept in Turkey and Greece in the Autumn of 1857 and the Beginning of 1858.*

Senior regards political economy as a purely deductive science, derivable from four elementary propositions. The premises from which it sets out are, according to him, not assumptions but facts. The science concerns itself, however, with wealth only, and can give no practical counsel for political action: it can only suggest considerations which the politician should keep in view in studying the questions with which he has to deal. In several instances Senior improved the forms in which accepted doctrines were habitually stated. He also did excellent service by pointing out the disadvantages of Ricardo's terminology—as, for example, his use of "value" in the sense of "cost of production," and of "high" and "low" wages in the sense of a certain proportion of the product as distinguished from an absolute amount, and his peculiar employment of the epithets "fixed" and "circulating" as applied to capital. He shows, too, that in numerous instances the premises assumed by Ricardo are false.

Besides adopting some terms, such as that of "natural agents," from Say, Senior introduced the word "abstinence"—which, though obviously not free from objection, is for some purposes useful—to express the conduct of the capitalist which is remunerated by interest; but in defining "cost of production" as the sum of labour and abstinence necessary to production he failed to see that an amount of labour and an amount of abstinence are disparate, and do not admit of reduction to a common quantitative standard. He added some important considerations to what had been said by Smith on the division of labour.

(J. K. I.; X.)

SENJ (Magyar, *Zengg*), a town of Croatia-Slavonia, Yugoslavia, on the Adriatic sea. Pop. (1921) 3,037. It lies at the entrance to a long cleft among the Velebit mountains, down

which the *bora* sweeps with such violence as often to render the harbour unsafe. The town is the seat of a Roman Catholic bishop, and has a cathedral, a gymnasium and some ancient fortifications. It carries on a small trade in tobacco, fish and salt, and is connected with the cable to Krk (Veglia). The captaincy of Senj was established in the 15th century by King Matthias Corvinus of Hungary, as a check upon the Turks, and subsequently, until 1617, it was the stronghold of the Uskoks (*q.v.*).

SENLIS, a town of northern France, capital of an arrondissement in the department of Oise, on the right side of the Nonette, a left-hand affluent of the Oise, 34 m. N.N.E. of Paris by the Northern railway on the branch line (Chantilly-Crépy) connecting the Paris-Creil and Paris-Soissons lines. Pop. (1926) 5,607. Senlis can be traced back to the Gallo-Roman township of the Silvanectes, which afterwards became Augustomagus. Christianity was introduced by St. Rieul probably about the close of the 3rd century. During the first two dynasties of France Senlis was a royal residence and generally formed part of the royal domain; it obtained a communal charter in 1173. In the middle ages local manufactures, especially that of cloth, were active. The burgesses took part in the Jacquerie of the 14th century, then sided with the Burgundians and the English; whom they afterwards expelled. The Leaguers were there beaten in 1589 by Henry I., duke of Longueville, and François de La Noue. The bishopric was suppressed at the Revolution.

Senlis lies in a valley, in the midst of the three great forests of Hallatte, Chantilly and Ermenonville. It has Gallo-Roman walls, 23 ft. high and 13 ft. thick. They enclose an oval area 1,024 ft. long from east to west and 794 ft. wide from north to south. At each of the angles formed by the broken lines, of which the circuit of 2,756 ft. is composed, stood a tower; originally 28, there remain 16; they are semicircular in plan, and up to the height of the wall are unpierced. The Roman city had two gates; there are now five. The site of the praetorium was afterwards occupied by a royal castle, of which there are ruins dating from the 11th, 13th and 16th centuries. Near Senlis the foundations of a Roman amphitheatre have also been discovered. The old cathedral of Notre Dame (12th, 13th and 16th centuries) was begun in 1155 on a vast scale, but the transept was finished only under Francis I. At the west front there are three doorways and two bell towers, of which the right-hand tower (256 ft. high) consists, above the belfry stage, of a very slender octagonal drum with open-work turrets and a spire with eight dormer windows. The episcopal palace dates from the 13th century; the old collegiate church of St. Frambourg was built in the 12th century in the style which became characteristic of the "saintes chapelles" of the 13th and 14th centuries; St. Pierre (chiefly of the 15th and 16th centuries) serves as a market.

SENNA, a popular purgative, consisting of the leaves of two species of *Cassia* (natural order Leguminosae), viz. *C. acutifolia* and *C. angustifolia.* These are small shrubs about 2ft. high, with numerous lanceolate leaflets arranged pinnately on a main stalk with no terminal leaflet; the yellow flowers are borne in long-stalked racemes in the leaf-axils, and are succeeded by broad flattish pods about 2in. long. *C. acutifolia* is a native of many districts of Nubia, but is grown also in Timbuctoo and Sokoto. The leaflets are collected twice a year, dried by exposure to the sun, packed in large bags made of palm leaves, conveyed by camels to Assouan and Darao and thence to Cairo and Alexandria, or by ship by way of Massowah and Suakim. The leaflets form the Alexandrian senna of commerce. *C. angustifolia* affords the Bombay, East Indian, Arabian or Mecca senna of commerce. This plant grows wild in the neighbourhood of Yemen and Hadramaut in the south of Arabia, in Somaliland, and in Sind and the Punjab in India. It is also cultivated in the extreme south of India, and there grows larger leaves, which are known in commerce as Tinnevelly senna. American senna is *Cassia marilandica.*

The British Pharmacopoeia recognizes both *Senna Alexandrina* and *Senna Indica.* The active ingredient is cathartic acid, a sulphur containing glucoside of complex formula which is combined with calcium and magnesium to form soluble salts. Cathartic acid can easily be decomposed into glucose and cathartogenic acid. The leaves contain at least two other glucosides, sennapicrin and sennacrol, but as these are insoluble in water, they are not contained in most of the preparations of senna. Senna also contains a little chrysophanic acid.

Of the numerous pharmacopoeial preparations three must be mentioned. The *confectio sennae,* an admirable laxative for children, contains senna, coriander fruit, figs, tamarind, cassia, pulp, prunes, extract of liquorice, sugar and water. When coated with chocolate it is known as Tamar Indien. The *pulvis glycerhizae compositus* contains two parts of senna in twelve, the other ingredients being unimportant. A third preparation, rarely employed nowadays, is the nauseous "black draught," once in high favour. It is known as the *mistura sennae composita,* and contains sulphate of magnesium, liquorice, cardamoms, aromatic spirit of ammonia and infusion of senna.

Senna stimulates the muscular coat of the bowel, the colon being more particularly affected. As some congestion of the rectum is thereby produced, senna is contra-indicated whenever haemorrhoids are present. The drug has the advantage of not producing subsequent constipation.

SENNACHERIB, son and successor of Sargon, mounted the throne on the 12th of Ab. 705 B.C. His first campaign was against Babylonia, where Merodach-baladan had reappeared. The Chaldaean usurper was compelled to fly and Bel-ibni was appointed king of Babylon in his place. In 701 B.C. came a great campaign in the west, which had revolted from Assyrian rule. Sidon and other Phoenician cities were captured, but Tyre held out, while its king Lulia (Elulaeus) fled to Cyprus. Ashdod, Ammon, Moab and Edom now submitted, but Hezekiah of Judah with the dependent Philistine princes of Ashkelon and Ekron successfully defied the Assyrian army (*see* HEZEKIAH). The following year Sennacherib made his son Assur-nadin-sum king in place of Bel-ibni and drove Merodach-baladan out of the marshes in which he had taken refuge. A few years later he had a fleet of ships built near Birejik on the Euphrates by his Phoenician captives; these were manned by Ionians and transported overland to the Euphrates and so to the Persian gulf. Then they sailed to the coast of Elam, and there destroyed the colony of Merodach-baladan's followers at Nagitu. In return for this unprovoked invasion the Elamites descended upon Babylonia, carried away Assur-nadin-sum (694 B.C.) and made Nergal-yusezib king. Three years later a great battle was fought at Khalulē on the Tigris between the Assyrians on the one side and the Elamites and Babylonians on the other. Both sides claimed the victory, but in 689 B.C. Sennacherib captured Babylon and razed it to the ground. Some time previously he had overrun the mountain districts of Cilicia. On the 20th of Tebet 681 B.C. he was murdered by his two sons, who fled to Armenia after holding Nineveh for 42 days. He is famous as the builder of the palace of Kuyunjik at Nineveh, 1,500ft. long by 700ft. broad, as well as the great wall of the city, 8m. in circumference.

See S. Smith, *Camb. Anc. Hist.* iii. ch. III. (A. H. S.)

SENNAR, a country of north-east Africa, part of the Anglo-Egyptian Sudan. Its boundaries have varied considerably, but Sennar proper is the triangular-shaped territory between the White and Blue Niles north of 10° N. This region is called by the Arabs "The Island of Sennar" and by the negro inhabitants "Hui." The northern part, where the two Niles approach nearer one another, is also known as El Gezira, *i.e.,* "the Island." South-east Sennar stretches to the Abyssinian hills. By the Sudan administration this region has been divided into *mudirias* (provinces), one, including the central portion, retaining the name of Sennar. The present article deals with the country as a whole.

In general Sennar is a vast plain, lying for the most part much higher than the river-levels and about 2,000 ft. above the sea, its western part, towards the White Nile, being largely wilderness. From the plain rise isolated granitic hills, attaining heights of 1,000 to 2,000 ft. above the general level. Jebel Segadi is red granite of the finest quality.

Sennar lies in the region of light rain, increasing in the south-east districts to as much as 20 in. in the year. The rainy season is from July to September. The climate is generally unhealthy

during that period and the months following. The temperature, which rises at times to over 120° Fahr., is also very changeable, often sinking from 100° during the day to under 60° at night.

The soil, mainly alluvial, is naturally very fertile, and wherever cultivated yields abundant crops, durra being the principal grain grown. Many kinds of vegetables, and cotton, wheat and barley are also grown. The forest vegetation includes the *Adansonia* (baobab) which in the Fazogli district attains gigantic proportions, the tamarind, of which bread is made, the deleb palm, several valuable gum trees (whence the term Sennari often applied in Egypt to gum-arabic), some dyewoods, ebony, ironwood and many varieties of acacia. In these forests are found the two-horned rhinoceros, the elephant, lion, panther, numerous apes and antelopes, while the crocodile and hippopotamus frequent the rivers. The chief domestic animals are the camel, horse, ass, ox, buffalo (used both as a beast of burden and for riding), sheep with a short silky fleece, the goat and the pig, which last here reaches its southernmost limit.

The country is occupied by a partly settled, partly nomad population of an extremely mixed negroid character. The great plain of Sennar is mainly occupied by Hassania Arabs in the north, by Abu-Rof (Rufaya) Hamites of Beja stock in the east as far as Fazogli, and elsewhere by the negroid Funj and the group of tribes collectively known as Shangalla. The chief towns are on the banks of the Blue Nile. They are: Wad Medani 148 m. above Khartum, one of the most thriving towns in the eastern Sudan; Sennar, 241 m. above Khartum, the capital of the Funj empire and chief town of the *mudiria* of Sennar—of the ancient city little remains except a mosque with a high minaret; and Roseires, 426 m. from Khartum and the limit of navigation up stream from that city. Near the Abyssinian frontier are Fazogli (left bank) and Famaka (right bank) on a navigable stretch of the Blue Nile above the rapids at Roseires and close to the Tumat confluence and the gold district of Beni Shangul. On the river Dinder is the town of Singa. A railway, built in 1909–1910, connects Khartum, Wad Medani and Sennar with Kordofan, the White Nile being bridged near Goz Abu Guma.

History.—Sennar, lying between Nubia and Abyssinia, was in ancient times under Egyptian or Ethiopian influence and its inhabitants appear to have embraced Christianity at an early period. In the 7th or 8th centuries A.D. there was a considerable emigration of Arabs into the country. Christianity very gradually died out. The Funj who had meantime settled in Sennar became the dominant race by the 15th century. They adopted the Mohammedan religion and founded an empire which in the 17th and 18th centuries ruled over a large part of the eastern Sudan. This empire was finally overthrown by the Egyptians in 1821.

SENONES, a Celtic people of Gallia Celtica, who in Caesar's time inhabited the district which now includes the departments of Seine-et-Marne, Loiret, and Yonne. From 53–51 B.C. they were engaged in hostilities with Caesar. In 51 B.C. a Senonian named Drappes threatened the Provincia, but was captured and starved himself to death. From this time the Gallic Senones disappear from history. In later times they were included in Gallia Lugudunensis. Their chief town was Agedincum (later Senones, whence Sens).

A branch of the Senones, called Σένωνες, Senōnes, by Polybius, crossed the Alps about 400 B.C. and settled on the east coast of Italy from Ariminum to Ancona, in the so-called *ager Gallicus*, and founded the town of Sena. In 391 B.C. they invaded Etruria and besieged Clusium. The Clusines appealed to Rome, whose intervention led to war, the defeat of the Romans at the Allia (July 18, 390 B.C.) and the capture of Rome. For 100 years the Senones were at war with Rome, but were finally subdued and expelled (283 B.C.) by P. Cornelius Dolabella. Nothing more was heard of them in Italy.

For ancient authorities, *see* A. Holden, *Altceltischer Sprachschatz*, ii. (1904); for the Gallic Senones, *see* T. R. Holmes, *Caesar's Conquest of Gaul* (1899); for the subjugation of the Cisalpine Senones by the Romans, *see* T. Mommsen, *History of Rome* (Eng. trans.), bk. ii. ch. vii.

SENS (sons), a town of north-central France, capital of an arrondissement, department of Yonne, 70 m. S.E. of Paris on the P.L.M. railway. Pop. (1926) 14,641. Sens (*Agedincum*) was the capital of the Senones, one of the most powerful peoples of Gaul. It was not finally subdued by the Romans till after the defeat of Vercingetorix. On the division of Gaul into 17 provinces under the emperor Valens, *Agedincum* became the metropolis of the 4th Lugdunensis. Theatres, circuses, amphitheatres, triumphal arches and aqueducts were all built in the town by the Romans. It was the meeting-point of six great highways. The inhabitants, converted to Christianity by the martyrs Savinian and Potentian, held out against the Alamanni and the Franks in 356, against the Saracens in 731 or 738, and finally against the Normans in 886. The early feudal government of Sens was by counts, hereditary in the middle of the 10th century, and their quarrels with the archbishops, etc., were serious until, in 1055, the countship was united to the royal domain. Several councils were held at Sens, notably that of 1140, at which St. Bernard and Abelard met. The burgesses in the middle of the 12th century formed themselves into a commune which carried on war against the clergy. This was suppressed by Louis VIII., and restored by Philip Augustus. Sens massacred the Protestants in 1562, and it was one of the first towns to join the League. Henry IV. entered it in 1594, and deprived the town of its privileges. In 1622 Paris, hitherto suffragan to Sens, was made an archbishopric, and the bishoprics of Chartres, Orleans and Meaux were transferred to the new jurisdiction. In 1791 the archbishopric was reduced to a bishopric of the department of Yonne. Suppressed in 1801, the see was restored in 1817 with the rank of archbishopric. The town was occupied by the Allies in 1814 and by the Germans in 1870–71.

Sens stands on the right bank of, and on an island in, the Yonne near its confluence with the Vanne. The cathedral of St. Étienne (1140–16th century), one of the earliest Gothic buildings in France, is additionally interesting because the architecture of its choir influenced through the architect, William of Sens, that of the choir of Canterbury cathedral. The west front is pierced by three portals; that in the middle has good sculptures, representing the parable of the virgins and the story of St. Stephen. The right-hand portal contains remarkable statuettes of the prophets.

To the south of the cathedral are the 13th century official buildings, restored by Viollet-le-Duc, on the first story of which is the synod hall, vaulted with stone and lighted by beautiful grisaille windows. A Renaissance structure connects the buildings with the archiepiscopal palace, of the same period. The church of St. Savinian, the foundation of which dates from the 3rd century, has a Romanesque crypt. The museum of Sens contains some precious mss., notably a famous missal with ivory covers, and a collection of sculptured stones from the old Roman fortifications, themselves built from the ruins of public monuments at the beginning of the barbarian invasions. Sens is the seat of a sub-prefect, and has a tribunal of commerce, a chamber of commerce and a board of trade arbitrators. Among the industries are flour-milling, tanning and the manufacture of iron goods, boots and shoes, brushes, chemicals and cutlery; there is trade in wine, grain, wood, coal and wool, shared by the port on the Yonne.

SENSITIVITY, a term used to define the degree to which a radio receiving set responds to signals of the frequency to which it is tuned.

SENTENCE, in law, the term signifying a judgment of a court of criminal jurisdiction imposing a punishment such as a fine or imprisonment. It is given orally by the presiding judge or magistrate, and may be altered before it is entered. Concurrent sentences are those which run from the same date in respect of convictions on various counts or on various indictments at the same assizes or sessions. A cumulative sentence is the sum total of consecutive sentences passed in respect of each distinct offence of which an accused person has been found guilty at the same time and court. It is for the court to decide in its discretion whether the sentences shall be concurrent or consecutive. In England a sentence, in trials before a court of assize, begins to run from the first day of the sitting of the court, but in that of courts of quarter sessions from the time the sentence is pronounced unless the court otherwise orders.

The same differentiations apply in the United States.

SENTIMENT, in psychology, means a constellation or system of emotional dispositions related to some person or object. Love, friendship, and reverence, *e.g.*, are sentiments.

See FEELING; EMOTION; A. Shand, *Foundations of Character* (1922); PSYCHOLOGY, and the bibliography given there.

SENTINUM, an ancient town of Umbria, Italy, lying to the south of the modern town of Sassoferrato, in the low ground. The foundations of the city walls are preserved, and a road and remains of houses have been discovered, including several mosaic pavements. In the neighbourhood the battle took place in which the Romans defeated the combined forces of the Samnites and Gauls in 295 B.C. It was taken and destroyed in 41 B.C. by the troops of the Emperor Augustus, but revived under the Empire. It was a municipium, not a colonia.

SENUFO, a tall, long headed people of the French Sudan and Ivory Coast, with long, wide noses. The Senufo have numerous subdivisions, notably the Minianka, Pomporo, Tagwana, Djimini, Diamala, Nafana, etc., all speaking a language related to the Volta group. Each tribe is subdivided into clans having each its tabu animal, and the tribes are split up into independent chiefdoms. The Senufo have a number of age-classes with progressive initiation, and they are animist in religion though a few are Muslims. They are agriculturalists and live in houses that are either thatched or have platform roofs. Inheritance goes to the uterine brother, or maternal nephew; the son is excluded.

See Delafosse, "Le Peuple Siena ou Senoufo," *Revue des Études Ethnographiques et Sociologiques,* Vols. i., ii. (1908–09).

SENUSSI and **SENUSSITES,** the names respectively of a Muslim family (and especially its chief member) and of the fraternity or sect recognizing the authority of the Senussi.

Seyyid or Sidi (*i.e.,* Lord) Mohammed ben Ali ben Es Senussi el Khettabi el Hassani el Idrissi el Mehajiri, the founder of the order, commonly called the Sheikh es Senussi, was born near Mostaganem, Algeria, and was called es Senussi after a much venerated saint whose tomb is near Tlemsen. The date of his birth is given variously as 1791, 1792, 1796 and 1803. He was a member of the Walad Sidi Abdalla tribe of Arabs and his descent is traced from Fatima, the daughter of Mohammed. As a young man he spent several years at Fez, where he studied theology. When about 30 years old he left Morocco and travelled in the Saharan regions of Algeria, preaching a reform of the faith. From Algeria he went to Tunisia and Tripoli, gaining many adherents, and thence to Cairo, where he was opposed by the Ulema of El Azhar, who considered him unorthodox. Leaving Egypt Senussi went to Mecca, where he joined Mohammed b. Idris el Fassi, the head of the Khadirites, a fraternity of Moroccan origin. On the death of el Fassi Senussi became head of one of the two branches into which the Khadirites divided, and in 1835 he founded his first monastery at Abu Kobeis, near Mecca. While in Arabia Senussi visited the Wahhabites, and his connection with that body caused him to be looked upon with suspicion by the Ulema of Mecca. It was at Mecca, however, that Senussi gained his most powerful supporter, Mohammed Sherif, a prince of Wadai, who became in 1838 sultan of his native State, then the most powerful Mohammedan kingdom in the central Sudan. Finding the opposition to him at Mecca too powerful Senussi quitted that city in 1843 and settled in Cyrenaica, where in the mountains near Derna he built the *Zawia Baida,* or White Monastery. There he was in close touch with all the Maghribin, gaining many followers among the Tripolitans and Moroccans. The spread of the *Senussia* was, however, not viewed with favour by the Turks, who at that time ruled Cyrenaica. Probably with the desire to avoid pressure from the Turks, Senussi removed in 1855 to Jaghbub, a small oasis some 30m. N.W. of Siwa. Here he died in 1859 or 1860, leaving two sons, one Mohammed Sherif (named after the sultan of Wadai), born in 1844, and the other, el Mahdi, born in 1845. To the second son was left the succession. It is related that as the younger son showed a spirit in all things superior to that of his brother the father decided to put them to the test. Before the whole *zawia* at Jahgbub he bade both sons climb a tall palm tree and then adjured them by Allah and His Prophet to leap to the ground. The younger lad leapt at once and reached the ground unharmed; the elder boy refused to spring. To el Mahdi, "who feared not to commit himself to the will of God," passed the birthright of Mohammed Sherif. Mohammed appears to have accepted the situation without complaint. He held the chief administrative position in the fraternity under his brother until his death in 1895.

The Second Senussi.—Senussi el Mahdi, only 14 when his father died, enjoyed all his father's reputation for holiness and wisdom, attributes consistent with all that is known of his life. Mohammed Sherif, the sultan of Wadai, had died in 1858, but his successors the sultan Ali (who reigned until 1874) and the sultan Yusef (reigned 1874–98) were equally devoted to the *Senussia.* Under the Senussi el Mahdi the *zawias* of the order extended from Fez to Damascus, to Constantinople and to India. In the Hejāz members of the order were numerous. In most of these countries the Senussites occupied a position in no respect more powerful than that of numbers of other Muslim fraternities. In the Hausa States (*i.e.,* north Nigeria) the *Senussia* made little headway, the Muslims there acknowledging the headship of the sultan of Sokoto. In the eastern Sahara and in the central Sudan the position was different. From the western borders of Egypt south to Darfur, Wadai and Bornu, west to Bilma and Murzuk, and north to the coast lands of Tripolitania, Senussi el Mahdi became the most powerful sheikh, acquiring the authority of a territorial sovereign. The oases in the Libyan desert were occupied and cultivated by the Senussites, trade with Tripoli and Benghazi was encouraged, law and order were maintained among the savage Bedouin of the desert. But the eastern Sahara is among the most desolate and thinly populated parts of the world, and of more importance to the order was the influence possessed by the sheikh in the central Sudan.

Although named el Mahdi by his father there is no evidence to show that the younger Senussi ever claimed to be *the* Mahdi, though so regarded by some of his followers. When, however, Mohammed Ahmed, the Dongalese, rose against the Egyptians in the eastern Sudan and proclaimed himself *the* Mahdi, Senussi was disquieted. He sent an emissary via Wadai to Mohammed Ahmed, this delegate reaching the Mahdi's camp in 1883 soon after the sack of el Obeid. "The moral and industrial training of the Senussi" [delegate], writes Sir Reginald Wingate, "revolted from the slaughter and rapine he saw around him. The sincere conviction of the regeneration of the world by a mahdi whose earnest piety should influence others to lead wholesome and temperate lives, the dignity of honest labour and self-restraint, these were the sentiments which filled the mind of the emissary from Wadai" (*Mahdiism and the Egyptian Sudan,* 1891).

The sheikh Senussi, there is reason to believe, shared the lofty views which Wingate attributes to his agent. He decided to have nothing to do with the Sudanese Mahdi, though Mohammed Ahmed wrote twice asking him to become one of his four great khalifs. To neither letter did Senussi reply: he warned the people of Wadai, Bornu and neighbouring States to abstain from Sudan affairs. The Darfurian revolt of 1888–89 against the khalifa Abdullah was nevertheless carried out in the name of the Senussi.

Contact with the French.—The growing fame of the Senussi sheikh once more aroused anxiety among the Turks, the sultan, Abdul Hamid II., seeing with alarm that in many parts of Tripolitania and in Benghazi the power of the sheikh was greater than that of the Ottoman governors. In 1889 the sheikh Senussi was visited at Jaghbub by the pasha of Benghazi at the head of some troops. This event led the sheikh (1894) to leave Jaghbub and fix his headquarters at Jof in the oases of Kufara, a place sufficiently remote to secure him from any chance of sudden attack. By this time a new danger to Senussia had arisen; the French were advancing from the Congo towards the western and southern borders of Wadai. In 1898 Senussi, wishing to range together all the States menaced by the French advance, sought to reconcile Rabah Zobeir (*q.v.*) and the sultan of Bagirmi; neither of those chieftains belonged to the Senussi order and the sheikh's appeal was unavailing. In Wadai, Sultan Yusef's successor, Ibrahim, who ascended the throne in 1898, showed signs of resenting the advice of the sheikh, stirred, perhaps, by the overthrow of the

khalifa Abdullah at Omdurman. Senussi retaliated, says Capt. Julien in his history of Wadai, by prohibiting the people of Wadai from smoking tobacco or drinking merissa, the native beer, "which is to the Wadaiin what the skin is to the body." Sultan Ibrahim rejoined that his people would fight and die for merissa; rather than give it up they would renounce Senussiism. The sheikh had the wisdom to give way, declaring that in response to his prayers Allah had deigned to make an exception in favour of the faithful Wadaiins. Ibrahim died in 1900 and his successors fell again under the influence of the sheikh.

In 1900 Senussi el Mahdi left Kufara for Dar Gorane, on the western confines of Wadai. There, at Geru, on the top of a rocky hill, he built and strongly fortified a *zawia*. Senussi's object was to try to stem the advance of the French, who in this same year had slain Rabah in battle and occupied Bagirmi. The sheikh sought to prevent the French from occupying Kanem, a country north-east of Lake Chad and bordering the Sahara, that is, impinging on what was considered Senussi land. Thus, for the first time, the Senussites came into conflict with a European Power. There had been for some time a belief among certain French and British travellers in north Africa that the Senussites would proclaim a *jihad* or holy war, and that they would have the support of all the Muslims of north and west Africa. This belief was founded partly on the supposed tenets of the order and partly on an exaggerated conception of the strength of the Senussites. The Senussi warriors proper, those who owned direct allegiance to the head of the order, numbered a few thousands at most. For the rest the Senussi sheikh depended upon his spiritual influence and its effect in inducing the peoples who had embraced his doctrines to act as he wished. Moreover, the record of the first and second Senussi chiefs shows them to have acted on the defensive. Senussi el Mahdi, in opposing the French, undertook no war of aggression, nor was there any great rally of the tribes to his banner. In Kanem he was left to fight with his Bedouin followers and such help as the people of Kanem were able to give. A *zawai* was built at Bir Allali (an *entrepôt* for the trade of Tripoli with the Chad countries) and strongly garrisoned. War ensued and continued for over a year, but after a severe engagement Bir Allali was captured by a French column in Jan. 1902. Senussi el Mahdi was much discouraged by the loss of Kanem and died shortly afterwards, on May 30, 1902, at Geru. There he was buried, in the *zawai-el-Taj*. But for years the Bedouin believed him to be alive and to have gone on "a secret journey."

At the time of the death of Senussi el Mahdi his sons were minors and the chieftainship went to his nephew, Ahmed esh Sherif, an ambitious man, not without ability, but lacking the wisdom of his predecessors. Ahmed continued his uncle's policy of resisting the French, but despite his efforts, after a long and bitter struggle lasting from 1904–11, Wadai was conquered by them. (*See* WADAI.) In the central Sudan the prestige of the Senussites waned and the advances made by the sheikh Ahmed to Ali Dinar, the sultan of Darfur, were not at that time reciprocated. With Egypt, and with the British authorities in Egypt, the Senussi maintained friendly relations. Ahmed, in view of the activity of the French, had again fixed his headquarters at Jof in the Kufara oases; and in these and the other oases of the Libyan desert he was master. That the desert had been recognized by France as within the British sphere gave him no concern. In Egypt the number of adherents to the order was increasing, and at Alexandria Mohammed el Idris, the eldest son of Senussi el Mahdi, lived in some state, receiving Senussi notables from many lands.

The Invasion of Egypt.—Meanwhile the sheikh Ahmed had succumbed to the Pan-Islamic movement which Abdul Hamed II., the sultan of Turkey, had revived and his successor continued. In consequence the Senussites gave substantial aid to the Turks when in 1911 the Italians invaded Tripolitania and Cyrenaica. After the Turks had been compelled to acknowledge defeat Ahmed continued the war with Italy, helped by Turkish troops who, in violation of the Treaty of Lausanne, had remained in the country. When the World War began the Italians held only a strip of coast land; the Senussites were masters of the interior of Cyrenaica. Terms of accommodation were discussed in the later half of 1914 and an arrangement might have been reached had not Sidi Ahmed refused to accept the position of a "protected Bey." In the spring of 1915 the Senussites were again attacking Italian ports.

At this time a number of Turkish officers and Arabic-speaking German officers had been smuggled into Cyrenaica and by heavy bribes and gross flattery they worked upon the vanity and cupidity of the sheikh Ahmed to proclaim a *jihad* and invade western Egypt. Ahmed hesitated; his hesitation was known to the British in Egypt, and in Nov. 1915 Mohammed el Idris was sent from Alexandria to his cousin to arrange with him "to get rid of his Turkish advisers in return for a sum of money." It was too late; Ahmed was already well supplied with Turco-German gold and armaments. At the end of 1915 Ahmed invaded western Egypt. The *muhafizia* or Senussite regular troops numbered at most 5,000; the Turkish troops about 1,000; but the real danger was that any Senussite success might cause a rising among the Bedouin of western Egypt and in the Nile valley. Owing to the prompt measures taken by Gen. Sir John Maxwell (commanding in Egypt) the Senussites failed to gain victories; the invaders were eventually repulsed and by Feb. 1917 Sidi Ahmed—who in Nov. 1916 had been given by the Turks the title of "viceroy of Africa"—was completely defeated. He retired to the oasis of Jaghbub. (For the military operations *see* SENUSSI, OPERATIONS AGAINST THE.) The failure of this invasion seemed to show definitely that the Senussi brotherhood was not so powerful, either politically or spiritually, as had been imagined. The Germans and Turks had done their utmost by exploiting Senussi influence to cause trouble in directions other than Egypt. In the Sudan Ali Dinar, the sultan of Darfur, had been won over, but he was decisively beaten by an Egyptian force under Maj. P. V. Kelly in May 1916; and elsewhere in the Anglo-Egyptian Sudan the Senussi had few adherents. Further west, towards Lake Chad, there was some trouble, but the French, pushing north from Kanen, had seized the Saharan borderlands and had captured Ain Gallaka (in Borku), the Senussi southern base, in Nov. 1913. During the World War this and other French outposts formed an effective barrier against Senussi raids. In the hinterland of Tripolitania Senussi influence was strong and, the Italians being compelled to withdraw to the coast, Mohammed el Abid, a brother of the Senussi sheikh, ruled in Fezzan until the summer of 1917. Discords in Tripolitania, however, showed clearly that tribal rivalries were stronger than religious bonds.

Relations with the Italians.—Mohammed el Idris and other Senussi chiefs had not approved Sidi Ahmed's invasion of Egypt; Idris from his residence in Egypt had gained a knowledge of affairs which Ahmed lacked, and he was a peaceably inclined man. With Idris the Italian and British Governments entered into an agreement in 1917; the Senussi chiefs acknowledged Idris as "Grand Senussi," and in Aug. 1918 the defeated and discredited Ahmed found it convenient to quit Cyrenaica. He was conveyed by a German submarine from Misurata to Pola, whence he went to Turkey, still claiming to be head of the brotherhood. In 1919 Idris sent his brother Rida on an embassy to Rome, and, by the Accord of Regima, Nov. 1920, Idris acknowledged Italian suzerainty. He was given the hereditary title of emir (prince), with jurisdiction over the oases of Kufara, Jaghbub, Jalo, Aujela and Jedabia. Peaceful relations continued for some time, but Italy under Fascist rule found the situation irksome. There was also evidence that Idris was encouraging the insurgents in Tripolitania who in July 1922 had invited him to become their leader and prince. Declaring the position incompatible with the national dignity of Italy the Fascist Government denounced the agreements with the Senussi early in 1923. Idris himself had in January of that year withdrawn to Egypt, where he remained. Seemingly he suffered no loss of spiritual prestige, upon which his friends declared he set more store than on temporal authority. In Cyrenaica Senussite resistance to the Italians was organized by the sheikh Rida. It was of a guerilla character.

The Italians, however, were placed in an advantageous position to control Senussi activity by an agreement made with Egypt on

Dec. 6, 1925. This agreement gave them the sovereignty over the oases of Jaghbub, while south of that place the frontier was drawn along the 25th degree of E. long., thus including Kufara in Cyrenaica. Jaghbub was occupied by Italian troops in Feb. 1926 without opposition. It is important as containing the tomb-mosque of the founder of the Senussi sect and a *zawia* for the training of the *ikhwan* (brethren).

In 1927 the Italians undertook a regular campaign in Cyrenaica, with such effect that on Jan. 3, 1928, Sidi Rida surrendered. He was exiled to Sicily. In the spring of the same year Jalo and other oases were occupied. Operations against the tribesmen were continued with vigour, so that by 1929 Kufara alone remained to the Senussites. These remote oases were visited in 1920–23 by Hassanein Bey, Rosita Forbes and Bruneau de Laborie. All three drew a pleasing picture of Senussi culture which however includes slavery. The only other Europeans known to have visited Kufara except a French prisoner of war were Gerhard Rohlfs and Anton Stecker, who ventured there in 1879, and had to flee for their lives.

Tenets of the Order.—The Senussi *ikhwan* (brethren) are not probably a very numerous clan, but they have followers and adherents in many lands. Moreover, while other dervish fraternities are mystical and latitudinarian in theology, and only sporadically meddle in politics, the Senussites have exercised a distinct political influence and have sought to revive the faith and usages of the early days of Islam. The order is in a sense an outcome of the Wahhabite movement, but, as gathered from the writings of Mohammed el Hechaish, a Tunisian sheikh, and other trustworthy sources, appears to be neither mystical nor puritan. There is less of secrecy about their rites than is usual in Muslim fraternities. The use of tobacco and coffee is forbidden, but the drinking of tea is encouraged, and the wearing of fine clothes is allowed. While they profess to belong to the Malikite rite (one of the four orthodox sects of Islam), the Senussites are charged by the Ulema of Cairo with many deviations from the true faith; chiefly they are accused of interpreting the Koran and Sunna without consulting one of the recognized glosses. Thus the Egyptian theologians regard the Senussites as inaugurating a new rite rather than forming a simple fraternity; in this, if not in puritanism, resembling the Wahhabites. Apart from their theological beliefs their chief work, before they were confronted by the activities of European Powers, seems to have been colonization and the encouragement of trade. Wells were dug and oases cultivated, rest houses built along caravan routes, merchants from Tripoli, Bornu, Wadai and Darfur welcomed. Such was the report of Mohammedan writers and of French and British political agents; for few Europeans had opportunities of making personal observations. At the oasis of Siwa (Jupiter Ammon), however, Senussites were in contact with the Egyptian administration. There for many years the agent of the Senussi sheikh dwelt in amity with the Egyptian authorities.

The missionary zeal of the Senussites is undoubted. Outside the regions adjacent to their headquarters adherents of the order are drawn from a higher social rank than the generality of Muslim secret societies. Its chief agents are personages of wealth and importance and highly educated in oriental lore. They are in general on good terms with the rulers of the countries in which they live, as instanced in 1902 by the conferment of the Legion of Honour on the head of the *zawia* at Hillil in Algeria. These agents make regular tours to the various *zawias* placed under their charge and expound the Senussi doctrines at the Muslim universities.

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SENUSSI, OPERATIONS AGAINST THE. Military activity of the Senussi from 1900 to 1910 had been directed against the French in the regions between Lake Chad and the Nile Basin. There was evidence of an increase of adherents to the sect in Egypt and Arabia; in north-west Africa and the Sudan it had made practically no headway. During 1911 the Senussi Sheikh, Sidi Ahmed, aided the Turks in their campaign against Italy in Cyrenaica. After the treaty of Lausanne, in Oct. 1912, by which Turkey agreed to evacuate Tripoli and Cyrenaica, Sidi Ahmed continued the war against the Italians, who were powerless to penetrate into the interior.

At the outbreak of war in 1914 the Germans and Turks saw in the Senussi a powerful instrument for attacking the British position in Egypt and the Sudan. For long Sidi Ahmed resisted the efforts to embroil him with Egypt, with which he had always maintained good relations. But the adherence of his enemy, Italy, to the Allied cause in May 1915 gave his Turkish advisers a powerful lever and finally the influence of Nuri Bey, a half-brother of Enver, prevailed.

The plan instigated by the Turks and Germans was for simultaneous advances on Egypt along the coastal strip and by the oases leading from Siwa to the Nile. At the same time the sultan of Darfur was to rise, invade Kordofan and advance on Khartoum. The danger to the British in Egypt and the Sudan was not so much in the military force actually at the command of Sidi Ahmed and his allies as in the spiritual authority he exercised and the possibility of a religious rising.

Hostilities began on Nov. 15, 1915. The small garrisons of Es Sollum and other advanced posts were withdrawn, and Mersa Matruh was made the base for the British operations. The difficulty was to collect a sufficient force, for during the Gallipoli operations Egypt had been practically denuded of troops. The force assembled under Maj.-Gen. A. Wallace consisted of Yeomanry, Territorials, Australians, New Zealanders, Indians and Egyptians. The Senussi leader had a few Turkish troops with him, about 5,000 of his own regular forces and a varying number of irregular tribesmen.

A Decisive Engagement.—Gen. Wallace succeeded in striking a severe blow at the enemy on Christmas Day, 1915, but the rainy season and a lack of troops and transport prevented any further attempt to bring the enemy to battle till Feb. 1916. On Feb. 20, Maj.-Gen. W. E. Peyton, who had succeeded Gen. Wallace, began an advance to re-occupy Es Sollum. On Feb. 26 at Agagya, about half-way to Es Sollum, a decisive engagement was fought. The infantry, which included two South African battalions, captured the Senussites' position. In the pursuit the Dorset Yeomanry, by a fine charge, broke the enemy and captured Jafar Pasha, an able Baghdadi Arab who commanded the Senussites. There was little further fighting. Es Sollum was re-occupied on March 14, the enemy retiring into Cyrenaica. During Feb. and April 1916, the Senussites, under Sidi Ahmed himself, occupied the Bahariya, Farafra, Dakhla and Kharga oases, but made no further advance. The British had at the time no forces available for re-occupation, but kept the oases under observation by aeroplane.

Meanwhile the rebellious sultan of Darfur, Ali Dinar, in May 1916, was attacked and defeated by a force from the Sudan under Lieut.-Col. P. V. Kelly. The sultan himself was killed in November. By Oct. 1916 the British had organized a camel corps and light car patrols, and proceeded to re-occupy the oases. Sidi Ahmed retired to Siwa, where he was attacked and defeated at the beginning of Feb. 1917 by a force of armoured cars from Es Sollum under Brig.-Gen. H. W. Hodgson. This action at Siwa discredited the Senussi and removed the danger to Egypt.

During 1917 and 1918 Turkish and German influence amongst the Senussites declined and Sidi Ahmed's own position was discredited. In the summer of 1918 he found it advisable to leave Cyrenaica for Turkey and was succeeded by Sidi Mohammed el Idris, the son of Senussi-el-Mahdi. The new Grand Senussi concluded agreements with Great Britain and Italy, recognizing Italian sovereignty. In 1925 a rectification of frontier was made between Egypt and Italy, Jaghbub being transferred to the Italian sphere.

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SEONI or **SEONI-CHAPARA,** a town and district of British India in the Jubbulpur division of the Central Provinces. The town is 2,000 feet above sea level, half way on the great northern road between Nagpur and Jubbulpur. Population (1921) 12,772. It is a favourite station, being well-wooded and has a fine tank and good public gardens. It is the headquarters of the district and "the Original Seceders from the Church of Scotland" have established an excellent mission there.

The district of Seoni forms part of the Satpura tableland, containing the head-waters of the Wainganga. It is largely covered with forests and some 40% of the inhabitants belong to aboriginal tribes. Area 3,216 square miles. The population of the district, 348,871 by the census of 1921, though far above the figure of 1872, shows a large fall during the preceding decade, a result of influenza, famine and relapsing fever, but also partially due to fluctuations in seasonal migrations. The north of the district is drained by the tributaries of the Narbada, the south by the Wainganga and its affluents. There are many plateaux and valleys scattered over its rugged surface, but its chief plain is the Haveli, between Seoni town and the Chaurai tract of Chhindwara, from which it is divided by the Pench river. The east and south-east of the district consists of light siliceous land on which the Ponwars, akin to those of Balaghat and Bhandara, have made many tanks for irrigating rice. The black soil plains and valleys produce wheat, and the rugged areas grow minor oil seeds, hemp and small millets. The northern portion of the district round Lakhnadon is especially hilly and poor. There are many beautiful spots among the forests in the north and the south, especially in the Koraighat leading down to the Nagpur plain.

Besides the great northern road connecting the districts of Jubbulpur and Nagpur, there is a road from Lakhnadon to Narsinghpur by which rice is carted from the large rice market of Barghat for sale in the Narbada valley. The Satpura railway system runs rather athwart the old trade routes and has not yet fully captured the cart traffic, but has greatly developed the centre and north-east of the district. The population includes nearly 16,000 Mohammedans, 137,000 Animists, the rest being Hindus. In literacy the district is very backward, because of the large aboriginal element. There are some large landed estates and the chief cultivating castes, Kurmis, Lodhis, Malis and Ahirs, are of the same type as those of more advanced plains districts.

SEOUL, the capital of Korea (Chosen), situated in 37° 34′ N. and 127° 6′ E., at an altitude of 120 ft., 25 m. from Chemulpo, its seaport, and 4 from Mapu, its river-port. Pop. (1925) 302,711. It lies in a basin among granite hills, nowhere exceeding 2,627 ft., remarkable for their denudation and their abrupt black crags and pinnacles. A well-built, crenelated stone wall from 20 to 30 ft. high, about 11 m. in circuit, and pierced by 8 gateways with double-roofed gate towers, surrounds it. The native houses are built of stone or mud, deeply eaved, and either tiled or thatched. Above these rise the towers of the Roman Catholic cathedral, the high curved roofs of the royal audience halls, the palace gateways, and the buildings of the Russian and French legations. The antiquities are the Bell Tower, with a huge bronze bell dated 1468, a marble pagoda elaborately carved, but not of Korean workmanship, seven centuries old, and a "Turtle-Stone" of about the same date. Seoul has an electric tramway and is the centre of the railway system of the country.

SEPARATOR (CREAM): *see* DAIRY FARMING.

SEPARATOR, MAGNETIC, is a device for the separation of iron or steel, and of feebly magnetic ores, for the purification of materials and the prevention of damage to machines. There are a great many designs of machines, including numerous continuous feed types for handling large quantities of material. One common form has a rotating drum carrying magnets on which the material falls, the magnetic portions clinging to the drum, to be brushed off. Another type has a belt passing over two pulleys, the belt being fitted with magnetized feelers. A larger type with long conveyor belt is employed in mining practice for the separation of weakly magnetic minerals from non-magnetic, such as wolfram from tin, etc. A series of magnets above the belt deal with the material in its passage below them. Some machines are portable, to work at dumps or tips, while for treating house refuse a rather large fixed separator supplied by a conveyor belt lifts tins and other iron pieces out of the waste and places them automatically into a chute. Used foundry sand can be dealt with by a machine which recovers small splashes of iron, brads, chippings, etc., and also sieves and grades the sand ready for use again. Mixed iron and brass turnings are separated in the rotary drum class of apparatus, while some separation, as for the pottery and china trade, is effected in a wet trough device. Many kinds of powders and seeds, cocoa-beans, tea, tobacco, etc., are treated by a magnetic separator. Substances that have to go through a crusher are treated magnetically to avoid the risk of damage by "tramp" iron.

SEPARATOR, STEAM, also termed a steam drier, a device fixed in a line of steam piping to separate the water of condensation from the steam. The steam, which travels at about a mile a minute (90 ft. per second) is usually caused to flow in a spiral direction around a central pipe in the separator, as in the Lancaster and Tonge type of machine. The inertia of any particles of water which may be in the steam flowing at this speed causes them to continue in a spiral direction to the lower portion of the receiver. The water is thrown outwards, while the drier portion of the steam stays in the centre and is carried off by the central pipe. The ribs in the lower part carry off the water and any dirt separated from the steam, and also act as a brake on the revolving wet steam, thus slowing it down and allowing any particles of water not separated by centrifugal force to fall by gravity to the bottom.

SEPIA is a dark brown pigment obtained from the ink-sacs of cuttlefish (Gr. σηπία, cuttlefish, *q.v.*). The ink-sacs (which are speedily removed on capture and dried to prevent putrefaction) are digested with dilute alkali, the solution is filtered and the colour precipitated with dilute hydrochloric acid, washed, filtered and dried. It is fairly permanent and inert and is used as an artists' water colour particularly in monochrome. *See* PAINTS, CHEMISTRY OF.

SEPOY. The Anglo-Indian word for a native soldier of the British native army of India in contradistinction to *gorā*, a "fair-complexioned (European) soldier." The word is derived from the Persian, *Sipahi*, from *Sipah*, soldiers, an army. The expression *sepoy* was in use in Southern India before the East India Company had troops in Bengal, and was probably introduced by the Portuguese.

SEPPINGS, SIR ROBERT (1767–1840), English naval architect, was born at Fakenham, Norfolk, and in 1782 was apprenticed in Plymouth. For an invention simplifying repairs on the keels of ships Seppings received £1,000 from the Admiralty, and in 1804 was a master shipwright at Chatham. Despite opposition, he introduced important improvements in ship-construction. He increased the longitudinal strength of the vessels by a system of diagonal bracing, and strengthened the bows and stern, so that they offered better protection to the crews and permitted a powerful armament to be fitted. Seppings was surveyor of the navy from 1813 to 1832. He died at Taunton on Sept. 25, 1840.

SEPSIS, a term in medicine denoting infection of a wound or collection of fluid or dead material by bacteria usually conveyed from without. Etymologically the term signifies putrefaction and at first it was thought that the wound was putrefying as dead animal material putrefies. This view was found to be too narrow

under the advances made by knowledge in bacteriology and the term now embraces conditions differing widely in pathology and severity.

In one group, that to which the names *sapraemia* and *septic intoxication* are given, the condition is in reality putrefactive. Where dead protein material is contained within a cavity and putrefactive bacteria gain access to it, these bacteria multiply, use the protein as food and form therefrom waste products that are poisonous to animals. These poisons are absorbed into the patient's body by the veins and lymphatics in the walls of the cavity and produce fever, wasting, sweating, etc., characteristic of the toxic condition. But the essential point is that they are the products of putrefactive bacteria which cannot live in the circulating blood. Hence the factory of the poisons is *physiologically outside* the body and removal of the dead protein by drainage or washing out the cavity at once stops the formation of the poisons, they are no longer absorbed, the symptoms disappear and the patient recovers.

In the other group the general conditions may be identical, apparently, but the bacteria concerned are not those of putrefaction; they are pathogenetic and capable of living within the blood and tissues of the patient. Here the factory of the poison is *physiologically within* the body and removal of dead protein by drainage or washing out the cavity is incapable of any noteworthy influence on the course of the disease. This group is known as *septicaemia* or *septic infection* with a subgroup *pyaemia* if the bacteria concerned give rise to foci of suppuration. The micro-organisms concerned in this group are chiefly streptococci and staphylococcus pyogenes aureus.

Together the two groups form the condition of "blood poisoning" and it is clear that the second group is infinitely the more dangerous. Diagnosis between them is not always easy but sapraemia does not occur in the absence of a relatively large cavity with much putrescible material therein, whereas a minute scratch, as in conducting a post-mortem examination, may suffice for the introduction of streptococci that occasion a fatal septicaemia. Nevertheless, with such primary conditions as a wound at the bottom of which there is pent up blood clot or exudation, a collection of fluid in the abdomen or a joint cavity after operation or a uterus after parturition, particularly if it has not contracted well and still contains blood clot or portions of afterbirth, the symptoms may depend on either sapraemia or septicaemia and diagnosis can only be made by noting the results of clearing out the infected cavity, and bacteriological examination of the contents of the cavity and the patient's blood.

The pathology of sapraemia needs no further remark than that the bacteria concerned are mainly the proteus group (*see* BACTERIOLOGY) and that they are introduced into the putrescible material from without by instruments, hands, etc. But the septicaemic group requires more consideration for in many instances the source of the infection is not obvious.

Septicaemia and Pyaemia.—In the pre-Listerian era (*see* LISTER: *Antiseptics*) septicaemia and pyaemia with their allies, hospital gangrene, malignant oedema, erysipelas and in maternity hospitals, puerperal fever, were rife to a degree that is now almost incredible and there is no doubt that infection was carried by doctors, nurses and students from one case to another by hands, instruments and sponges. With the introduction of antiseptics (*q.v.*) and later asepsis this source of danger was reduced enormously and surgical operations and childbirth became the relatively safe procedures that they are at the present day. Even now when in such a case septicaemia unfortunately occurs a strict enquiry is always conducted to determine if possible the source of infection and a commencement is made with doctor, nurses, students.

But cases of septicaemia sometimes occur when the entire procedure appears to have been blameless and the question arises whether in these cases the origin of the blood poisoning does not lie in the patient. The whole subject is bound up with those of susceptibility and immunity (*q.v.*), the behaviour of micro-organisms in producing infective disease (*see* BACTERIA AND DISEASE) and the bacterial flora of the animal body, particularly the alimentary tract. It may be granted that septicaemia can only occur if the causal organisms have gained access to the blood, that invasion may take place with a minute inoculation, if the susceptibility of the patient be very great (*i.e.*, his defensive mechanisms be impaired) or the organisms be highly virulent and that *probably* the operation wound or the puerperal uterus is the seat of invasion, the organisms being introduced from without. Nevertheless it is not impossible that operation or parturition has impaired the patient's natural defences and that the invading micro-organisms have come from the intestines, where streptococci normally exist in great numbers and several varieties, or from such a focus as a septic tooth cavity, middle ear disease, chronic appendicitis, a gonococcal infection or even endocarditis. Such foci have long been recognized as occasional starting points of pyaemia.

Pyaemia differs from septicaemia chiefly in the facts (1) that the invading organisms are pyogenetic, usually staphylococcus pyogenes aureus, but sometimes varieties of streptococci or diplococcus pneumoniae; (2) that the infection is rarely so great that micro-organisms can be recovered from the circulating blood by bacteriological culture; (3) that abscesses are formed where the bacteria become lodged, that is, in the smaller arterial ramifications often in muscles, around joints and, secondarily, from those foci in the lungs and pleural cavities. A special variety of pyaemia occurs in ulcerative endocarditis in which particles of the inflammatory material on the mitral or aortic valves with the entangled micro-organisms are carried away in the blood stream.

Symptoms and Treatment.—The existence of sapraemia or septicaemia is signalized by rise of temperature in a patient who has a wounded and absorbing surface (*i.e.*, within the first three days after operation, injury or parturition). The extent of rise varies, temperatures of 101° and 102° F being common; thereafter the temperature may remain high with irregular but small remissions or there may be daily remissions over a large range of degrees, *e.g.*, evening 103° F, morning 99° F. Probably these differences depend upon the amount of poison being formed and absorbed from time to time. In pyaemia temperature conditions are similar but obviously pyaemia cannot be diagnosed before the septic abscesses have begun to form; this is generally first shown by the appearance of a painful and reddened focus. The primary wound usually becomes red and oedematous, the lymphatic glands draining the area are enlarged and painful and may suppurate and there may be lymphangeitis (*see* LYMPHATIC SYSTEM, DISEASES OF).

As regards treatment, apart from the removal of dead material by drainage and lavage which is rapidly effective in sapraemia treatment of this condition is usually unnecessary. In septicaemia and pyaemia the sole rational treatment is by antisera (*see* SERUM THERAPY). Full doses of a polyvalent antistreptococcus serum should be given in all cases and the strength of the patient should be husbanded to the fullest possible extent. The conditions are extremely grave, but hope should never be abandoned so long as life remains. (W. S. L.-B.)

SEPT (sĕt or sĕpt), a clan, applied to the families of Ireland, and sometimes used of East Indian tribes (probably Lat. *saeptum*, an enclosure).

SEPTEMBER, the seventh month of the old Roman year, in which it had 30 days assigned to it (Lat. *septem*, seven). In the Julian calendar, while retaining its former name and number of days, it became the ninth month. The Ludi Magni (Ludi Romani) in honour of Jupiter, Juno, and Minerva began on Sept. 4. September was called "harvest month" in Charlemagne's calendar, and it corresponds partly to the Fructidor and partly to the Vendémiaire of the first French republic. The Anglo-Saxons called the month *Gerstmonath*, barley month, that crop being then usually harvested. It is still called *Herbstmonat*, harvest month, in Switzerland.

SEPTUAGINT, THE, the earliest Greek translation of the Old Testament, so named from the legend of its composition by 70 (Lat. *Septuaginta*, LXX), or more exactly 72, translators sent from Jerusalem to Alexandria at the request of Ptolemy II. Philadelphus (288–247 B.C.) by the high priest Eleazar. The

Letter of Aristeas to *Philocrates* (*see* ARISTEAS) which unfolds a fantastic story is certainly spurious, though it contains some elements of truth; *e.g.*, that the work was the result of collaboration and was approved by the Jewish community in Alexandria. The king's share in the business is quite secondary, but we know that Ptolemy Philadelphus was a ruler of eclectic literary tastes, and he may well have encouraged an enterprise which not only appealed to his own curiosity but would promote the use of the Greek tongue among the large Jewish population of his city.

That population had been steadily increasing since the time of Alexander the Great, and while remaining loyal to the Hebrew faith had lost its knowledge of the Hebrew tongue, without acquiring that Aramaic equivalent which had become the common speech of Palestine, and in which the law and the prophets were expounded in the synagogues of Palestine. Faced by sheer necessity, the pious Jews of Alexandria were resolved to understand the Scriptures which were read to them in their own synagogues, and they overcame the age-long prejudice of the authorities at Jerusalem against the *writing* of Scripture in any but the old holy form.

It was natural to begin with the law, and the Greek version of the Pentateuch dates from the beginning of the 3rd century B.C. In the 2nd century B.C., when it had become customary to read not only the law but the prophets in public worship, the bulk of this second section of the Hebrew scriptures was similarly translated. In each case the work was done by a small company, but afterwards the enterprise became more casual. From the prologue to Ecclesiasticus we learn that about 130 B.C. portions of the third division of the Hebrew Bible—the "Writings"—were also extant in Greek, but these were private ventures made not so much to meet the direct need of the synagogue as those of a public now becoming interested in the growing series of translations of the Hebrew sacred books. Philo (*c.* A.D. 40) seems to have known the Greek versions of all the O.T. books except Esther, Ecclesiastes, Canticles and Daniel.

As the work of translation went on so gradually, the compass of the Greek Bible came to be somewhat indefinite. The law always maintained its pre-eminence as the basis of the canon; but the prophetic collection changed its aspect by having various writings incorporated with it according to an arbitrary arrangement by subjects. In some books the translators made considerable additions to the original, *e.g.*, those to Daniel, and these became a part of the Septuagint. To some extent the widening of the O.T. canon in Greek must be laid to the account of Christians. The Septuagint does not keep the triple Hebrew division of law, prophets (which included history) and writings, but groups its books according to subject-matter, law, history, poetry, prophecy, a divergence which was important for the history of the O.T. canon in the Christian Church. The early Christians generally accepted the LXX. canon, which through the Old Latin, despite Jerome's Vulgate adoption of the Hebrew canon, passed into the West and into Latin Bibles, where the Apocrypha are still included.

After the destruction of the temple at Jerusalem in A.D. 70 there was a reaction against the LXX., a movement connected with the strict definition of the canon and the fixing of an authoritative Hebrew text by the rabbis of Palestine. But long usage had made it impossible for the Jews to do without a Greek Bible, and to meet the need a new version was prepared in accurate correspondence with the Pharisaic text and canon. This was the version of Aquila, which took the place of the LXX. in the synagogues, and long continued in use there. Later versions were produced by Theodotion (whose Daniel even got into LXX. mss.) and Symmachus (*see* BIBLE: OLD TESTAMENT, *Texts and Versions*). The vocabulary and accidence of the Greek of the Septuagint are substantially those of the κοινὴ διάλεκτος or Hellenistic Greek spoken throughout the empire of Alexander. The language of the Pentateuch attains the higher level of the papyri of the early Ptolemaic age; that of the prophets reflects the less literary style of the papyri of *c.* 130–100 B.C. In the latest parts of the translation Dr. St. John Thackeray notes two opposing influences: (*a*) the growing reverence for the letter of Scripture, tending to a pedantic literalism; (*b*) the influence of the Atticistic school, strongest in free writings like 4 Macc. but leaving its mark also on 4 Kings. In syntax especially the LXX. is strongly tinged with Hebraisms, and there are many passages where it is almost impossible to extract any rational meaning.

In some cases a book bears the marks of two hands, *e.g.*, Jeremiah i.–xxviii. is from another hand than xxix–li., and so with Ezekiel, where xxviii.–xxxix. stands apart from the remainder. In these cases probably one man dictated, the other translated, and then they changed over. Isaiah is more akin to classical Greek; like the Pentateuch and 1 Macc., *i.e.*, is good κοινή. The two chief mss. of Judges vary so much as to point to different recensions. In some books, especially Jeremiah xxv.–li., the order of the LXX. is totally different from that of the Massoretic Hebrew (*cf.*, also Proverbs xxiv.–xxix.). In some cases, *e.g.*, Job, the original LXX. text was much shorter than that of the Massoretes; in Esther and Daniel there are numerous additions. Apart from its being the oldest translation of considerable extent that ever was written, the Septuagint was "the first step towards that fusion of the Hebraic with the Hellenic strain which has issued in the mind and heart of modern Christendom." It is also the starting point for the history of Jewish interpretation and the Jewish view of Scripture. Hence its importance as a document of exegetical tradition, especially in lexical matters, may be easily understood. It was largely composed before the close of the O.T. canon, and in it alone are preserved several Jewish writings that never became canonical. As the book which at last codified the dialect of biblical Greek, it is a key to the N.T. and its dependent literature. To many its chief value is that it is the only independent witness for the text of O.T. which we have to compare with the Massoretic text. Its critical value is unfortunately greatly impaired by the corrupt state of its own text. As we have not the version itself in authentic form we cannot reconstruct with certainty the Hebrew text from which it was made. The difficulties in getting behind the confusion of versions and recensions and of weighing the patristic evidence are very formidable. The chief uncial mss. are, as for N.T. ℵ A, B, of which A and B are largely complete, but though both of Egyptian origin, vary considerably. A may represent the edition of Hesychius, B that of Origen. When the arduous task of reconstructing the text of LXX. has been achieved, there still remains the problem of its relation to the Hebrew. The Hebrew text from which the LXX. translators worked was often divergent from that represented by the Massoretic text, but we need not assume that in cases of difference the Greek is to be preferred. The LXX. translators made some palpable mistakes; their knowledge of Hebrew was often inadequate; they occasionally interpreted as well as translated, and they sometimes introduced local colour. Yet there is no doubt that much (*e.g.*, in 1 Sam.) may be learned from the Septuagint; all one can say is that each case must be treated on its own merits.

Amongst recent studies of the Septuagint may be mentioned the theory of Dr. M. Gaster that it is a Palestinian work, a first step towards a Targum, written for the masses rather than for synagogue worship, and "an answer to Greek pretensions," a carrying of the war against Hellenism into the enemy's camp. But neither this nor the quaint notion of Wutz that the LXX. translators worked not from Hebrew mss. but from a transliterated text, *i.e.*, Hebrew written in Greek characters, has met with any acceptance. More fruitful are the suggestions made by Dr. St. John Thackeray as to the "liturgical" aspect of the Greek Bible. The LXX. was first printed in the Complutension Polyglot (1514–17), but before this was published in 1521, Aldus had published another edition in 1519. H. B. Swete's compact edition in 3 vols. (1887–94; revised 1895–99) gives the text of B so far as available, then A or ℵ, with variant readings from the chief uncials. The larger Cambridge edition (1906, in progress) by A. E. Brooke and N. McLean follows the same plan with the text, but its apparatus includes all the uncials, the best minuscules and the chief versions and patristic quotations.

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(A. J. G.)

SEPULCHRE, CANONS REGULAR OF THE HOLY, an order said to have been founded in 1114 (or, according to other accounts, during the rule of Godfrey of Bouillon in Jerusalem) on the rule of St. Augustine. Pope Celestine III., in 1143, confirmed the Church and Canons of the Holy Sepulchre in all their possessions, and enumerated several churches both in the Holy Land and in Italy belonging to the Canons.

See the *Catholic Encyclopaedia*, article "Sepulchre, Canons Regular."

SEPULCHRE, THE HOLY. The authenticity of this site has been much disputed. From N.T. data it is evident that the tomb of Joseph of Arimathea was near Calvary, which adjoined a high road and was outside the City walls, but perhaps quite near, as the Romans crucified criminals in such situations. On which side of the City it lay is not recorded. There is no reference in Christian literature of the first three centuries to the "empty tomb." Even if the tomb was venerated—as one might suppose probable—there must have been a break in the possibility of access to it at the destruction of Jerusalem by Titus (A.D. 70) and again in the more complete devastation after Bar Kokba's rebellion and whether any tradition regarding the site survived is doubtful. When (A.D. 135) Hadrian rebuilt the City, calling it Aelia Capitolina, he is stated by Eusebius to have erected a Temple of Aphrodite over the site of the Holy tomb. In A.D. 325 the remains of this pagan shrine were removed by Macarius and under these were found an ancient Jewish tomb. The rock around was cut away, the tomb chamber was isolated and a circular building—the Anastasius—was erected around it. That this is the same tomb as that shown today is indisputable though the actual roof and much of its walls were destroyed (A.D. 1010) by orders of the Chalif Hakim.

The situation of this tomb presents topographical difficulties. Thus the site is now so much the centre of Jerusalem as to make it difficult to accept its genuineness. It must however be remembered that in earlier times the City extended further south and the present position of the walls is in no small measure the result of veneration for the Traditional Sacred Sites. The course of the ancient northern walls is one which is still unsolved. The "First Wall" ran from the neighbourhood of the existing Jaffa Gate eastwards to the wall of the Temple enclosure and the "Second Wall," which began at the Gate Ganath—a site on the "First Wall" unidentified—ran round the northern quarter of the City to the fortress of Antonia. It is admittedly difficult—but not impossible—to plot out a wall running this course, which would exclude the Holy Sepulchre, but actually, no remains of a City wall following such a possible course have been found. Some authorities claim that the existing northern City wall is not, as many suppose, on the general lines of the third wall, but on those of the second wall, making the traditional site impossible. This view has certainly been strengthened by the recent excavation of extensive remains of a more northern wall, which by position and construction may be the third wall built, but not completed by King Herod Agrippa (about A.D. 41).

The traditional view being so difficult, speculation naturally suggested alternative sites. Thus—among others—in 1730 Korte of Altona suggested one west of the Jaffa Gate, Clarke in 1812 one south of the Zion Gate and Barclay one east of St. Stephen's Gate. In 1842 Otto Thenius promulgated his theory that the Crucifixion must have taken place above Jeremiah's Grotto, outside the Damascus Gate. This theory—with the addition of a tomb to the west of this hill claimed to be the true Sepulchre—has had many supporters notably General Gordon. It must be admitted that no site lends itself better to a spectacular reconstruction of the Crucifixion Story but it presupposes that the centuries have made but little change in the topography of the City and the archaeological evidence is entirely against it. The fact is that while the claims of the Holy Sepulchre rest upon uncertain tradition and the archaeological evidence raises difficulties, no other site can be said to have any serious validity.

The Church of the Holy Sepulchre is a collection of buildings mainly of mediaeval origin and only the most scanty traces of the work of Constantine the Great have been found. The circular building, round the little Greek Chapel covering the tomb, is certainly in the original position of the Circular Anastasius of the fourth century. The various ancient branches of the Church hold property in the collection of buildings around, and all have rights in the rotunda and the Sepulchre itself—a position which has led to many bitter disputes.

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(E. W. G. M.)

SEQUANI, in ancient geography, a Celtic people who occupied the upper basin of the river Arar (Saône), their territory corresponding to Franche-Comté and part of Burgundy. Before the arrival of Caesar in Gaul, the Sequani had taken the part of the Arverni against their rivals the Aedui, and hired the Germans under Ariovistus to help them (71 B.C.). But although they thus defeated the Aedui, the Sequani were worse off than before, for Ariovistus deprived them of a third of their territory and threatened to take another third. The Sequani appealed to Caesar, who drove back the Germans (58), but at the same time compelled the Sequani to surrender all that they had gained from the Aedui. The Sequani therefore joined in the revolt of Vercingetorix (52) and shared in the defeat at Alesia. Under Augustus, the district known as Sequania formed part of Belgica. After the death of Vitellius, the inhabitants refused to join Iulius Civilis and Iulius Sabinus in revolt against Rome and drove back Sabinus, who had invaded their territory. A triumphal arch at Vesontio (Besançon), which in return for this service was made a colony, possibly commemorates this victory. Diocletian added Helvetia, and part of Germania Superior to Sequania, which was now called *Provincia maxima Sequanorum*. Fifty years later (A.D. 355) Vesontio was sacked by the barbarians. Under Julian it recovered some of its importance as a fortified town, and was able to withstand the attacks of the Vandals. Later, the Sequani became merged in the newly formed kingdom of Burgundy.

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SEQUENCE DATING. A sequence date (adopted in Germany as *Staffelzahl*) is a dating by relation to things earlier and later in arbitrary units, not by years. All history is mainly concerned with the order of events; the dates A.D. are of much less consequence than the connection of cause and effect. To know that the Armada preceded the Stuarts is essential; that it was 15 years earlier is a detail. In ages where no dated history exists our endeavour must be to put what we know into its true order.

The most obvious kind of evidence of sequence is in geology, when strata lie deposited one on the other, and similarly in human settlements when buildings or refuse heaps are superimposed. Such evidence is finally conclusive, where accidents do not occur. (*See* STRATIGRAPHY.) But changes do occur, and may upset the evidence. Strata may be deficient where contact is sought, or may have been separated by a sill of molten rock, or have suffered overthrust by compression, or even been altogether inverted. In strata of man's works burrowing animals or men may upset order and let objects shift far down, or throw them up; dyed wool occurred in a prehistoric grave, but it had been carried down by a rat for lining its nest; the Persians dug granaries 20 feet deep through many centuries of town levels.

Another kind of evidence of sequence is that from the style of objects. Suppose in a great mansion that the room in which each master had died was left with its furniture untouched. If we could thus compare the surroundings of each generation we should

have little or no doubt as to the sequence of the rooms. The changes of fashion—Victorian. Regency, French Revolution, Georgian—would make it impossible to mistake the order, so as to put a Chippendale sofa between the '51 and '62 Exhibition periods. There is the ancient equivalent of such successive rooms in the funeral outfit for the dead. Each generation varied the forms of its objects—pottery, weapons, ornaments—and the connection of the varieties can thus be traced. (*See* TYPOLOGY.)

Establishing a Dating.—If, then, we are able to put a large number of graves into their relative order, we need to be able to denote each part of the series. This may be done by dividing a series of, say, 1,000 graves into 50 parts, of about 20 graves in each part. Thus we have a series of divisions that may be numbered consecutively, and so form a chain of periods, though not of equal periods of years; they are periods of equivalent mortality or productivity. Yet such numbers of the periods, or sequence dates, constitute as true a history as if they specified the date in years. The stages of perceptible change are not so close together as single years; they may be most nearly generations, or centuries, or even millennia in early ages of man. The method of numbering them in order gives the handle by which to use the history of prehistoric ages, as familiarly as we refer to the years or centuries of written history. An ancient dating by numbers is already familiar in the naming of the successive dynasties of Egypt from 1 to 30; a mode of reference which avoids the differences of opinion about the dates in years.

The Material for Study.—The basis for starting the sequence dates must be a simple notation of all the variations of common objects, especially pottery. A set of drawings of every form of pottery dealt with must be put into some systematic order (such as from the most open plate to the most closed bottle). Each principal form must be numbered (say, 1 to 99), lesser variations having a letter, as 34c, 34m. This notation can be applied to each different kind of pottery. Thus every pot found can be expressed, for instance, as B17d (Black pottery, form 17, variety d), or F85t. This numbered series of drawings is termed a *corpus*, and with it the pottery in a grave can be recorded completely for future study, without taking it away. Such records are necessary material for discovering the sequence of the graves.

The Method of Working.—Some starting connection is needful, either in a related series of forms or a link to historic times, or some stratification of a site. For instance, a long series of degradations of a globular pot to a cylinder and of a handle into a cord pattern, served to start the interpretation of the later prehistoric pottery of Egypt. Or, on the other method, the Badarian settlement was divided by a layer of rock chips, while it was deserted; the pottery from under the chips was certainly then the older.

Having got thus some intimation, by style or by place, which of two groups A and B is the older, the next stage is to group all graves containing A types and none of B, and arrange them in order of the proportion of A types; those with 5, 4, 3, 2, 1 or 0 types like A being ranked in that order. Similarly those with B types on the other side away from A. In this way the order is arranged as forms like A, 0, 1, 2, 3, 4, 5, 6, then A, A and B types conjoined, B, 6, 5, 4, 3, 2, 1, 0 like B. Thus a rough breaking up into many groups in approximate order can be made statistically.

Having a rough classing the next process is to deal with each type individually. It is obvious that if a series were arranged in true order of succession, a disturbance to a false order would be more likely to scatter types than to concentrate them in their range. Hence the shortest possible range of each type is the most probable. Then outlying examples of each type in the series of graves must be examined to see whether that grave could be brought nearer to the other examples of the type, without dispersing any other type which is associated with it. This process may be graphically imagined by supposing that every example of a type is tied to all other examples of it by an elastic cord in tension. Then a scattered type will tend to pull itself together, provided it does not increase the tension of the cord of another type. The whole process might be solved mechanically by such a model.

Method in Practice.—The way to handle all this material is to take for each grave a slip of card, about 7in. long and ½in. high. Rule it into as many spaces as there are kinds of pottery, A, B, C, etc., about half a dozen. Enter in its respective space the number of each type of pot in the graves, in order of numbers. Then place all the cards in a column, so that a hundred grave contents can be reviewed in a height of 25in., laid on a tray. Ten such trays allow of a review of every pot in a thousand graves at once, on a table about six ft. wide. Usually only two or three trays need to be seen at once. Each type is searched in turn, every example noted (by putting a drawing pin point up at each place); the earliest and latest are then examined to see what associated types are with them, and if moving these extreme slips will make divergence in other types. This is a process which has to be repeated many times, each time getting a better concentration of each type. Where several types found together have to be searched in all their connections, a different pattern of drawing pin can be used to mark each type.

Results.—The eventual result is a classing of, say, 1,000 graves in nearly their original order. Each selected grave should contain at least five different types of pottery. Next the whole series can be divided into numbered groups, modifying the groups so as to divide at the beginning or end of prominent types. When these groups are consecutively numbered, then each type of pot can have its limits in sequence dates; say from 42 to 48. Some simple types will have a very long range; other decorated types may have been made by only one generation. The more elaborate a type the more it demands concentration. In mechanical parallel the tension of the elastic cord will be greatest for the peculiar types.

The Sequence Date of Graves.—The different types of pottery in a grave will each give a fresh limitation of the possible range, as in the following cases, from Abydos:—

B 22b 30–37	W 55 72–78	B 38a 43–66
B 25f 30–50	R 26 55–80	W 42 62–72
P 11a 31–63	L 17c 51–78	R 23c 36–80
P 11b 35–71	L 36a 58–80	R 65a 49–68
	L 53a 48–74	R 80 41–72
		L 53c 54–80
Limits 35–37	72–74	62–66

These dates of graves serve then to date all the other objects found in the grave. A fresh series of graves will sometimes slightly extend one or two of the ranges already found for a type; but the graves with sufficient varieties work out with a very small range of uncertainty. The scale of 50 parts, 30–79, which was adopted for Egypt, is not at all too minute in its subdivision, as the resulting dates work out to two or three units. Twenty-five years after this was done the scale has been continued back to S.D. 20–29 to include the still earlier prehistoric age of Badari.

Precautions.—In forming a *corpus*, various of the 99 numbers should be left unused where a large step lies between types, so as to leave numbers for future discoveries; similarly in assigning letters for varieties, especially where a large difference exists. In ages where a good dating is already known by records, it is best to make larger groups (as 33–37), and place all the forms in order of date, as this will point to their true relation.

For applying the system of sequences precautions are needed. First, there must be a sufficient series of dated graves, each containing many varieties of pottery. For an entirely fresh country at least 500 grave groups are wanted; for joining on an extension to an existing system a few dozen graves will give a preliminary view, useful as a framework for fresh evidence. Secondly, all kinds of evidence must be taken into account, not only forms, but decoration, relation to other forms, descent of a type, peculiar personalities in the work, and not only pottery but all other material of which there may be enough to give an indication, as ivory, stone, flintwork, and metal. Thirdly, the historical view should have consistency. If there is a large change of types at any point of the dating, this may modify the arrangement of the slips.

The final aim of archaeology is to have a separate *corpus* of types of each great period of each country, not only for pottery but for all other classes of objects. Thus the whole of the materi-

al products of the past can be put in an organized connection, and so give a definite basis for our knowledge of man's ability and purpose. (W. M. F. P.)

SEQUESTER, VIBIUS (4th or 5th century A.D.), the supposed author of an alphabetical list of geographical names occurring in the Roman poets. Several of the names given cannot be traced; the compiler perhaps had access to sources no longer extant.

Editions by C. Bursian (Zürich, 1867), and in A. Riese, *Geographi Latini minores* (1878); *see* also Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 445, 1.

SEQUESTRATION. In law, the term "sequestration" has many applications; thus it is applied to the act of a belligerent power which seizes the debts due from its own subjects to the enemy power; to a writ directed to persons, "sequestrators," to enter on the property of the defendant and seize the goods (*see* EXECUTION); to the action of taking profits of a benefice to satisfy the creditors of the incumbent. As the goods of the church cannot be touched by a lay hand, the writ is issued to the bishop, and he issues the sequestration order to the churchwardens who collect the profits and satisfy the demand. Similarly when a benefice is vacant the churchwardens take out sequestration under the seal of the Ordinary and manage the profits for the next incumbent. In the Scots law of bankruptcy the term "sequestration" is used of the taking of the bankrupt's estate by order of the court for the benefit of the creditors.

SEQUIN, the French form of Ital. *zecchino,* the name of a Venetian gold coin, first minted about 1280, and in use until the fall of the Venetian republic. It was worth about nine shillings. It bore on the obverse a figure of St. Mark blessing the banner of the republic, held by a kneeling doge, and on the reverse a figure of Christ. Milan and Genoa also issued gold sequins. The word in Italian was formed from *zecca,* Span. *zeca,* a mint, an adaptation of Arabic *sikka,* a die for coins.

The term "sequin" is used for small discs made of thin metal, tinfoil, celluloid or other composite material, highly glazed and brightly coloured, and applied as trimming for ladies' dresses.

SEQUOIA, a genus of conifers (*see* GYMNOSPERMS) forming one of several surviving links between the firs and the cypresses. The two species are evergreen trees of immense size, indigenous to the west coast of North America. Both bear their round or ovoid male catkins at the ends of the slender terminal branchlets; the ovoid cones, either terminal or on short lateral twigs, have thick woody scales dilated at the extremity, with a broad disk depressed in the centre and usually furnished with a short spine; at the base of the scales are from three to seven ovules, which become reversed or partially so by compression, ripening into small angular seed with a narrow winglike expansion.

SEQUOIA SEMPERVIRENS, SHOWING BRANCH WITH GREEN CONES AND MALE CATKINS. (A) CROSS SECTION OF A CONE

The redwood of the Californian lumbermen, *S. sempervirens,* abounds on the Pacific coast from the southern borders of Oregon southward to Salmon Creek canyon, about 12 m. south of Punta Gorda, Monterey county, California, forming a narrow mountain forest belt, rarely extending more than 20 or 30 m. from the coast or beyond the influence of ocean fogs, or more than 3,000 ft. above sea-level. (*See* C. S. Sargent, *Manual of the Trees of North America,* 2nd ed., 1922.) It grows to a gigantic size, from 200 to 340 ft. in height, with a diameter of from 10 to 15, or even to 28 ft., at the much-buttressed base. It is the tallest American tree. In old age the huge columnar trunk rises to a great height bare of boughs, while on the upper part the branches are short and irregular.

The bark is red, like that of the Scots fir, deeply furrowed, with the ridges often much curved and twisted. When young the stem rises straight and tapering, with somewhat irregular whorls of drooping branches, the lower ones sweeping the ground—giving an elegant conical outline. The twigs are densely clothed with flat spreading linear leaves of a fine glossy green above and glaucous beneath; in the old trees they become shorter and more rigid and partly lose their distichous habit. The cones, from $\frac{3}{4}$ to 1 in. long, are at first of a bluish-green colour, but when mature change to a reddish brown; the scales are very small at the base, dilating into a broad thick head, with a short curved spine below the deep transverse depression. From the great size of the trunk and the even grain of the red cedar-like wood it is a valuable tree: it splits readily and evenly, and planes and polishes well; cut radially, the medullary plates give the wood a fine satiny lustre; it is strong and durable, but not so elastic as many of the western pines and firs. Sargent describes it as the most valuable timber tree of the forests of Pacific North America. In England the tree grows well in warm situations, but suffers much in severe winters. It was discovered by Archibald Menzies in 1795 and was first described as *Taxodium sempervirens,* under which name it was known until distinguished by Stephan Endlicher as a new genus in 1847.

The only other member of the genus is the giant sequoia or "big tree" of the Sierra Nevada, *S. gigantea,* the largest of known conifers; it is confined to the western portion of the great Californian range for a length of about 260 miles, at an altitude of from 5,000 to 8,400 ft. above the sea, and forms extensive forests, or, in the northern part of the area, isolated groves, such as the Calaveras grove, the Mariposa grove, and others. The leaves of this species are awl-shaped, short and rigid, with pointed apex; closely adpressed, they completely cover the branchlets. The young tree is more formal and rigid in growth than *S. sempervirens,* but when old the outline of the head becomes cylindrical, with short branches sparsely clad with foliage sprays. The bark, of nearly the same tint as that of the redwood, is extremely thick and is channelled towards the base with vertical furrows; at the root the ridges often stand out in buttress-like projections. The average height is about 275 ft. with a diameter near the ground of 20 ft.; but specimens from 300 to 320 ft. tall, with trunks 25–35 ft. thick, have been found.

The famous group known as the Mammoth grove of Calaveras in California, containing over 90 large trees, stands in 38° N., about 4,370 ft. above the sea, between the San Antonio and Stanislaus rivers. It was discovered by A. T. Dowd, a hunter of Murphy's Camp, in 1853. The tree was made known to science by W. Lobb, who sent specimens to John Lindley in England. Some trees in the Mariposa grove rival these in size: one measures 101 ft. round the root, and a cut stump is 31 ft. in diameter.

The longevity of the big trees is very great. A tree under 1,000 years of age may be regarded as still youthful. Huntington counted the annual rings of woody growth in 79 trees that were more than 2,000 years old and in 4 that exceeded 3,000 years.

The wood of both sequoias makes excellent lumber, especially that of the coast redwood. Because of this, the original forests of these magnificent trees have been very greatly depleted. In 1925 the total cut of redwood lumber in California and Oregon was 510,639,000 bd.ft., valued at the mill at $17,356,620.

In early geological times the sequoias occupied a far more important place in the vegetation of the earth. They occur in the Lower Chalk formations, and in Tertiary times were widely diffused; the genus is represented in the Eocene flora of Great Britain, and in the succeeding Miocene period was widely distributed in Europe and western Asia. It is presumed that in the Glacial epoch the genus was exterminated except in the areas in western North America where it still persists.

In earlier geological times the sequoias occupied a far more important place in the vegetation of the earth than at present, and it is interesting to note that fossil cones, branches and leaves of these trees were known to science many years before the living species were discovered. Instead of being confined chiefly within the limits of a single State they were once distributed over four

continents. The most ancient positively identified sequoia was recently discovered in the Upper Jurassic of France. In Lower Cretaceous times sequoias were widespread in North America and Europe. In Tertiary times they were still more widely diffused, occurring in the Eocene flora of Great Britain and attaining their maximum development in the Miocene period. Fossiled trunks, 6 ft. to 10 ft. in diameter and 30 ft. high, still standing erect, in deposits in the Yellowstone region (Miocene), are scarcely distinguishable in the microscopical characters of the wood from the living species. During the glacial period the sequoias were exterminated except in the limited area in North America where they still persist.

See E. W. Berry, *Tree Ancestors* (Baltimore, 1923).

SERAING, town, province of Liége, Belgium. Pop. (1925), 41,352. It is on the Meuse, above Liége, and owes its importance to John Cockerill, who, in partnership with King William I. of the Netherlands, founded what is still called the "John Cockerill company," making machinery, with headquarters in the old summer-palace of the prince-bishops of Liége.

SERAMPORE, a town of British India, in the Hooghly district of Bengal, on the right bank of the river Hooghly, opposite Barrackpore, on the East Indian railway, 12 m. from Howrah. Pop. (1921) 33,197. The Danes established themselves here in 1755 and called the town Frederiksnagar. With the rest of the Danish possessions in India, it was acquired by purchase by the English in 1845.

SERAO, MATILDA (1856–1927), Italian novelist and journalist, was born at Patras in Greece. Her father was an Italian, a political emigrant, and her mother a Greek. She was a telegraph clerk in Naples, but early attracted notice by short stories contributed to the press. Her novel, *Fantasia* (1883), first definitely established her as a writer full of feeling and analytical subtlety. She spent the years between 1880 and 1886 in Rome, where she published volumes of short stories and also novels, all dealing with the life of the people: *Cuore Infermo* (1881), *Fior di Passione* (1883), *La Conquista di Roma* (1885), *La Virtù di Checchina* (1884) and *Piccole Anime* (1883). With her husband, Edoardo Scarfoglio, she founded *Il Corriere di Roma*, the first Italian attempt to model a daily journal on the lines of the Parisian press. The paper was short-lived, and when it was given up Matilda Serao established herself in Naples, where she edited *Il Corriere di Napoli* and in 1891 founded *Il Mattino*, which became the most popular daily paper of southern Italy. Between 1890 and 1902 she produced *Paese di Cuccagna, Ventre di Napoli, Addio Amore, All' Erta Sentinella, Castigo, La Ballerina, Suor Giovanna della Croce, Paese di Gesù*, novels in which the character of the people is rendered with sensitive power and wide sympathy. Most of these have been translated into English. She died on July 25, 1927.

SERAPHIM, plural of the Hebrew noun *sārāph*, is the name of the supernatural beings attendant upon Yahweh in Isaiah's vision, Isaiah vi. 2, 6. Each has six wings, and apparently human feet, hands and voice. They chant in antiphon the praise of Yahweh. Representations of such mixed figures were to be found at the entrance to oriental temples, where they served as guardians of the gate, and they also are depicted upon coins of the Roman period. It is not unlikely that this feature in the prophet's vision was due to his seeing such figures at the entrance to the Temple and hearing the chants of the choir immediately before he passed into ecstasy. It is noteworthy that "the thresholds were moved" (*v.* 4) at the voice of the seraphim. The singular noun is used in Numbers xxi. 8, Isaiah xiv. 29, xxx. 6, where it is rendered "fiery serpent": accordingly it has been supposed that the seraphim were originally serpentlike in form.

SERAPION or SARAPION (*fl. c.* 350), bishop of Thmuis in the Nile Delta and a prominent supporter of Athanasius in the struggle against Arianism (sometimes called, for his learning, Scholasticus), is best known in connection with a prayer-book or sacramentary intended for the use of bishops. This document, contained in a collection of Egyptian documents in an 11th-century ms. at the Laura on Mount Athos, was published by A. Dmitrijewskij in 1894, but attracted little attention until independently discovered and published by G. Wobbermin in 1899. It is a celebrant's book, containing thirty prayers belonging to the mass (19–30, 1–6), baptism (7–11, 15, 16), ordination (12–14), benediction of oil, bread and water (17), and burial (18), omitting the fixed structural formulae of the rites, the parts of the other ministers, and almost all rubrication, except what is implied in the titles of the prayers. The name of Serapion is prefixed to the anaphora of the mass (1) and to the group 15–18: but whether this indicates authorship is doubtful; for whereas the whole collection is bound together by certain marks of vocabulary, style and thought, 15–18 have characteristics of their own not shared by the anaphora, while no part of the collection shows special affinities with the current works of Serapion.

But his name is at least a symbol of probable date and provenance: the theology, which is orthodox so far as it goes, but "conservative," and perhaps glancing at Arianism, shows no sign that the Macedonian question has arisen; the doxologies, of a type abandoned by the orthodox, and by *c.* 370 treated by Didymus of Alexandria as heretical; the apparent presupposition that the population is mainly pagan (1, 20); the exclusive appropriation of the mass to Sunday (19; cp. Ath. *ap. c. Ar.* 11), whereas the liturgical observance of Saturday prevailed in Egypt by *c.* 380: the terms in which monasticism is referred to—together point to *c.* 350; the occurrence of official interpreters (25) points to a bilingual Church, *i.e.*, Syria or Egypt; and certain theological phrases (ἀγέννητος, ἐπιδημία, μόνη καθολικὴ ἐκκλησία) characteristic of the old Egyptian creed, and the liturgical characteristics, indicate Egypt; while the petition for rains (23), without reference to the Nile-rising, points to the Delta as distinguished from Upper Egypt. The book is important, therefore, as the earliest liturgical collection on so large a scale, and as belonging to Egypt, where evidence for 4th-century ritual is scanty as compared with Syria.

The rites form a link between those of the *Egyptian Church Order* (a 3rd- or early 4th-century development of the Hippolytean Canons, which are perhaps Egyptian of *c.* 260) and later Egyptian rites—marking the stage of development reached in Egypt by *c.* 350, while exhibiting characteristics of their own.

See J. Wordsworth, *Bishop Sarapion's Prayer-Book* (1899).

SERAPIS, a famous Graeco-Egyptian god. The statue of Serapis in the Serapeum of Alexandria was of purely Greek type and workmanship—a Hades or Pluto enthroned with a basket or corn measure on his head, a sceptre in his hand, Cerberus at his feet, and (apparently) a serpent. It was proclaimed as the anthropomorphic equivalent of a much revered and highly popular Egyptian beast-divinity, the dead Apis, assimilated to Osiris. The Greek figure probably had little effect on the native ideas, but it is likely that it served as a useful link between the two religions. The god of Alexandria soon won an important place in the Greek world. The anthropomorphic Isis and Horus were easily rendered in Greek style, and Anubis was prepared for by Cerberus. The worship of Serapis along with Isis, Horus and Anubis spread far and wide, reached Rome, and ultimately became one of the leading cults of the west. The destruction in A.D. 385 of the Serapeum of Alexandria, and of the famous idol within it, after the decree of Theodosius, marked the death-agony of paganism throughout the empire.

It is assumed above that the name Serapis (so written in later Greek and in Latin, in earlier Greek Sarapis) is derived from the Egyptian Userhapi—as it were Osiris-Apis—the name of the bull Apis, dead and, like all the blessed dead, assimilated to Osiris, king of the underworld. There is no doubt that Serapis was before long identified with Userhapi; the identification appears clearly in a bilingual inscription of the time of Ptolemy Philopator (221–205 B.C.), and frequently later. It has, however, been contended by an eminent authority (Wilcken, *Archiv für Papyrusforschung*, iii. 249) that the parallel occurrence of the names Sarapis and Osorapis (Userhapi) points to an independent origin for the former. But doublets, *e.g.*, Petisis-Petēsis, are common in Graecisms of Egyptian names. *See* EGYPT: *Religion*.

See ISIS; A. Bouché-Leclercq, *Histoire des Lagides*, i. (1903), ch. iv.; J. G. Milne, *History of Egypt under Roman Rule* (1898), p. 140;

G. Lafaye, *Histoire du culte des divinités d'Alexandrie hors de l'Égypte* (Paris, 1884).

SERBIA (*Srbiya*), formerly an inland kingdom of south-eastern Europe, situated in the north of the Balkan Peninsula, now incorporated in Yugoslavia (*q.v.*). The frontier, as defined by the Berlin Treaty of 1878, was, roughly speaking, indicated by rivers in the north, and by mountains in the south. In the north, between Verciorova and Belgrade, the Danube divided Serbia from Hungary for 157 m.; and between Belgrade and the border village of Racha the Save divided it from Croatia-Slavonia for 80 m. In the north-west the Drina flowed for 102 m. between Bosnia and Serbia; in the north-east the Danube, for 50 m., and the Timok for 23 m., constituted respectively the Rumanian and Bulgarian boundaries. Various mountain ranges marked the frontiers of Bosnia on the west, Turkey on the south-west and south, and Bulgaria on the south and south-east. According to the survey carried out by the Serbian general staff in 1884 the area of the country was 18,782 sq.m.

HISTORY

The Serbs (*Srbi*, as they call themselves) are a Slavonic nation, ethnically and by language the same as the Croats (*Hrvati, Horvati, Croati*). The Croats, however, are Roman Catholics and use the Latin alphabet, while the Serbs belong to the Orthodox Church and use the Cyrillic alphabet, augmented by special signs for the special sounds of the Serb language. (*See* SLAVS.)

The earliest mention of the Serbs is to be found in the ninth century; the origin of the name which appears alike in Lusatia and the Balkans is obscure. Nothing is known of their earlier history except that they lived as an agricultural people in Galicia, near the source of the river Dniester. In the beginning of the 6th century they descended to the shores of the Black Sea. Thence they began to move westerly along the left shore of the Danube, crossed that river and occupied the north-western corner of the Balkan Peninsula. According to the emperor Constantine Porphyrogenitus, the emperor Heraclius (610–640) invited the Serbs to settle in the devastated north-western provinces of the Byzantine empire and to defend them against the incursions of the Avars. According to newer investigations, Heraclius only made peace with them, confirming them in the possession of the provinces which they already had occupied, and obtaining from them at the same time the recognition of his suzerainty. Their known history as a Balkan nation begins towards the middle of the 7th century.

The Zhupaniyas.—In their new settlements the Serbs did not form at once a united political organization. The clans more or less related to each other, occupied a certain territory, which as a geographical and political unit was called *Zhupa* or *Zhupaniya* (county), the political and military chief of which was called *Zhupan*. The history of the Serbs during the first five centuries after their arrival in their present country was a struggle between the attempts at union and centralization of the Zhupaniyas into one state under one government, and the resistance to such union and centralization. The more powerful Zhupan was tempted to subjugate and absorb the less powerful Zhupaniyas. If successful, he would take the title of *Veliki Zhupan* (Grand Zhupan). But such unions were followed again and again by decentralization and disruption. The earlier history of the Serbs on the Balkan territory is especially turbulent and bloody, one of the minor causes being the struggle between the ancient Slavonic order of inheritance, according to which a Zhupan ought to be succeeded by the oldest member of the family and not necessarily by his own son, and the natural desire of every ruler that his own son should inherit the throne.

This internal political process was complicated by the struggle between the Greek Church and Greek emperors on the one side and the Roman Catholic Church and the Roman Catholic Powers (Venice and Hungary) on the other, for the possession of exclusive ecclesiastical and political influence. The danger increased when the Bulgarians came, towards the end of the 7th century, and formed a powerful kingdom on the eastern and south-eastern frontiers of the Serbs. Practically from the 8th to the 12th century the bulk of the Serbs was under either Bulgarian or Greek suzerainty, while the Serbo-Croat provinces of Dalmatia acknowledged either Venetian or Hungarian supremacy.

The Visheslav Dynasty.—The first Serb princes who more or less successfully united several Zhupaniyas into one state, belonged to what might be called "the Visheslav dynasty." Zhupan Visheslav lived in the beginning of the 9th century, and seems to have been the descendant of that leader of the Serbs who signed the settlement treaty with the emperor Heraclius towards the middle of the 7th century. His ancestral Zhupaniya comprised Tara, Piva, Lim (the neck of land between the Montenegro and Serbia of pre-war days). Visheslav's son Radoslav, his grandson Prissegoy, and his great-grandson Vlastimir, "the first clear personality" of Serbian history, continued his work. Vlastimir successfully defended the western provinces of Serbia against the Bulgarians, although the eastern provinces (Branichevo, Morava, Timok, Vardar, Podrimlye) were occupied by the Bulgars. The Bulgarian danger, and probably the successful operations of the Greek emperor Basil the Macedonian (867–886), determined the Serbian Zhupans to acknowledge again the suzerainty of the Greek emperors. One of the important consequences of this new vassalship to the Byzantine empire was that the entire Serbian people embraced Christianity, about 879—a process begun, however, by Latin priests between 642 and 731. In all important transactions the Serbians were led by the Grand Zhupan Mutimir Visheslavich (d. 890). During the reign of his heirs almost all the Serbian provinces were conquered by the Bulgarian Tsar Simeon (924). In 931 Chaslav, one of the princes of the Visheslav dynasty, liberated the largest part of the Serbian territory from Bulgarian domination, but to maintain that liberty he had to acknowledge the Byzantine emperors as his suzerains.

The Princes of Zeta and the First Serb Kingdom.—Towards the end of the 9th century the political centre of the Serbs was transferred to Zeta (or Zenta: *see* MONTENEGRO) and the Primorye (Sea-Coast). The prince (sometimes called king) of Zeta, Yovan Vladimir, tried to stop the triumphal march of the Bulgarian Tsar Samuel through the Serb provinces, but in 989 was defeated, made prisoner and sent to Samuel's capital, Prespa. The historical fact that Vladimir married Kossara, the daughter of Samuel, and was sent back to Zeta as reigning prince under the Bulgarian suzerainty, forms the subject of the first Serb novel, *Vladimir and Kossara*, as early as the 13th century. Vladimir, who seems to have been a noble-minded man, was murdered by Samuel's successor, the usurper Tsar Vladislav (1015). By the Christians of both churches in Albania he is to this day venerated as a saint. But after the death of Samuel the Bulgarian power rapidly lost the Serb provinces, which, to get rid of the Bulgarians, again acknowledged the Greek overlordship. About 1042, however, Prince Voislav of Travuniya (Trebinje), cousin of the assassinated Vladimir of Zeta, started a successful insurrection against the Greeks, and united under his own rule Travuniya, Zahumlye (the modern Herzegovina) and Zeta. His son Michael Voislavich annexed the important Zhupaniya of Rashka (Rascia or Rassia), and in 1077 was addressed as king (rex) in a letter from Pope Gregory VII. His son Bodin enlarged the first Serb kingdom by annexing territories which up to that time were under direct Greek rule. After Bodin's death the civil wars between his sons and relatives materially weakened the kingdom. Bosnia reclaimed her own independence; so did Rashka, whose Grand Zhupans came forward as leaders of the Serb national policy, which aimed at freedom from Greek suzerainty and the union of all the Serb Zhupaniyas into one kingdom under one king. The task was difficult enough, as the Byzantine empire, then under the reign of the energetic Manuel Comnenus, regained much of its lost influence. About the middle of the 12th century all the Serb Zhupaniyas were acknowledging the suzerainty of the Byzantine emperors.

The Nemanyich Dynasty and the Serb Empire.—A change for the better began when Stephen Nemanya became the Grand Zhupan of Rashka (1159). He succeeded in uniting all the Serb countries except Bosnia under his rule, and although he never took the title of king, he was the real founder of the Serb kingdom and

of the royal dynasty of Nemanyich, which reigned for nearly 200 years. His youngest son, Prince Rastko, secretly left his father's court, went to a convent in Mount Athos, where Stephen Nemanya died as the monk Simeon at Chiliandarion in 1200, became a monk, and afterwards, under the name of Sava, the first archbishop of Serbia. As such he established eight bishoprics and encouraged learning. He is regarded as the great patron of education among the Serbs, as a saint, and as one of the greatest statesmen. After Stephen Nemanya and Sava the most distinguished members of the Nemanyich dynasty were Stephen Urosh I. (1243–76), his son Milutin (1281–1321) and Stephen Dushan[1] (1331–1355). Urosh married Helen, a daughter of the exiled Latin Emperor of Constantinople, Baldwin II., and through her kept friendly relations with the French court of Charles of Anjou in Naples. He endeavoured to negotiate an alliance between Serbs and French for the partition of the Byzantine empire. His son Milutin continued that policy and increased his territory by taking several fortified places from the Greeks; but later he joined the Greeks under the emperor Andronicus against the Turks. Milutin's bastard's son, Stephen Dushan, was a great soldier and statesman. Seeing the danger which menaced the disorganized Byzantine empire from the Turks, he tried to prevent the Turkish invasion of the Balkan peninsula by replacing that empire by a Serbo-Greek empire. He took from the Greeks Albania, Epeiros, Thessaly and Macedonia (excepting Salonika). Towards the end of 1345 he proclaimed himself "emperor of the Serbs and the Greeks," and was solemnly crowned at Skoplje on Easter Day 1346. At the same time he raised the archbishop of Ipek (Petch), the primate of Serbia, to the dignity of patriarch. Three years later he convoked the *Sabor* (parliament) at Skoplje to begin a codification of the laws and legal usages. The result was the publication, in 1349, of the *Zakonik Tsara Dushana* (Tsar Dushan's Book of Laws), a code of great historical interest which proves that Serbia was not much behind the foremost European states in civilization. In 1355 Dushan began a new campaign against the Greeks, the object of which was to unite Greeks, Serbs and Bulgars and prevent the Turkish power taking root on European ground. While making preparations for a siege of Constantinople he died suddenly at Deabolis on Dec. 20, 1355. Under his only son Stephen Urosh V., a young man of nineteen, his brother Simeon Urosh and some of the powerful viceroys of Dushan's provinces made themselves independent. The most prominent amongst them was Vukashin, who proclaimed himself king of Macedonia. He wished to continue Dushan's policy and to expel the Turks from Europe, but in the battle on the Maritza on Sept. 26, 1371, his army was destroyed and he was slain. Two months later Tsar Urosh died, and the rule of the Nemanyich dynasty ended.

The Turkish Invasion: Kosovo.—After a few years of indecision and anarchy the Sabor met at Ipek in 1374 and elected Knez (count) Lazar Hrebelyanovich, a kinsman of Urosh, as ruler of the Serbs. He tried to stop the further disruption of the empire and to organize a Christian league against the Turks. This was the real cause of the Turkish attacks on Bulgaria and Serbia in 1389, which resulted in the subjugation of Bulgaria and in the defeat of the Serbs at Kosovo (June 15, 1389). No event has made such a deep impression on the Serbs as the battle of Kosovo —probably because the flower of the Serb aristocracy fell in that battle, and because both the tsar of the Serbs, Lazar, and the sultan of the Turks, Murad I., lost their lives. The Sultan was killed by the Serb knight or voyvode Milosh Obilich (the later alteration of the inelegant Kobil "son of a brood-mare"). There exists a cycle of national songs—sung to this day by the Serb bards (*guslari*)—concerning this battle.

The Despotate.—After the battle of Kosovo Serbia existed for some seventy years (1389–1459) as a country tributary to the sultans but governing itself under its own rulers, who received from the Greek Emperor and bore the Greek title of "despot." The first despot was Tsar Lazar's eldest son, Lazar II, or "Stephen the Tall," who was an intimate friend of Sigismund IV., king of Hungary and emperor of the Germans. Being childless, Stephen appointed his nephew, George Brankovich, to be his successor. George worked to establish an alliance between Serbia, Bosnia and Hungary. But before such an alliance could be arranged, Murad II. attacked Serbia in 1437 and forced George to seek refuge in Hungary, where he continued to work for a Serbo-Hungarian alliance and organized an expedition, under the joint command of the Despot George and of Hunyádi János, which defeated the Turks in a great battle at Kunovitsa in 1444. The sultan was forced to restore all the countries previously taken. At the age of ninety George was wounded in a quarrel with the Hungarian governor of Belgrade, Michael Szilagyi, and died on Dec. 24, 1456. His youngest son Lazar III. succeeded him, but only for a few months. Lazar's widow Helena Palaeoliogina offered Serbia to the pope, hoping thereby the secure the assistance of Roman Catholic Europe against the Turks. Indeed, for a few months, a Roman Catholic prince, Stephen Tomashevich, son of the king of Bosnia, who had married Lazar III.'s daughter, was "despot" at the then capital of Semendria. But no one in Europe moved a finger to help Serbia, and Sultan Mohammed II. occupied the country in 1459, with the aid of the anti-Catholic Serbs, making it a pashalik under the direct government of the Porte.

For fully 345 years Serbia remained a Turkish pashalik, enduring all the miseries which that lawless régime implied (*see* TURKEY: *History*). But the more or less successful invasions of the Turkish empire in Europe by the Austrian armies in the 18th century—invasions in which thousands of Serbs always participated as volunteers—prepared the way for a new state of things.

1400–1909

The defeat of Kosovo reduced Serbia to a passive rôle: she looked on helplessly when the Turks overran Bulgaria (1393) and when Sigismund of Hungary's new crusade ended in the disaster of Nicopolis (1396). The Turks thus entrenched themselves firmly to the south and east, and all that Stephen Lazarević could hold was the country lying between the Danube, Save, Drina and Timok, as far south as Niš. Stephen paid tribute to the Sultan and served as his vassal at Angora (1402), afterwards escaping to Byzantium and receiving from Manuel II. the title of Despot. In this dignity he was succeeded in 1427 by his nephew George Branković, who married a Cantacuzene and maintained himself by alliance with the Eastern Empire and Hungary. King Sigismund seized Belgrade and forced George to transfer his capital to the Danubian fortress of Smederevo (Semendria), but compensated him with huge grants of land in Southern Hungary. Though he gave his daughter Mara in marriage to Sultan Murad (1433), George was attacked and expelled by the Turks in 1439 and only recovered his dominions thanks to King Ladislas of Hungary's victorious Balkan campaign in 1443. The Turkish triumph at Varna next year ended all hope of a general Christian Coalition, and the rest of George's reign is filled by precarious intrigue and negotiation with Turk, Hungarian and Venetian, with Skanderbeg and the new ruler of Hercegovina. George died at the age of 80 in 1456, in the same year that John Hunyády died after his successful defence of Belgrade against Mohammed II. George's son Lazar only survived him one year, the succession was disputed, and in 1459 Smederevo and all Serbia were finally overrun by Mohammed. The fall of Bosnia (1463) and of Hercegovina (1483) set the seal to Turkish predominance in the Balkans. The only fragments of Southern Slav territory to retain independence were the Ragusan Republic (Dubrovnik) and Montenegro. Under the Sultans Selim I. (1512–20) and Suleiman I. (1520–66) the Turks resumed the offensive northwards: in 1521 Belgrade was wrested from Hungary, and in 1526 the battle of Mohács broke Hungary's powers of resistance, and led to her partition. The numerous Serb colonies which had been formed along the Danube and in Southern Hungary after the conquest of Serbia, shared the fate of the Magyars: the Banat of Jajce, Syrmia and parts of Croatia and Dalmatia were also seized by the Turks, whose constant raids into Croat and Slovene territory forced the Habsburgs to organize the defensive Military Frontiers (*q.v.*).

[1] *Dushan* is a term of endearment, derived from *dusha*, "the soul," and not, as formerly believed by Western philologists, from *dushiti*, "to strangle."

Serbia Under Turkish Rule.—Serbia, like Bulgaria, felt the full weight of Turkish rule, for they were the direct road of strategic advance westwards. The Serbian aristocracy was wiped out—save in Bosnia, where it accepted Islam to save its lands and thus became a-national in feeling: the peasantry was bled mercilessly by the *haratch* (bloodtax), their children thus supplying the Turkish army with recruits and becoming the instrument of their own subjection. Only the Church kept the national spirit alive. In 1557 the grand Vizier Mohammed Sokolović, a native of Herzegovina, revived the Patriarchate of Peć (Ipek) in favour of his brother Makarij: and this See avoided the Hellenizing influences which submerged the Bulgarian sister Patriarchate of Ohrid. Native literature almost ceased to exist, though fragments of culture survived in the monasteries. During the 16th century Serb was still the *lingua franca* of the Peninsula, spoken by the local Begs and Pashas and freely used in correspondence between the Porte and Ragusa or John Zápolya of Hungary: this explains the attempt of the Slovenes, Primus Truber and Baron Ungnad, to win over to Protestantism the Balkan Slavs, and even the Turks, by issuing from Urach and Tübingen Slav books in Latin, Cyrillic and Glagolitic type. Under Turkish rule the Serbs were increasingly agricultural, Balkan trade being mainly in the hands of Vlachs and Ragusans. The mining industry was abandoned, and Sarajevo, Mostar and Novipazar grew in importance. Ragusan efforts declined rapidly after the earthquake of 1667: while colonies of exiled Sephardim Jews from Spain became prominent trading factors. In the 17th century there grew up a class of broken men, known as Hajduks, round whom popular legend and poetry centred: the most notable examples were in Montenegro (*q.v.*) and among the Uskoks (*q.v.*), of Dalmatia.

In the long war waged by the Habsburgs to recover Hungary, Croat and Serb soldiers played a great part in the Imperialist armies. It seemed as though Leopold I. might emancipate at least the western half of the Balkan Peninsula. In 1690 he issued a proclamation to the Christian population, urging them to rise against their oppressors and promising his protection: and on the strength of this the Patriarch, Arsen Crnojević, with 36,000 Serbian families, migrated to Hungary. Two charters assured their recognition as a nation, freedom of religion and the right to elect their patriarch and *voivode*. These privileges were not observed, Arsen's successors were not allowed to call themselves Patriarchs, and the office of *voivode* remained unfilled. But the tide of Serb emigration continued; in the 18th century the Serbs formed flourishing centres at Karlovci (Karlowitz), Novi Sad (Neusatz), Kikinda etc.; and in the repeopling of the Banat and Bačka under Charles VI. and Maria Theresa they played a part only second to the Germans.

The Treaty of Karlowitz (1699) restored all Hungary save the Banat to Habsburg rule: after Eugène's victories the Treaty of Požarevac (Passarowitz, 1718) not merely won back the Banat, but converted Belgrade and the northern portion of Serbia (known as the Šumadija) into an Austrian province. During the next 20 years the hopes of the whole race turned towards Vienna, and such culture as the Serbs possessed centered in the towns of southern Hungary and the Military Frontiers. But the constant diversions of western policy and the exhaustion following the long wars prevented the Habsburgs from extending their conquests farther southwards: and when in 1737 they renewed hostilities with Turkey, they suffered reverses and by the Treaty of Belgrade (1739) restored to the Porte all territory south of the Danube and Save. This, following upon the abortive rising in 1735 (due to non-fulfilment of the Leopoldine charter), increased the disillusionment of the Serbs, who henceforth turned their eyes increasingly towards Russia; numerous Serb colonies were founded north of Odessa by the Empress Elizabeth. In the Turkish war of 1769–74 Catherine the Great issued a manifesto to the subject Christian populations, while Austria remained inactive: and the Treaty of Kuchuk Kainardji (1774) formally recognised Russia's claim to champion Orthodox and Slav interests. In 1787, when Russia and Austria again made joint cause against Turkey, the Serbs formed irregular bands in the latter's service, and Loudon's capture of Belgrade was the chief exploit of the war. When foreign complications forced Leopold II. to conclude peace and restore Belgrade (1792), the Serbs again saw their hopes dashed: but a new spirit was stirring, and the Turkish commissioner who saw one of the fortresses evacuated by a well armed and drilled detachment of native Serbs, exclaimed in just alarm to the Austrians, "Neighbours, what have you made of our rayah?"

Serbia's War of Independence.—During the next decade the rapid decay of the central Turkish authority placed outlying provinces at the mercy of insubordinate and rapacious soldiers: in Serbia there was a sharp conflict between the Pasha of Belgrade, Hadji Mustafa, and the Janissaries quartered throughout the country. These latter allied themselves with Pasvan Oglu, the Pasha of Vidin, who successfully defied two sieges by regular Turkish armies (1796–98) and on his reconciliation with the Porte induced it to support the Janissaries against Mustafa, whose mildness had earned him the name of "Mother of the Serbs." Finally the four "Dahis," or military chiefs, murdered Mustafa in Dec. 1801, subjected Serbia to their lawless rule, and when the Serbs protested to Constantinople, organized a massacre of many of their foremost leaders (Feb. 1804). Fortunately a notable substitute was found in Karageorge (*q.v.*), who led an insurrection against the Dahis and decisively defeated the Pasha of Bosnia at Mišar in Aug. 1805, storming the citadel of Belgrade in the following December. Though at first the insurgents professed loyalty to the Sultan, the breach became irreparable when in March 1807 Suleiman Pasha and his 200 Janissaries, after having duly evacuated the fortress, were treacherously murdered on their way to the frontier. This was followed by the complete ejection of the Turks from the whole Pashalik of Belgrade. Kara George, combining in a primitive manner the functions of commander-in-chief and chief of state, summoned the first Skupština or assembly of notables, created a Senate on western models and laid the rudiments of administration and education. Finding his overtures to Vienna (through Archduke Charles and the Aulic War Council) rejected, he turned to Russia, and in July 1807 negotiated a convention with Rodofinikin, the first Russian agent in Belgrade. The young state gallantly cooperated with Russia in her war with the Porte, and the Treaty of Bucharest (1812) included clauses which are the first international recognition of Serbia, secured to her a limited autonomy and to Russia a permanent right of interference on her behalf. On the other hand, its reinstatement of Turkish garrisons in Belgrade and other fortresses was a bitter disappointment to the Serbs, who had hoped for complete independence. Moreover, the withdrawal of Russian forces in the south owing to Napoleon's Moscow campaign encouraged the Porte to attempt the reconquest of Serbia in the summer of 1813. By October all resistance was crushed, and Kara George forced into flight. But the new Pasha, Suleiman Skopljak, revived many of the worst features of the old regime, defied the Treaty and in Dec. 1814 beheaded or impaled nearly 200 of the younger notables. On Palm Sunday 1815, then, Miloš Obrenović (*q.v.*), again raised the standard of revolt. By August Serbia was virtually free, and Miloš by diplomatic tact and moderation secured his recognition by the Porte as "Supreme Chief" (Vrhovni Knez) of Serbia. He further reassured the Porte by arranging the secret assassination of Kara George, who had returned from exile in the hope of heading a movement for full independence. Thus began the long feud between two rival dynasties.

Serbia as Autonomous State.—In 1817 Miloš secured from the Skupština the recognition of his hereditary right, but this status was confirmed by the Sultan only in 1830, after the Convention of Akkerman (1826) and the Treaty of Adrianople (1829) had provided for Serbian autonomy on fuller lines than those laid down at Bucharest in 1812. The *hatti sherif* of 1830 still further defined that autonomy and in 1833 Miloš was able to occupy the Six Districts till then in dispute with the Turks. Turkish garrisons were retained in Belgrade, Šabac, Smederevo, Užice and two other places, and Turkish residents were henceforth restricted to these towns. In home affairs Miloš developed highly autocratic tendencies, opposed representative institutions and used his position to

enrich himself. In 1835, however, a serious conspiracy forced him to summon a Skupština, and though the new constitution which it voted never came into force owing to the hostility of the Porte and the Powers, another was promulgated by *hatti sherif* of the Sultan in 1838, instituting a Council of State or Senate and a Cabinet of four ministers. These years witnessed the curious spectacle of the two autocracies, Russia and Turkey, working to restrict the Prince's autocratic powers, while the Western Liberal Powers, Britain and France, favoured their extension. Fortunately the efforts of Palmerston's agents, Colonel Hodges and Lord Ponsonby, were unsuccessful. In 1839 Miloš was forced to abdicate and withdraw, and government was carried on by the so-called "Defenders of the Constitution" (Ustavobranitelji), led by Vučić and Petronijević, first in the name of Miloš's eldest son Milan, and on his death a month later, of the second son Michael (*q.v.*). In 1842 Michael also was abandoned by the army and popular feeling and driven into exile. The Skupština, instead of electing Thomas Vučić as he himself had hoped, now summoned to the throne Alexander, son of Kara George, a man of mediocre ability and weak will. The hostility of Tsar Nicholas delayed recognition for many months, but in June 1843 a newly elected Skupština unanimously confirmed the election of Prince Alexander.

Alexander Karageorgjević.—The new reign was a period of growth and transition, in which a civil code was promulgated (1844), the judicial system completed (1846), a state printing press set up, the National Museum and Serbian Scientific Society founded. Primary and secondary education was encouraged, and an increasing number of young Serbs began to visit French and German universities. The publication of Vuk Karadžić's version of the New Testament (1847) was a landmark in literary progress: and his great services in collecting popular tales, ballads and proverbs and issuing the first scientific Serbian grammar and dictionary were crowned by his philological reforms and a new phonetic Serbian orthography, which, following parallel lines with Gaj's revision of Croat orthography, made Serbo-Croat literary unity a reality and thus laid the basis for political unity.

In foreign policy Alexander leaned towards Austria. The racial war in Hungary which followed the revolution of 1848 (*see* Hungary and Croatia-Slavonia) caused great excitement in Serbia, numerous volunteers flocking across the river to help their Serb kinsmen against the Magyars—notably the Senator Stephen Knićanin. There were close confidential relations between Alexander, the Patriarch Rajačić and Meyerhofer, the Austrian Consul-General, who afterwards became governor of the autonomous *Vojvodina* established by Austria (1849–59). The Prince's chief minister Garašanin, an enthusiast for Western culture, but also infected by the Slavophil ideas current in Prague, travelled to the Court of Napoleon III. to appeal for French help, but Tsar Nicholas regarded him as a pupil of Kossuth and Mazzini and forced his dismissal upon the reluctant Prince. In the Crimean War Serbia found it difficult to choose between her suzerain and her protector, and maintained an uneasy armed neutrality which at least prevented an Austrian occupation. The Treaty of Paris (1856) brought Serbia one stage nearer to independence: she was now placed under a special guarantee of the signatory Powers, and was assured full autonomy in administration, legislation, religion and trade. The Turkish garrisons remained, but armed interference in Serbian affairs was henceforth forbidden, save by consent of the Powers (§ 21). Thus a quite illogical situation arose, in which the sovereign rights of the Porte were restricted by the Powers, who substituted a virtual protectorate of their own for that of Russia.

The Return of Miloš and Michael.—In 1858 discontent against Alexander's weak rule culminated in an attempt of the oligarchy to establish a kind of *Kaimakamate* or regency. But the new Assembly through which they hoped to secure this result, was almost as hostile to Vučić and his friends as to the Prince, and in December, after proclaiming Alexander's deposition, promptly recalled Miloš Obrenović, who skilfully secured the Porte's approval before returning. The leading oligarchs were imprisoned, and Vučić died in prison under suspicious circumstances. Miloš, now nearly eighty, governed as highhandedly as ever, but was quick enough to check any encroachments on the part of the Porte. In September 1860 he was succeeded by Michael, Serbia's ablest modern ruler, who introduced more Western methods of government, but set himself to strengthen the princely power: by the new Constitution of 1861 he had the right to nominate and dismiss members of the Council, and ministers were responsible to him and to it jointly, not to the Skupština. Helped by a French officer, Captain Mondain, as Minister of War, he completely reformed the Serbian army, and in 1862 when the Turks in the fortress of Belgrade bombarded the town, he pressed the question of complete evacuation upon the Powers. The opposition of Britain and Austria postponed a solution, though the Turkish garrisons were reduced to four and the Turkish civil population withdrawn from Serbia. But in 1867 (Austria having lost prestige after the war of 1866 and Stanley following less Turcophil lines than Russell) the Powers persuaded the Porte to hand over the four fortresses, though the Turkish flag was still to fly beside the Serbian. Michael meanwhile pursued far-reaching designs of policy, negotiated with Kossuth and Cuza, worked out plans with the exiled Bulgarian committee for a joint Serbo-Bulgarian state, corresponded with the Croat and Serb leaders in Habsburg territory and concluded secret alliances with Montenegro, Greece and Rumania, for joint action against the Turks. These ambitious dreams suddenly collapsed on June 10, 1868, when Michael was murdered in the park of Topčider, outside Belgrade, by adherents of the rival dynasty.

Prince Milan and the Eastern Crisis.—The conspiracy failed, and Michael's cousin and only male heir, Milan (*q.v*), was elected Prince at the age of 14. The Regency, led by Blaznavac, the Minister of War, and Jovan Ristić, governed till Milan's majority in 1872. The new constitution which it introduced in 1869, by abolishing the senate and giving wider powers to the Skupština, was a step towards parliamentary government: but in certain directions the princely power was still further entrenched, and the demand for constitutional revision dominated internal politics during Milan's reign. In foreign policy the regency showed Austrophil leanings, but the visit of Prince Milan to the Tsar at Livadia in Oct. 1871 marked a turn in favour of Russia. Milan, a man of real ability, but a neurasthenic, lacking in morals or powers of endurance, failed to win the affection of the nation, preferred the amusements of Paris or Vienna, and saw his dynasty steadily losing ground. The Bosnian insurrection of 1875 (whose leaders aimed at union with their kinsmen in Serbia and Montenegro), and the resultant European crisis aroused intense excitement in Serbia, and the prince would have risked his throne had he left the insurgents to their fate. In May 1876 the Liberal cabinet concluded an alliance with Montenegro, and answered the Porte's refusal to entrust Milan with the administration of Bosnia-Hercegovina, by declaring war. But the Serbian army, though swelled by Russian volunteers and led by a Russian general, was ill prepared and unable to resist the Turks, whose victory at Aleksinac forced the prince to appeal to the tsar's protection. Turkey only consented to grant Serbia an armistice after Russia had addressed an ultimatum to the Porte (October) and Serbia's position remained in suspense during the Conference of Constantinople (December), but after its failure she found it necessary to conclude peace with Turkey on the basis of the *status quo* (March 1, 1877) and thus was reduced to a passive rôle throughout the critical period of the Russo-Turkish War. On Dec. 15, five days after the fall of Plevna, Milan again declared war upon Turkey, but was coldly received by the Russians, who were now much more interested in Bulgaria than in Serbia. Hence the Treaty of San Stefano, imposed by victorious Russia on March 3, 1878, provided a purely "Big Bulgarian" solution of the Balkan problem, Serbia acquiring only Niš and Pirot, and Bosnia-Hercegovina being reserved for special autonomy. The opposition of the Great Powers prevented the enforcement of San Stefano, and the Congress of Berlin decided the fate of the Balkans for another generation. Serbia saw her Bosnian kinsmen, for whom she had unsuccessfully

waged war, assigned by European mandate to Austria-Hungary, who also obtained the right of garrisoning the Sanjak of Novipazar, thereby securing her strategic line of advance upon Salonica and separating Serbia from Montenegro. Serbia herself obtained only the recognition of full independence, and the right to annex Niš, Pirot and Vranje, Austria vetoing her possession of Kosovo and "Old Serbia," and Russia not merely opposing her exaggerated claim to Vidin, but wishing to assign Niš to Bulgaria. The Russian delegates at Berlin, Gorchakov and Shuvalov, received Ristić with indifference and urged him to come to terms with Austria-Hungary. Ristić, completely disillusioned at the failure of a Russophil policy, resigned office in 1880, and Milan henceforth looked to Vienna.

Serbia and Austria-Hungary.—On June 28, 1881, a secret alliance for ten years was signed between Serbia and Austria-Hungary, by which the former undertook not to conclude any political treaty without Vienna's previous consent, and to prevent on her territory any "political or religious agitation" against the Dual Monarchy. The latter, in return, promised to use "her whole influence" in favour of the Obrenović, to recognise Serbia as a kingdom, and in the event of fresh Balkan complications to sanction her expansion in the Vilayet of Kosovo and Central Macedonia, though not in Novipazar. Behind the back of the Premier Piroćanac, Milan gave a still more explicit personal pledge and offered Haymerle a secret declaration "in whatever terms you care to notify to me, and annulling completely the effect of" the Premier's qualifying note. Milan's dealings with the court of Vienna are among the most humiliating incidents in Serbian history. They culminated in May 1885 in a contingent offer to withdraw from Serbia in favour of the Habsburgs and a request that in the event of his own death Austria-Hungary should prevent his son Alexander from mounting the throne as a minor, and should take charge of his education, or if she could not obtain possession of his person, should occupy Serbia by force of arms. Neither Kálnoky nor Francis Joseph responded, rightly regarding the offer as the outcome of an unbalanced mind.

Serbia Under King Milan.—On Feb. 22, 1882, the Skupština proclaimed Serbia a kingdom. But the internal situation remained unsatisfactory. The compensation to Turkish landlords in the new territory, and the building of railways, under the terms of the Berlin Treaty, necessitated foreign loans, and hence increased taxation. An attempt was made on Milan's life in 1882, and in 1883 there was an abortive rising at Zaječar, which was used as a pretext for savage measures of repression against the newly formed Radical Party. Milan by his favouritism and personal policy envenomed the party struggle, and the scandals of his private life and his undignified quarrel with Queen Natalie undermined the prestige of the dynasty. Serbia's rash and unprovoked attack upon Bulgaria, after the union of Eastern Rumelia in 1885, was mainly the work of Milan himself, who hoped to regain popularity by foreign conquest and regarded Bulgarian unity as a blow to the Balkan balance of power. The Serbian advance on Sofia was suddenly arrested by Prince Alexander's victory at Slivniča: the Bulgarian army in its turn invaded Serbia and thanks to unpreparedness, bad leadership and panic on the Serbian side, would probably have entered Belgrade, had not Austria-Hungary threatened armed intervention. Kálnoky explained to his German ally, who feared increased Austro-Russian friction, that he had acted not for the sake of Serbia or Milan, but on account of the moral effect upon Serbia's kinsmen inside the Dual Monarchy. The Treaty of Bucharest (March 1886) restored the *status quo,* but Serbia's prestige in Europe was effectually eclipsed for over two decades. King Milan's personal situation was undermined, and the divorce scandals of 1888 were the last straw. In the winter of that year he initiated a new and more liberal constitution (Dec. 22, 1888—N.S. Jan. 5, 1889), which provided for an extended franchise, closer parliamentary control, irremovability of judges and liberty of the press. From Milan's point of view this was devised as a *beau geste,* such as might rehabilitate the dynasty in popular favour. It was followed by his abdication (March 1889) in favour of his only child Alexander, then only 13: and a regency was formed by the veteran Ristić, with Generals Protić and Belimarković. A month before withdrawing from Serbia, Milan renewed the secret treaty with Austria-Hungary for another six years: as redrafted, it pledged the latter to protect the Obrenović dynasty, especially against "hostile incursions directed from Montenegro," and in the event of a Balkan upheaval to support Serbia's "territorial extension" southwards. Her definition of this as meaning "the valley of the Vardar as far as circumstances shall permit," amounted to the endorsement of Serbian as against Bulgarian claims in Macedonia.

King Alexander.—The regents, despite their own conservative leanings, found it necessary to entrust power to the Radical Party, under General Sava Grujić, which had a strong majority behind it: and its first achievement was to improve Serbian finances, reducing the deficit from 14,000,000 dinars in 1889 to 4,000,000 in 1890 and to 686,000 in 1891. But internal progress was still delayed by the constant interference and public wrangling of Milan and Natalie, and even after the ex-king's solemn renunciation had been endorsed by parliament (March 1892) he plotted in the background, with Austrian backing. The party struggle between Radicals and Liberals had reached a deadlock, when on April 14, 1893, the young king, by a sudden *coup d'état* ejected the regents, proclaimed himself of age and superseded the Liberal cabinet by one drawn from the moderate Radical wing. As, however, its first act was to impeach some of its predecessors, party feeling ran as high as ever, and turned into anti-dynastic lines. Alexander, whose character bore traces of a hereditary taint and whose education had suffered fatally from his parents' misconduct, grew up suspicious, callous and arbitrary. Early in 1894 he recalled Milan from his Parisian amusements, and on his advice suspended the constitution of 1889, reestablishing the more reactionary one of 1869. The Radicals went into violent opposition, but the situation was temporarily saved by a cabinet under the Progressive leader Stojan Novaković, whose position was however undermined by the King's refusal to sanction his project of constitutional reform, on a two-chamber basis, and also by friction with Austria-Hungary, the secret treaty with whom lapsed in 1895. At the elections of 1897 the Radicals maintained their majority, but Alexander refused to call them to power and formed a Cabinet under Dr. Vladan Gjorgjević, the doctor and intimate friend of King Milan, and known as a pronounced Russophobe. Milan was appointed commander-in-chief, and though he increased the army by one-third, and worked hard at its reorganization, his methods of favouritism did much to introduce the spirit of faction and conspiracy into the officers' corps. An attempt on his life in 1899 was used as a pretext for drastic measures against all the Radical leaders, some of whom, without serious proof, were sentenced to banishment or hard labour.

The End of the Obrenović Régime.—Dr. Gjorgjević's efforts to secure the succession by finding Alexander a wife from some reigning dynasty were checkmated by the King's rash decision in the summer of 1900 to marry his mistress Draga Mašin (née Lunjevica), the widow of a Czech engineer, a woman much older than himself. This decision led to a final breach between Alexander and Milan, who ended his dissolute existence at Vienna early in 1901: it led the Gjorgjević cabinet to resign out of protest at so suicidal a step: it was keenly resented in the country and isolated the dynasty in Europe. Emancipated from his father's influence in foreign policy, Alexander now flung himself into the arms of Russia and in return induced the Tsar to stand sponsor at his marriage. But at home he was the object of universal aversion, and only made matters worse by dabbling in illegal political experiments. In April 1901 he promulgated a new constitution, based on an adaptation of the Novaković project, establishing a second chamber and guaranteeing liberty of the press and of association. But in the winter of 1902 he reverted to open reaction, appointed General Cincar Marković premier, and in April 1903 suddenly suspended his own Constitution, removed all the officials and senators appointed under it, dissolved both Chambers and then declared the Constitution to be once more valid. In June new elections were conducted under such official terrorism that the whole opposition held aloof. The

country was full of unrest, wild rumours circulated, and it was widely believed that Queen Draga intended to secure the succession for her two brothers. Prompted by this untenable situation, a widespread military conspiracy was hatched, and on June 10, 1903, Alexander and Draga were assassinated in the palace of Belgrade, under peculiarly atrocious circumstances. Draga's two brothers, the Premier and the Minister of War shared the same fate. The details of the plot had been worked out in a well-known café in Vienna, and there is reason to believe that both the Austro-Hungarian and Russian Governments were aware of what was on foot, but allowed matters to take their course.

Serbia After the Murders of 1903.—The Obrenović régime was held in such universal odium in Serbia that the removal of its last representative, and hence of the old and grievous dynastic feud, was greeted with relief rather than horror. The regicides at once formed a cabinet representing all parties, reestablished the constitution of 1901 and convoked parliament for June 15. It unanimously elected Prince Peter Karageorgević, son of the ex-Prince Alexander to the vacant throne, and then restored the constitution of 1889, acknowledged as the most liberal of all those under which Serbia had been governed. Thus the shortlived senate disappeared, the franchise was extended, and the practice of tampering with such fundamental institutions as the bench, the press and the right of assembly received a salutary check. The new king found himself in a position of extreme delicacy, for the regicides were at first all-powerful politically. Austria-Hungary and Russia, indeed, at once congratulated him on his accession, but in Dec. 1903 all the Powers represented at Belgrade protested against the Government's weak attitude towards the regicides, and it was not till 1906 that a British Minister was appointed to return to Belgrade. The sinister incident of the murder of the Novaković brothers in the Belgrade state prison caused a reaction of feeling against the regicides, and the Radical Party, predominant since the murder, split into two sections, the Old and the Young, the former evolving steadily towards extreme conservatism. Their chief merit was a further reform of the finances; in 1903 there had been a deficit of 11,500,000 dinars, in 1904 and 1905 there were surpluses of 6,500,000 and 4,700,000. Under Dr. Paču as finance minister confidence revived both at home and abroad.

In foreign policy the Radicals concluded in June 1905 a customs convention with Bulgaria, which was intended to lead to a political alliance and common action in the Balkans. But it was prematurely disclosed (probably by the deliberate design of Prince Ferdinand) just as negotiations between Vienna and Belgrade for a new commercial treaty were nearing the final stage. Early in 1906 Austria-Hungary peremptorily vetoed Serbia's ratification of the Bulgarian agreement, and when the Government demurred, broke off the Austro-Serbian negotiations and closed her frontiers to Serbian imports. The result was a prolonged tariff war, due largely to the increased political influence of the Agrarians both in Austria and Hungary and their desire to prevent Serbia from extending her market for livestock and agricultural produce in Vienna and other cities. Serbia was also embarrassed by Austria-Hungary's further demand that she should order the guns and munitions which she required, at the Škoda works rather than in Western countries. This too was firmly resisted, and the orders were placed with Schneider-Creusot. In the end Serbia was surprisingly successful in finding fresh markets, *e.g.*, in Egypt: in the first year of the tariff war her foreign trade only diminished by 300,000 dinars, in 1907 it had again increased by 10,000,000 dinars, and after a drop in 1908, which was still inferior to the pre-war figure, it continued to grow steadily, keeping pace with improved finances.

The Bosnian Crisis.—The "Pig War" touched every Serbian peasant in his pocket, and was a heavy blow to such Austrophil sentiments as still lingered. Friction between Serbia and Austria-Hungary became more acute when in October 1908 Baron Aehrenthal proclaimed the annexation of Bosnia-Hercegovina, without consulting the other signatories of the Treaty of Berlin, on which Austria-Hungary's mandate of occupation rested. During the prolonged international crisis that followed (Oct. 1908–March 1909), excitement in Serbia became intense, and the wilder spirits clamoured for war against the Dual Monarchy. After a secret session of the Skupština, the Foreign Minister, Dr. Milovanović, undertook a mission to the courts of Europe and pressed Serbia's claim for the cession of a strip of territory linking up Serbia with Montenegro and with the Adriatic and securing the much needed independence for her commerce. Popular sentiment had never abandoned the hope of union with the Serbs of Bosnia, but the Government retained sufficient sanity to frame its demands within the limits of the possible. Austria-Hungary, however, though while annexing Bosnia she had simultaneously evacuated the Sanjak (partly to prevent Italy from claiming compensation under Clause 7 of her alliance) resolutely refused any territorial concession to Serbia, declining also to enter an international Congress until the Powers stood committed to endorse the annexation. Serbia received encouragement from Russia, one aspect of the crisis being the acute rivalry between the two Foreign Ministers, Aehrenthal and Izvolsky, who regarded himself as having been duped at their Buchlau meeting in September 1908. In January 1909 Milovanović declared in the Skupština that the Bosnian question was one of European interest, that Austria-Hungary's Balkan mission was ended and that she must not drive Serbia to despair. The war fever grew, Austria-Hungary mobilised and a very dangerous situation had arisen when Russia, yielding to a German ultimatum, recognised the annexation and advised Serbia to submit. On March 31, 1909, on the collective advice of the Triple Entente and Italy, she addressed a Note to Vienna, recognising "the fait accompli created in Bosnia" as "in no way affecting her rights." A few days earlier Crown Prince George, who had been the soul of the war party, abdicated his right of succession, owing to the report that he had mortally injured his valet in a fit of passion: his younger brother Alexander thus became Heir Apparent.

(R. W. S.-W.)

THE WAR ERA

The Balkan League.—The annexation of Bosnia marked a turning-point in Serbian history. Henceforth public opinion, supported by prominent statesmen in every party, was practically unanimous in regarding a conflict with Austria-Hungary as sooner or later inevitable. Aehrenthal's policy inevitably strengthened the tendencies towards the creation of a Balkan League, and these were accelerated by the political unrest evoked throughout the Balkan peninsula by the Young Turk revolution. At first the inclusion of Turkey in such a league was openly advocated by Russia, and favoured by Milovanović and Venizelos. But the increasing chauvinism of the Young Turks in Macedonia led Venizelos to discuss with Bulgaria measures of common defence against a possible Turkish attack. Negotiations followed between Sofia and Belgrade in the winter of 1912. Secret treaties of alliance were concluded on March 13, 1912, between Serbia and Bulgaria and on May 29 between Bulgaria and Greece. There was no actual treaty binding Serbia and Greece, while the Serbo-Montenegrin treaty, concluded in Sept. 1912, was less political than military, and provided for separate though parallel action.

By the first of these each State was bound to assist the other with all its forces in the event of an attack, and in particular in the event of any Great Power trying to annex any portion of Turkey's Balkan possessions. If internal troubles should arise in Turkey, either ally might initiate proposals for military action, and any point upon which agreement was not reached should then be referred to Russia for decision. Special provision was made for possible conquests, Serbia recognizing Bulgaria's rights over the territory lying east of the Rhodope mountains and the Struma river, and Bulgaria similarly recognizing Serbia's rights north and west of the Šar mountains. The districts lying between these limits, the Aegean and the Lake of Okhrida were to form "a distinct autonomous province," but should their partition prove inevitable, then Serbia undertook to make no claim beyond a line drawn from the Lake of Okhrida to near Kriva Palanka on the old Turco-Bulgarian frontier and including Skoplje, but not Monastir, Prilep or Veles. In the event of a dispute the

tsar was to act as arbitrator, and Bulgaria undertook to accept the more southerly line as its new frontier with Serbia if the tsar should decide in its favour. In the event of war Bulgaria undertook to place at least 200,000, Serbia at least 150,000 men in the field against Turkey. If either Turkey or Rumania attacked Bulgaria, Serbia was to send 100,000 men to her aid, while she on her part must provide 200,000 men in support of Serbia in the event of an attack by Austria-Hungary.

Internal disorder spread rapidly throughout Turkey-in-Europe after 1911; and the repressive policy adopted by the Committee of Union and Progress towards all non-Turks culminated in a reign of terror at the parliamentary elections of 1912, a recrudescence of Komitadji activities and a fresh Albanian rising. The premature death of Milovanović on July 1 both deprived Serbia of her ablest modern statesman, and removed one of the few restraining influences in any Balkan capital. On Sept. 12 Pašić, who placed almost unreserved reliance on Russian support, became premier at the head of a purely Old Radical cabinet.

Nothing could now have arrested the growing anarchy in Turkey. Public opinion in Belgrade and Sofia was roused by a massacre of Bulgarians at Kočana on Aug. 1. By the middle of the month Skoplje, and the entire district recognized by the secret treaty as Serbian, were in the hands of the insurgent Albanians. The proposals for reform put forward by Count Berchtold on Aug. 20 prompted the Balkan Allies to hasten their preparations, and before the Powers had taken any collective action, they mobilized almost simultaneously (Oct. 1). At the last moment the Porte announced its intention to enforce the Vilayet Law of 1880, which had from the first remained on paper. Soon after, the Powers addressed a conciliatory Note to Constantinople and simultaneously warned the Allies that even in the event of their victory no change in the territorial *status quo* would be tolerated. The four allies decided to precipitate events, and before any further Note could reach them, the King of Montenegro, by an act of undoubted collusion, declared war upon Turkey. On Oct. 13 the other three Balkan Governments presented to the Porte a series of far-reaching demands, culminating in racial autonomy for all the nationalities of the Ottoman Empire; and four days later the Turks, without even deigning to answer the note, declared war on Serbia and Bulgaria (*see* BALKAN WARS).

The First War.—The rapid and overwhelming success of the Allies radically transformed the situation. By the end of Nov. Turkish rule in Europe was restricted to the Chatalja lines, the Gallipoli Peninsula and the three fortresses of Adrianople, Janina and Scutari. The Serbs in particular, after the victories of Kumanovo and Monastir, were in actual occupation of all Macedonia west of the Vardar and had reached the Adriatic at Durazzo and Medua.

Kumanovo was much more than an ordinary victory. It restored to Serbia that self-confidence which had been so gravely shaken by the rebuffs and scandals of the previous 30 years; and throughout the Yugoslav provinces of Austria-Hungary it was hailed as an atonement for Serbia's downfall on the field of Kosovo and as a pledge of her new mission as the Southern Slav Piedmont. Austria-Hungary at first adopted a waiting attitude, but as the Serbs approached the Adriatic she suddenly ordered a general mobilization, and suppressed all public expressions of feeling, while the official press of Vienna and Budapest adopted a menacing tone towards Serbia. Great prominence was given to the alleged insults offered to Prochaska, Austro-Hungarian Consul at Prizren, and for some weeks public opinion was allowed to believe that he had been shamefully mutilated by Serbian officers. It only transpired long after that Prochaska had been entirely unmolested by the invaders, but had received definite instructions from Vienna to create an "incident" such as might provide a pretext for action. The Austro-Hungarian Chief of Staff and War Minister, Generals Conrad and Auffenberg, are known to have favoured a radical solution of the Southern Slav question by immediate war with Serbia; and similar views were held by the leading Ballplatz officials, Macchio, Kanya and Forgács. But both the emperor and Francis Ferdinand were averse to war, and Germany, finding Italy restive as to any change in the Balkan *status quo*, exercised a moderating influence over Vienna in connection with the fourth renewal of the Triple Alliance (Dec. 7).

Meanwhile, the success of the Balkan Allies, and the general relief with which public opinion hailed the downfall of Turkish rule in Europe, led the Powers to accept the accomplished fact. The Turks, seeing themselves isolated in Europe, made overtures of peace as early as the 11th to King Ferdinand, who was not willing to consider them until his troops had been checked before Chatalja.

The Conference of London.—The armistice of Dec. 3 was followed by a peace conference in London on Dec. 16, at which Serbia was represented by Novaković, Nikolić and Vesnić. After a month of fruitless negotiations, complicated by a revolution in Constantinople, the Balkan Delegates broke off the negotiations on Jan. 28. The Council of Ambassadors initiated by Sir Edward Grey continued to sit in London, and devoted especial attention to the Albanian problem and to the friction produced between Albanians and Serbs by the latter's presence on the Adriatic.

When war was resumed on Feb. 3 the brunt fell upon Bulgaria, and the Serbs, being complete masters of Macedonia, were free to contribute 47,000 men and a siege train of 38 guns to the operations against Adrianople, which held out until March 26. The dispute which arose as to whether Shükri Pasha had surrendered to the Bulgarians or to the Serbs was in itself quite unprofitable but was a symptom of the friction which was daily increasing between the two allies. The final phase of the war concentrated round Scutari, which Montenegro and Serbia made desperate efforts to reduce. Even the announcement that the Council of Ambassadors had definitely assigned Scutari to the new Albanian state, only strengthened the resolve of King Nicholas to create a fresh *fait accompli*. But Austria-Hungary upheld her veto, and on March 20 addressed a severe note to Montenegro and dispatched a strong naval squadron to the Southern Adriatic. Realizing the danger of Austro-Hungarian intervention, the Powers on March 31 joined Vienna in ordering Montenegro to cease hostilities, and on her refusal established a naval blockade of her strip of coast. On April 23 Scutari surrendered to the Montenegrins, but the Powers, after a crisis of some weeks, eventually compelled the Montenegrins to surrender it to Admiral Burney, as commander of the international fleet.

Negotiations were resumed in London on May 20. By the Treaty of London (May 30, 1913) Turkey ceded to the four allies conjointly the island of Crete and all territory lying to the west of the Enos-Midia line, while the settlement of Albania and the Aegean Islands was referred to the Great Powers.

The Second Balkan War.—The Balkan Allies were now faced by the thorny problem of dividing the spoils. Macedonian autonomy, which the treaty had laid down as the ideal solution, was from the first abandoned by all parties. Between Bulgaria and Greece there was no territorial bargain, and no obvious means of reaching one, while Serbia as early as Jan. 23 formally raised the question of a revision of the Serbo-Bulgarian treaty. She claimed compensation for four reasons: (1) that she had furnished her ally with military support far in excess of her bargain; (2) that she had absolved Bulgaria from her military obligations in Macedonia; (3) that she had loyally continued the war three months after her own work was done; and (4) that the acquisition of Adrianople by Bulgaria radically modified the basis upon which the bargain rested. But if her attitude can be justified, it must be on the broader ground that Austria's veto on her obtaining a port in Northern Albania had upset her whole basic calculation, leaving the Vardar valley her only possible alternative outlet; and this involved her retention of Veles, Prilep, Monastir and Okhrida as well as the "disputed zone."

While Russia strained every effort to avert a conflict, Bulgaria was encouraged by the openly Serbophobe tone of the official press in Vienna and Budapest; and King Ferdinand had already ordered General Savov to hasten the transference of the army from the Thracian to the Macedonian front, when on May 27, Pašić, under pressure from the Serbian Opposition, publicly committed his Government to the demand for treaty revision. This hastened the resignation of the pacific Gvešov. His successor Danev opposed the

suggestion that the Premiers should meet at St. Petersburg, contended that Russia had already prejudged the case by even considering revision, and relied increasingly upon Austria-Hungary. Serbia and Greece, realizing the danger, concluded first a military convention, and then a definite treaty of alliance for ten years (June 1). While the first of these provided for mutual military support in case of a Bulgarian attack upon either ally, the second extended the *casus foederis* to an attack by a third Power. Both the wording and the events of the moment make it clear that the intention was to guard against an Austro-Hungarian attack upon Serbia.

The tsar's personal appeal to the kings of Serbia and Bulgaria in the name of "the Slav Cause," fell on deaf ears (June 8). On June 13 Bulgaria rejected the proposal of the Powers in favour of parallel demobilization, and her attitude stiffened still further after the speech of the new Hungarian premier, Count Tisza, who emphasized the right of the Balkan States to settle differences in their own way—*even by war*—and declared that Austria-Hungary could not allow any other Power to acquire special prerogatives in the Peninsula (June 19).

Danev rejected Russia's fresh proposals for a compromise and reiterated the demand for the joint occupation of Macedonia. With Sazonov's sharp reply bidding Bulgaria to expect nothing more from Russia, St. Petersburg's influence over Sofia ended. On the night of June 29, without previous declaration of war, the Bulgarian armies made an almost simultaneous attack upon the Serbs and Greeks in the hope of seizing and holding the coveted districts of Macedonia until the foreign intervention which King Ferdinand believed to be imminent settled the dispute on a basis of *beati possidentes*. This is borne out, not merely by captured dispatches, but by the fact that when Putnik's forces everywhere held their own, Savov on July 1 telegraphed the order to stop hostilities. But that very afternoon the Serbian counter-offensive opened, and after a desperate struggle of nine days on the Bregalnica front (July 1–9), the Bulgarians were obliged to abandon the whole Ovčepolje, the strategic key to central Macedonia.

The Treaty of Bucharest.—By July 17 the Serbs had forced back the Bulgarians at all points to the frontier of 1912, and could henceforth adopt a mainly defensive attitude, while Greeks, Rumanians and Turks continued to advance. The appeals of Sofia to the Powers to enforce upon Turkey respect for a treaty concluded under their auspices were disregarded; and Western public opinion was not inclined to save Bulgaria from the consequences of her own act. Meanwhile Austria-Hungary was held back from intervention by both her allies—Italy, who viewed with alarm the Balkan activities of any outside Power and was determined to insist upon compensation, and Germany, who feared the loss of Rumania for the Triple Alliance and the consequent derangement of the military balance in Europe. Italy indeed made it clear to Vienna that she would not recognize the *casus foederis* of the Triple Alliance as applicable to such a case; and the combined pressure of Rome and Berlin, coupled with the certainty of Russian aid to Serbia, again averted war at the last moment. Bulgaria was forced to sign an armistice on July 31 and to open peace negotiations at Bucharest with her four Christian neighbours.

By the Treaty of Bucharest (Aug. 10) Serbia acquired all Macedonia west of the Vardar, and to the east the districts of Štip (Istib) and Kočana: Bulgaria retained possession of a dangerous salient at Strumnica, which enabled her to threaten Serbia's only railway connection with the Aegean. The Treaty of Constantinople, which was concluded between Bulgaria and Turkey (Sept. 29) and deprived the former of the greater part of Thrace, did not directly concern Serbia; but the indifference shown by her and her new allies, and still more by Britain and Russia, to Turkey's violation of a treaty which was their joint work, and indeed was morally binding upon them, was to be dearly paid for by Bulgaria's attitude in the World War. The treaties marked a new orientation in the Near East. Slav co-operation was replaced by mutual hatred, which threw defeated Bulgaria into the arms of Turkey and predisposed both for alliance with Berlin; Rumania's ties with the Triple Alliance were sensibly loosened, while Greece was drawn in two directions by dynastic attractions and party rancours.

The Albanian Conflicts.—Austria-Hungary now concentrated her attention upon Albania, and thereby rendered still more acute the relations between Serbs and Albanians. The summons addressed to Belgrade by the Great Powers for the withdrawal of the Serbian troops (Aug. 19) was a signal for further trouble. Late in Sept. there was a formidable Albanian rising, and the insurgents seized Dibra and even Okhrida, and forced Serbia to remobilize. In October the Serbs, in response to a peremptory demand from Austria-Hungary, withdrew their troops, but sent an effective Note to the Great Powers, begging them to enjoin upon their Albanian protégés a respect for the frontiers created for their benefit.

By Christmas 1913 the situation in the new territory was rapidly becoming normal, but its administration left much to be desired, and the closing of Bulgarian schools, the expulsion of Exarchist clergy and occasional excesses against the Moslem population caused serious unrest and discontent. The Pašić administration became absorbed in defending itself against the increasingly violent onslaughts of the Opposition, which on March 4, 1914, withdrew from the Chamber as a protest against alleged unconstitutional action of the Government in budget matters. But though the tension was increased by the activities of a powerful military society known colloquially as "The Black Hand," and by the seizure of its club premises by the Minister of the Interior, Protić, the Government was still in office in the summer. The visit of Crown Prince Alexander and Pašić to St. Petersburg early in February had given rise to rumours of a new Balkan League under Russian auspices; but the return of Radoslavov to power in Sofia had really made any such plan impracticable.

Murder of the Archduke.—On June 24 King Peter, incapacitated by ill-health, appointed Prince Alexander as regent, and simultaneously dissolved parliament, Pašić having in April pledged himself to the elections for a "Great Skupština" for constitutional changes. Only four days later the assassination of the Archduke Francis Ferdinand and his wife at Sarajevo revived the latent Austro-Serbian conflict in an acuter form than ever. The authors of the crime, Princip and Cabrinović, belonged to a group of Bosnian Serb students, mostly under the age of 20, who gave terrorist expression to the universal discontent aroused by Austro-Hungarian repression throughout her Yugoslav provinces. The victories of Serbia during the Balkan Wars and the openly hostile policy pursued towards her by Vienna and Budapest had assured to her in the eyes of public opinion the position of a Yugoslav Piedmont. Though the initiative unquestionably rested with the Bosnians themselves, it was proved that the assassins had been in Belgrade and had been secretly smuggled across the Drina into Bosnia, after receiving hand grenades and revolvers from the Serbian Komitadjis Major Tankosić and Ciganović. On these facts the Ballplatz sought to establish the complicity, or at least the foreknowledge, of the Serbian Government, yet despite the compromising admissions of Ljuba Jovanović, the theory is improbable. The country itself was exhausted by two wars; the Albanian campaign in the previous autumn had shown the reluctance of the peasant soldiers to return to the colours, and it was now the eve of harvest. Military stocks were alarmingly low; the young Prince had only just assumed the reins of government: the position of the Cabinet was shaky, and a fierce electoral campaign was opening. Delicate negotiations with Montenegro for a customs and military union, and perhaps even a dynastic arrangement, were still pending. Serbia had every conceivable motive for avoiding aggressive action. After the tragedy, it is difficult to see what other course her Government could have pursued; its one grave omission was failure to offer a thorough inquiry, without waiting for any suggestion from Vienna.

Ultimatum to Serbia.—The secret of the ultimatum was jealously guarded, and the long delay created, as was intended, a false sense of security in some quarters. Its delivery at Belgrade, which took place at 6 P.M. on July 23, was carefully timed for the moment after President Poincaré's departure from St. Petersburg after his state visit; the object being to disorganize the diplomacy of the allies. The ultimatum, after reminding the Serbian Government of its formal undertakings of March 31, 1909,

charged it with "culpable tolerance" of terrorist propaganda directed against Austria-Hungary, and accused Serbian officers and functionaries of planning the Sarajevo murders. It therefore demanded that the Narodna Odbrana and any similar society guilty of anti-Austrian propaganda should be dissolved, that objectionable passages should be expunged from Serbian educational works, that all officers or officials whom Austria-Hungary might name as guilty of propaganda should be dismissed, and that the Belgrade Government should not merely arrest certain specified persons charged with complicity, but should order the trial of others, allow Austro-Hungarian delegates to take part in the inquiry and accept the collaboration of Austro-Hungarian officials "in the suppression of the subversive movement."

The general impression produced by this document upon European opinion is best summarized in the words of Sir E. Grey, who telegraphed the next day to Sir M. de Bunsen that he "had never before seen one State address to another independent State a document of so formidable a character." The fifth demand in particular, that of collaboration, he pointed out, "would be hardly consistent with the maintenance of Serbia's independent sovereignty." None the less, Serbia in her reply actually consented to "such collaboration as agrees with the principle of international law, with criminal procedure and with good neighbourly relations." Only on one point did she reply definitely in the negative—the share of Austro-Hungarian officials in the actual inquiry would, it was argued, be a violation of the Constitution and the criminal code; but even this could be met by "communications in concrete cases." As a final proof of sincerity, Serbia offered to submit any outstanding points to the decision of The Hague Tribunal or even to the Great Powers which had imposed upon her the declaration of March 31, 1909. Thus Serbia for the third time in six years offered to submit herself to the verdict of The Hague (the two previous occasions being the Bosnian crisis and the Friedjung trial), and each time Austria-Hungary rejected the proposal.

Austria-Hungary had left a period of 48 hours for either reply or mediation. The official documents published in Berlin and Vienna since the war make it abundantly clear that the Ballplatz deliberately couched the note in such terms as to be unacceptable. They also reveal that even William II. (to judge from his marginal notes) was impressed by the moderation of the Serbs, regarded Vienna's essential wishes as fulfilled and expressed the view that Giesl ought to have remained in Belgrade. His ministers, however, had failed to support Sir E. Grey's proposal for a prolongation of the time limit, and were thus responsible for bringing Russia into action. On July 27 the tsar replied to a despairing appeal of the prince regent for assistance to Serbia by a telegram strongly urging him to "neglect no step which might lead to a settlement," but conveying the assurance that "Russia will in no case disinterest herself in the fate of Serbia." On July 28 Austria-Hungary formally declared war upon Serbia. Henceforward the Austro-Serbian quarrel is merged in the larger diplomatic conflict between Alliance and Entente; and the reader may be referred to the special articles dealing with that subject.

Opening of the World War.—When Baron Giesl presented the ultimatum, Pašić had been absent electioneering in the provinces; but he at once returned to Belgrade, and on July 25 mobilization was ordered, and the seat of government and the archives were hastily transferred to Niš. In view of so grave a crisis elections became impossible, and as parliamentary sanction was more than ever necessary, the Government was forced to ignore the fact of dissolution and to call the previous Skupština once more into existence. At its first meeting in Niš on Aug. 1, the entire Opposition endorsed the Government's action, and for the moment party life was in abeyance. But after Serbia's early military successes, the enforced evacuation of Belgrade (Nov. 29) brought the latent political crisis to a head. On Dec. 13 the purely Radical cabinet was succeeded by a Coalition Government, in which Pašić remained Premier, but the leaders of all parties save the Liberals received portfolios. It was, however, in this blackest week that the Skupština unanimously endorsed the Government's declaration that its foremost war aim was "the liberation and union of all our Serb, Croat and Slovene brethren not yet set free." This was the first public step of Serbia in favour of Yugoslav unity.

The brilliant offensive initiated on Dec. 2 by General Mišić and the I. Army cleared Serbian soil for the third time from invaders, and an enormous booty was captured. But the enemy left deadly infection behind him, and by the early spring of 1915 exhausted Serbia was immobilized by a typhus epidemic which is estimated to have caused about 300,000 deaths among the civil population. Serbia's negative rôle during 1915 was due not only to exhaustion but to considerations of high policy. Meanwhile the Entente was eagerly working for the intervention of Italy and of Bulgaria, neither of whom could receive adequate satisfaction save at the expense of Serbian aspirations. During the winter pressure was repeatedly brought to bear upon Niš to make territorial concessions to Bulgaria in Macedonia; but the one and only condition upon which Serbia could safely have considered this—namely, that the Allies should guarantee Yugoslav unity in the event of victory—was precluded by their parallel negotiations with Italy, whose official policy it was to prevent, not to further Yugoslav unity, and to whom by the Treaty of London, concluded on April 26, 1915, no less than 700,000 Yugoslavs were assigned. The fact that the concealment of this treaty from Serbia was made an absolute condition by Rome did not tend to diminish the reserve of Belgrade, which almost immediately learned the essential facts through St. Petersburg. The Serbs were more conscious than ever of the value to them of the Vardar valley, which would form part of any serious concessions to Bulgaria, whom they also believed to be tied to Vienna and Berlin by a secret compact. They were further handicapped by the attitude of Greece, who in the autumn of 1914 exercised her right of veto, under the Serbo-Greek Treaty, upon any cession of territory to Bulgaria and was prepared to demand Monastir as compensation. After the Dardanelles failure Bulgaria leaned increasingly towards Germany, and the concrete proposals addressed to Sofia by the Entente on May 28, over Serbia's head, came two months too late.

The Conquest of Serbia.—On Sept. 6 Bulgaria concluded a secret alliance with the Central Powers. Meanwhile the Serbian Government was unduly optimistic as to Greek and Rumanian intervention, and its disbelief in a German invasion was encouraged by Allied military opinion, which clung obstinately to the illusion that Bulgaria might enter on the Entente side, and therefore vetoed the Serbian general staff's plan for an immediate attack upon Sofia before the Bulgarian army was ready (Sept. 27). Next day Sir Edward Grey in the House of Commons announced that in the event of Bulgaria's aggression, "our friends in the Balkans" would receive help "without reserve and without qualification." Relying on the fulfilment of this pledge, the Serbs devoted their main effort to checking the Austro-German advance and remained on the defensive towards Bulgaria. The danger was increased by King Constantine's repudiation of Greece's treaty obligations towards Serbia and the overthrow of Venizelos. That statesman, however, had inquired of the Allies as early as Sept. 23 whether, if Bulgaria declared war on Serbia, and if Greece asked Serbia to supply the 150,000 men stipulated by the Serbo-Greek Treaty for such a contingency, France and Britain would assume Serbia's obligation for her; and an affirmative answer was received within 48 hours.

On Oct. 6 the rupture with Bulgaria was complete. The fatal delays in sending the promised troops, coupled with Allied insistence that the Serbs should hold back Mackensen to the last moment, belong to military history; but their results were eminently political. At the critical moment of the Bulgarian menace to the Niš-Salonika railway there were at Salonika not 150,000 Allied troops ready for action, but 35,000 French and 13,000 British, the latter under strict injunctions from London not to cross the frontier into Serbia (*see* General Sarrail, *Mon Commandement en Orient*, p. 27). Niš was decorated to welcome Allies who never came. The whole Serbian plan of campaign collapsed, and the armies, losing control of the railway southwards, retired precipitately through the passes leading to the plain of Kosovo. General Sarrail, informed that he must not expect reinforcements, was forced to arrest his belated offensive

northwards (Nov. 12) and soon to withdraw to the west of the Vardar. The Serbs were thus cut off from Allied help, lost Skoplje and only just escaped being cut off between the converging Austro-German and Bulgarian armies.

The final retreat of the Serbian Army and Government across the inhospitable snowy mountains of Albania and Montenegro stands out as one of the great tragedies of the war. After dreadful sufferings the fugitives were conveyed by Allied transports to Corfu, which for the remainder of the war became the seat of the Serbian Government and a base for the convalescence and reorganization of the army. Notable assistance was rendered by British voluntary units, and some idea of the generous response of the British public to Serbia's need may be gathered from the fact that the Serbian Relief Fund from first to last collected over £1,000,000, in money and material, and employed over 700 workers in Serbia, Albania, Corfu, Salonika, Corsica, Biserta and France; while the Scottish Women's Hospitals, under Dr. Elsie Inglis, performed notable services for the Serbs both on the Balkan and the Russian fronts.

Conquered Serbia was divided for administrative purposes between Austria-Hungary and Bulgaria; all that remained to the Serbs was a fragment of territory south of Monastir. Bulgaria, officially declaring the Serbian State to have ceased to exist, enrolled all men of military age throughout the occupied territory, and in Feb. 1917 extended this to include the whole male population. It refused to recognize the Serbian Red Cross and seized the Serbian Legation in Sofia; all Serbian schools, law courts and inscriptions were Bulgarized, libraries and collections were either destroyed or removed to Bulgaria, the Serbian clergy were evicted or executed. A formidable rising in the mountains behind Kursumlje was brutally repressed, with over 2,000 executions (March 1917). The war aims now repeatedly avowed by Sofia were the annexation not only of Macedonia, but of Kosovo, Prizren and the whole upper Morava and Timok valleys; a common frontier with Hungary; and the prevention of Yugoslav unity. Radoslavov more than once proclaimed Bulgaria's resolve to keep all her conquests (see *Vossische Zeitung*, Oct. 10, 1916), and his official organs declared that Serbia's reconstitution, "no matter under what form, would be a perpetual menace to Balkan peace." Austria-Hungary showed much greater reserve, airing from time to time various alternative schemes for a vassal Southern Slav State under the Habsburgs, keeping Prince Mirko of Montenegro as a possible candidate for its throne and employing agents in Switzerland to sow dissension among the exiles.

The Serbs in Exile.—Soon after the establishment of the Serbian Government at Corfu party rivalries began to revive. The deputies were scattered, an independent press was impossible and regular Allied subsidies made the Government virtually immune from serious democratic control. The supersession of the Voivode Putnik and almost all his staff caused great indignation; and though the whole Serbian Coalition must bear the responsibility, it was known to be the work of Pašić and his colleague Protić, then still out of office. In Aug. 1916 an attempt is alleged to have been made upon the life of the prince regent at the front, and the Government proceeded in the winter—while the joint advance under Sarrail was crowned by the capture of Monastir from the Bulgarians—to order numerous arrests on a charge of conspiracy and murder. The conspiracy trial which opened in Salonika in Jan. 1917, and was conducted behind the shelter of a strict military censorship, resulted in a death sentence upon nine Serbian officers, and notably of Colonel Dimitriević (*q.v.*), head of the "Black Hand." There is no doubt that Dimitriević favoured a military *coup d'état* against his Radical enemies, and that he had his hand in the Sarajevo murder; but the evidence for a plot against Prince Alexander was clearly inadequate, and he was the victim of rival military and political cliques. This trial revived all the old party dissensions: the reactionaries had triumphed on the very eve of the collapse of their chief support, the Tsarist Government. Pašić found himself between two fires—the need for a more democratic restatement of foreign policy, and the demand of the Young Radical and Progressive parties for a revision of the Salonika trial. Refusal led to their withdrawal from the Cabinet, and its reconstruction on a purely Old Radical basis under Pašić and Protić.

The last occasion when all parties co-operated was on July 20, 1917, when the Declaration of Corfu, drawn up between Trumbić for the Yugoslav Committee and Pašić for the Serbian Government, met with unanimous approval. It affirms that the Serbs, Croats and Slovenes constitute a single nation, and demands complete national unity under the Karagjorgjević dynasty, a constitutional democratic and parliamentary monarchy and the reference of all details to a Constituent Assembly after the war. Pašić, having strengthened his position abroad by a visit to Paris and London, declined to convoke parliament for four months after the legal period had expired. At last, as the result of a direct appeal of its president to the Crown, it met in Corfu on Feb. 12, 1918, and the Government resigned, but after weeks of fruitless negotiation for a Coalition Ministry was allowed to resume office. In April, the Opposition, which numbered 60 as against 64 Old Radicals, withdrew in a body from the Chamber, thus leaving the Government without the quorum of 84 required by the Serbian Constitution.

During the spring and summer of 1918 there was acute tension among the rival Serbian groups, and the real initiative in the Yugoslav question and in the political campaign against Austria-Hungary passed to Trumbić, Beneš, Lansing and the Allies and to the leaders of the movement inside the Dual Monarchy. On April 8, 1918, a "Congress of the Oppressed Nationalities of Austria-Hungary" was opened in Rome, based on the agreement reached a month earlier in London between Trumbić, on behalf of the Yugoslav Committee, and Andrea Torre, representing an influential committee of Italian deputies and senators. The result was immediate in two directions. The propaganda organized on the Italian front by the various national committees led to wholesale defections from the Austro-Hungarian army, and contributed materially, according to the high command's own admission, to the failure of the last Piave offensive in June. Meanwhile the Roman Congress was deliberately imitated inside the Dual Monarchy by an imposing Congress at Prague: it was attended by Czech, Polish, Rumanian, Slovak and Yugoslav delegates—among the latter Radić and Pribičević—and adopted a pledge of mutual support in the cause of unity and independence.

During 1918 the initiative among the Yugoslavs of the Monarchy fell more and more into the hands of the Slovenes, led by Father Korošec. The official recognition accorded to the Pact of Rome by Lansing in the name of America (May 31) was a fresh encouragement; and Korošec, after constituting a Yugoslav National Council for the furtherance of unity, convoked a new Slav Congress at Ljubljana on Aug. 18, at which the Catholic hierarchy and clergy took a prominent part. In the early autumn, at the Emperor Charles's instance, Count Tisza visited Zagreb, Sarajevo and Dalmatia with the object of promoting a Hungarian solution of the Southern Slav question, but met everywhere with a blank refusal. After the surrender of Bulgaria (Sept. 30) the Czech and Yugoslav spokesmen in the Reichsrat were still less conciliatory and insisted on separate representation at the peace negotiations and the absolute right to decide their own future state allegiance.

The Collapse of Austria-Hungary.—Events now followed each other with lightning speed. On Oct. 4 Austria-Hungary in a note to America accepted President Wilson's speeches as a basis of discussion, and on the 8th Baron Hussarek admitted that the Monarchy's internal structure must be modified and "full-grown nations" determine their own future. This only precipitated the collapse, and while Count Tisza voiced Hungarian public opinion in declaring the basis of the Dual system to be shattered, the Yugoslav National Council was transplanted from Ljubljana to Zagreb and strengthened by the inclusion of representatives of all parties (Oct. 10). On the 16th the Hungarian Government declared in favour of Personal Union, and next day Hussarek published an Imperial Proclamation, dated Oct. 16, dividing *Austria* (not Austria-Hungary) into four federal units (German, Czech, Yugoslav and Ukrainian), and leaving the Poles to make their own decision. Korošec, in the name of the Czech and Yugoslav Clubs

unreservedly rejected this stillborn project and claimed that the future of both nations was an international problem which only the Peace Conference could solve.

Henceforth the Yugoslavs acted independently of both Vienna and Budapest; and when on Oct. 21 the news of President Wilson's answer to Count Burián's final Peace Note (refusing to negotiate save on the basis of a recognition of Czechoslovak and Yugoslav national claims) became generally known, the old régime vanished almost as if by magic. Extraordinary scenes took place in many towns, the troops tearing off their military badges with the Habsburg arms and trampling them underfoot. National councils were speedily formed in Dalmatia and Bosnia, which arranged for the disarmament of the troops pouring northwards from the broken Albanian and Macedonian fronts. As early as the 23rd a Croat regiment stationed in Fiume disarmed the Magyar militia and took possession of the town. On the 24th Count Andrássy was appointed Joint Foreign Minister, but the machinery of State had ceased to work, and both the Austrian and Hungarian Cabinets were *in statu demissionis.*

On the 28th, the military command in Zagreb handed over its authority to the National Council, and next day the Diet proclaimed the independence of Croatia from Hungary and assumed control of Fiume. The arsenals of Pola and Cattaro were already in the hands of the insurgents; and the Emperor Charles, in the hope either of winning the favour of the new régime in Zagreb or throwing an apple of discord between it and the Entente, signed a decree on Oct. 31 making over the whole Austro-Hungarian fleet to the Yugoslav State—a step which was interpreted by the Italian Nationalists as a proof of collusion between Zagreb and Vienna.

On the other hand, the action of the Supreme Council in Paris in prescribing the frontier line of the Secret Treaty of London as the line of occupation under the Austro-Hungarian Armistice was keenly resented by the Yugoslavs as a breach with Wilsonian principles. The Allies very properly insisted that the fleet must be surrendered into their hands, but before this could take place a deplorable incident occurred in Pola harbour, the "Viribus Unitis" being blown up by an Italian mine, with a Yugoslav admiral and crew on board. In Italy Baron Sonnino's frankly anti-Slav attitude threw Signor Orlando and the Pact of Rome into the shade; and the Consulta worked hard to prevent Yugoslavia's recognition by the Allies.

Rival Programmes.—That this recognition had not already been accorded before the collapse of the Central Powers began was due to disunion among the Yugoslavs themselves. Pašić, free from the restraints of a coalition and from all parliamentary control, had reverted to his original Pan-Serb standpoint, and steadily declined to reconstruct his Cabinet on a wider Yugoslav basis. Trumbić on his part could not enter a purely Serbian Cabinet without prejudicing that freedom of choice of his compatriots in the Dual Monarchy upon which the moral case of the Yugoslavs depended. A series of incidents, such as Pašić's dismissal of the Serbian Ministers in London and Washington for their Yugoslav sentiment, proved the difference of outlook to be not merely personal but fundamental. When on Aug. 9 Balfour officially recognized the Czechoslovak National Council as "trustees of the future Czechoslovak Government," he was ready to extend a similar recognition to the Yugoslav cause, but as a preliminary condition he very reasonably insisted upon unanimity between those who claimed to represent the rival groups of Yugoslavs. But every effort to bring Pašić and Trumbić together was unavailing, and when in the last week of Oct. the rival statesmen moved from London to Paris, all hope of Yugoslav recognition before the Peace Conference had vanished, owing to the stiffening in the attitude of Italy.

To meet the impending danger, the Zagreb Government urgently invited the assistance of the Serbian army, which during the final advance contained a large proportion of Yugoslav volunteers. The first Serbian troops entered Fiume on Nov. 18, and a most dangerous situation arose between them and the Italians in Istria and Dalmatia, which was only very partially mitigated by the dispatch of American military and naval forces to Trieste and Fiume. Much of the blame falls upon the Supreme Council, which shrank from the only effective means of allaying friction —immediate Allied occupation of the disputed zone, pending the decision of the Peace Conference.

The Union.—The equivocal attitude of the Entente towards the new State, and Italy's insistence upon a fulfilment of the Treaty of London, naturally hastened the process of union. On Nov. 23 the Zagreb National Council proclaimed the union of the territories under its control with the kingdoms of Serbia and Montenegro, and invited the prince regent of Serbia to assume the regency of the new State. This decision (passed with only one dissentient voice, but that, unhappily, Stephen Radić, the peasant leader) took formal effect on Dec. 1, when Prince Alexander, at the formal request of 24 delegates from Zagreb, proclaimed the union. Meanwhile on Nov. 26 a hurriedly convoked National Assembly at Podgoriča had proclaimed the deposition of King Nicholas and his dynasty and the union of Montenegro with Serbia in the new united State. The first Yugoslav Cabinet was constituted under Protić as Premier and Korošec as Vice-Premier; Trumbić became Foreign Minister; other portfolios were divided more or less equally between Serbia and the new territories. (X.)

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SERBIAN CAMPAIGNS (1914–1915). The 1914 operations and the conquest of Serbia in 1915 are described below, while an account is given of the Allied operations in Macedonia, 1915–8, and of the reconquest of Serbia, under the heading SALONIKA CAMPAIGNS.

I. 1914 CAMPAIGN

The Austro-Hungarian problem in starting a campaign against Serbia was complicated by the prospect of Russian intervention in Galicia; the Austrian staff had, accordingly, drawn up two plans of concentration.

Alternative Austro-Hungarian Plans.—The first plan, in case of war against Serbia and Montenegro, called Concentration

B (Balkan), involved the employment of seven corps. The second plan, in case of war with Russia and Serbia, called Concentration R (Russia), involved the employment against Russia of nine corps; against Serbia and Montenegro of a minimum group of three corps and the formation of a reserve (four corps) which could be directed as required towards the Russian frontier or those of Serbia and Montenegro.

Convinced at first that they would have to deal only with the southern Slavs, Austria-Hungary ordered, on July 26, the partial mobilization required for Concentration B; but, owing to complications with Russia, general mobilization was proclaimed on July 31. To avoid confusion, the Austro-Hungarian staff decided to allow Concentration B to be completed before withdrawing the reserve provided for in plan R.

Serbian Mobilization.—The Serbian general mobilization, ordered on July 25, yielded 490,000 men at the outset, and some 43,000 more between August and September. Montenegro declared war on Austria-Hungary on Aug. 5, 1914. Her forces amounted to about 50,000 militia with very little artillery, and were of no direct assistance to Serbia, though they occupied the attention of three Austrian mountain brigades. Circumstances compelled Serbia to adopt a purely defensive strategy. Her army, commanded by the Crown Prince Alexander, with Voivode Putnik as chief of staff, was therefore concentrated in a central position enabling it to operate either towards the Sava and Danube or towards the Drina.

After the withdrawal according to Concentration R of the Austrian II. Army, the Serbs had a superiority not only in numbers but also in quality, 90% of them having fought in the 1912–13 wars, and three-quarters of their guns being better than the Austrians'. On the other hand, Austria's equipment and resources in ammunition were far superior.

Jadar Operations, and Cer Battle: Aug. 16–24.—North Serbia is a mountainous country, devoid of good communications, particularly in the northwest, whilst the actual frontier was formed on the north by the formidable obstacle of the Danube and Sava, on the west by the Drina, a river not very broad but swift and difficult to bridge. The plan for the invasion of Serbia, drawn up by Conrad von Hötzendorff and Moltke in consultation, involved a concentric advance from all fronts, but was vitiated by the withdrawal of the II. Army. Potiorek, however, who feared an advance of the Serbs over the Drina to excite insurrection among their kinsmen in Bosnia, launched, on his own responsibility, a preventive offensive.

On the night of Aug. 11–12, the Austrian V. Army (VIII. and XIII. Corps) and elements of IV. and IX. Corps from the II. Army began to cross on a wide front from Drenovac on the Sava to Ljubovija on the Middle Drina, successfully driving back the Serbian frontier detachments. The Serbians moved to oppose the enemy, and by the evening of the 15th their II. Army occupied positions on a line south of Šabac, across the Cer and Iverak ridges and the Jadar valley, connecting with their III. Army who had moved forward from Valjevo to Zavlaka and Krupanj. Their I. Army had taken over the whole northern front as far as Obrenovac.

On the 16th, after severe fighting, the Austrian XIII. Corps drove back the left and centre of the Serbian III. Army, capturing Krupanj and threatening the Valjevo-Osečina road behind the Serbian positions. On the right of the II. Army the Serbs were also forced to give way, but in the centre a local counter-attack secured for the Serbs the important position of Kosaningrad (Aug. 18). This enabled the II. Army Commander Stepanović, to launch on the 19th a counter-stroke along the Cer and Iverak ridges, which swept the Austrian VIII. Corps down in and over the Drina. The Austrian right wing (VI. Army), which had concentrated around Vingrad, less hard pressed, and better organized for mountain warfare, retired in good order, but by the 22nd the whole river front was again occupied by the Serbs. The Austrian II. Army fared no better, losing prisoners and guns in their retreat over the Sava.

By the 24th the first invasion of Serbia was ended, with a loss of about 50,000 men to the Austrians. The Austrian commander-in-chief had greatly underestimated the military value of the forces opposed to him, while, on the Serbian side, Putnik's management of his forces and his choice of the moment and place of counter-attack were masterly.

Syrmian Operation, and Drina Battle.—Meanwhile, no events had taken place on the northern front east of Obrenovac other than the evident withdrawal of the Austrian II. Army. Putnik decided to throw his I. Army across the Sava into Syrmia in order to secure the line Mitrovica-Fruška range—Danube to Semlin and Belgrade. This would enable the Serbs to invade Bosnia without fear of a sudden attack on their north flank and rear.

After making good crossings on the night of Sept. 5–6, the I. Army occupied Semlin and was progressing towards its objective when the situation on the Drina front caused its recall. For, on the Austrian side, Potiorek was reorganizing his forces for a new thrust across the Drina. His VIII., XIII., XV. and the major part of his XVI. Corps bordered the Drina from the Sava to Ljubovija.

Potiorek's second offensive opened on the night of Sept. 7–8. In the north the VIII. Corps only succeeded in securing a bridgehead at Parašnica, but in the south the IV. and the right of the XIII. Corps crossed in force between Zvornik and Ljubovija, driving back the Serbian left. By the 11th, the situation was serious enough to compel Serbian G.H.Q. to order the transfer of the I. Army from Syrmia to Valjevo-Pecka. On the 13th, the Austrian XIII. Corps threatened to cut the Serbian line in two, but, on Sept. 16, a strong counter-attack was launched by the I. Army against the Austrian right. Even so, the Serbs barely succeeded in holding up the invaders, whom they failed to drive back over the rivers. Meanwhile the Užice Army and the Montenegrins had successfully undertaken a series of operations designed to prepare the way for the offensive over the Drina, but, being forestalled by the Austrian attack, they had no practical results.

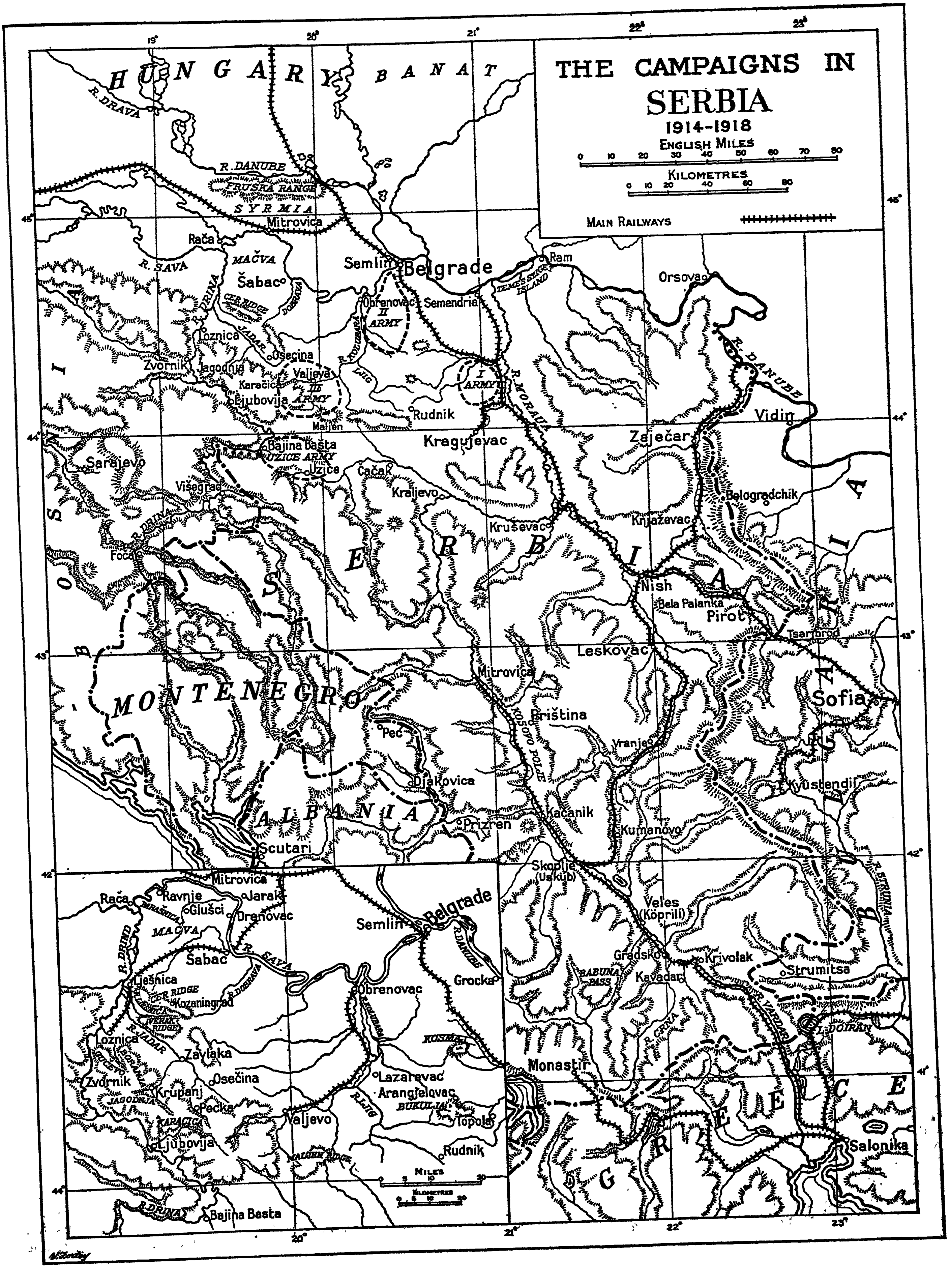
Kolubara and Rudnik Operations.—The Serbs suffered severely from the unfamiliar conditions of trench warfare and a shortage of ammunition, and Potiorek decided to make a third attack, although winter was near at hand. The new offensive opened with an attack in the Mačva, which drove back the Serbs to the line Dobrava-Cer ridge. The main Austrian attack, however, again took place in the Zvornik area, where the Serbian centre had to be withdrawn. Putnik, after attempting to cover Valjevo, decided to try and hold up the Austrian advance on the so-called "Kolubara line." The weather was terrible, but the Austrians, pushing along the Maljen ridge, attacked on the 17th, and drove the Serbs off that ridge. The Austrian left made good the passage of the Lower Kolubara by the 25th.

Putnik now resolved to give up Belgrade and to fight for time so as to last out until the arrival of ammunition enabled him to launch a counter-offensive. He therefore withdrew his forces during the night of Nov. 29–30 to a line with its flanks resting at Obrenovac and on the Lower Morava, its centre on the Rudnik Massif. The Austrians entered Belgrade on Dec. 1.

On the arrival of munitions Putnik undertook a counter-offensive; it opened on Dec. 3 with an attack of the I. Army under Mišic, which drove a deep wedge in the enemy lines. Further north the II. and III. Armies made little progress at first, the Serbian right being seriously threatened by a counter-attack (Dec. 6–9) effected by Krauss's and VIII. Corps. In the south, however, Mišic's Army swept the Austrians back towards Valjevo and Užice with such success that, on the 9th, Potiorek ordered a general retreat on Belgrade, Šabac and Loznica. All the Serbian armies then took up the pursuit, but mud and exhaustion prevented them from turning the Austrian retreat into a rout. By Dec. 16, Belgrade had been re-occupied, while Šabac, Loznica and Bajina Bašta had been retaken. Putnik's decisive victory gave Serbia peace for a few months, but her losses had been very heavy—69,000 killed or died of sickness, 18,000 wounded and some 15,000 prisoners.

II. THE CONQUEST OF SERBIA, 1915

The third expedition having ended in failure, Potiorek was


THE CAMPAIGNS IN
SERBIA
1914-1918
ENGLISH MILES
KILOMETRES
MAIN RAILWAYS
HUNGARY
BANAT
R. DRAVA
R. DANUBE
FRUSKA RANGE
SYRMIA
Mitrovica
Rača
MAČVA
R. SAVA
Šabac
CER RIDGE
Semlin
Belgrade
Ram
TEMES SZIGET ISLAND
Orsova
Obrenovac
II ARMY
Semendria
Loznica
Osečina
Zvornik
Jagodnja
Valjevo
III ARMY
Karačica
Ljubovija
Maljen
I ARMY
Rudnik
R. MORAVA
Vidin
Bajina bašta
UZICE ARMY
Kragujevac
Zaječar
Sarajevo
Užice
Čačak
Kraljevo
Višegrad
Belogradchik
Kruševac
Knjaževac
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Leskovac
Mitrovica
MONTENEGRO
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ALBANIA
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Kačanik
Kumanovo
Scutari
Skoplje (Usküb)
Veles (Köprili)
Gradsko
Krivolak
Strumitsa
BABUNA PASS
Kavadar
R. VARDAR
L. DOIRAN
R. CRNA
Monastir
GREECE
Salonika
R. STRUMA
BULGARIA
BOSNIA
Ravnje
Jarak
Glušci
Drenovac
Grocka
Lješnica
Kozaningrad
R. DOBRAVA
IVERAK RIDGE
Zavlaka
R. JADAR
Krupanj
Pecka
JAGODNJA
Lazarevac
Arangjelovac
KOSMAJ
BUKULJA
Topola
R. LJIG
KARAČICA
Ljubovija
MALJEN RIDGE
Bajina Basta
R. KOLUBARA
MILES
KILOMETRES

relieved of his command, a portion of his troops transferred to other fronts, and General Tersztianski left with a much weakened force. The latter, however, were incapable of taking the offensive, their sorely depleted ranks being further devastated by an epidemic of typhus. Meanwhile Falkenhayn (*q.v.*) had become convinced of the necessity of opening up direct railway communications with Turkey, and, the active support of Bulgaria having been secured, a new combined offensive was prepared for the autumn under a German commander, Marshal Mackensen.

His forces consisted of the Austrian III. Army (two Austrian, one German Corps), under Kövess, concentrated in Syrmia; the German XI. Army (three corps) under Gallwitz, in Banat; the Bulgarian I. Army (four double size divisions), under Bojadiev, between Vidin and Tsaribrod; and the Bulgarian II. Army, under Tokorov, between Kyustendil and Strumitsa.

The Serbian dispositions were influenced by the threat from the east which the Western Powers had forbidden Serbia to meet by a preventive offensive, and by the hope of assistance from Salonika. Serbian fighting strength was not more than 200,000; but the help of Greece was invoked under the 1913 treaty, and that of the Western Powers promised. Putnik deployed three-fifths of his forces facing north and guarded the route to Salonika with the rest.

Mackensen's Attack.—Mackensen assembled a mass of heavy artillery and modern appliances, and a heavy preliminary bombardment opened on Oct. 5, the 6th being fixed as the day of attack for Kövess and Gallwitz and the 11th for the Bulgars. Kövess's main crossing, undertaken by two corps with the support of an intense bombardment, took place at Belgrade. After three days' fierce fighting, bridgeheads were secured and the Serbs forced to evacuate their capital (Oct. 9–10). His third corps, who crossed the Lower Drina and Sava, were held up in the Mačva. Simultaneously after a demonstration at Orsova and a Bulgarian threat towards Negotin, two of Gallwitz's corps secured crossings at Ram, and over Temessziget (Ostrovo) Island, but his third corps was held up near Semendria.

On the 11th Putnik began a steady policy of fighting successive delaying actions on the northern front, keeping back the Bulgars on the right and rear in order to gain time for the arrival of French and British aid, the first elements of which (British 10th, French 156th Div.) had started to land at Salonika on Oct. 3. Whilst heavy fighting was going on in the Morava valley and the mountains to the west, the Bulgarian advance began to threaten Pirot and the Salonika railway. Vranje was occupied on Oct. 16, whilst further south Todorov occupied Skoplje (Üsküb) on Oct. 21, thus cutting the Salonika line, and driving a deep wedge between the Serbs and the advancing Anglo-French force under Sarrail.

Until then the Austro-German armies from the north had made but slow progress, but the Bulgarian successes on his right forced Putnik to withdraw his left and centre concentrically towards Kraljevo-Kruševac. From Nov. 1 onwards a desperate effort was made by the Serbs to hold the arc Čačak-Kragujevac-Jagodnja-Nish-Leskovac. The Bulgars were held back at Bela Palanka, but the Germans and Austrians advanced steadily. Kragujevac fell with its arsenal on Nov. 1, and by the 9th Nish fell. The Orient railway, Falkenhayn's objective, was now clear from Germany to Constantinople.

Final Serbian Effort.—Making a further effort to envelop the Serbian right, the Bulgar II. Army moved out fanwise from Vranje on Priština and from Skoplje (Üsküb) on Kačanik and the Babuna pass, whilst its left was heavily engaged with considerable Anglo-French forces from Lake Doiran to Krivolak and Kavadar. In a last attempt to break through to the south Putnik assembled the remnants of five divisions round Priština and struck at the Bulgar II. Army on the 9th, driving back its right to Vranje and towards Kumanovo. But the arrival of part of the Bulgar I. Army from Leskovac on his left rear and the pressure of the Germans and Austrians from the north made it impossible for Putnik to persist; he then decided to escape through Albania with what could be saved of his army.

Between Nov. 20 and 25, the historic plain of Kosovo Polje witnessed another last effort of the Serbian people, then everything flowed away towards Peć, Djakovica and Prizyen. The pursuit ceased in the first week of December. The Bulgar II. Army then turned south and drove the Anglo-French force over the Serbian border. By Dec. 16 this force had withdrawn to Salonika (*see* SALONIKA CAMPAIGNS). Montenegro was completely occupied by the third week in Jan. 1916.

The end of the pursuit did not mean rest and reorganization for the remnant of the Serbian Army. A midwinter march through the Albanian mountains brought those whom its rigour left alive to the coast of the Adriatic. Thence they were transferred to Corfu, and later to Salonika, where the Western Powers provided food, clothing, equipment and stores, mitigating to that extent a disaster which might have been prevented by a more vigorous policy towards Bulgaria and Greece, and the earlier dispatch of the reinforcements which were ultimately sent.

See WORLD WAR: BIBLIOGRAPHY. (T. G. G. H.)

SERBO-BULGARIAN WAR (1885). The Berlin Congress of 1878, by its revision of the treaty of San Stefano, created two states in the Balkan Peninsula: the principality of Bulgaria, owning a nominal suzerainty to Turkey, and the autonomous province of Eastern Rumelia, presided over by a Turkish governor-general, and apparently intended to remain in close relations with the porte. This settlement ended when the movement for a united Bulgaria culminated (Sept. 1885) in a revolution in the Rumelian capital, Philippopolis. Prince Alexander of Bulgaria, recognizing that the movement was irresistible, placed himself at its head, and, proceeding to Philippopolis, formally accepted the government of the united Bulgarian states. As it was assumed that the sultan would reassert his claim by force of arms, the Bulgaro-Rumelian forces were concentrated as rapidly as possible near the Turkish frontier. Prince Alexander, however, had taken the step of acknowledging the sultan's suzerainty; and Turkey was not inclined to begin a war which would probably cause a revolt in Macedonia and might end by rendering Russian influence paramount in Bulgaria. But, while a conference of ambassadors was vainly discussing the situation at Constantinople, the Gordian knot was cut by the announcement that Serbia, seeking compensation for the aggrandizement of Bulgaria, had constituted herself the champion of the treaty of Berlin. King Milan had issued orders for the Serbian army mobilization on the very day of Prince Alexander's proclamation at Philippopolis, and large forces were concentrated (Oct. 1–12) on the Bulgarian frontier. On the 19th the prince ordered troops to the quarter thus threatened, but it seems certain that, whilst in eastern Rumelia every preparation had been made for war, Prince Alexander had so little expectation of, and wish for, a war with Serbia, that few measures were taken to supply the needs of a field army on that side.

Unlike the Serbian army, which contained few permanent units and consisted mainly of militiamen, the standing army of Bulgaria, trained and commanded by Russian officers since 1877–78, was organized on the German system of filling up relatively strong *cadres* to war strength and forming additional units. When fully mobilized the field army numbered about 55,000 men. The Rumelian forces (militia) consisted in all of about 35,000 men. Besides these, there was the "Bandit brigade" of Capt. Panitza, an irregular force some 3,000 strong. This force did good service as a flying right wing of the main army. In the Bulgarian army the whole of the staff and superior officers, as well as about half the regimental captains, were Russians. When the mobilization of the Bulgarian and Rumelian forces was decreed the Russian officers were at once withdrawn, and the heavy task of creating a staff and selecting young officers for all the superior commands had to be undertaken in face of the enemy. Moreover, when on Nov. 14, Milan declared war, the Bulgarian forces were mostly far away on the Turkish frontier. The Serbian main army (under King Milan), and the army of the Timok promptly crossed the frontier and soon came in contact with small forces of the enemy. On the Timok little or nothing of importance took place throughout the war, as the forces opposing the army of the Timok near Vidin effectually neutralized that force. In front of Dragoman and Trn the Bulgarians fell back, engaging in stubborn rearguard combats at every favourable

place. The Serbian "Army of the Nishava" advanced but slowly and with hesitation, while the most strenuous exertions were made by Prince Alexander and his newly formed staff to collect their far-distant troops in the Slivnitza position. Every commander was given the simple order to march on Slivnitza. The civilian population was warned to be ready with supplies to meet the troops by the roadside, and under these peculiar conditions and extraordinary difficulties of country and weather, the Bulgarians marched on the decisive point at the highest possible speed of man and horse. Some remarkable marches are recorded: the 8th infantry, 4,500 strong, covered 59m. in 32 hours, leaving only 62 men behind; the troops that were sent up by rail were packed in open trucks, 60 men to a truck. The furious energy displayed had its reward on the field of battle. Before the last shot of the battle of Slivnitza was fired, nearly half of the entire forces of Bulgaria and Rumelia were in the lines, and 14,000 men more faced the army of the Timok at Vidin. With the main army—a striking display of what could be accomplished by patriotism and vigour—were 56 pieces of artillery, most of which had been dragged over the Balkan passes in mid-winter.

The position of Slivnitza, barring the high road between Nish and Sofia, had been extensively fortified, but when the Serbians opened their attack on Nov. 17, there were but few troops available to occupy the works. On the right of the Bulgarian line was the Meka Krud height; here fighting went on through the short winter day, which ended with a gallant, and for the time successful, counter-attack by six Bulgarian battalions led by Capt. Benderev. The prince, not yet ready for the offensive, withdrew these troops to their original position. In the centre, near the high road, a hot and, at one moment of the day, almost successful attack of the Serbs ended with their complete repulse. The latter had had 17,000 men against the Bulgarians' 11,000; yet they had, owing mainly to faults in the superior leading, been unsuccessful. Next day their chances of victory would be even less, for the defenders were hourly reinforced from Sofia, and on the 18th were actually somewhat superior in numbers. On this day the Serbs made a very heavy attack on the Bulgarian left wing, which was eventually repulsed, though not without great difficulty, by the newly arrived troops from Sofia. Later a half-hearted attack was made on the centre, and from his position on Meka Krud Benderev again attacked the Serbian "Danube" division. On this day a Serbian division pushed the Bulgarians out of Breznik, but made no farther advance either on Sofia or on the left flank of the Bulgarians at Slivnitza, in spite of orders to do so. On the 19th alarm and consternation at Sofia, caused by the presence of hostile forces at Breznik, were so great that Alexander left the command in the hands of his chief of staff, Major Guchev, and hurried back to the capital in order to organize the defence. The Serbian leader was, however, as inactive on the 19th as on the 18th, and when he at last moved forward towards Slivnitza it was only with a portion of his force; this was driven back, by a detachment from the left wing of the Bulgarian position, to Rakita. Meanwhile, the active Benderev had reopened his attack on the Danube division. Twice he was repulsed, but finally at about 3 P.M. his battalions carried the heights held by the Serbs. A little before this the Bulgarian centre likewise moved forward, and, though a final attack of the Serbs on the gap caused by the absence of the Bulgarian troops detached towards Breznik came near to success, the prince returned to the battlefield to find his troops everywhere victorious and driving the enemy before them. Two days later, reorganized and reinforced, the Bulgarians took the offensive and carried the Dragoman pass.

On the 25th Prince Alexander received at Tsaribrod proposals for an armistice from King Milan; these were not accepted, and the Bulgarian army, crossing the frontier, advanced in several columns upon Pirot, where the army of the Nishava took up a defensive position in the town and on the surrounding heights. A two-days' engagement followed (Nov. 26 and 27). On the 26th the Bulgarians were successful, but a heavy counter attack on the following day almost snatched the victory out of their hands, and it was only after a severe contest lasting 11 hours that the Serbs finally gave way. The Bulgarians were not permitted to reap the fruits of their success. As they were preparing to pursue the defeated and now greatly demoralized enemy on the 28th, the Austrian minister at Belgrade arrived at headquarters and hostilities ceased. The intervention of Austria saved the Serbian army, which was greatly demoralized, and was now threatened by the united Bulgarian force of nearly 55,000 men. On the same day the army of the Timok was repulsed with heavy loss in an attack on Vidin.

Serbia escaped almost unpunished from her war of aggression. The young Bulgarian army, with its improvised staff and newly-appointed field officers, displayed admirable marching power and fighting qualities, and the Rumelian militiamen proved themselves to be good soldiers. The Serbs had, however, fought with great bravery also, and the victory must be ascribed in the main to the personal influence, the strenuous exertions and the sound military judgment of Prince Alexander; and the brief but decisive campaign set the seal to Bulgarian unity.

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SERBO-CROAT LANGUAGE AND LITERATURE.

Apart from the occasional differences that are to be found in vocabulary and also, to a slight extent, in grammatical usage, the Serb and Croat literary languages are identical, although the former is written in the Cyrillic and the latter in the Latin alphabet. The spoken dialects represent, in general, a transition from Slovene in the West to Bulgarian in the East. The uniformity of the literary language, which is based on the central dialects, is so complete that books with precisely the same text are frequently published in both characters, and it is therefore usual in scientific, and not uncommon in popular, works to speak of the Serbo-Croat language, a term which has quite ousted that prevalent in the first half of the 19th century, namely Illyrian. The names Serb and Croat were borne in the 9th century by some of the tribes which, about two centuries earlier, penetrated into the North-Western parts of the Balkan peninsula. The other tribal names, including *Slovinski, i.e.*, Slavonic, which was used to designate the Western form of the language as late as the 18th century, have now been absorbed by Serb and Croat or replaced by modern territorial names, such as Bosnian, Dalmatian, etc.

Together with Slovene and Bulgarian, which however is sometimes grouped apart, Serbo-Croat forms the Southern branch of the Slavonic group of languages in the Indo-European family. The vowel system is simple, and the clarity with which all vowels, long or short, accented or unaccented, are pronounced, is reminiscent of Czech. A specifically Serbo-Croat characteristic is the passage of both *ŭ* and *ĭ*, in circumstances when a full vowel was developed, into *a*. On the other hand, neither the replacement of the back vowel *y* by *i*, nor the loss of nasality by *ǫ* and *ę*, nor the development of a vowel *r* is peculiar to Serbo-Croat.

The consonants have undergone comparatively few changes since the Common Slav period, the most notable being that of *tj* to *ć* (a sound not unlike that in English *tune*) and of *dj* to *đ* (also written *dj, gj*, and resembling English *dune*). The difficult consonantal groups which have arisen in some of the Slavonic languages after the abandonment of the old rule which tolerated only open syllables, are rare in Serbo-Croat, as the vowel *a* has been frequently developed from the earlier semi-vowels, and this has facilitated pronunciation. Moreover, with the exception of *lj* and *nj* (pronounced like Italian *gl* and *gn*), there are no such palatal or palatalised consonants as occur in West Slavonic or Russian.

The morphological and syntactical peculiarities of the language

present no special points of interest: the case system of the noun has been well preserved in the singular, but there has been a generalization of one case (in origin a dual) to express three in the plural. The dual has only survived in traces. In the verb, the use of the infinitive and, in quite recent times, of the aorist and imperfect also is declining, the language following in this latter respect the lines struck out at a much earlier date by the Eastern and Western branches of the family. One interesting characteristic of Serbo-Croat is the enclitic use of pronouns and unaccented forms of the copula, which are put, contrary to the usage of most modern languages, as early as possible in the sentence, but always after the first word.

Serbo-Croat has retained a free accentuation, with the exception that in the literary language a polysyllable may not be accented on the last syllable; all vowels, whether long or short, may have a rising or a falling intonation.

This musical intonation and the clarity of the vowels, together with the absence of difficult consonant sounds, have combined to make Serbo-Croat (which has often been compared with Italian) the most melodious of all the Slavonic languages. It is easier for a foreigner to acquire with approximate accuracy than the sister languages.

The vocabulary has been affected by Turkish (especially in the East), and less so by Italian (in the Western dialects), but the efforts made during the last hundred years to expel foreign words have been largely successful.

It is usual to distinguish three dialects, according to the word used for the interrogative pronoun "what." That area which uses *što* is by far the largest and embraces the dialects on which the literary language has been based. The *kaj* dialect is spoken in the north-western part of the kingdom, especially Croatia, and, in this and other respects, links up with Slovene. The *ča* dialect is steadily losing ground and is now chiefly spoken in a small part of the Croatian littoral, along the Dalmatian coast and in some of the islands. Its interest for philologists lies in its having preserved with great fidelity the accent on that syllable which bore it in original Slavonic.

The treatment of original *ě* forms another criterion of classification into dialects; *e* is the Eastern development, and *(i)je* the Western. The literary, *što*, language uses both *(i)je* and *e*, *(i)je* prevailing in Bosnia, Hercegovina, Montenegro and Croatia, and *e* in Serbia. There are dialects which have *i* for original *ě*, but they are not used for literary purposes.

The dialects spoken in Macedonia increasingly approximate to Bulgarian as the frontier is reached, but the study of their precise relationship to Serb and Bulgarian has been frequently impeded by the political bias of the investigators, and the interest they present is exclusively philological.

Until the 19th century there was no common literary language, most works being written in a form of Church Slavonic more or less tinctured, according to the education of the writers, by genuine Serb or Croat and, subsequently, also by the form of Church Slavonic used in Russia. The first works to be written in a language which faithfully mirrored a spoken dialect and was wholly uninfluenced by the Church language, belong to the end of the 15th century and are due to a band of Dalmatian poets, most of whom had been schooled in Italy and were familiar with Italian literature. Their activity covered a wide range and was almost wholly poetical in form. The influence of Italian models is everywhere obvious, and extends even to syntax, phraseology and style. Although the writers generally use their native dialect, it is possible to trace the beginnings of a literary language. The best work of this Dalmatian school belongs to the 16th century; it declined afterwards, and by the end of the 18th century had become negligible.

In the meanwhile Serbia continued to use the mongrel literary language of the Church, which, in spite of the strenuous efforts made by some 18th century scholars to assert the claims of the popular idiom, continued to remain all-powerful until the reforms of Vuk Stefanović Karadžić (1787–1864). His great collection of songs, popular stories and proverbs, gathered throughout the length and breadth of his country, the magnificent and pure language of his own writings, and his amazing industry and linguistic sureness, have created a literary language of great flexibility and beauty.

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LITERATURE

As far as present knowledge goes, the origin of Yugoslav literature was in the 9th century, when the "Slav Apostles" Cyril and Methodius, with their disciples, translated church books from Greek into Old Slavonic. The earliest Yugoslav mss. are of Slovene origin, the "Monuments" from the monastery of Freising (*Brizinski Spomenici*) in the 9th or 10th century, consisting of a form of confession, a sermon and a prayer. A stone inscription in a church on the island of Krk, called *Baščanska ploča* (1100), is the earliest known Croatian record. The first recorded Serbian mss. are the decree of the Ban of Bosnia (1189) and the *Miroslavljevo jevangjelje*, a gospel written in the 12th century for Miroslav, prince of Zahumlje.

Serbian translations from all branches of Byzantine literature, ecclesiastical and secular, are numerous. Of the early original works the most important are biographies and chronicles. It is known that four biographers wrote in the 13th century, the first being Archbishop Sava or St. Sava (d. 1236). Both Sava and his brother King Stephen wrote brief accounts of their father's life; the monks Domentian and Theodosius wrote longer works on the life of St. Sava. In the 14th century Archbishop Danilo (d. 1346) is the only known biographer. He wrote *The Lives of Serbian Kings and Archbishops*. To the 15th century belong Camblak and Constantine "the philosopher." The latter wrote *The Life of Despot Stephen Lazarević*, under whose patronage the monastery of Manasija became a literary centre. The chronicles may be divided into (1) *letopisi*, short works of Serbian history, (2) *rodoslovi*, largely dealing in genealogy and (3) *hronografi*, general writings on Roman, Byzantine and Hebrew history.

The Croats, having come under the influence of the Latin Church, did not produce an early national literature of any importance. Practically the only works of secular literature were those on jurisprudence and legal statutes; the "Code of Vinodol" (1238) and the "Statute of Krk" (1388).

The 16th and 17th Centuries.—While the other peoples of Europe progressed the Yugoslavs were doomed to lose their independence at the hands of the Turks. Literature in Cyrillic script was almost wiped out in Serbia, Bosnia and Montenegro. The Glagolitic literature in Croatia suffered repression from Rome and Venice. The first Cyrillic printed book is ascribed to Cetinje, 1494, and the first Glagolitic to Venice, 1483. Dalmatia by reason of geographical position and political relations, was saved from the general overthrow, and the city of Ragusa became a literary centre. The first influence was that of the troubadours, as shown in the lyrics of Š. Menčetić (d. 1527) and Gj. Držić (d. 1501). Their work has come down in a collection of 620 songs in Serbo-Croat. The Carnival burlesques of Florence also had their imitators, the principal being A. Čubranović (d. 1530?). The most prolific writer of the 16th century was the Benedictine monk M. Vetranović (1482–1576). His most original work is the "Hermit" (*Remeta*), in which his own retired existence is compared with the gay life of Dubrovnik. A reaction from Italian influence, in favour of the Greek and Latin classics, makes itself felt in the work of D. Ranjina (d. 1607) and D. Zlatarić (d. 1609) in the second half of the 16th century. M. Držić (b. *c.* 1519), a

writer of Plautine comedies, strikes original ground in his *Dundo Maroje* (1550). The 17th century is the golden age of Ragusan literature. There are three outstanding names in poetry. Ivan Gundulić (1558–1638), the greatest poet produced by Dubrovnik, owes his fame to his epic *Osman*, and his pastoral play *Dubravka*. I. Bunić (d. 1658) excelled in lyrics, especially love songs (*Plandovanja*). J. Palmotić (d. 1657) was a creator of national drama with his *Pavlimir*. A decline set in in the 18th century, though it was marked by the establishment of literary academies. Two names may be mentioned: A. Glegjević, (d. 1728), a playwright, and I. Gjorgjić (d. 1737), the only gifted poet of the republic in this century.

Conditions in Dalmatia generally were not favourable to literature, owing to the domination of Venice and Hungary, and the incursions of the Turks. M. Marulić (d. 1524), wrote the epic *Judita* (1521), the first book printed in the vernacular. H. Lucić's (d. 1553) *Robinja* is one of the earliest attempts in European drama to create a secular romantic play. P. Hektorović (d. 1567) is noteworthy for his *Ribanje* ("Fishing and Fisherman's Talk"), while P. Zoranić's pastoral *Planine* may be considered the first novel in Serbo-Croat literature. More important are the collections of popular poems that began to be made in the 18th century. The outstanding work of A. Kačić (1702–60), *Razgovor Ugodni*, a national chronicle from the earliest times, contains numbers of these. It was published in Venice four years before Percy published his *Reliques of Ancient English Poetry*.

In the Slovene, Bosnian and Croatian portions of Jugoslav lands, the literary development was largely directed by Jesuits and Franciscans, following on the counter-Reformation. The Franciscans in Bosnia published numerous religious works in the *štokavski* dialect, which gradually attained supremacy as the literary medium of Serbo-Croat.

References to popular poetry have been traced to Serbian biographies of the 13th century and to Dalmatian poets of the 15th. This poetry, known as *narodne pesme* (people's songs), corresponds to the popular ballads of other European countries. Modern collections have brought the number of popular ballads up to nearly 10,000. Other evidences of popular literature are a large number of folk-tales. The chief collector of all these as well as of the popular songs was Vuk Karadžić (1787–1864).

The 18th Century.—The first writings of the modern period appear among those Serbs and Croats who had remained under Habsburg rule. They were not based on previous native tradition, but on modern European literature. In an effort to preserve their orthodoxy, the Serbs imported books written in the Russian recension of Old Church Slavonic, thus creating an artificial literary language known as "Slav-Serbian" (*Slaveno-Srpski*), the effect of which was to retard the development of the vernacular. Among the early writers Zaharija Stefanović Orfelin and Jovan Rajić are the most important; the former produced in 1768 a Review in the vernacular, while the latter, besides a history of the Slavs (the Southern Slavs in particular), written in the "Slav-Serbian" language, wrote also a vernacular epic. But the real father of modern Serbian literature is Dositej Obradović (1739–1811), who after early training in a monastery started on a series of journeys to different European countries. The result was his *Life and Adventures* (1783), followed by his *Counsel of Sound Reason*, his *Fables* and his *Ethics*. An encyclopaedic writer rather than an original thinker, his work was directed towards the enlightenment not only of his countrymen, but of Yugoslavs in general. His work was continued by P. Solarić and other disciples.

Among the Croats three writers of this period are worthy of mention, the Jesuit A. Kanižlić, the Franciscan M. Katačić, and an army officer A. Reljković (1732–98). The latter, the greatest Croatian writer of the 18th century, is best known for his *Satyr, or the Wild Man* (1762).

Among the Slovenes practically nothing had been done from the days of P. Trubar (1508–86), a Protestant writer, till the late 18th century, when V. Vodnik (1758–1819) laid the foundations of modern Slovene literature. The formation of the Illyrian Provinces (1809) under Napoleon tended to revive the national spirit.

The 19th Century saw the consolidation of efforts to establish firmly the Serbo-Croat vernacular based on the most widely extended *što*-dialect. The leaders were Vuk Karadžić for the Serbs, and Ljudevit Gaj (1809–72) for the Croats. Vuk, under the influence of the Slovene scholar J. Kopitar, began to devote himself to collecting traditional songs. He succeeded in interesting Goethe and the brothers Grimm in Serbian popular poetry. His efforts to establish the "civil" as opposed to the "church" spelling were brought to fruition by Gj. Daničić (1825–82), who laid the foundations of Serbian philology. The Illyrian movement under Gaj, which aimed at first at the linguistic union of all the Yugoslavs, in its earlier stages had favoured the *kaj*-dialect and the old spelling, but soon the *što*-dialect was adopted and the spelling reformed; and in 1836 one single literary language became the common property of the Serbs and Croats. The movement produced a number of poets, among whom are P. Preradović, who wrote lyrics of love and patriotism, and I. Mažuranić, author of an epic on the *Death of Smail Aga Čengić* (an incident of the Montenegrin rising of 1840), which counts among the gems of Serbo-Croat literature (Eng. trans. by J. W. Wiles). The Serbs viewed the Illyrian movement with sympathy in so far as its aim was a literary union with the Croats, and their literature made considerable progress. Poetry on classical models is represented by L. Mušicki. B. Radičević broke with this scholastic tradition by composing poems in the pure vernacular, expressive of sincere and passionate feelings. A contemporary of these two, the Bosnian S. Milutinović, was much admired in his time for his patriotic poetry. Greater than any of these was Petar Petrović Njegoš (1813–51), prince-bishop of Montenegro. His masterpiece is an epic *Gorski Vijenac* ("The Garland of the Mountains"). No other poet has been able so to penetrate the spirit of the people and to depict their character. The outstanding dramatist of this period is J. Popović (1806–86). Influenced by European literature, he produced a number of comedies both of "character" and of "manners" and is considered the founder of modern Serbian drama.

By the middle of the century the centre of the literary activities of the Serbs was transferred from Budapest to Novi Sad, a town in the heart of the Serbian population in southern Hungary. Here a "Young Serbian Movement," based on a return to popular poetry and tradition, became very active. Lyric poetry is represented by J. Jovanović and Gj. Jakšić. The realistic novel was initiated by J. Ignatović. Drama in verse had many followers, the most important being L. Kostić, translator of several plays of Shakespeare, and K. Trifković. The movement towards autonomy in Croatia after Solferino was accompanied by revived interest in the language. The prominent figure in the movement is Bishop Strossmayer, founder of the Yugoslav Academy in 1867 and the university at Zagreb in 1874. Literary journals sprang up. A series of prose writings and historical novels by A. Šenoa and J. E. Tomić did much to create a reading public, while a school of literary criticism was initiated by F. Marković. I. Trnski's lyrics and epics on national subjects kept alive the patriotic fire. The Slovenes were similarly affected by improved political conditions, and the freedom of the press. F. Prešern (1800–49) may be considered the greatest modern Slovene poet. F. Levstik's simple lyrics and prose writings make him the central figure till the coming of J. Stritar (1836–1923), "the creator of the cultured and civilized speech."

In the early '70s the influence of the German romantics was replaced by that of the Russian realists, and the new tendencies in western European thought were introduced through Russian channels. The champion of the new ideas was S. Marković, who had studied in Russia. The new ideas found expression chiefly in the novel and short story, the former having its best exponents among the Croats, while the Serbs excelled in the latter. The first efforts of the new school were mainly directed towards the painting of village and peasant life. The founder of this school in Serbia was M. Glišić. He is excelled in artistry by L. Lazarević whose gifts of observation and composition made him one of the greatest of Serb writers. J. Veselinović is a master of lyrical descriptions of nature. Conditions of life in Croatia offered more material for the larger canvas of the novel. L. Babić Gjalski may be considered the founder of the realistic novel of psychological interest, a field

in which he was followed by Borislavić, V. Novak and others. Among the Slovenes important names are J. Kersnik, whose powers were especially shown in the delineation of female character, and I. Tavčar, who was particularly interested in philosophical problems. Apart from novelists, two Yugoslav writers, Lj. Nenadović of Serbia and Lj. Vuličević of Dalmatia, must be mentioned as excellent examples of the best modern prose.

Poetry is overshadowed by the novel and story during this period. The most distinguished poet was the Serb, V. Ilić, a disciple of Pushkin. Among the Croats an original lyric vein is displayed by S. Kranjčević, whose themes were freedom and patriotism, whilst the Slovene A. Askerc was a vigorous writer of ballads and romances. A less known field of Yugoslav literature to which attention has only recently been directed is the popular poetry of the Muslims of Bosnia and Herzegovina.

The 20th Century has witnessed a closer *rapprochement* between the different sections of Yugoslav literature and in particular between Serbia and Croatia. A close association between the different authors, an interchange of literary contributions and the co-operation between the Royal Academies of Belgrade (founded in 1886) and Zagreb and the Slovene "Matica" (1864) at Ljubljana are all symbols of approaching unity, though it is perhaps too soon to speak of one and the same "Serbo-Croat," still less of one and the same "Yugoslav" literature.

In the matter of literary influences, that of Russia has tended to decrease, being supplanted in Serbia by that of France, and in Croatia and Slovenia by the "Moderna" movement which unites to French symbolism Scandinavian influences with Ibsen and Strindberg and German with Hauptmann and H. Bahr. In poetry the new fashion among the Croats was introduced by V. Vidrić. The patriotic poetry of V. Nazor entitles him to be considered their greatest modern lyrist. Of Serbian poets the most representative are J. Dučić, M. Rakić and S. Ćorović. Since Prešern the greatest interest in Slovene poetry attaches to O. Župančić. Croatia has continued to maintain its supremacy in the field of the novel and the drama with Gjalski and I. Vojnović, and newcomers are J. Kosor, M. Begović, M. Ogrizović and S. Tucić. The Serbs have given proof of their proficiency in the writing of stories by the work of B. Stanković, P. Kočić and M. Uskoković. The only names of importance in drama are B. Nušić and V. Jovanović. In Slovene literature the outstanding figure is the novelist I. Cankar.

A notable feature of the realistic period was a steady development of literary criticism, especially among the Serbs. In the '90s Lj. Nedić, educated in Germany, broke with the old formalism, and introduced a criticism free from bias and convention. Among the Croats and Slovenes, the union of creative and critical faculties in the same writer is more frequent, as exemplified in Marković, Levstik and Stritar. Under French influence, there is a marked advance in subtlety of judgment, leading often to hypercriticism. The scope of criticism has also widened so as to embrace social and political problems. J. Skerić (d. 1914) held the first place as a many-sided critic in Serbia, and exercised a profound influence on the movement towards Yugoslav unity. B. Popović represents in Serbia the school of Sainte-Beuve and Faguet, and his brother P. Popović has made a name as a literary historian. S. Jovanović, the historian and sociologist, ranks as one of the best stylists in Yugoslav literature. A development of fairly recent date is the increasing number of women poets, story writers, essayists and critics; *e.g.*, Isidora Sekulić among the Serbs, Z. Kveder among the Croats.

BIBLIOGRAPHY.—For Serbian literature *see* the works of P. Popović, J. Skerlić and A. Gavrilović; for Croatian those of Gj. Šurmin, V. Vodnik and D. Bogdanović; for Slovene I. Grafenauer and I. Prijatelj. A brief survey of the three literatures is given by P. Popović in *Jugoslovenska Književnost* (1918); M. S. Stanojevic, *Early Yugoslav Literature*, vol. i. A.D. 1100–1800 (1922), is at present the only work in English. *The Slavonic Review* (London: School of Slavonic Studies) has published articles on *Serbian Traditional Folk Poetry* by D. P. Subotić, and a *Survey of Modern Slovene Literature* by J. Vidmar. The *Heroic Ballads of Serbia*, trans. by G. R. Noyes and L. Bacon (Boston, 1913) and the *Ballads of Marko Kraljević* by D. H. Low (1922) give brief accounts of Serbian popular poetry. For the early period consult M. Murko, *Geschichte der ältern südslavischen Literaturen* (Leipzig, 1908). (D. Su.)

SERENA or LA SERENA, a city of Chile, capital of the province of Coquimbo, on the south bank of the Coquimbo river about 5 m. from the sea. Pop. (1920) 15,240. It has a good water supply, lighted and well-paved streets, tramway service and several small industries, including brewing and the making of fruit conserves. The annual rainfall is only 5·6 in. and its mean annual temperature is 59·2° F. Its railway connections include a line to Coquimbo (9 m.), its port, one to the Tamaya copper mines, and a narrow-gauge line up the valley of the Elqui to Guanta, through a region celebrated for its fruit. It is also in direct railway communication with the national capital via the "longitudinal" system.

Serena was founded by Juan Bohón in 1544, on the opposite side of the river, and was named after Pedro Valdivia's birthplace in Estremadura, Spain. It was destroyed by the Indians soon after, and was rebuilt on its present site in 1549 by Francisco de Aguirre.

SERENUS "of Antissa," Greek geometer, probably not of Antissa but of Antinoeia or Antinoupolis, a city in Egypt founded by Hadrian, lived most probably in the 4th century, between Pappus and Theon of Alexandria. Two treatises of his have survived, viz., *On the Section of the Cylinder* and *On the Section of the Cone*, the Greek text of which was first edited by Edmund Halley along with his Apollonius (Oxford, 1710), and is now available in a definitive critical edition by J. L. Heiberg (*Sereni Antissensis Opuscula*, Leipzig, 1896). A Latin translation by Commandinus appeared at Bologna in 1566, and a German translation by E. Nizze in 1860-61 (Stralsund). Besides these works Serenus wrote commentaries on Apollonius, and in certain mss. of Theon of Smyrna there appears a proposition "of Serenus the philosopher, from the Lemmas" to the effect that, if a number of rectilineal angles be subtended, at a point on a diameter of a circle which is not the centre, by equal arcs of that circle, the angle nearer to the centre is less than the angle more remote.

The book *On the Section of the Cylinder* states as its primary object the correction of an error on the part of certain geometers of the time who supposed that the transverse sections of a cylinder were different from the elliptic sections of a cone. When this has been done, Serenus shows (Prop. 20) that "it is possible to exhibit a cone and a cylinder cutting one another in one and the same ellipse." Other propositions naturally deal with subcontrary and other circular sections of a scalene cylinder or cone.

The treatise *On the Section of the Cone*, though Serenus claims originality for it, is unimportant. (T. L. H.)

SERENUS, SAMMONICUS, Roman savant, author of a didactic medical poem, *De medicina praecepta* (probably incomplete). The work (1,115 hexameters) contains a number of popular remedies, borrowed from Pliny and Dioscorides, and various magic formulae, amongst others the famous Abracadabra (*q.v.*), as a cure for fever and ague. It concludes with a description of the famous antidote of Mithradates VI. of Pontus. It is uncertain whether the author was the famous physician and polymath who was put to death in A.D. 212 at a banquet to which he had been invited by Caracalla, or his son, the tutor of the younger Gordian. The father, who was one of the most learned men of his age, wrote upon a variety of subjects, and possessed a library of 60,000 volumes, bequeathed to his son.

The editio princeps (ed. Sulpitius Verulanus, before 1484) is very rare; later ed. by J. G. Ackermann (Leipzig, 1786) and E. Bährens *Poetae Latini minores*, iii.; *see* also A. Baur, *Quaestiones Sammoniceae* (Giessen, 1886); M. Schanz, *Geschichte der römischen Literatur*, iii. (1896); W. S. Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 374, 4, and 383, 1.

SERER, a vigorous, coarse-featured people of Senegal. They speak a language that is related to Wolof and Fulani, and were for long subject to the Wolof, but with a paramount chief for their own race in the Sine country. The upper land-owning class lends or hires land to the lower class, slavery being unknown. There is no artisan caste amongst the Serer, but there is a caste of musicians and singers. Descent is patrilineal, the paternal uncle being head of the family. Marriage is endogamous. The Serer are cultivators and cattle-raisers, and their villages are subdivided into different quarters. The dead are buried outside the village and provided with arms and grave-furniture. The

bodies of *griots* are wrapped in cloth and placed in hollow baobab trunks. The people are animists, believe in sorcery, and practise the ordeal by redwood and red-hot irons.

See Bérenger-Feraud, *Les Peuplades de la Sénégambie* (1879); A. Hovelacque, *Les Nègres de l'Afrique Sus-Équatoriale* (1889); Dr. Lasnet, *Une mission au sénégal* (1900).

SÉRES, the chief town of the Séres province of Greek Macedonia, 43 m. by rail N.E. of Salonica. Pop. about 40,000, almost wholly Greek immigrants settled after 1922. A very few Bulgarians remain. In 1912 only 30% of the population was Greek. Séres is built in a district so fertile as to have borne among the Turks the name of Altin Ovassi, or Golden Plain. It is the seat of a Greek archbishop and patriarch. It consists of the old town, *Varosh,* situated at the foot and on the slope of the hill crowned by the old castle, and of the new town built in the European fashion on the plain, and forming the commercial centre. There is a large trade in rice and cereals, and the other exports include tobacco, cotton and hides.

Séres is the ancient *Sirrhae,* mentioned by Herodotus in connection with Xerxes's retreat, and by Livy as the place where Aemilius Paulus received a deputation from Perseus. In the 14th century, when Stephen Dushan of Serbia assumed the title emperor of Serbia, he chose Sirrhae as his capital; and it remained in the hands of the Serbians till its capture by Sultan Murad II. (1421–1451). In 1913 the city was looted and largely burnt by Bulgarian troops during the Greek advance up the Struma valley. It later fell into Greek territory but was occupied by the Bulgarian army in 1916 until Oct. 1918. It suffered severely from bombardment but has been largely rebuilt since. It is now the administrative centre for the control of refugee settlements in the Struma valley.

SERFDOM. The notion of serfdom is distinct from those of freedom and of slavery. The serf is not his own master: to perform services for other persons is the essence of his status, but he is not given over to his lord to be owned as a thing or an animal—there are legal limits to the lord's power. Serfdom is very often conceived as a perpetual adherence to the soil of an estate owned by a lord, but this praedial character is not a necessary feature of the condition. Hereditary serfdom may sometimes assume the shape of a personal relation between servant and master. Serfdom will be formed naturally in cases when one barbarous community conquers another, but is not able to destroy entirely the latter or to treat its members as mere chattels, but this mitigated form may be brought about as well by the paucity or comparative weakness of the victors as by the difficulty for them to draw income from pure slaves. In a state of backward agriculture and natural economy it will sometimes be more profitable for the conquerors as well as for the conquered to leave the dependent population in their own households and on their own plots, at the same time taxing them heavily in the way of tribute and services. Such an arrangement clearly obtained in several of the agricultural states of ancient Greece. The Penestae of Thessaly appear as a remnant of a distinct tribe settled on the confines of Macedonia and at the same time as a class of tributary peasants serving Thessalian aristocrats. The Mnoitae, Klarotae and Aphamiotae of Crete were more or less in the same position. Even in the case of the Helots of Sparta, who were made to perform services to any Spartiate who might require them to do so, features of a similar tributary condition are apparent. The chief work of the Helots was to provide a certain quantity of corn, wine and oil for the lords of the shares on which they were settled; personal services to other Spartiates were exceptional. Pollux in his account of the Helots places them distinctly in an intermediate position between free men and slaves. The fact that in these instances governments had a good deal to say in the regulation of the status of such serfs is well worth noting: it explains to a great extent the legal limitations of the power of the lords. Even downright slaves belonging to the state or to some great temple corporation were treated better than private slaves by the Greeks.

We shall not be astonished to find, therefore, in the Hellenistic states of Asia a population of peasants who seem to have been in a condition of hereditary subjection and adherent to the glebe on the great estates of the Seleucid kings. They were certainly not slaves, but their condition was closely bound up with the cultivation of the estates where they lived. The regulation by the state of the duties and customary status of peasants on government domains turns out to be one of the roots of serfdom in the Roman world, which in this respect as in many others follows on the lines laid down by Hellenistic culture. It is important for our purpose to notice that the condition of *coloni* was developed as a result of historic necessity by the working of economic and social agencies in the first centuries of the Roman empire and was made the subject of regular legislation in the 4th and 5th centuries. In the enactments of Justinian, summing up the whole course of development (C.J. xi., 48, 23), two classes of coloni are distinguished—the *adscripticii,* representing a more complete state of serfdom, and the free coloni, with property of their own. But the whole class, apart from minor variations, was characterized by the idea that the peasants in question were serfs of the soil on which they were settled, though protected by the laws in their personal and even in their praedial status. Thus the ascription to the soil, although originally a consequence of ascription to the tributes (*adscriptio censibus*), became the mark of the legal status of serfdom. The emperors actually tried in their legislation to prevent the landowners from evicting their coloni and from raising their rents. In this way fixity of tenure and service was aimed at and to a certain degree enforced by the state.

With the break-up of the Roman empire, the weak governments which took the place of imperial authority were not able to maintain the discipline and judicial power which would have been necessary to guarantee the tenure and status of the serfs. And yet serfdom became the prevailing condition for the lower orders during the middle ages, custom and economic requirements producing checks on the sway of masters. The direction of events towards the formation of serfdom is already clearly noticeable in Celtic communities. In Wales and Ireland the greater part of the rural working classes was reduced not to a state of slavery, but to serfdom. The male slave (W. *caeth*) does not play an important part in Celtic economic arrangements: there is not much room for his activity as a completely dependent tool of the master. The female slave (*cumal*) was evidently much more prominent in the household. Prices are reckoned out in numbers of such slaves and there must have been a constant call for them both as concubines and as household servants. As for male workmen, they are chiefly *taeogs* in Wales, that is half-free bondmen with a certain though base standing in law. Even these, however, could not be said to form the social basis for the existence of an upper free class. The latter was numerous, not wealthy as a rule, and had to undertake directly a great part of the common work, as may be seen from the extent of the free and servile tenures on the estates carved out for English conquerors in Wales and Ireland. Anyhow, the taeog class of half-free peasants stands by the side of the smaller tribesmen as subjected to heavier burdens in the way of taxation and services in kind. In Wales they are distributed into *gavells* and *gwelys,* like the free tribesmen themselves and thus connected with the land, but there is nothing to show that this connection was deemed a servitude of the glebe. The tie with the lord is after all a personal one.

The Germanic tribes moved on similar lines. The slaves had their separate households, while the masters exacted tribute from them in the shape of corn, cattle or clothes, and the serfs had to obey to the extent of rendering such tribute (Tacitus, *Germania,* 21). This means, of course, that it was in the interest of the master to levy tribute and not to organize slave labour. After the conquest of the provinces by the Germanic invaders the Roman stock of coloni naturally combined with German tributary peasants to form mediaeval serfdom. A half-free group is marked off in the early laws under the designation of *liti, lazzi, aldiones.* But in process of time this group was merged with freedmen, settled slaves (*servi casati*) and small freedmen into the numerous class of serfs (*servi, rustici, villani*) which appears under different names in all western European countries. The customary regulations of the duties of an important group of this class in regard to their lords are clearly expressed in the Bavarian law (7th century): serfs settled on the estates of the church have to work,

as a rule, three days in the week for their masters and are subject to divers rents and payments in kind. The regulations in question, although entered in a legal text, are not a legislative enactment but the result of a slow process of adjustment of claims between the ecclesiastical landowners and masters on one side and their rural dependents on the other. There can be no doubt that they were largely representative of the conditions prevailing on Bavarian estates belonging not only to the church but also to the duke and to lay lords. The old English *Rectitudines singularum personarum* (11th century) present other variations of the same customary arrangements. The rustic class appears in them to be differentiated into several subdivisions—the *geneats* performing riding duties and occasional services, the *gebúrs* burdened with week work and the *cotsets* holding cottages and performing light work in the shape of one day in the week and services to match (*see* VILLENAGE). Of these various groups that of the gebúrs corresponds more closely to the continental serfs (*coloni, Hörige, unfreie Hintersassen*).

The dualism characteristic of mediaeval serfdom, its formation out of debased freedom and rising servitude, may be traced all through the history of the middle ages. French jurists of the 13th century, *e.g.*, lay stress on a fundamental difference in law between the complete serf whose very body belongs to his lord (*cf.* the German *Leibeigenschaft*) and the villein or *roturier,* who is only bound to perform certain duties and ought not to be further oppressed by the landowners on whose soil he is settled (Beaumanoir, *Coutume de Beauvaisis*). But the same texts which draw the line between the two classes make it clear that there were no other guarantees to the maintenance of the rights of the superior rustics than the moral sense and the self-interest of their masters. It must be added, however, that even in the darkest times, economic forces provided some protection for the peasants who had lost the means of appealing to legal remedies. Lords who did not wish to see their estates deserted had to submit to the rule of custom in respect of exactions. And the screen of rural custom proved sufficient to allow of the growth of some property in the hands of the toiling class, a result which in itself rendered possible further emancipation.

A very instructive example of the formation of serfdom is presented by the history of Russia. Personal slavery in the sense in which it existed in the West was practised in ancient Russia (*kholopi*) and arose chiefly from conquest, but also from voluntary subjection in cases of great hardship and from the redemption of fines and debts (*cf.* the O. Eng. *wite-theow*). The great mass of the peasantry was originally free. Even when landownership was appropriated by the crown, the ecclesiastical corporations and the nobles, the tillers of the land retained their personal freedom and were considered to be farmers holding their plots under contracts. They were free to leave their farms provided they were able to effect a settlement in regard to all outstanding rent arrears and debts. The custom of the country gradually took the shape of a simultaneous resettlement of all conditions of rural occupation about St. George's day (Nov. 24), that is after the gathering of the harvest and the practical winding up of rural work.

Such was the legal state of affairs up to the end of the 16th century. A great change supervened, however, through the slow working of economic and political causes. The peasants settled under the sway of nobles and churches could very seldom produce a clean bill in regard to their money relations with the landlords. Thus, they gradually lapsed into a state of perpetual subjection from which they could not emancipate themselves by legal means. On the other hand, the growth of the Muscovite state with its fiscal governmental requirements involved a watchful repartition of burdens among the population and led ultimately to a system of collective liability in which the farms were considered chiefly as the sources of taxable income. The government was directly interested in maintaining their efficiency and in preventing migrations and desertions which led to a weakening of the taxpaying communities. A third aspect of the question must also not be disregarded, namely, the keen competition between landowners trying to attract settlers to their estates at the expense of their needy or less powerful neighbours. The first legislative measures of the Moscow rulers directed towards the establishment of a servile class similar to the Roman coloni fall into the first years of the 17th century (A.D. 1601, 1606) and consist in enactments against landowners depriving their neighbours of the tillers of their estates. But matters were clearly ripe for a wider application of the view that the peasant ought to stick to the soil, and the restoration of the Muscovite empire under the Romanovs brought with it the consolidation of all rural arrangements around this principle. Peter the Great regularized and completed this evolution by effecting a comprehensive cadastre and census of the rural population. The ultimate result was, however, not only the fixity of peasant tenures, but the subjection of the entire peasant population as a separate class (*Krepostrie*) to the personal sway of the landowners. The state insisted to a certain extent on the public character of this subjection and drew distinctions between personal slavery and serfdom. In the midst of the peasants themselves there lived a consciousness of their special claims as to tenant right. But, in fact, serfdom naturally took the form of an ugly ownership of live chattels on the part of a privileged class. Emancipation was brought about in the 19th century by economic causes as well as by humanitarian considerations. Private enterprise and the free application of capital and labour were hindered in every way by the bondage of the peasant class. Even such a necessary measure as that of moving cultivators to the rich soil of the south was thwarted by the adherence of the northern peasantry to the glebe. After several half-hearted attempts directed in the course of Nicholas I.'s reign to face the question while safeguarding at the same time the rights and privileges of the old aristocracy, the moral collapse of the *ancien régime* during the Crimean war brought about the Emancipation Act of Feb. 19, 1861, by which some 15 millions of serfs were freed from bondage. The most characteristic feature of this act was that the peasants, as distinct from household servants, received not only personal freedom but allotments in land in certain proportions to their former holdings. The state indemnified the former landowners, and the peasants had to redeem the loan by yearly payments extending over a number of years.

If we turn back from this course of development to the history of serfdom in the West striking contrasts appear. As we have already noticed, mediaeval serfdom in the West was the result of a process of customary feudal growth hardly interfered with by central governments. The loosening of bondage is also, to a great extent, prepared by the working of local economic agencies. Villeins and serfs in France rise gradually in the social scale, redeem many of the onerous services of feudalism and practically acquire tenant-right on most of the plots occupied by them. Tocqueville has pointed out that already before the revolution of 1789 the greater part of the territory of France was in the hands of small peasant owners, and modern researches have confirmed Tocqueville's estimate. Thus feudal overlordship in France had resolved itself into a superficial dominion undermined in all directions by economic realities. The fact that there still existed all kinds of survivals of harsh forms of dependence, *e.g.* the bondage of the serfs in the Jura Mountains, only rendered the contrast between legal conditions and social realities more pointed. The night of Aug. 4, 1789 put an end to this contrast at one stroke and the further history of rural population came to depend entirely on the play of free competition and free contract.

In the evolution of serfdom in Germany the regulating influence of government made itself felt to a greater extent, especially in the east. The colonization of the eastern provinces and the struggle against the Slavs necessitated a stronger concentration of aristocratic power, and the reception of Roman law during the 15th and 16th centuries hardened the forms of subjection originated by customary conditions. It may be said in a general way that Germany occupied in this respect, as in many others, an intermediate position between the west of Europe and Russia. Emancipation followed also a middle course, being brought about chiefly by governmental measures, although the ground was to a great extent prepared by social evolution. The reforms of Stein and Hardenberg in Prussia, of the French and of their clients in South

Germany, opened the way for a gradual redemption of the peasantry. Personal serfdom (*Leibeigenschaft*) was abolished first, hereditary subjection (*Erbunterthätigkeit*) followed next. Emancipation in this case was not connected with a recognition of the full tenant-right of the peasants; they had to part with a good deal of their land. To the last the landowners were not disturbed in their economic predominance, and succeeded very well in working their estates by the help of agricultural labourers and farmers. In the West the small peasant proprietorship had a better chance, but it arose in the course of economic competition rather than through any general recognition of tenant-right. On the whole serfdom appears as a characteristic corollary of feudalism. It grew up as a consequence of customary subjection and natural husbandry; it melted away with the coming in of an industrial and commercial age.

Authorities—Wallon, *Histoire de l'esclavage dans l'antiquité;* Pauly-Wissowa, *Realencyklopädie des klassischen Altertums, s.v.* "Coloni"; Fustel de Coulanges, *Recherches sur quelques problèmes d'histoire; Institutions politiques de la France* (*L'alleu et le domaine rural*); F. Seebohm, *English Village Community* (1883); P. Vinogradoff, *The Growth of the Manor* (1905); G. Waitz, *Deutsche Verfassungsgeschichte* (1844, ff.); P. Viollet, *Histoire du droit français* (3rd ed., 1905); Engelmann, *Geschichte der Leibeigenschaft in Russland;* Kluchevsky, *Lectures on the History of Russia* (in Russian), ii. (1906); G. Hansen, *Die Aufhebung der Leibeigenschaft in Schleswig und Holstein* (1861); G. F. Knapp, *Die Bauernbefreiung in Preussen* (1887); *Handwörterbuch der Staatswissenschaften,* ed. by Conrad and Lexis *s.vv.* "Bauernbefreiung," "Unfreiheit," "Grundherrschaft."

(P. Vi.; X.)

SERGE. A general term denoting several varieties of worsted twill fabrics, but more particularly that employed for men's suitings and women's costume, dress and coating fabrics. Serge fabrics are produced with a distinct twill weave and are of a coarser and somewhat rougher texture than the lighter grades of worsted fabrics. They are usually based on the even-sided regular twill weaves, as the four-end two-and-two ($\frac{2}{2}$) twill, and the six-end three-and-three ($\frac{3}{3}$) twill weave, according to the character of texture required and the purpose for which it is intended.

Thus, serge of lighter and medium textures suitable for women's wear, are usually based on the two-and-two twill weave, whilst the three-and-three twill weave is better suited for serge of heavier, closer and stronger textures, as this weave, by permitting of a relatively freer interlacement of the warp and weft threads thereby allows of the employment either of coarser and stronger yarn or else of a greater number both of warp and weft threads per inch being inserted in the fabric produced.

Serge fabrics are usually woven from Botany worsted yarns of counts ranging from 2/30's down to 2/18's, and with the number of warp threads and picks per inch varying according to the counts of yarn employed, and the weight and character of texture required, and of which there are innumerable grades and qualities ranging between extreme limits chiefly according to the particular use for which they are intended. Worsted yarn for the warp and woollen yarn for the weft, or else all worsted yarn both for warp and weft, of the better grades of wool, are employed in the superior qualities of serge fabrics.

So-called silk serges are used for women's dress and coating fabrics, while lighter grades of silk serge are used for coat and dress linings and also for umbrella covers. The description of "serge" is also applied to many other varieties of fabrics having the general textural features and other characteristics of serge fabrics. (H. N.)

SERGEANT: *see* Serjeant.

SERGIPE, a small Atlantic State, north-eastern Brazil (originally Sergipe d'el-Rey). Its area is 8,319 sq.m. Its population in 1920 was 477,064, three-fourths of which were half-castes and negroes. The São Francisco forms its northern boundary, and the drainage of the northern part of the State is northward and eastward to that river. The southern half of the State, however, slopes eastward and is drained directly into the Atlantic through a number of small rivers, the largest of which are the Irapiranga, the Real and the Cotinguiba. These are navigable for short distances, but are obstructed by sand-bars at their mouths. The surface of the State resembles in part that of Bahia, with a zone of forested lands near the coast, and back of this a higher zone of rough open country, called *agrestes.* There is a sandy belt along the coast, and the western frontier is slightly mountainous. The intermediate lands are highly fertile, especially in the forested region, where the rainfall is abundant. Further inland the year is divided into wet and dry seasons with occasional prolonged droughts. These districts are pastoral. The lower fertile lands are cultivated for sugar, cotton, maize, tobacco, rice, beans and *mandioca*—sugar being the principal product. Rubber and some other natural products are exported. There is a railway which runs from Aracajú northward to Capella, and one running southward to Bahia. The only manufacturing industries of importance are cotton-mills, sugar factories and distilleries, one of the largest sugar usines in Brazil being located at Riachuelo near Laranjeiras.

The capital of the State is Aracajú (pop. 37,440), on the lower course, or estuary, of the Cotinguiba river, near the coast. The bar at the entrance to this river is exceptionally dangerous, and the port is frequented only by coasting vessels of light draught. The town stands on a sandy plain, and there are sand dunes within the city limits. The public buildings are a large plain church with unfinished twin towers, the Government palace, the legislative halls, a normal school and public hospital. The other principal towns are Estancia (pop. 1920, 15,868); Laranjeiras (12,661); Capella (19,563); Lagarto (26,084); São Christovão, formerly Sergipe d'el-Rey (14,093), and Maroim (7,998).

SERGIUS, ST., usually associated with St. Bacchus, one of the most celebrated martyrs of Christian antiquity. His festival is on Oct. 7, and the centre of his cult was Resafa, or Rosafa, in Syria. This town, also called Sergiopolis, acquired importance as a place of pilgrimage, and became a bishop's see (Le Quien, *Oriens Christ.* ii. 951). According to their *Acta* (which, however, have little authority), SS. Sergius and Bacchus were soldiers.

See *Acta sanctorum* (October), iii. 833–883; *Analecta Bollandiana* xiv. 373–395.

SERGIUS, the name of four popes.

Sergius I., pope from 687 to 701, came of an Antiochene family which had settled at Palermo. He was elected after a fierce struggle between two other candidates, Paschal and Theodore. In the second year of his pontificate he baptized King Ceadwalla of Wessex at Rome. For rejecting certain canons of the Trullan (Quinisext) council of 692, Justinian II. commanded his arrest and transportation to Constantinople, but the militia of Ravenna and the Pentapolis forced the imperial protospatharius to abandon the attempt to carry out his orders. Sergius was followed by John VI. as pope.

Sergius II., pope from 844 to 847, a Roman of noble birth, elected by the clergy and people to succeed Gregory IV., was forthwith consecrated without waiting for the sanction of the emperor Lothair, who accordingly sent his son Louis with an army to punish the breach of faith. A pacific arrangement was ultimately made, and Louis was crowned king of Lombardy by Sergius. In this pontificate Rome was ravaged, and the churches of St. Peter and St. Paul robbed, by Saracens (August 846). Sergius was succeeded by Leo IV.

Sergius III., elected pope by one of the factions in Rome in 898, simultaneously with John IX., was expelled from the city by his adversaries. He reappeared in 904, seized the two claimants, Leo V. and Christopher, who were disputing the succession of Benedict IV., and had them strangled. His adherents rallied round the vestiarius Theophylact, a powerful Roman functionary, and his wife, Theodora. Sergius is reputed to have been the lover of Theodora's daughter Marozia, by whom he is said to have had a son, who became pope as John XI. Sergius was very hostile to the memory of Pope Formosus, and refused to recognize any of the ordinances celebrated by him, thus causing grave disorders. He also affected to consider as anti-popes, not only John IX., but also his successors down to and including Christopher. He restored the Lateran basilica, which had fallen down in 897. He died on April 14, 911, and was succeeded by Anastasius III.

Sergius IV., pope from 1009 to 1012, originally bore the name of Bucca porca (*Os porci*). He was a mere tool in the hands of the nobility of the city; he was succeeded by Benedict VIII.

SERGIYEVO (Sergiev), a town of Russia in the province of Moscow, in 56° 23′ N., 38° 5′ E. It grew up around the

monastery or *lavra* of Troitsko-Sergiyevskaya, one of the most important architectural and historic relics of the Russian Middle Ages. It was formerly greatly venerated in Russia and visited by thousands of pilgrims; the inhabitants (31,413 in 1900) were renowned for their carved and painted ikons and wooden souvenirs sold to the visitors. After the 1917 revolution it was converted into a museum. The electro-technical academy of the Red Army has been located in the town and a textile artel has been formed. The population in 1926 was 21,391.

A small wooden church erected by the monk Sergius was burned by the Tatars in 1391, and the cathedral of the Trinity (Troitsk) built in the Vladimir Suzdal style in 1422 stands on the site. It contains a number of ikons, including one by Rublev. The Uspensky (Assumption) cathedral was erected in 1585 and in the southern part of the monastery is the church of Sergius, beneath which are the spacious rooms where in pre-revolution times dinners were distributed gratis to pilgrims. The bell tower of the monastery, 320 ft. high has a bell weighing 64 tons. Several monasteries of lesser importance existed in the neighbourhood. The monastery acquired so much wealth that walls 25 to 50 ft. in height and fortified by nine towers were erected in 1513 and within them were the two cathedrals, several churches, buildings for the monks and pilgrims, including a hospital, and a theological academy. Ivan the Terrible made the Sergiyevo monastery the centre of the ecclesiastical province of Moscow in 1561.

SERI, a tribe of Tiburon island and adjacent parts of Sonora, reputed one of the most primitive in America. Alone among all their neighbours they are non-agricultural, subsisting on shell-fish, turtles, pelicans and cactus fruit. They make pottery and navigate boat-shaped rush rafts. They are said to be matrilineal, but the statement needs authentication. Although sometimes reckoned an independent stock, they form part of the larger Hokan group (*q.v.*), and seem to be specially related to the Yuman peoples (*q.v.*). *See* W. J. McGee, *Bur. Am. Ethn. Rep.* XVII. (1898).

SERIEMA or **CARIAMA** (*Cariama cristata*), a South American bird, belonging to the family *Cariamidae*, allied to the cranes (*q.v.*) and trumpeters, which, owing to its long legs and neck, stands some 2ft. high. The beak and legs are red, the plumage grey above and dull white beneath with bluish skin round the eyes. It inhabits the *campos* of Brazil, extending inland as far as the Matto Grosso, living in high grass, where it runs swiftly. The nest is built in bushes or trees and contains two eggs. The young are hatched covered with grey down. The seriema feeds on insects, snails, reptiles and berries.

THE SERIEMA OF SOUTH AMERICA

An allied bird, *Chunga burmeisteri*, inhabits Argentina. It is darker and has shorter legs.

See W. H. Hudson, *A Naturalist in La Plata.*

SERIES. The following notations will be used freely throughout this article. The modulus of x, denoted by $|x|$, means the absolute numerical value of x, when x is real; and when x is complex of the form $a+ib$, it means the positive square root of a^2+b^2. The expression $f(x)\to l$, $x\to a$, means that $f(x)$ tends to a limit l, as x tends to a in any manner; if we write $x\to a+$ or $x\to a-$, this means that as x tends to a it always remains greater than a or less than a respectively. If n is a positive integer $f(n)\to l$ means that $f(n)$ tends to the limit l as n tends to infinity. The symbol $O(x)$ means "of the order of x." The symbol $\geqq$ means "greater than or equal to" and the symbol $\leqq$ means "less than or equal to." Logarithms, wherever mentioned, are to the base e.

A set of numbers $u_1, u_2, u_3, \cdots$ corresponding unequivocally to the set of positive integers $1, 2, 3, \cdots$ is called a sequence (*see* NUMBER SEQUENCES). The terms of a sequence, written in order, with the sign of addition between every adjacent two, thus $u_1+u_2+u_3+\cdots$, are said to form a series. If the sum of the first n terms of the series, $u_1+u_2+u_3+\cdots+u_n$, is denoted by s_n, the study of the series is the study of the sequence $s_1, s_2, s_3, \cdots$. If the number of terms is unlimited the series is said to be an infinite series. The series itself may be denoted by Σu_n. If s_n tends to a finite limit S, as n tends to infinity, the series is said to be *convergent* and S is said to be its *sum*. Such a series is often said to *converge* to S. If s_n tends to infinity, positive or negative, the series is said to be *divergent* and to *diverge* to $+\infty$ or to $-\infty$, as the case may be. When the symbol ∞ is written alone, it denotes $+\infty$. If s_n oscillates between two numbers a and b, the series is said to *oscillate finitely*. If s_n may assume positive or negative values, increasing numerically without limit, the series is said to *oscillate infinitely*. In modern writings all series which are not convergent are usually called divergent, the distinction being specified if necessary.

The chief problem connected with an infinite series is to discover whether it is convergent. The formal necessary and sufficient test for convergence is that, ϵ being any arbitrary small positive number, it is possible to find an integer ν, such that $|s_m-s_n|<\epsilon$, provided only that $m\geqq\nu$ and $n\geqq\nu$. As, however, it is generally impossible to find any compact expression for s_n, this test cannot be applied directly. We can, however, draw some useful conclusions from it. For example we must have $u_n\to 0$, and if $u_n\to 0$ and never increases we must have $nu_n\to 0$. The first shows at once that a series in which u_n is $x^n \sin n\theta$, cannot be convergent unless $|x|<1$. The second shows that the series $\Sigma 1/n$ is divergent. Neither condition is at all sufficient. The series $\Sigma 1/n \log n$, for example, is divergent, although $nu_n\to 0$. Since it is generally impossible to appeal directly to s_n, tests have to be constructed which depend on u_n. It may be said at once that completely general tests, both necessary and sufficient, have not been nor are likely to be found. Series can be constructed to defy any test, however delicate. But tests exist which are adequate to deal with nearly all such series as are likely to occur in applications.

Series of Positive Terms. The Ratio Tests.—There is an important difference between series in which all the terms, at least after some stage, are all of one sign and those in which the terms persist in being of variable sign. If the terms are all positive the terms of the sequence s_n are steadily increasing and it is not only a necessary but also a sufficient condition for s_n to tend to a limit that a number A can be found, such that $s_n<A$, for all values of n. If no such number can be found, then $s_n\to\infty$. A series of positive terms cannot oscillate. If the terms are of variable sign, the condition $|s_n|<A$ is necessary but is sufficient only to exclude infinite oscillation.

One of the simplest tests applicable to series of positive terms is that, if Σv_n and Σu_n are two series of positive terms, then the convergence or divergence of one implies the convergence or divergence of the other, if u_n/v_n tends to a finite limit, or if two positive numbers A and B can be found, such that $A>u_n/v_n>B$. In this way, convergence of Σu_n can be deduced from that of a series Σv_n, whose convergence or divergence is readily established. Thus Σn^{-2} is convergent if $\Sigma\{n(n+1)\}^{-1}$ is convergent. But if $v_n=\{n(n+1)\}^{-1}$, $s_n=1-1/(n+1)$, and $s_n\to 1$, so that Σv_n is convergent and therefore Σn^{-2} is convergent. If $u_n/v_n\to 0$, then Σu_n is convergent, if Σv_n is convergent, but both series may be divergent. If u_n and v_n may have variable signs, the existence of a limit for u_n/v_n is no indication that the convergence of Σv_n implies that of Σu_n.

In most series of positive terms required in applications the terms tend to zero, steadily diminishing. To such series we can apply a test called *Cauchy's condensation test*, viz., that $\Sigma\phi(n)$ is convergent, if $\Sigma a^n\phi(a^n)$ is convergent, a being any positive integer. We have also Maclaurin's test, viz., that if $u_n=\phi(n)$,

$$\int_1^n \phi(x)dx-s_n \text{ tends to a finite limit; so that the convergence or}$$

divergence of $\Sigma\phi(n)$ occurs with that of $\int_1^n \phi(x)dx$. By either test we show readily that the series

$$\Sigma n^{-p},\quad \Sigma n(\log n)^{-p},\quad \Sigma n\log n\{\log(\log n)\}^{-p},$$

and so on, are each convergent if $p>1$ but divergent if $p \leqq 1$.

A series of tests, called the ratio-tests, applicable only to series in which $u_n \to 0$ steadily, is of great historical as well as of great practical interest. The more elaborate of them are associated with the names of A. De Morgan, A. Cauchy, J. Bertrand and others and can be proved by means of the comparison test and the convergence or divergence of the series just mentioned. They are most readily established by means of a general theorem associated with the names of Dini and Kummer, which is as follows: If a function $f(n)$ can be found such that

$$f(n)\frac{u_n}{u_{n+1}} - f(n+1) \to l > 0,$$

or, if not tending to a limit, is always greater than some fixed positive number, the series Σu_n is convergent. If, moreover, $\Sigma\{f(n)\}^{-1}$ is divergent, then, if $f_n(n)\dfrac{u_n}{u_{n+1}} - f(n+1) \to l < 0$, or is never positive, Σu_n is divergent. By taking $f(n)$ in succession as $1, n, n\log n, \cdots$ we obtain the following series of tests:

(1) If $u_n/u_{n+1} \to l > 1$, or u_n/u_{n+1} is always greater than some fixed number >1, Σu_n is convergent. If $u_n/u_{n+1} \to l < 1$, or never exceeds unity, Σu_n is divergent. If $l=1$, nothing is settled unless u_n/u_{n+1} always remains <1. Σu_n is then divergent. This is known as D'Alembert's test. If this fails we may proceed to the next test, known as Raabe's test.

(2) If $n\{u_n/u_{n+1} - 1\} \to l$, then Σu_n is convergent if $l>1$, divergent if $l<1$. If $l=1$, nothing is settled. There are the same modifications as in test (1). If this fails we may proceed to the next test.

(3) If $\{n(u_n/u_{n+1} - 1) - 1\}\log n \to l$, then Σu_n is convergent if $l>1$, divergent if $l<1$, and nothing is settled if $l=1$, with the same modifications as before.

The following rule will cover most cases. If u_n/u_{n+1} can be expressed in the form $1+\mu/n+O(n^{-\lambda})$, $\lambda>1$, then Σu_n is convergent if $\mu>1$, divergent if $\mu \leqq 1$.

Alternative forms of the second and third tests are as follows: If $n\log(u_n/u_{n+1}) \to l$, or $\log n \log\{n\log(u_n/u_{n+1})\} \to l$, the series is convergent, if $l>1$, divergent if $l<1$, and so on. There are still other forms of these tests, superficially different but essentially the same.

Another test, known as Cauchy's test, of great theoretical importance, is the following. If $u_n^{1/n} \to l < 1$, or if, after some stage, $u_n^{1/n}$ is never greater than l, some fixed number <1, Σu_n is convergent. If $u_n^{1/n} \to l > 1$, or if after any stage, there are an unlimited number of integers n for which $u_n^{1/n}$ is as great as unity, the series is divergent. For under these conditions u_n cannot tend to zero. This test is applicable to series in which u_n does not tend steadily to zero, as for instance the series $\Sigma a^n \sin^2 n\theta$, where $a<1$. For $u_n^{1/n}$, though it tends to no definite limit, cannot exceed a. It may be remarked that, if u_{n+1}/u_n has a limit, $u_n^{1/n}$ has the same limit, though the converse is not necessarily true.

If the terms of a convergent series of positive terms are deranged according to any law to form a new series, the new series is also convergent and its sum is that of the original series. If Σu_n is convergent so is $\Sigma a_n u_n$, where a_n is any positive number less than some fixed number independent of n. Similar results hold for a divergent series of positive terms. It is generally possible from these considerations to determine the convergence or divergence of a series of positive terms, in which u_n does not tend steadily to zero.

Series Whose Terms Are of Variable Sign. Absolute Convergence.—When a series consists of terms not all of the same sign, it may happen that the series $\Sigma|u_n|$ is convergent. In this case Σu_n is convergent and is said to be *absolutely convergent*. The positive terms alone form a convergent series and the negative terms alone form another convergent series. If the terms of such a series are deranged to form a second series, the second series is convergent and its sum is the same as that of the original series. If $\Sigma|u_n|$ is divergent, the series is said to be *non-absolutely* or *conditionally convergent*. The positive terms alone form a divergent series and the negative terms alone form a second divergent series. Its sum depends upon the order of its terms. It has been proved by Riemann that the terms of such a series can be arranged to form a series which shall converge to any assigned sum or even to diverge. The series $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}-\frac{1}{6}+\cdots$ is convergent, its sum being $\log 2$. The series $1+\frac{1}{3}-\frac{1}{2}+\frac{1}{5}+\frac{1}{7}-\frac{1}{4}+$, obtained by rearranging its terms, is convergent but its sum is $\frac{3}{2}\log 2$. The series $\dfrac{\log 2}{2}-\dfrac{\log 3}{3}+\dfrac{\log 4}{4}-\dfrac{\log 5}{5}+\cdots$ is convergent, but the series $\sum\left\{\dfrac{\log(4n-2)}{4n-2}+\dfrac{\log 4n}{4n}-\dfrac{\log(2n+1)}{2n+1}\right\}$, obtained by rearranging its terms, is divergent.

Such tests as exist for series of this type, which are not absolutely convergent, depend upon a theorem known as *Abel's Lemma*, which is that, if $a_1, a_2, a_3, \cdots$ is a steadily decreasing set of numbers, then $a_1u_1+a_2u_2+\cdots+a_nu_n$ is less than a_1A and greater than a_1B, where A and B are respectively the greatest and least of the expressions

$$u_1,\ u_1+u_2,\ u_1+u_2+u_3, \cdots\ u_1+u_2+\cdots+u_n.$$

It follows that, if Σu_n is convergent and a_n is steadily increasing or steadily decreasing to a finite limit, then $\Sigma a_n u_n$ is convergent. It follows also that, if $|u_1+u_2+\cdots+u_n|$ is always less than some fixed number independent of n, and a_n decreases steadily to zero, then $\Sigma a_n u_n$ is a convergent series. A particular case is that, if a_n decreases steadily to zero, the series $\Sigma a_n \cos(n\theta+\alpha)$ is convergent. A still more particular case is that the series $a_1-a_2+a_3-a_4+\cdots$ is convergent. Such a series is called an alternating series.

If Σv_n is a convergent series and u_n/v_n tends to a limit l, different from zero, it cannot be inferred, if u_n and v_n are not always of the same sign, that Σu_n is also convergent. It may however happen that the convergence or divergence of the series $\Sigma(u_n - lv_n)$ can be readily established. If this series is convergent, then Σu_n is convergent. If it is not convergent, then Σu_n is not convergent. For example, if $v_n=(-1)^{n-1}n^{-p}$, then Σv_n is convergent, if p is positive. If $u_n=(-1)^{n-1}/\{n^p+(-1)^{n-1}\}$, then $u_n/v_n \to 1$. Now $v_n-u_n=n^{-p}/\{n^p+(-1)^{n-1}\}$, which is always positive and is convergent or divergent with the series n^{-2p}, and so is convergent only if $2p>1$. Hence Σu_n is convergent only if $2p>1$.

Series of Complex Terms.—A series of complex terms $\Sigma(a_n+ib_n)$ can only be convergent if Σa_n and Σb_n are separately convergent. If $\Sigma|a_n+ib_n|$ is convergent, the series is said to be absolutely convergent. In this case Σa_n and Σb_n are each absolutely convergent, and the converse also holds. Certain tests can be extended to series of complex terms. Thus by an extension of Maclaurin's Integral test the series $\Sigma n^{-\mu}$, where $\mu=\alpha+i\beta$, may be shown to be convergent only if $\alpha>1$. The following is an extension of the ratio-test. If $u_n/u_{n+1}=1+\mu/n+O(n^{-k})$, $k>1$, then the series is absolutely convergent if the real part of μ is greater than 1 and is not convergent at all in any other case.

Double Series.—A double series is formed by the addition of terms $a_{m,n}$ depending on two integers. We may suppose the term $a_{m,n}$ to occupy the point whose cartesian co-ordinates referred to two axes are m,n. The sum of all the terms inside the rectangle bounded by the axes and the lines $x=m+1$, $y=n+1$ may be denoted by $s_{m,n}$. The double series may be said to converge if $s_{m,n}$ tends to a definite limit as m and n each tend *independently* to infinity. Other methods of summation are as follows. Keeping n fixed we may try to sum the infinite series $a_{n,1}+a_{n,2}+\cdots$. If this converges to a sum A_n, we may then sum the infinite series $A_1+A_2+\cdots$. If this series converges we call the sum the sum by rows of the double series. We can similarly investigate a sum by columns. But it does not follow that, if the double series has a sum in the first sense, it has a sum either by rows or columns equal to this sum. This does actually happen when the rows and columns are both convergent and the double series is convergent in the first sense. If the double series is not convergent in the

first sense, the sums by rows and columns may both exist but are not necessarily equal, nor does the fact that the sums by rows and columns both exist and are equal imply that the double series is convergent in the first sense.

Another method of summation is to form a single series Σc_n, where $c_m = a_{1,m} + a_{2,m-1} + \cdots + a_{m,1}$. If this series is convergent, its sum is called the sum of the double series by *diagonals*. The existence of this sum does not imply the existence of any other sum. If all the terms of a double series are positive, then, if it can be summed in any way, it can be summed in every other way and all the sums are the same, and are unaffected by any derangement of its terms. The idea of absolute convergence may be extended to double series. Tests for double series of positive terms may be obtained analogous to those for single series. Thus, if $f(x, y)$ is positive and steadily decreases to zero as x and y increase, the double series $\Sigma\Sigma f(m, n)$ and the double integral $\int^\infty\int^\infty f(x, y)dx\,dy$ are convergent or divergent together. Thus the double series $\Sigma\Sigma(m^2+n^2)^{-\alpha}$ is convergent if $\alpha > 1$, but divergent otherwise, a result having an application of fundamental importance in the theory of elliptic functions. Triple and multiple series are obvious extensions of double series.

Multiplication of Series.—The most interesting case of double series is perhaps that furnished by the multiplication of series. We are able to exhibit the product of the series Σu_n and Σv_n as a double series $\Sigma\Sigma u_m v_n$. If Σu_n converges to a sum U and Σv_n converges to a sum V, then since $s_{m,n}$ is equal to

$$(u_1+u_2+\cdots+u_m)(v_1+v_2+\cdots+v_n) \quad \text{so that} \quad s_{m,n} \rightarrow UV,$$

the double series is always convergent in the first sense. The sum usually taken as the product of the two series is however the sum of the double series by diagonals, that is, Σw_n, where

$$w_n \equiv u_1 v_n + u_2 v_{n-1} + \cdots + u_n v_1.$$

This arises from the fact that the formal product of the two series $\Sigma u_n x^n$, $\Sigma v_n x^n$ arranged in powers of x, is $\Sigma w_n x^n$. The chief theorems concerning this product, sometimes specifically alluded to as Cauchy's product, are

(1) *Cauchy's theorem.* If Σu_n and Σv_n converge absolutely to the sums U and V respectively, then Σw_n converges absolutely to UV.

(2) *Merten's theorem.* If Σu_n converges absolutely to U and Σv_n converges, but not absolutely, to V, then Σw_n converges to UV.

(3) *Abel's theorem.* If Σu_n converges to U and Σv_n converges to V and Σw_n is convergent, then Σw_n converges to UV.

(4) *G. H. Hardy's theorem.* If Σu_n converges to U and Σv_n converges to V and $|nu_n| < K$ and $|nv_n| < K$, where K is some fixed number, then Σw_n converges to UV. Further, if we take a third series, whose terms satisfy the same condition, the Cauchy product of this series and Σw_n is convergent, and so on for any finite number of such series.

The product of two convergent alternating series

$$u_1 - u_2 + u_3 - \quad \text{and} \quad v_1 - v_2 + v_3 - \cdots$$

is convergent, if $w_n \rightarrow 0$, this condition being both necessary and sufficient. This theorem is due to Pringsheim who has shown that a sufficient condition is that $\Sigma u_n v_n$ should be convergent. This is not necessary, nor can there be any necessary and sufficient condition based on the product $u_n v_n$. If $u_n = v_n = (n \log n)^{-\frac{1}{2}}$, the product is convergent. If $u_n = n^{-1}$ and $v_n = (\log n)^{-1}$, the product is not convergent, although in each case $u_n v_n = (n \log n)^{-1}$. It may be noted that, if Σu_n and Σv_n are both convergent, the series Σw_n cannot be strictly divergent, although it may oscillate, the range of oscillation being possibly infinite.

Series of Terms Containing a Variable. Uniform Convergence.—If the terms of a series contain a variable x, real or complex, and if the series $\Sigma u_n(x)$ is convergent for values of x in a certain interval, if x is real, or within a certain region, if x is complex, the sum of the series, which we may denote by $S(x)$, determines a function of x within that interval (or region). If each term of the series is a continuous function of the variable, it does not follow that the function $S(x)$ is continuous. For if we find the limit of $S_n(x)$, as n tends to infinity, for general values of x and then give x a particular value a, it is not at all certain that we shall obtain the same result as if we put x equal to a, before proceeding to the limit. Thus, if $S_n(x) = 1/(1+nx)$, $S_n(x) \rightarrow 0$ for all values of x, positive or negative; but $S_n(0) = 1$ and therefore the sum of the series, when $x = 0$, is 1. Thus the function determined by the sum of the convergent series in which $S_n(x) = 1/(1+nx)$ is discontinuous at $x = 0$. Discontinuity in a function defined by the sum of an infinite convergent series of continuous functions is always accompanied by a phenomenon known as *non-uniform convergence.* The term *uniform convergence* is due to Weierstrass and the idea, though not unknown to Abel, was developed about the middle of the 19th century by him and by Sir G. G. Stokes, Seidel and Arndt. The fundamental notion of uniform convergence is this:—the formal condition that the series $\Sigma u_n(x)$ should be convergent is that, given any arbitrarily small positive number, ϵ, it is possible to find an integer ν, such that $|S_{n+p}(x) - S_n(x)| < \epsilon$, for all values of p if $n \geqq \nu$. The least value of ν, or the least that can be found in practice, depends not only on ϵ but on x, and may be denoted by $\nu(x)$. It may happen that an integer K can be found, depending only on ϵ and not on x, such that for every value of x in the interval (or region) of convergence $K > \nu(x)$. In this case the series is said to converge *uniformly* to $S(x)$ in the interval (or region). If however it happens that, N being any arbitrarily chosen number, however large, we can always find a value of x in the interval, such that $\nu(x) > N$, then the series is non-uniformly convergent. If we consider $S_n(x) = 1/(1+nx)$ and determine ν such that $|S_n(x)| < \epsilon$, $n \geqq \nu$, we must have $\nu \geqq (\epsilon^{-1} - 1)/x$, x positive, and $\nu \geqq (\epsilon^{-1} + 1)/|x|$, x negative. Thus in any interval which does not include zero, there is uniform convergence; for, if a is the lower limit of the interval if x is positive, or $-b$ is the upper limit of the interval if x is negative, we can take ν to be the next integer above $(\epsilon^{-1} - 1)/a$ or $(\epsilon^{-1} + 1)/b$. But evidently we can take x sufficiently near to zero to require $\nu > N$, any assigned integer, however great. Hence the series is not uniformly convergent in any interval which includes zero.

One of the most important properties of a function defined by a convergent infinite series of functions of a variable is that it is continuous in any interval (or region) in which the series is uniformly convergent. If the series has a discontinuity at any point, it cannot be uniformly convergent throughout any interval containing that point. It does not however follow that non-uniform convergence necessarily involves discontinuity. If $s_n(x) = x/(1+nx)$, the sum of the series for all values of x, zero included, is zero, but the series is not uniformly convergent in a range which includes zero.

A less artificial looking series is the series $\Sigma \frac{1}{n} \sin n\theta$, which is convergent for all real values of θ. If $0 < \theta < 2\pi$, the series converges to $\frac{1}{2}(\pi - \theta)$, but clearly, if $\theta = 0$ or 2π, its sum is zero. Hence there cannot be uniform convergence throughout any interval which includes 0 or 2π. Actually the series is uniformly convergent in any range given by $0 < \delta < \theta < \delta' < 2\pi$.

Tests for uniform convergence are not numerous nor are they always very simple. One very simple test, which covers most applications, is known as the *Weierstrass M-test.* It is this. If a number U_n can be found such that $|u_n(x)| \leqq U_n$ for all values of x in an interval (or region) and ΣU_n is convergent, then $\Sigma u_n(x)$ is uniformly convergent throughout the interval.

Thus the series $\Sigma x^n \cos\{\phi_n(x)\}$, where $\phi_n(x)$ is any real function of x, is uniformly convergent in any interval a to b, where $|a|$ and $|b|$ are each less than unity.

It has been remarked that the series $\Sigma a_n \sin n\theta$, where a_n decreases steadily to zero, is convergent for all real values of θ. Such a series is uniformly convergent in any range that does not include zero or a multiple of 2π. That it should be uniformly convergent in any range whatever it is necessary and sufficient that na_n should tend to zero. This is practically the only type of series for which a condition for uniform convergence, necessary as well as sufficient, exists.

If $\Sigma u_n(x)$ converges uniformly to $S(x)$ throughout the interval a to b, then $\int S(x)dx=\Sigma\int u_n(x)dx$, if both the upper and lower limits of integration are not outside the interval. It is not absolutely necessary that uniform convergence should exist for term-by-term integration, as it is called, to be valid, but no better completely general conditions are known. One case may be mentioned where term-by-term integration is valid over a range which contains a point of non-uniform convergence and that is if $|s_n(x)|<K$, some fixed number, for all values of n and for all values of x within the range of integration.

For term-by-term differentiation we have the theorem that $\Sigma \dfrac{d}{dx} u_n(x) = \dfrac{d}{dx}S(x)$, at all points of an interval throughout which the series on the left-hand side is uniformly convergent. But this condition is not necessary.

It should be noted that even when the series $\Sigma u_n(x)dx$ is uniformly convergent throughout any interval, however large its upper limit, term-by-term integration with infinity as the upper limit is not always possible. The series for e^{-bx}, viz.

$$1-bx+\frac{b^2x^2}{2!}-\frac{b^3x^3}{3!}+\cdots$$

is uniformly convergent in any interval $(-N, +N)$, however large N may be, and so is the series obtained by multiplying each term by e^{-x}.

But $\displaystyle\int_0^\infty e^{-x}(1-bx+\frac{b^2x^2}{2!}-\cdots)dx=1-b+b^2-b^3+\cdots$ which is equal to $(1+b)^{-1}$, the value of $\displaystyle\int_0^\infty e^{-(1+b)x}dx$, only if $|b|<1$; the series of integrated terms not being convergent otherwise.

Absolute convergence and uniform convergence are quite distinct. Neither implies the other. The series $\Sigma(-1)^n(n+x^2)^{-1}$, where x is real, is uniformly convergent in any interval. For $|S_{n+p}(x)-S_n(x)|<1/(n+1+x^2)<1/(n+1)$ and therefore $<\epsilon$, if $n+1>\epsilon^{-1}$, a condition independent of x. Yet the series is not absolutely convergent for any value of x. On the other hand the series $\Sigma\{1(1+nx)-1/(1+\overline{n+1}x)\}$ is absolutely convergent for all values of x, but is not uniformly convergent throughout any interval which includes $x=0$.

The following important theorem, known as Tannery's theorem, is based upon an idea similar to that of uniform convergence. Let $u_1(n)$, $u_2(n)$, $\cdots$ be a sequence of numbers each involving n. Let $S(n)\equiv u_1(n)+u_2(n)+\cdots$ where the series is infinite or stops at a term $u_p(n)$, where p depends on n and becomes infinite with n. Let $u_r(n)$ tend to u_r as n tends to infinity, and let it be possible to find U_r, independent of n, such that $|u_r(n)|<U_r$ for all positive values of n and the series ΣU_r is convergent. Then $S(n)$ tends to a limit, as n tends to infinity, which is the sum of the series Σu_r. By means of this theorem we can prove that the exponential series $\Sigma z^n/(n!)$ is the limit of $\left(1+\dfrac{z}{n}\right)^n$ as n, a positive integer, tends to infinity. We can also deduce the expansions of $\cos\theta$ and $\sin\theta$ as power series in θ from the identities

$$\cos\theta=\cos^n\frac{\theta}{n}\left\{1-\frac{n(n-1)}{1\cdot 2}\tan^2\frac{\theta}{n}+\cdots\right\}$$

and

$$\sin\theta=\cos^n\frac{\theta}{n}\left\{n\tan\frac{\theta}{n}-\frac{n(n-1)(n-2)}{1\cdot 2\cdot 3}\tan^3\frac{\theta}{n}+\cdots\right\}.$$

The treatment of these deductions given in many elementary textbooks is quite unsound.

Power Series.—A type of series of great interest and importance is the *Power series, i.e.*, a series whose general term is of the form $a_n(x-h)^n$, where x is a variable, real or complex, and h is a constant. There is no loss of generality in taking h as zero. Such a series is convergent throughout a certain interval if x is real and throughout the interior of a certain circle with its centre at the origin if x is complex. For values of the variable outside this interval (or region) the series ceases to be convergent. The radius of the circle is the limit of $|a_n/a_{n+1}|$, if this limit exists, or the reciprocal of the limit of $|a_n|^{1/n}$, if this limit exists. If neither of these limits exists, the radius is the reciprocal of the upper limit of $|a_n|^{1/n}$, that is, the greatest number G such that an infinite set of integers (not consecutive) can be found such that for every such integer $|G-|a_n|^{1/n}|<\epsilon$, where ϵ is an arbitrarily assigned small positive number. For instance, if $a_n=\sin n\theta$, G is evidently unity, though neither of the other limits exists. If x is restricted to be real, then x must lie on that diameter of the circle which is the axis of real numbers. The circle is called the *circle of convergence*. The radius of the circle may in some cases be indefinitely great, as in the case of the exponential series and the sine and cosine series, which are convergent in the interior of any circle, however great its radius, or the circle may shrink to a point as with the series $1!+2!x+3!x^2+\cdots$ which is convergent for no value of x except zero. For points on the circle itself, the series may or may not be convergent. For example, if we take the binomial series $1+nz+\dfrac{n(n-1)}{2!}z^2+\cdots$, where n is not a positive integer, the circle of convergence is the circle $|z|=1$. If n is positive the series converges absolutely for every point on the circle. If n is negative but $n+1$ is positive, the series converges, but not absolutely, at every point of the circle except $z=-1$. If $n+1$ is not positive, the series does not converge at any point of the circle.

A power series converges absolutely and uniformly throughout the interior of its circle of convergence. It can be integrated or differentiated term by term at all points of the interior of the circle. Two power series in the same variable cannot represent the same function in any region without being identical.

An important theorem on power series is *Abel's theorem.* If Σa_nx^n converges to $f(x)$ for $|x|<1$, and if Σa_n converges to a sum S, then $\lim f(x)x\to 1-=S$.

But the existence of $\lim f(x)x\to 1-$ does not necessarily imply the convergence of Σa_n. It was shown by Tauber that the condition $na_n\to 0$ is sufficient to secure the convergence of Σa_n if $\lim f(x)x\to 1-$ exists. More recently J. E. Littlewood has shown that the condition $na_n<K$, some fixed number, is sufficient. The alternative $na_n>-K$ is also sufficient, but is really the same thing since the convergence of $\Sigma -a_n$ necessitates that of Σa_n. Also no less stringent condition is generally sufficient. Such questions as the representation of a function by a Fourier series (*q.v.*) or as a series of Legendre polynomials or other standard functions are outside the scope of this article and are treated elsewhere.

Non-convergent Series. Summability. Asymptotic Series.—A series that is not convergent cannot have a sum in the ordinary sense. Nevertheless it is possible to modify the definition of the sum of a series so that a sum can be assigned to a non-convergent series and the sums of such series can be used in applications as if they were the sum of ordinary convergent series. Euler used such sums to obtain accurate results. Their use by writers whose mathematical insight was less acute than Euler's frequently led to grave errors and great mathematicians of the early 19th century, such as Abel and Cauchy, deliberately excluded from analysis the use of any such series and refused to accept as sound any demonstration involving their use. Towards the end of the 19th century interest in such series was revived and their treatment put on a sound footing. The subject of such series has received much attention in this century and many important contributions have been made to it by English mathematicians. Only the briefest sketch of it can be given here. The idea of the sum of a non-convergent series is based on the following principle. If certain limiting operations connected with a convergent series result in a finite limit which is the sum of the series, it may happen that the same operations applied in connection with a non-convergent series result in a finite limit. The non-convergent series is then said to be *summable* and the limit thus found is said to be its sum. For example, if the series

$$a_0+a_1x+a_2x^2+\cdots,$$

is convergent for $|x|<1$, its sum being $f(x)$, and if Σa_n is conver-

gent with a sum S, then S is the limit of $f(x)$ as x approaches 1 from below. But $f(x)$ may tend to a limit in this way without Σa_n being convergent and we may regard this limit, if it exists, as the sum of the series Σa_n, when it is not convergent. Thus the series $1-x+x^2-x^3+\cdots$ converges to $(1+x)^{-1}$, if $|x|<1$, and we may regard the series $1-1+1-1+\cdots$ as having a sum, which is $\frac{1}{2}$. A classical method of summing a non-convergent series, due to E. Borel, is the following. The integral

$$\int_0^\infty e^{-x}\sum_0^n \frac{a_n x^n}{n!}dx$$

is equal to $a_0+a_1+\cdots+a_n$. It may happen that the infinite series $\sum_0^\infty \frac{a_n x^n}{n!}$ converges to a sum $\phi(x)$ and that $\int_0^\infty e^{-x}\phi(x)dx$ has a definite value. In this case the series is said to be summable and the resulting sum to be "*Borel's sum.*" If we apply this method to the series $1-t+t^2-t^3+\cdots$ we obtain as the sum $(1+t)^{-1}$, which is the actual sum when the series is convergent. Another classical method is that of E. Césaro. If a_n has a limit, $b_n\equiv(a_1+a_2+\cdots+a_n)/n$ has the same limit, but b_n may have a limit, although a_n oscillates. Hence, although the sequence $s_1, s_2, \cdots$ may not have a limit, it may happen that

$$(s_1+s_2+\cdots+s_n)/n$$

has a limit. If this happens, the series is said to be summable $(C1)$. The Cauchy product of any two convergent series is summable $(C1)$. If this mean has not a limit we may repeat the operation, and so on any number of times. Actually Césaro uses as his rth mean the quotient of $s_n+A_1s_{n-1}+\cdots+A_2s_{n-1}$ by $1+A_1+\cdots+A_{n-1}$, where A_r is the coefficient of x^r in the expansion of $(1-x)^{-r}$ by the Binomial Formula (*q.v.*). If this rth mean gives a limit the series is said to be summable (Cr). A series, summable (C, r) is also summable $(C, r+1)$ and so on. It is not true that an arbitrary series can be summed by any of Césaro's means or by any known method. A striking and important theorem connected with Césaro's means, due to G. H. Hardy, is that a series which is summable $(C1)$ is convergent, if its terms are such that $na_n<K$ (or $na_n>-K$), and no less stringent condition is sufficient in complete generality.

A different application of non-convergent series is the representation of functions by means of so-called asymptotic series. These series when carried to infinity are not convergent but are such that it is possible to estimate at any stage the order of the difference between the function and the expansion, and it may happen that a few terms of the expansion give a good approximation. For a function of a variable x, such expansions are usually power series in $1/x$, and the difference between the value of the function and the first n terms of the expansion is $O\{(n+1)!/x^{n+1}\}$. Now $(n+1)!x^{n+1}$ decreases so long as $n+1$ is less than x, though afterwards it increases without limit, and when x is very large the least value of $(n+1)!/x^{n+1}$ is very small, so that the first n terms of the expansion will give a very good approximation to the value of the function. One of the best known of such expansions is Stirling's formula,

$$\log(n!)=(n+\tfrac{1}{2})\log n-n+\tfrac{1}{2}\log(2\pi)+\theta/12n,$$

where $0<\theta<1$. The term $\theta/12n$ can be replaced by a formal development as a power series in n^{-1}, but it is not convergent for any value of n.

Summation of Series. Asymptotic Representation of the Sum of n Terms of a Series.—If u_n can be decomposed into a number of expressions of the form $a^n\phi(n)$, where a is some fixed number, real or complex, and $\phi(n)$ is a polynomial in n, then it is possible to find a compact expression for s_n, but there is no other type of series for which the same property holds with complete generality. Included in this type are the ordinary arithmetic and geometric progressions; for the harmonic series Σn^{-1} and generally Σn^{-r} no exact expression for s_n can be found. The sum of the first n terms of the series Σn^r, where r is a positive integer, can be expressed as a polynomial in n or $n+\frac{1}{2}$, of degree $r+1$, by means of the identities

$$e^x+e^{2x}+\cdots+e^{nx}=(e^{nx}-1)/(1-e^{-x})=(e^{(n+\frac{1}{2})x}-e^{\frac{1}{2}x})/(e^{\frac{1}{2}x}-e^{-\frac{1}{2}x}).$$

The first polynomial is

$$\frac{n^{r+1}}{r+1}+\tfrac{1}{2}n^r+\frac{r}{2!}B_1n^{r-1}-\frac{r(r-1)(r-2)}{4!}B_2n^{r-3}+\cdots$$

where $$1-\tfrac{1}{2}x+B_1\frac{x^2}{2!}-B_2\frac{x^4}{4!}+B_3\frac{x^6}{6!}-\cdots$$

is the expansion of $x/(e^x-1)$ as a power series in x.

The numbers $B_1, B_2, B_3\cdots$ are called Bernoulli numbers (*q.v.*). They have been tabulated as far as B_{90}. The second polynomial involves the coefficients in the expansion of $x/(e^{\frac{1}{2}x}-e^{-\frac{1}{2}x})$, that is, $x\{(e^{\frac{1}{2}x}-1)^{-1}-(e^x-1)^{-1}\}$, which can therefore be expressed in terms of Bernoulli numbers. If r is odd, Σn^r can be expressed as a polynomial $f(\xi)$ of degree $\frac{1}{2}(r+1)$ in ξ, which denotes n^2+n, and $\Sigma n^{r-1}=(2n+1)f(\xi)/r$. Unless r is very large the coefficients in the polynomial can be determined fairly easily from the identity $n^r=f(n^2+n)-f(n^2-n)$. The sum of the rth powers of the first n *odd* integers can be expressed as a polynomial of degree $r+1$ in n, containing no odd powers of n, if r is odd, and no even powers of n, if r is even, divisible by n in either case.

It is often possible to obtain asymptotic formulae for the sum of the first n terms of a series. Two functions $\phi(n)$ and $\psi(n)$ are said to represent each other asymptotically if the ratio $\phi(n)/\psi(n)$ tends to unity as n tends to infinity and we write $\phi(n)\backsim\psi(n)$. If $u_n=\phi(n)$, which is steadily decreasing,

$$s_n-\int_1^n\phi(x)dx$$

tends to a finite limit and we can write $s_n\backsim\int_1^n\phi(x)dx$. Thus, if $u_n=n^{-1}$, $s_n\backsim\log n$. Stirling's formula for $\log(n!)$ is an asymptotic formula for s_n, when $u_n=\log n$. The limit of $1+\frac{1}{2}+\cdots+\frac{1}{n}-\log n$ is an important number in analysis. It is called Euler's constant and is denoted by C or sometimes by γ.

It is often possible to find the sum of a convergent series although no expression for s_n can be obtained. By means of the infinite products for the trigonometrical functions it can be shown that the sum of Σn^{-r}, when r is an *even* positive integer, is a rational multiple of π^r, and that the sum of $\Sigma(-1)^n(2n+1)^{-r}$, when r is an *odd* positive integer, is a rational multiple of π^r. The sum of a series can be found occasionally by the help of Euler's constant. Thus the sum of the first $2n$ terms of the series $\Sigma(-1)^{n-1}n^{-1}$ is equal to $s_{2n}-s_n$, where $u_n=n^{-1}$, which is equal to

$$(s_{2n}-\log 2n)-(s_n-\log n)+\log 2.$$

Since $(s_{2n}-\log 2n)$ and $s_n-\log n$ each tend to C, Euler's constant, the sum of the series is $\log 2$. For since the series is convergent its sum is the limit of the sum of the first $2n$ terms. By a somewhat similar method we can prove that the sum of the series $\Sigma(-1)^n(\log n)/n$ is $C\log 2-\frac{1}{2}(\log 2)^2$.

Methods of obtaining approximations to the sum of a series and of converting slowly converging series into more rapidly converging series belong to the Calculus of Finite Differences (*q.v.*).

Infinite Products.—If from a sequence of numbers (v_n) we form a sequence (p_n) in which $p_n=v_1v_2v_3\cdots v_n$, then, if p_n tends to a finite limit, *distinct from zero*, the infinite product $\Pi(v_n)$ is said to be convergent. The infinite product is said to diverge to infinity or to zero, if p_n tends to infinity or to zero. If p_n oscillates, the infinite product is said to oscillate.

If the product is convergent p_n/p_{n-1} must tend to unity, so that v_n must be of the form $1+u_n$, where u_n tends to zero. In considering the question of the convergence of infinite products we may, without any loss of real generality, consider only products in which $|u_n|<1$ for all values of n.

The convergence of an infinite product can be discussed directly by means of certain inequalities, due to Weierstrass (*see* Bromwich, *Theory of Infinite Series*); but the results may be obtained readily from the fact that the infinite product $\Pi(1+u_n)$ is con-

vergent, if the series $\Sigma\log(1+u_n)$ is convergent, divergent to $+\infty$ (or to zero), if the series is divergent to $+\infty$ (or $-\infty$), and oscillatory, if the series is oscillatory. If u_n is complex, $\log(1+u_n)$ is the principal value of the logarithm: that is, the value which tends to zero with u_n. We see from the above why we regard an infinite product as diverging to zero rather than converging to zero.

If u_n is real and one-signed, then $\log(1+u_n)$ is one-signed and so also is $\log(1-u_n)$. Since

$$\{\log(1+u_n)\}/u_n \to 1 \text{ and } \{\log(1-u_n)\}/u_n \to -1,$$

it follows that $\Sigma\log(1+u_n)$ and $\Sigma\log(1-u_n)$ are each convergent or divergent according as Σu_n is convergent or divergent. Hence if u_n is real and positive $\Pi(1+u_n)$ and $\Pi(1-u_n)$ are each convergent, if Σu_n is convergent. If Σu_n is divergent $\Pi(1+u_n)$ diverges to ∞ and $\Pi(1-u_n)$ diverges to zero.

If u_n is either real or complex $|\log(1\pm u_n)| \leqq \log\{1/(1-|u_n|)\}$, so that $\Sigma\log(1\pm u_n)$ is absolutely convergent, if Σu_n is absolutely convergent, and therefore if Σu_n is absolutely convergent, $\Pi(1+u_n)$ is convergent and also $\Pi(1+|u_n|)$. Such a product is said to be absolutely convergent. The order of its factors may be rearranged according to any law to form a new infinite product, which will converge to the same limit as the original product.

If Σu_n is not absolutely convergent, we use the fact that if $|u_n|<1$, $\log(1+u_n)=u_n-A_n u_n^2$, where $A_n<$some fixed number, independent of n (but varying of course with different sequences). If u_n is real, A_n is positive. From this it follows that, when u_n is real, if Σu_n is convergent but not absolutely convergent, then $\Pi(1+u_n)$ and $\Pi(1-u_n)$ are convergent, if Σu_n^2 is convergent. If Σu_n^2 is divergent, $\Pi(1+u_n)$ and $\Pi(1-u_n)$ both diverge to zero. If u_n is complex and Σu_n is convergent, but not absolutely, then $\Pi(1+u_n)$ and $\Pi(1-u_n)$ are both convergent, if $\Sigma|u_n|^2$ is convergent. This condition is not necessary. It should be mentioned that convergent infinite products $\Pi(1+u_n)$ can be constructed, in which Σu_n and Σu_n^2 are both divergent to $+\infty$.

If u_n contains a variable x and is written as $u_n(x)$, then a convergent infinite product $\Pi\{1+u_n(x)\}$ defines a function of x. For such products there is a theory of uniform convergence similar to that developed in connection with infinite series.

Corresponding to Tannery's theorem we have the theorem that, if $F(n)=\prod_{r=1}^{p}\{1+u_r(n)\}$, and $u_r(n)$ satisfies the conditions of Tannery's theorem, then $F(n)$ tends to a limit, which is the value of the convergent infinite product $\Pi(1+u_r)$. We can by this theorem deduce from the identity,

$$\sin\theta = (2n+1)\sin\frac{\theta}{2n+1}\prod_{r=1}^{n}\left\{1-\sin^2\frac{\theta}{2n+1}\operatorname{cosec}^2\frac{r\pi}{2n+1}\right\},$$

that the infinite product $\Pi\left(1-\frac{\theta^2}{r^2\pi^2}\right)$ converges to $(\sin\theta)/\theta$.

A particular case is the infinite product for $\pi/2$, viz.

$$\tfrac{2}{1}\cdot\tfrac{2}{3}\cdot\tfrac{4}{3}\cdot\tfrac{4}{5}\cdot\tfrac{6}{5}\cdot\tfrac{6}{7}\cdots,$$

discovered by Wallis.

Weierstrass has shown that, if $a_1, a_2, a_3, \cdots$ is an infinite sequence, in which $|a_n|$ never decreases and tends to infinity with n, and is such that $\Sigma\,|a_n|^{-1}$ is divergent, we can find polynomials $g_n(z)$, such that the infinite product $\Pi(1-z/a_n)e^{g_n(z)}$ is absolutely convergent for all values of z. Here we do not say that the series diverges for the values $z=a_1, a_2, \cdots$ because, if the factor $(1-z/a_n)$ is omitted, the remaining infinite product is convergent when $z=a_n$. We say that $z=a_n$ is a zero of the function determined by the infinite product. One simple example is provided by taking the sequence to be $-1, -2, -3, \cdots$. The simplest factor that can be associated with $(1+z/n)$ is $e^{-z/n}$, so that the infinite product $\Pi(1+z/n)e^{-z/n}$ is convergent. Since $1+\frac{1}{2}+\cdots+\frac{1}{n}-\log n$ tends to Euler's constant C, it follows that $n^{-z}(z+1)(z+2)\cdots(z+n)/n!$ tends to a limit as n tends to infinity. The reciprocal of the function of z defined by this limit has been denoted by Gauss by $\Pi(z)$. It is also $\Gamma(z+1)$, where $\Gamma(z)$ is the Gamma-function. Further details of functions defined by infinite products belong to the theory of functions. As with infinite series, so with infinite products, we may have doubly and multiply-infinite double products, and the treatment of such products may be made to depend on series. The function defined by the doubly-infinite product

$$z\Pi(1-z/\Omega)e^{z/\Omega+\frac{1}{2}z^2/\Omega^2},$$

where $\Omega=2m\omega_1+2n\omega_2$, ω_1 and ω_2 being any two numbers whose ratio is complex, and m and n have any positive or negative integral values, simultaneous zero values alone being excluded, is Weierstrass's Sigma-function, fundamental in the theory of elliptic functions.

Bibliography.—*See* the article, "Algebräische Analysis," by A. Pringsheim and G. Faber, in the *Encyklopädie der mathematischen Wissenschaften* (Leipzig, 1898, etc., vol. ii., ch. i.). The elementary treatment of series may be found in W. P. Milne, *Higher Algebra* (1913); F. Bowman, *Algebra* (1925–27); and in great detail in G. Chrystal, *Introduction to Algebra* (1898, 4th ed. 1920). More advanced treatment can be found in G. H. Hardy, *A Course of Pure Mathematics* (1908, 4th ed. 1925); E. T. Whittaker and G. N. Watson, *A Course of Modern Analysis* (1902, 4th ed. 1927); T. J. I'A. Bromwich, *An Introduction to the Theory of Infinite Series* (1908, 2nd ed. 1926); E. W. Hobson, *Theory of Functions of a Real Variable* (1907, 3rd ed. 1927 etc.). Except that the 2nd ed. of Bromwich omits the question of summability and Hobson is restricted to real variables, these last two works are practically exhaustive. A very complete treatment is given in K. Knopp, *Theorie und Anwendung der unendlichen Reihen* (1922, Eng. Trans., 1928). For particular portions of the theory, refer to E. Borel, *Leçons sur les séries divergentes* (1901) and to others of the series of monographs on the theory of functions edited by Borel. Numerous important contributions to the theory will be found in the publications of recent years of the London Mathematical Society and the Cambridge Philosophical Society. A paper by G. H. Hardy in the *Proceedings* of the C. P. S., vol. xiv. (May 1918), entitled "Sir George Stokes and the Concept of Uniform Convergence," will be found of particular interest. (A. E. J.)

SERINGAPATAM, a town of India, formerly capital of the state of Mysore, situated on an island of the same name in the Cauvery river. Pop., including the suburb of Gaujam (1921) 7,217. The town is chiefly noted for its fortress, which figured prominently in Indian history at the close of the 18th century, twice sustained a siege from the British, and was finally stormed in 1799. After its capture the island was ceded to the British, but restored to Mysore in 1881. The island of Seringapatam is about 3 m. in length from east to west and 1 in breadth. The fort, which occupies the western side, immediately overhanging the river, contains the railway station on the line from Bangalore to Mysore. At the eastern or lower end of the island is the Lal Bagh or "red garden," containing the mausoleum built by Tippoo Sultan for his father, Hyder Ali, where Tippoo himself also lies.

SERJEANT or **SERGEANT,** the title (1) of a non-commissioned officer in the army and of a subordinate officer of police to which the spelling "Sergeant" now applies; the designation also, with the spelling "Serjeant," of (2) certain officials of the royal household and (3) the name formerly given to the highest rank of barristers in England and Ireland (*see* Serjeant-at-Law). In the middle ages *serviens* had a variety of applications from the *serviens de pane et mensa*, the domestic servant of a monastery, to the *servientes de armis*, the serjeants-at-arms of monarchs, and vassals who held by a special service (*see* Serjeanty). The *serjeants* (*fratres servientes*) formed also an important division of the great military orders (*see* Saint John of Jerusalem, Knights of the Hospital of, and Templars). Du Cange (*Glossarium*, *s.v.* "Serviens") gives many other instances.

Military Title.—In the 13th century on the continent of Europe the term Sergeant referred to a foot-soldier, but gradually it became attached to the tenant in charge of a knight's party on service, and usually a tenant who had seen some service. With the abolition of armies on feudal lines, the sergeant became an important member of a company in a regiment, and in the 17th century he was always "elected" to his position by the captain. He had great powers of authority over the men but Barry (1634) counsels him not to "slashe or cutt soulders with his swourde,

except uppon juste occationes." Up to the 19th century the insigne of office of a sergeant was the halberd. All military writers of the 16th, 17th and 18th centuries allot innumerable duties to the sergeant, which clearly indicate that he was the captain's right-hand man in all matters of drill and interior economy (*see* MAJOR). The term is not found in organised cavalry until the 18th century and even now it is not used in the British Household Cavalry, the equivalent rank therein being "corporal-of-horse." In 1641 Hexham states that there should be 2 sergeants to a private company and 3 to a colonel's or double company, the senior being termed the "Eldest Sergeant."

In modern armies sergeant is the N.C.O. rank immediately above corporal. A lance-sergeant is a corporal holding an appointment of a temporary nature between the ranks of corporal and sergeant. As it is now the almost universal practice to indicate in a N.C.O.'s title the particular duties he performs, the word sergeant forms part of numerous titles, *e.g.*, orderly-room sergeant, band-sergeant, signalling-sergeant.

Serjeants-at-Arms.—In the British royal household there are eight serjeants-at-arms, whose duties are ceremonial; they have to be in attendance only at drawing-rooms, levees, State balls and State concerts. There are also two other serjeants-at-arms to whom special duties are assigned, the one attending the Speaker of the House of Commons and the other the lord chancellor in the House of Lords, carrying their maces and executing their orders. The Speaker's serjeant-at-arms is the disciplinary officer of the House of Commons, whose duty it is to expel members at the order of the Speaker and to arrest and keep in custody those persons condemned to this punishment by the authority of the House. The serjeants-at-arms have no special uniform. At court they wear any naval, military or civil uniform to which they may be entitled, or the court dress of those holding legal appointments, but not entitled to wear robes, *i.e.*, a suit of black cloth, with knee-breeches, lace bands and ruffles, a black silk cocked hat with rosette and steel loop and a sword. A silver collar of office is worn on special occasions.

In the United States, the executive officer of certain legislative bodies is called the sergeant-at-arms.

SERJEANTS-AT-LAW or **SERVIENTES AD LEGEM** constituted the highest order of counsel at the English and Irish bar. The title is said by Coke to have been introduced into England by William the Conqueror with other titles of serjeanty (*q.v.*). However this may be, Bracton, writing *c.* 1250–58, says that the king had his serjeants-at-law in every county, and that until 19 Stephen he had no other chief officer in the city of Norwich but his serjeant, who presided in the courts there. After the Conquest the sheriffs are officers of the Crown, and we know from other sources that they were usually serjeants-at-law. They were therefore styled *servientes Regis ad legem* who as stewards of courts baron served the lords of the manor in a similar capacity, or who as counsel—*conteurs* or *narratores*—appeared for suitors in the courts. These men were styled common serjeants, a title which survives in the common serjeant of the City of London, and (a second class) king's serjeants. As it happened, both were selected from the utter-barristers. The serjeants (except king's serjeants) were created by writ of summons under the great seal, and wore a gown and scarlet hood. They had social precedence after knights bachelors and before companions of the Bath and other orders. In this they differed from king's counsel, who had simply professional as distinguished from social rank. The serjeants at the Irish bar had precedence next after law officers of the Crown. Till past the middle of the 19th century a limited number of the serjeants were called "king's (queen's) serjeants." They were appointed by patent and summoned to parliament. Until 1814 the two senior king's serjeants had precedence of the attorney-general and solicitor-general. It was the custom for serjeants, on their appointment, to give gold rings inscribed with mottoes to their colleagues. Down to 1845 the order enjoyed a very valuable monopoly of practice.

Certainly, for at least 600 years the judges of the king's bench and common pleas were always serjeants, but by the Judicature Act 1873 this qualification was abolished. The serjeants had their own Inns, one in Fleet street and one in Chancery lane. In 1758 the members of the former joined the latter. In 1877 the society was dissolved, the Inn sold to one of the members, and the proceeds divided among the existing serjeants. The order is now extinct.

See J. Manning, *Serviens ad Legem* (1840); A. Pulling, *The Order of the Coif* (1897).

SERJEANTY. Tenure by serjeanty was a form of land-holding under the feudal system, intermediate between tenure by knight-service (*q.v.*) and tenure in socage. It originated in the assignation of an estate in land on condition of the performance of a certain duty, which can hardly be described more exactly than as not being that of knight-service. Its essence, according to Pollock and Maitland, might be described as "servantship," the discharge of duties in the household of king or noble; but it ranged from service in the king's host, distinguished only by equipment from that of the knight, to petty renders scarcely distinguishable from those of the rent-paying tenant or socager. The varieties of serjeanty were afterwards increased by lawyers classing for convenience under this head such duties as those of escort service to the abbess of Barking, or of military service on the Welsh border by the men of Archenfield.

Serjeants (*servientes*) are already entered as a distinct class in Domesday Book (1086), though not in all cases differentiated from the barons, who held by knight-service. Sometimes, as in the case of three Hampshire serjeanties—those of acting as king's marshal, of finding an archer for his service, and of keeping the gaol in Winchester castle—the tenure can be definitely traced as far back as Domesday. It is probable, however, that many supposed tenures by serjeanty were not really such, although so described in returns, in inquests after death, and other records. The simplest legal test of the tenure was that serjeants, though liable to the feudal exactions of wardship, etc., were not liable to scutage; they made in place of this exaction special composition with the Crown.

The germ of the later distinction between "grand" and "petty" serjeanty is found on the Great Charter (1215), the king there renouncing the right of prerogative wardship in the case of those who held of him by the render of small articles. The legal doctrine that serjeanties were (*a*) inalienable, (*b*) impartible, led to the "arrentation," under Henry III., of serjeanties the lands of which had been partly alienated, and which were converted into socage tenures, or, in some cases, tenures by knight-service. Gradually the gulf widened, and "petty" serjeanties, consisting of renders (usually a bow, sword, dagger or other small thing belonging to war), together with serjeanties held of mesne lords, sank into socage, while "grand" serjeanties, the holders of which performed their service in person, became alone liable to wardship and marriage.

When the military tenure of knight-service was abolished at the Restoration, that of grand serjeanty was retained, it being then limited in practice to the performance of certain duties at coronations, the discharge of which as a right has always been coveted. The most conspicuous are those of champion, appurtenant to the Dymokes' manor of Scrivelsby, and of supporting the king's right arm, appurtenant to that of Worksop.

The title of serjeant as a household officer is still preserved in the king's serjeants-at-arms, etc.

The best summary of tenure by serjeanty is in Pollock and Maitland, *Hist. Eng. Law;* McKechnie's *Magna Carta* (1905) should also be consulted; and for Domesday the *Victoria History of Hampshire*, vol. i. The best list of serjeanties is in the *Red Book of the Exchequer* ("Rolls" series), but the *Testa de Nevill* (Record Commission) contains the most valuable records concerning them. (J. H. R.)

SEROW or **SARAU** (*Capricornis sumatrensis*), found from the Himalayas to Sumatra, a goat-like antelope of the size of a donkey, nearly allied to the goral (*q.v.*) but larger, and with small face-glands. The name serow may be extended to embrace all species belonging to the genus, the range of which extends from the Himalayas to Burma, the Malay Peninsula and Sumatra in one direction, and to Tibet, China, Japan and Formosa in another. Serows inhabit scrub-clad mountains, at no great elevation.

SERPA PINTO, ALEXANDRE ALBERTO DE LA ROCHA (1846–1900), Portuguese explorer in Africa, was born at the castle of Polchras, on the Douro, on April 10, 1846. Entering the army in 1864, he served in Mozambique, and in 1869 took part in an expedition against tribes in revolt on the lower Zambezi. In 1877 he and Captains Capello and Ivens of the Portuguese navy were sent on an expedition to south central Africa. They left Benguella in Nov. 1877 for the interior, but Serpa Pinto soon parted from his colleagues and went east. He crossed the Kwando in June 1878, and in August reached Lialui, the Barotse capital on the Zambezi, continued his journey down the river to the Victoria falls, whence he turned south, arriving at Pretoria on Feb. 12, 1879. He was the fourth explorer to traverse Africa from west to east, and was the first to lay down the route between Bihe and Lialui. He received the founder's medal of the Royal Geographical Society of London. The account of his travels appeared in English under the title *How I Crossed Africa* (2 vols., London, 1881). In 1884 he attempted, with less success, the exploration of regions between Mozambique and Lake Nyasa. Appointed governor of Mozambique in 1889, he organized an expedition to obtain for Portugal the Shiré highlands and neighbouring regions, but the vigorous action of the British agents (John Buchanan and H. H. Johnston) frustrated this design. (*See* AFRICA.) Shortly afterwards Serpa Pinto returned to Lisbon and was promoted to the rank of colonel. He died on Dec. 28, 1900.

SERPENT, a synonym for reptile or snake (*see* REPTILE and SNAKES), now generally used only of dangerous varieties or metaphorically. *See* also SERPENT CULTS below.

In music the serpent is an obsolete bass wind instrument derived (towards the end of the 16th century) from the old wooden cornets and the progenitor of the bass-horn, and ophicleide.

SERPENT CULTS. Common belief associated serpents, dragons and other monsters with the guardianship of treasure or wealth; comp.; *e.g.*, the golden apples of the Hesperides, and the Egyptian Osiris, and the Indian Krishna and Indra. Serpents adorned with necklaces of jewels or with crowns were familiar in old susperstition, and the serpent with a ruby in its mouth was a favourite love-token. Many stories tell of the grateful reptile which brought valuable gifts to a benefactor. According to a common Indian belief a wealthy man who dies without an heir returns to guard his wealth in the form of a serpent, and it was an Italian superstition that a serpent's skin brought luck. The serpent is often associated with metallurgy, and to serpent deities have been ascribed the working of metals, gem-cutting and indeed culture in general. The Ophites (*q.v.*) actually identified the serpent with Sophia ("Wisdom"); the old sage Garga, one of the fathers of Indian astronomy, owed his learning to the serpent-god Sesha Nāga; and the Phoenician γέρων 'Οφίων wrote the seven tablets of fate which were guarded by Harmonia (Baudissin, *Stud. z. Rel. Gesch.*, i. 255–292 [on Semitic serpent cults]). The Aztec Quetzalcoatl taught metallurgy and agriculture, gave abundance of maize, also wisdom and freedom from disease. The Babylonian Ea, who sometimes has serpent attributes, introduced—like the American serpent Votan—knowledge and culture. The half-serpent Cadmus brought knowledge of mines, agriculture, and the "Cadmean" letters, while Cecrops inculcated laws and ways of life and was the first to establish monogamy. Although the reptile is not particularly intelligent, it has become famed for shrewdness and wisdom, whether in the Garden of Eden (Gen. iii. 1; 2 Cor. xi. 3) or generally (*cf.* Matt. x. 16): "Be ye therefore wise as serpents, and harmless as doves."

Serpents in Healing.—In one form or another the healing powers of the serpent are very familiar in legend and custom. Siegfried bathed in the blood of the dragon he slew and thus became invulnerable; the blind emperor Theodosius recovered his sight when a grateful serpent laid a precious stone upon his eyes; Cadmus and his wife were turned into serpents to cure human ills. In 1899 a court in Larnaca, Cyprus, awarded £80 (Turkish) as damages for the loss of a snake's horn which had been lent to cure a certain disease. It was popularly believed that medical skill could be gained by eating some part of a serpent; the idea that its valuable qualities would thus be assimilated belongs to one of the fundamental dogmas of primitive mankind (*cf.* Porphyry, *De abst.* ii. 48). Serpents were tended in the sanctuaries of the Greek Aesculapius (Asklēpios), the famous god of healing. (*See* AESCULAPIUS.)

At Emesa in Syria, watered by the Orontes, an image, the lower part of which was a scorpion, cured the sting of scorpions and freed the city from snakes. Constantinople was similarly protected by the serpent-trophy of Delphi which Constantine removed thither; an emperor was said to have performed an enchantment over the monument well known in Greek history. In modern India a walking-stick from a species of cane in the neighbourhood of a certain serpent-shrine protects against snakebite. At Fernando Po, when there was an epidemic among children, they were brought to touch a serpent's skin which hung on a pole. The same ideas underlie the story of the Brazen Serpent which cured the Israelites of the bites of the serpents in the Wilderness (Num. xxi. 6–9). The object, however, was no temporary device; centuries later, long after the founding of the temple of Jerusalem, the Brazen Serpent was at last regarded as unorthodox by the reforming king Hezekiah, and the historian who relates its overthrow ascribes its origin to the founder of Israelite national religion (2 Kings xviii. 4).

In Wells and Lakes.—According to primitive thought, rivers, lakes, springs and wells are commonly inhabited by spirits which readily assume human or animal form. Here the serpent and its kind are frequently encountered (Frazer's notes on *Pausanias*, vol. v. pp. 44 *sqq.*). In India the serpent-godlings are very often associated with water, and, even at the digging of a well, worship is paid to the "world serpent," and the Sālagrāma (spiral ammonite), sacred to Vishnu, is solemnly wedded to the Tulasī or basil plant, representative of the garden which the pool will fertilize. It is often supposed that the Nāga (serpent) chiefs rule countries in or under the water, and in Kashmir a submarine serpent-king became a convert and built churches. Especially common are the popular stories connecting serpents with submarine palaces and treasures (Crooke i. 45); and one submarine realm in the Ganges was reputed to possess "the water of strength." In Palestine and Syria, where demoniacal beings are frequently associated with water, local opinion is sometimes uncertain whether the water is under the care of a *jinn* or of a patron-saint. Several springs are named after the serpent, and the sacred fountain of Ephca at Palmyra, whose guardian in the early Christian era was appointed by the god Yarḥibol, is still tenanted by a female serpent-demon which can impede its flow. Jerusalem had the stone Zōḥeleth (possibly "serpent," 1 Kings i. 9) and also its Dragon Well (Neh. ii. 13); and in modern times the curative Virgin's Spring or St. Mary's Well has its dragon which, when awake, swallows the intermittent flow of the water.

The Cosmic Serpent.—The serpent of the water is also the serpent of the great sea upon which the earth rested. Sometimes the reptile lives in submarine infernal regions, and as the demon of the underworld it is sometimes the earth-shaker. The Greek demon or snake Poseidon, god of sea and springs, was an earthquake god. To the great half-serpent monster Typhon were ascribed numerous springs; he was also the cause of earthquakes, and when he buried himself in the earth he formed the bed of the Syrian Orontes. This river, which was otherwise called Drakōn, Typhōn or Ophites, is known at the present day as the "river of the rebel" (*Nahr El-'Aṣi*). The waterspout, sometimes taken for a long-tailed dragon, is a huge sea-serpent, according to the Wanika of East Africa (Tylor, *Primitive Culture*, i. 292 *seq.*). In ancient Persia the rainbow was the celestial serpent; and among some African tribes it is the subterranean wealth-conferring serpent, stretching its head to the clouds, and spilling the rain in its greedy thirst. An early Indian name of the Milky Way is "the path of the serpent" (Crooke i. 25), and a great dragon or serpent is often the cause of eclipses, so that in India, on the occasion of an eclipse, its attention can be attracted by bathing in a sacred stream, or by a ritual which

includes the worship of the image of the snake-god (i. 22 *sqq.*).

Serpent and Parentage.—The folk-lore of the Old and New World contains many examples of supernatural conception, an idea which is supplemented by the actual living belief in the East that supernatural beings can be fathers (E. S. Hartland, Primitive *Paternity; cf.* his *Legend of Perseus* i. 121, etc). In Annam where water spirits may take the form of serpents or of human beings, two deified heroes were said to have been serpents born of a childless woman, who drank from a bowl of water into which a star had fallen. It was a mediaeval belief that the household snake, if not propitiated, could prevent conception, and in Bombay barrenness is sometimes attributed to a serpent which has been killed by the man or his wife in a former state of their existence. Hence the demon is laid to rest by burning the serpent-image with due funereal rites. In the sanctuary of Aesculapius at Epidaurus women were visited in their dreams by a serpent—the reputed father of the child that was born, and elsewhere Sicyon who had such a progenitor was regarded as the son of the divine healer. Similar also was the origin of Augustus in a temple of Apollo, the god who had his tame serpents in the grove on Epirus. Further, as the serpent-father of Alexander the Great came with a healing-root to cure his general Pompey (Cicero, *De div.* ii. 66), so in an Indian story the son of a king of serpents and of a virgin (or, in a variant form, a widow) was succoured in warfare by his sire (Fergusson, p. 266). In India, China and Greece the serpent origin of kings and rulers is well-known.

Relations with Clans.—There are many instances of tribes or clans named after the serpent. These are not necessarily examples of nicknames, since a relationship between the two often shows itself in custom or belief. This feature sometimes applies, also, to cases where the clan does not bear the serpent name. In accordance with universal ideas of the reality of the "name," there are tribes who will refrain from mentioning the serpent. Also there are clans like the American Apaches and Navahos who will neither kill nor eat rattlesnakes. Where the reptile is venerated or feared it is usually inviolable, and among the Brassmen of the Niger the dangerous and destructive cobra was especially protected by an article in the diplomatic treaty of 1856 for the Bight of Biafra (J. F. Maclennan, *Studies,* ii. 524). The North American Indians fear lest their venerated rattlesnake should incite its kinsfolk to avenge any injury done to it, and when the Seminole Indians begged an English traveller to rid them of one of these troublesome intruders, they scratched him—as a matter of form—in order to appease the spirit of the dead snake. The snake-tribes of the Punjab clothe and bury a dead serpent; and elsewhere in India when one is killed in the village a copper coin is placed in its mouth and the body ceremonially burned to avert evil. These snake-tribes claim to be free from snake-bite, as also the ancient Psylli of Africa and the Ophiogenes ("serpent born") of Cyprus who were supposed to be able to cure others. This power was claimed likewise by the Marsians of ancient Italy, and is still possessed by the snake-clan of Senegambia. In Kashmir the serpent-tribes became famous for medical skill in general, and they attributed this to the health-giving serpent (J. Fergusson, *Tree and Serpent Worship* [1873], p. 260). Moreover, the Psylli would test the legitimacy of their new-born by exposing them to serpents which would not harm those of pure birth, and a similar ordeal among the Ophiogenes of Asia Minor showed whether a man was really of their kin (Strabo, xiii. 1, 14). This peculiar kinship between serpent-clans and serpents can be illustrated from Senegambia, where a python is supposed to visit every child of the python-clan within eight days of birth, apparently as a sign of recognition.

Relations with Families.—A kindred belief is that which regards the household snake an agreeable guest, if not a guardian spirit. In Sweden, even in the 16th century, such snakes were virtually household gods and to hurt them was a deadly sin. Among the old Prussians they were invited to share an annual sacrificial meal, and their refusal was a bad sign. Mohammed is said to have declared that the house-dwelling snakes were a kind of *jinn;* and, certainly, the heathen Arabs regarded them as malevolent or benevolent demoniacal beings (Nöldeke, on Arab serpent-lore, *Zeit. f. Völkerpsych* i. 412 *sqq.*) Among the Romans every place had its *genius,* also in the form of a serpent—*cf.* the doubt of Aeneas (Virgil *Aen.* v. 84 *sqq.*)—and household snakes were lodged and fed in vast numbers. They were the guardian-spirits of men and families, and stories are told of the way in which human life depended upon the safety of the reptile. As a chthonic animal the serpent has often been regarded as an embodiment of the soul of the dead. Grimm's story of king Gunthram tells how, while he slept, his soul in serpent-form visited a mountain full of gold (Paulus *Diac.* iii. 34), and Porphyry relates that a snake crawled from beneath the bed of Plotinus at the moment of the philosopher's death. In Bali near Java, where the Nāga-cult flourishes, a serpent is carried at the funeral ceremonies of the Kshatriya caste and burned with the corpse. Among many African tribes the house-haunting serpents are the dead, who are therefore treated with respect and often fed with milk.

As Heroes and Local Guardians.—In Greece, however, the dead man became a chthonic *daemon,* potent for good or evil; his natural symbol as such, often figured on tombs, was the snake. "The men of old time," as Plutarch observed, "associated the snake most of all beasts with heroes," and in Photius the term "speckled hero" thus finds an explanation. At the battle of Salamis the serpent which appeared among the ships was taken to be the hero Cychreus. These heroes might become objects of cult and local divinities of healing; people would pass their tombs in awe, or resort thither for divination or for taking oaths (Jane Harrison, *Journ. of Hell. Studies* xix. 204 *sqq.*). In Egypt not only are there serpents of the houses, but each quarter in Cairo had a serpent-guardian. This is said also of the villages and districts of Armenia, and Buddhist legends affirm it for India. The Satī (Suttee) wife immolated to accompany her deceased husband often became the guardian of the village, and on the Satī shrine a snake may be represented in the act of rising out of the masonry (Crooke, i. 187 *seq.*). Athene ("the Athenian one") was primarily the guardian spirit of Athens, and at the Erechtheum her sacred serpent (apparently known to the 3rd century A.D.), was fed monthly with honey-cakes; when, during the Persian War, it left the food untouched it was taken as a sign that the protectors had forsaken the city. At Lebadeia in the shrine of Trophonios and elsewhere serpents gave oracles.

Human Sacrifice.—The control of the weather was ascribed to the nāga demi-gods and rajahs of India and to the "king of snakes" among North American Indians. It is significant that in India the widely-distributed Nagapančami-festival occurs in the rainy season. There are popular stories of springs and waters which could only be used in return for regular human sacrifices. A very rich dynasty in the Upper Niger was supposed to owe its wealth to a serpent in a well which received yearly a maiden attired as a bride; the cessation of the practice brought drought and sickness (Hartland iii. 57 *seq.*). In Mexico the half-serpent Ahuizotl dragged into its pool hapless passers-by; however, their souls were supposed to go to the terrestrial paradise, and the relatives became rich through the unhappy accident. But in India human sacrifice was actually made in the expectation of gaining hidden treasure, and doubtless we have a survival of this when snake-charmers, for a drop of blood from the finger of a first-born, will track the snakes which are guardians of treasure (Crooke ii. 135, 170 *seq.*). Indian traditions tell how reformers have persuaded the people in the past to stop their human sacrifices to serpent-spirits.

The Famous Dahomey Cult.—Conspicuous in serpent cults is the prominence of women. In India, in Behār, during August, there is a colourless festival in which women, "wives of the snake," go round begging on behalf of the Brahmans and the villages. Among the Nāyars of Malabar at the ceremonies of the Pambantullel, the household serpent-deities show their benevolence by inspiring with oracles certain women who must be of perfect purity. In Travancore a serpent-god is the property of a family, the priests of a temple; the eldest female carries the

image at the festal processions and must lead a celibate life. The cult of the Python Dañh-gbi of Whydah, after taking root in Dahomey, became the most remarkable example of a thoroughly organic serpent cult (A. B. Ellis, *Ewe-speaking Peoples of Slave Coast of W. Africa*, pp. 47 *sqq.*, 140 *sqq.*). The python-deity is god of wisdom and earthly bliss and the benefactor of man: he opened the eyes of the first human pair who were born blind. He is specially invoked on behalf of the king (the nominal head of the priesthood) and the crops, and a very close connexion was supposed to exist between the god's agency and all agricultural life. Initiated priests, after remaining silent in his temple for seven days, receive a new name and thus become ordained. They possess a knowledge of poisons and antidotes and thereby acquire considerable income. Children who touch or are touched by one of the many temple-snakes are sequestered for a year and learn the songs and dances of the cult. Women who are touched become "possessed" by the god. In addition to his ministrant priestesses, the god has numerous "wives," who form a complete organization. Neither of these classes may marry, and the latter are specially sought at the season when the crops begin to sprout. These "wives" take part in licentious rites with the priests and male worshippers, and the python is the reputed father of the offspring. Every snake of its kind receives the profound veneration of the native of Whydah, who salutes it as master, father, mother and benefactor. Such snakes must be treated with every respect, and if they are even accidentally killed, the offending native may be burned alive. Occasional human sacrifice in honour of the god is attested.

Various Developments of Cults.—In the gloomy rites of the Diasia, the Olympian Zeus, as Zeus Meilichios god of wealth, has been imposed upon a chthonic snake-deity who is propitiated by holocausts of pigs and by a ritual of purgation (Harrison, *Prol.* 12–28). In the Thesmophoria (*q.v.*), a sowing festival of immemorial antiquity performed by women, cakes and pigs were thrown to serpents kept in caves and sacred to the corn-goddess Demeter, who, like the Bona Dea, was representative of the fertility of nature. The Maenads ("mad ones") or Bacchae, the women attendants of Dionysus, with their snake-accompaniments, are only one of the various snake-features associated with the cult of a deity who was also a god of healing. The symbol of the Bacchic orgies was a consecrated serpent, and the snakes kept in the sacred cistae of the cult of Dionysus find a parallel among the sect of the Ophites where, at the sacramental rites, bread was offered to the living serpent and afterwards distributed among the worshippers. Other developments may be illustrated from the cult of Aesculapius, who seems to have been merely a deified ancestor, or the interesting Indian healer Sokha Bāba (Crooke i. 147, ii. 122) (*see* AESCULAPIUS).

Contests with Serpents.—For the retention of older cults under a new name, Mohammedanism supplies several examples, as when a forest-serpent of India receives a Mohammedan name (Oldham, p. 128). But sometimes there is a contest between the new cult and the old. Thus Apollo has to fight the oracle serpent of Gaia, and it has been observed that where Apollo prevailed in Greek religion the serpent became a monster to be slain. At Thebes—the Thebans were Serpentigenae—Apollo took the place of Cadmus, who, after killing the dragon which guarded a well and freeing the district, had ended by being turned into a serpent. This looks like the assumption of indigenous traits by a foreigner—much in the same way as Hercules has contests with serpents and dragons, becomes the patron of medicinal springs, and by marrying the serpent Echidna is the ancestor of the snake-worshipping Scythians. But an ethnological tradition appears when Phorbas killed the serpent Ophiusa, freed Rhodes of snakes and obtained supremacy, or when Cychreus slew the dragon of Salamis and took the kingdom: compare the similar view of serpent-conflicts in Persian tradition (Fergusson, p. 44 *seq.*), and the story of the colonization of Cambodia, where the new-comer marries the dragon-king's daughter. A story told by Herodotus (i. 78) admirably shows how the serpent as a child of earth was a type of indigenous peoples.

In Christianity.—It remains to observe the overthrow or supersession of the serpent in Christian lands. At Axum in Abyssinia, where worship was divided between the serpent and the Mosaic Law, it is said that the great dragon was burst asunder by the prayers of Christian saints (*c.* A.D. 340; Fergusson, p. 35). At the Phrygian Hierapolis the serpent Echidna was expelled by the Apostles Philip and John. France had traditions of the destruction of serpents by missionaries (Deane, *Serpent Worship*, p. 283 *seq.*), and memory possibly survived at Luchon in the Pyrenees, where the clergy and people celebrated the eve of St. John by burning live serpents. Christian saints have also stepped into the shoes of earlier serpent-slayers; while, in stories of the "St. George and the Dragon" type, the victory of the pious over the enemy of mankind has often been treated as a literal conflict with dragons, thus introducing a new and confusing element into the subject. At Rouen the celebration of St. Romain seems to preserve a recollection of human sacrifice to a serpent-demon which was primarily suppressed by a pagan hero, and at Metz, where St. Clement is celebrated as the conqueror of a dragon, its image (formerly kept in the cathedral) was taken round the streets at the annual festival and received offerings of food. Most remarkable of all, at Cocullo in the Abruzzi mountains on the border of the old territory of the Marsi snake-men, the serpent-deity has a lineal descendant in the shape of St. Domenico of Foligno (A.D. 950–1031). The shrine is famous for its cures, and when the saint has his serpent-festival on the first Thursday in May, Serpari or serpent-men carry coils of live reptiles in procession before his image, which in turn is hung with serpents of all sizes. The rites are a valuable testimony to the persistence of the cult among people who still claim power over serpents and immunity from their bite, and who live hard by the home of the ancient tribe which ascribed its origin to the son of Circe (M. C. Harrison, *Folklore* xviii. 187 *sqq.*). One may recall the old cult of Sabazios where men waved great red snakes over their heads as they marched in procession. Moreover, we find at Madagascar the procession of the god of fertility and healing, the patron of serpents who are the ministers of his vengeance (Frazer, *Paus.* v. 66 *seq.*). In a Bengal festival the men march entwined with serpents, while the chief man has a rock-boa or python round his neck and is carried or rides on a buffalo (Fergusson 259). (S. A. C.)

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SERPENTINE, in mineralogy the name for a group of minerals of the composition $H_4(Mg,Fe)_3Si_2O_9$, probably crystallizing in the rhombic system. According to the habit and optical properties of the crystals, varieties are known under different names, the fibrous types including chrysotile, metaxite and picrolite and a platy variety is known as antigorite. The hardness is 3–4 and the density 2·5–2·7. The dominant cleavage is parallel to the fibres or plates. The colour of the minerals is usually green, but is dependent on the content of iron, colourless, red and yellow serpentines being known.

Serpentine is a common alteration product of magnesium silicates, particularly of olivine, and the rhombic and monoclinic pyroxenes. In igneous rocks it is believed to arise during a late pneumatolytic or hydrothermal stage of their consolidation. In metamorphic rocks the mineral is frequently met with as an alteration product of the olivine forsterite, less often of diopside, as in marbles and lime-silicate rocks.

The variety antigorite appears to be essentially a metamorphic

mineral, the original mineral coming from the Antigorio valley in Piedmont. Chrysotile serpentine often fills veins and seams in massive serpentine rocks and then displays a well-marked fibrous structure, with the fibres arranged transverse to the veins. The asbestos of commerce is largely chrysotile and is derived both from igneous rocks and metamorphosed dolomites.

In petrology the name serpentine is given to those rock masses which consist essentially of serpentine. The purest are derived from peridotites or dunites. In these as in other varieties the serpentine is frequently found as definite pseudomorphs after olivine, enstatite, augite or hornblende, and the mineral may show a characteristic arrangement indicative of the parent mineral. Thus serpentine derived from olivine frequently possesses a mesh structure, from monoclinic pyroxene, a knitted structure, from hornblende, a lattice structure, while the serpentine pseudomorphs of the rhombic pyroxenes are known as bastite.

Serpentines are largely used as ornamental stones. The beauty and variety of these rocks are due to the veining and mottling of the massive serpentine by talc, magnesite, iron oxide and individual crystals of schillerized pyroxenes. Serpentines of igneous origin are widely distributed. In the British Isles the largest masses occur at the Lizard in Cornwall and in the Shetland Isles. They are well developed in the Alps, Pyrenees and Urals, in North America, and occupy a large area of New Caledonia. In Australia, a linear belt of serpentine intrusions can be traced in north-eastern New South Wales over a distance of 200 miles.

The rock known as ophicalcite is an intimate mixture of calcite and serpentine, resulting from the metamorphism of an impure dolomitic limestone. The well-known "eozoon marble" of Canada and the serpentine marble of Connemara are of this character.

For serpentine in geometry *see* CURVE, SPECIAL. (C. E. T.)

SERPUKHOV, a town of Russia, in the province of Moscow, in 54° 56′ N., 37° 28′ E. Built on high cliffs on both banks of the river Nara, 3 m. above its confluence with the Oka, Serpukhov is an important manufacturing and commercial town. Pop. (1926) 43,918. It has important textile and dyeing industries, and its chintz is famous. There are also iron and copper foundries. Grain, hemp and timber, brought from the east down the Oka, are discharged at Serpukhov and sent on to Moscow and Leningrad. The cathedral (1380) was rebuilt in the 18th century; the old fortress has almost entirely disappeared.

Serpukhov is one of the oldest towns of the principality of Moscow; in 1328 it was a nearly independent principality under the protectorate of Moscow. Its fortress protected Moscow on the south and was often attacked by the Tatars; the Mongol prince Toktamish plundered it in 1382, and the Lithuanians in 1410. In 1556 the town was strongly fortified, so that fifteen years later it was able to resist the Mongols. Its commercial importance dates from the 18th century.

SERRA JUNÍPERO, MIGUEL JOSÉ (1713–1784), Spanish missionary in America, was born in the island of Majorca, on Nov. 24, 1713, entered the Franciscan order in 1729, and in 1750 arrived at Mexico City to devote his life to missionary work among the Indians. From 1750 to 1769 he laboured among the Indians of the Sierra Gorda region. In 1769 he accompanied the Gálvez expedition to the north-west, and at San Diego founded the first mission in the present State of California. In 1770 he founded the mission of San Carlos at Monterey, and in 1771 the missions of San Antonio and San Gabriel, the latter near Los Angeles. He began the mission of San Francisco in 1776 and that at Santa Clara in 1777. Many lesser missions were founded by Father Junípero or his band of 16 followers, and these became the first settlements in California. He made Monterey his headquarters, from which he frequently visited all his missions, always covering the distance between them on foot. His farewell visit was in 1783, his health rapidly declining after his return to Monterey, where he died on Aug. 28, 1784.

See Francisco Palou's *Life and Apostolic Labors of the Venerable Father Junípero Serra,* trans. by C. W. Williamson (1913); A. H. Fitch, *Junípero Serra: The Man and his Work* (1914); C. E. Chapman, *The Founding of Spanish California* (1916).

SERRANO, FRANCISCO, Duke de la Torre and Count of San Antonio (1810–1885), Spanish marshal and statesman, born in the island of Leon, Cadiz, on Dec. 17, 1810. A cadet in 1822, he was promoted from captain to brigadier-general in the Carlist War (1834–1839), and obtained the Cross of San Fernando and many medals. Member of the Cortes for Malaga in 1839, general of division and commander of the district of Valencia in 1840, he helped, in 1841, Espartero to overthrow the regency of Queen Cristina; in 1843 at Barcelona he made a *pronunciamiento* against Espartero. He was minister of war in the Lopez and Olozaga cabinets, senator in 1845, captain-general of Cranada in 1848: from then until 1853 he lived apart from politics. He assisted O'Donnell in the military movements of 1854 and 1856, was made marshal in 1856, and captain-general of Cuba (1859–62), being the first viceroy to advocate political and financial reforms in the colony. On his return to Spain he was made duke de la Torre, grandee of the first class and minister of foreign affairs by O'Donnell. Serrano gallantly exposed his life to help O'Donnell quell the formidable insurrection of June 22, 1866, at Madrid and was rewarded with the Golden Fleece. At the death of O'Donnell, as president of the senate, he helped Rios Rosas to draw up a petition to Queen Isabella against her Moderado ministers. Exiled, he conspired with the duke of Montpensier, Prim, and Sagasta, and was transported to the Canary Islands (July 7, 1868). On Sept. 18, Admiral Topete sent a steamer to bring him to Cadiz. On landing, he signed the manifesto of the revolution with Prim, Topete, Sagasta, and others and, taking command of the revolutionary army, routed Isabella's troops at Alcolea.

The queen fled to France, Serrano entered Madrid, convoked the Cortes Constituyentes (Feb. 1869), and was appointed regent. He respected the liberty of action of the Cortes in choosing Amadeus of Savoy, though he would have preferred Montpensier. He twice attempted to form a coalition cabinet under King Amadeus, and after his abdication (Feb. 11, 1873), he conspired against the federal republic (April 23, 1873), failed, and went to France until General Pavia recalled him on the eve of his *coup d'état* (Jan. 3, 1874). President of the executive again, Serrano tried first a coalition cabinet, in which Martos and Sagasta soon quarrelled, then formed a cabinet presided over by Sagasta, which, however, proved unable to cope with the military and political agitation that ended in the restoration of the Bourbons. During his eleven months of office, Serrano reorganized the finance, tried to renew relations with American and European powers and to suppress revolt. After the Restoration, he spent some time in France, returning to Madrid in 1876; marshal in the senate, he coquetted a little with Sagasta in 1881, and finally gave his open support to the formation of a dynastic left with a democratic programme defended by his own nephew, Gen. Lopez Dominguez. He died in Madrid on Nov. 26, 1885.

(A. E. Ho.)

SERRES, OLIVIA (1772–1834), an English impostor, who claimed the title of Princess Olive of Cumberland, was born at Warwick on April 3, 1772. She was the daughter of Robert Wilmot, a house-painter in that town, who subsequently moved to London. In 1791 she married her drawing-master, John Thomas Serres (1759–1825), marine painter to George III., but in 1804 separated from him. She claimed in 1817 to be the natural daughter of Henry Frederick, duke of Cumberland, brother of George III., and in 1820 claimed to be his legitimate daughter. Her story was that her mother had secretly married the duke in 1767, and that she had been substituted as an infant for the still-born child of Robert Wilmot. In 1823 Sir Robert Peel, then Home Secretary, speaking in parliament, declared her claims unfounded, and her husband expressly denied his belief in them in his will. Mrs. Serres died on Nov. 21, 1834, leaving two daughters. The eldest, who married Antony Ryves, a portrait painter, upheld her mother's claims and styled herself Princess Lavinia of Cumberland. In 1866 she took ner case into court, but the jury declared the signatures to the documents produced to be forgeries.

See W. J. Thoms, *Hannah Lightfoot, and Dr. Wilmot's Polish Princess* (London, 1867); *Princess of Cumberland's Statement to the English Nation; Annual Register* (1866), Case of *Ryves* v. *the Attorney-General.*

SERRI, a village in central Sardinia. To the west of it is a plateau, surrounded by rocky cliffs, which was of great importance in prehistoric times. A group of sacred buildings has been found here, notably a sanctuary containing a sacred well, of a type not infrequent in Sardinia. Two other buildings which served the purposes of worship contained numerous votive offerings in bronze; a group of three altars was also found. There were also massive fortifications forming a complicated defensive system, and the whole group, which was in use down to Roman times, is the finest example we have of an early Sardinian cult centre, especially interesting now that it is known that the cult of the double axe was practised here.

See Taramelli in *Monumenti dei Lincei,* xxiii. (1915–16) 313–436; *Year's Work in Classical Studies,* 1922–23, 114; 1923–24, 117.

SERTORIUS, QUINTUS (d. 72 B.C.) Roman statesman and general, was a native of Nursia in Sabine territory. After acquiring some reputation in Rome as a jurist and orator, he entered upon a military career. He served under Marius in 102 B.C. at Aquae Sextiae (mod. Aix). In 97 he was serving in Spain. In 91 he was quaestor in Cisalpine Gaul, and on his return to Rome he would have been elected to the tribuneship but for the opposition of Sulla. He now declared for Marius and the democratic party. On Sulla's return from the East in 83, Sertorius went to Spain, where he represented the Marian or democratic party, but without receiving any definite commission or appointment. Having been obliged to withdraw to Africa in consequence of the advance of the forces of Sulla over the Pyrenees, he carried on a campaign in Mauretania, in which he defeated one of Sulla's generals and captured Tingis (Tangier). The Lusitanian tribes then invited him (80) to head a rising. Brave and kindly, and gifted with a rough telling eloquence, Sertorius was just the man to impress them favourably, and the native militia, which he organized, spoke of him as the "new Hannibal." Many Roman refugees and deserters joined him, and with these and his Spanish volunteers he completely defeated one of Sulla's generals and drove Q. Caecilius Metellus Pius, who had been specially sent against him from Rome, out of Lusitania.

Sertorius owed much of his success to his statesmanlike ability. His object was to build up a stable government in the country with the consent and co-operation of the people, whom he wished to civilize after the Roman model. He established a senate of 300 members, drawn from Roman emigrants, with probably a sprinkling of the best Spaniards, and surrounded himself with a Spanish bodyguard. For the children of the chief native families he provided a school at Osca (Huesca), where they received a Roman education and even adopted the dress of Roman youths. Strict and severe as he was with his soldiers, he was particularly considerate to the people generally, and made their burdens as light as possible. It seems clear that he had a peculiar gift for evoking the enthusiasm of rude tribes, and we can well understand how the famous white fawn, a present from one of the natives, which was his constant companion and was supposed to communicate to him the advice of the goddess Diana, promoted his popularity.

For six years Sertorius may be said to have really ruled Spain. In 77 he was joined by M. Perperna (or Perpenna) Vento from Rome, with a following of Roman nobles, and in the same year the great Pompey (*q.v.*) was sent to conquer him. Sertorius proved himself more than a match for his adversaries, utterly defeating their united forces on one occasion near Saguntum. Pompey wrote to Rome for reinforcements, without which, he said, he and Metellus would be driven out of Spain. Sertorius was in league with the pirates in the Mediterranean, was negotiating with the formidable Mithridates, and was in communication with the insurgent slaves in Italy. But the arrival of Perperna formed a centre of disaffection, and his influence over the native tribes slipped away from him, though he won victories to the last. In 72 he was assassinated at a banquet, Perperna, it seems, being the chief instigator of the deed.

See Plutarch's lives of *Sertorius* and *Pompey;* Appian, *Bell. civ.* and *Hispanica;* the fragments of Sallust; Dio Cassius xxxvi. 25, 27, 28, xliv. 47; Vell. Pat. ii. 25, 29, 30, 90.

SERUM THERAPY. Serum therapy consists in the introduction into the patient of blood serum containing specific anti-bodies, preformed in some other animal, which will (*a*) neutralise the toxins produced by the corresponding infecting bacteria or (*b*) destroy the corresponding bacteria themselves—thus establishing a condition of "passive" immunity (*q.v.*).

Action of Microbes.—Disease-producing microbes may be divided into two broad groups (1) those secreting poisonous substances or *toxins* into the surrounding tissues or (2) those multiplying and invading areas far distant from the point at which they gained entry to the body of their host.

Again, speaking generally, natural recovery from a bacterial infection due to an organism of the first group coincides with the appearance in the blood serum of a neutralising agent known as *anti-toxin* in adequate amount; whilst when dealing with microbes of the second class, nature elaborates, also in the serum, a different anti-body—a bacteriolysin or immune body for the purpose of destroying the invading bacteria. In each instance the resulting anti-body is specific in character—that is to say, it will only act in opposition to the particular toxin in the one case or in the other to the members of that particular species of microbe whose entry into the body provoked its formation—the serum which is the vehicle of the curative substance is termed in this first instance "anti-toxic" and in the second "anti-bacterial." Thus the early and accurate recognition of the bacterium responsible for any infection it is proposed to treat determines the selection of the appropriate anti-serum.

Preparation of Anti-serum.—As these sera are nowadays employed in considerable quantities it is customary to select a large mammal, such as the horse, for immunisation. After a period of observation during which the freedom of the animal from diseases transmissible to man is established, a series of subcutaneous injections is undertaken starting with an artificially attenuated virus or a mixture of toxin and previously obtained anti-toxin as the case may be and gradually increasing the size of the dose and the potency thereof until the animal is able to withstand enormous quantities of highly poisonous material without any ill effects while maintaining perfect physical condition. From time to time small quantities of blood are withdrawn from the animal and the serum tested to ascertain the amount of anti-body that is available, and when a suitable stage has been reached the animal is bled to the extent of several pints, the serum carefully separated from the blood corpuscles and passed through a sterile porcelain filter to ensure its freedom from bacteria. Occasionally the serum is concentrated, some of its unneeded proteins removed and purified.

It is obvious that a correct appreciation of its valency is necessary for the scientific employment of any serum in the treatment of disease; but, unfortunately, bacterial poisons formed by various micro-organisms, and even by different strains of the same species, not only exhibit many variations in toxicity depending upon biological factors (not all of which are at present known) but they have, so far, proved incapable of isolation in a state of chemical purity. Consequently, it is only possible in the majority of instances to effect a comparison by observing the results of their introduction into suitable experimental animals.

Indeed only in the case of diphtheria toxin is there any universally accepted standard, for here Ehrlich prepared, many years ago, a standard diphtheria anti-toxin of constant valency which is preserved hermetically sealed in vacuo, by means of which all diphtheria toxins can be graded and the potency of the sera prepared by their means expressed in anti-toxic units.

In the case of toxins produced by other bacteria, and in the preparation of anti-bacterial sera, the plan usually adopted is to inoculate gradually decreasing doses of the virus into susceptible animals until the smallest quantity that will cause death with certainty, and within a specified time, is determined. This is termed the minimal lethal dose (M.L.D.) and forms the basis for the standardisation of the corresponding anti-serum. Varying quantities of serum are in turn mixed with a constant dose of virus—usually 100 M.L.D.—and injected into animals until that amount of serum is determined which will effectively neutralise the test dose. This quantity of serum is then regarded as containing one unit of anti-body and the serum which is in process of standardisa-

tion is stated to contain so many units per cubic centimetre.

Anti-toxin Sera.—Of the anti-toxin sera, diphtheria anti-toxin is rightly regarded as the most efficient. Its use, now almost universal, has been largely responsible for the reduction of the death-rate from diphtheria (*see* INFECTIOUS FEVERS) in a most striking manner from over 33% in pre-anti-toxin days to about 7 per cent. This latter figure includes all cases in all stages, but if treatment is instituted on the first day of disease the mortality falls to zero. Tetanus anti-toxin is also of great value, but owing chiefly to the fact that Tetanus (*q.v.*) is rarely diagnosed until the toxin has secured a firm hold upon nervous elements, it has not achieved a position as a therapeutic agent equal to that occupied by diphtheria anti-toxin. On the other hand the mass of evidence accumulated in the World War clearly demonstrates the necessity for its use in the prophylactic treatment of earth-soiled wounds. Gas gangrene, rife during the early days of the World War, led to the production of highly efficient anti-sera for the toxins of B. welchii and the vibrion septique, the necessity for which has largely passed. Another serum, for the neutralisation of the toxin of bacillus botulinus—a germ which gives rise to a particularly fatal type of food poisoning fortunately rare in the British Isles—is also prepared but there is little evidence available as to its efficiency (*see* FOOD POISONING).

Finally, Calmette has obtained an anti-toxic serum, "anti-venene," from horses which he had immunised against both colubrine and viperine venoms.

Anti-bacterial Sera.—Many varieties of anti-bacterial sera have been prepared against many of the microbes of the second group, but few of them have stood the test of time; and at the present day only anti-streptococcic, anti-meningococcic, anti-pneumococcic, anti-anthrax and anti-dysentery sera remain. These have established their positions in the therapeutic armament largely as the result of recent acquisitions to our knowledge of the biology of certain microbes but in part also to improvements in the methods of preparing anti-sera.

The recognition that numberless strains of streptococci exist which though morphologically identical are biologically diverse has resulted in the preparation of polyvalent sera which sometimes produce dramatic recoveries in apparently hopeless cases of septicaemia, although in other instances serum is employed without avail. In the case of infections by the pneumococcus too, several different types may be encountered to some of which no curative serum could be prepared. Within recent years these organisms have been classed into four different groups of which the two first were alone amenable to serum treatment—that designated Type 1 being particularly so. Similarly, and largely as the result of researches necessitated by the prevalence of the so-called "spotted fever" (*see* SPINAL MENINGITIS) during the War the meningococci have been grouped under four types and whilst multivalent sera comprising anti-bodies for all types have been made, the use of appropriate univalent sera has afforded even more successful results. The two anti-sera prepared against pathogenic bacilli, anti-anthrax and anti-dysentery, are both of very considerable value. The first has long been employed either alone or in conjunction with operative measures in the treatment of "malignant pustule," but the position of the latter depends almost entirely upon the ample demonstration of its value in the War provided it is used early in the disease. (J. W. E.)

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SERVAL (*Felis serval*), an African wild cat, ranging from Algeria to the Cape. It is of medium size, with long limbs, short tail, and tawny fur spotted with black. It may measure 56in., including the tail. The serval is fairly common in south Central Africa, frequenting thick bush near rivers and preying on the smaller antelopes, guinea-fowls, and francolins. The mantles made from its skin are reserved for native chiefs.

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THE SERVAL, A WILDCAT OF AFRICA

SERVETUS, MICHAEL [MIGUEL SERVETO] (1511–1553), Spanish physician and polemic, was born in 1511 at Tudela in Navarre, his father being Hernando Villanueva, a notary of good family in Aragon. His surname is given by himself as "Serveto" in his early works, "per Michaelem Serueto, alias Reues." Later he Latinized it "Servetus"; when writing French (1553) he signs "Michel Seruetus." The surname, Villanovanus or de Villeneufve, is derived from the home of the family, Villanueva. Servetus studied law at Toulouse, where he first became acquainted with the Bible (1528). From 1525 he had found a patron in Juan de Quintana (d. 1534), a Franciscan promoted in 1530 to be confessor to Charles V. In the train of Quintana he witnessed at Bologna the double coronation of Charles in Feb. 1530, visited Augsburg, and perhaps saw Luther at Coburg. The spectacle of the adoration of the pope at Bologna impressed him strongly in an anti-papal direction. He left Quintana, visited Lyons and Geneva, repaired to Oecolampadius at Basle, and pushed on to Bucer and Capito at Strasbourg. His first publication, *De Trinitatis erroribus* (1531, printed by John Setzer at Hagenau) is crude, but original and earnest, and shows a wide range of reading. The essay was followed in 1532 by a revised presentation of his views in dialogue form. We next find him at Lyons (1535) editing scientific works for the Trechsel firm, adopting the "Villanovanus" surname, which he constantly used till the year of his death. At Lyons he found a new patron in Dr. Symphorien Champier (Campegius) (1472–1539), and he then went (1536) to Paris to study medicine under Johann Günther, Jacques Dubois and Jean Fernel. In 1536 Calvin saw Servetus in Paris, and as he himself says, proposed to set him right on theological points. Servetus succeeded Vesalius as assistant to Günther, who extols his general culture, and notes his skill in dissection, and ranks him *vix ulli secundus* in knowledge of Galen. He graduated in arts, and claims to have graduated in medicine, published six lectures on "syrups" (the most popular of his works), lectured on geometry and "astrology" (from a medical point of view) and defended by counsel a suit brought against him (March 1538) by the medical faculty on the ground of his astrological lectures. Shortly afterwards, on the death of his master, he left Paris for Louvain, where he studied theology and Hebrew. He then practised medicine for a short time at Avignon, and for a longer period at Charlieu. In September 1540 he entered the medical school at Montpellier.

Pierre Paulmier, since 1528 archbishop of Vienne, who had attended his lectures in Paris, now invited Servetus to Vienne as his confidential physician. At Vienne he remained for 12 years (1541–53), making money by his practice, and also by renewed editorial work for the Lyons publishers. Outwardly he was a conforming Catholic; privately he pursued his theological speculations. It is probable that in 1541 he had been rebaptized (he maintained the duty of adult baptism at the age of 30). Late in 1545, or very early in 1546, he opened a fatal correspondence with Calvin, forwarding the ms. of a much-enlarged revision of his theological tracts and expressing a wish to visit Geneva. Calvin replied (Feb. 13, 1546) in a letter now lost, in which, he says, he expressed himself "plus durement que ma coustume ne porte." On the same day he wrote to Guillaume Farel, "si venerit, modo valeat mea autoritas, vivum exire nunquam patiar," and to Pierre Viret in the same terms. Evidently Servetus had warning that if he went to Geneva it was at his peril. Writing to Abel Poupin (in

or about 1547) he complains that Calvin would not return his ms., and adds, "mihi ob eam rem moriendum esse certo scio." The volume of theological tracts, again recast, was declined by two Basle publishers, Jean Frellon (at Calvin's instance) and Marrinus, but an edition of 1,000 copies was secretly printed at Vienna by Balthasar Arnollet. Ready by Jan. 3, 1553, the bulk of the impression was privately consigned to Lyons and Frankfort for the Easter market.

On Feb. 26, a letter, enclosing a sheet of the printed book, and revealing the secret of its authorship, was written from Geneva by Guillaume de Trye, formerly *échevin* of Lyons, to his cousin Antoine Arneys in that city. The letter bears no sign of dictation by Calvin (who must, however, have furnished the enclosed sheet). For a subsequent letter Calvin furnished (reluctantly, according to de Trye) samples of Servetus's handwriting, expressly to secure his conviction. The inquisitor-general at Lyons, Matthieu Ory (the "Doribus" of Rabelais) took up the case on March 12; Servetus was interrogated on March 16, arrested on April 4, and examined on the two following days. His defence was that, in correspondence with Calvin, he had assumed the character of Servetus for purposes of discussion. At 4 A.M. on April 7 he escaped from his prison, evidently by connivance. How he spent the next four months is not known. On Saturday, Aug. 6, he rode into Louyset, a village on the French side of Geneva. Next morning he walked into Geneva, put up at "the Rose," and asked for a boat to take him towards Zürich on his way to Naples. Finding he could not get the boat till next day (Monday) he attended afternoon service (he would probably have got into trouble if he had not done so), was recognized at church *par quelques frères*, and immediately arrested.

The process against Servetus (Nicholas de la Fontaine being in the first instance the nominal prosecutor) lasted from Aug. 14 to Oct. 26, when sentence to be burned alive was passed, and carried out next day at Champel (Oct. 27, 1553). Calvin would have had him beheaded. Meanwhile the civil tribunal at Vienne had ordered (June 17) that he be fined and burned alive; the sentence of the ecclesiastical tribunal at Vienne was delayed till Dec. 23. Jacques Charmier, a priest in Servetus's confidence, was condemned to three years' imprisonment in Vienne. The only likeness of Servetus is a small copperplate by C. Sichem, 1607 (often reproduced); the original is not known and the authenticity is uncertain. In 1876 a statue of Servetus was erected by Don Pedro Gonsalez de Velasco in front of his Instituto Antropologico at Madrid; in 1903 an expiatory block was erected at Champel; in 1907 a statue was erected in Paris (Place de la Mairie du XIV^{e} Arrondissement); another is at Aramnese; another was prepared (1910) for erection at Vienne.

The denial by Servetus of the tripersonality of the Godhead and the eternity of the Son, along with his anabaptism, made his system abhorrent to Catholics and Protestants alike, in spite of his intense Biblicism, his passionate devotion to the person of Christ, and his Christocentric scheme of the universe. His earliest theological writings, in which he approximates to the views of F. Socinus, are better known than his riper work. He has been classed with Arians, but he endorses in his own way the homoousian formula, and denounces Arius as "Christi gloriae incapacissimus." He has had many critics, some apologists (*e.g.*, Postel and Lincurius), few followers. The 15 condemnatory clauses, prefacing the sentence at Geneva, set forth in detail that he was guilty of heresies, blasphemously expressed, against the foundation of the Christian religion. An instance of his injurious language was found in his use of the term "trinitaires" to denote "ceux qui croyent en la Trinité." No law, current in Geneva, has ever been adduced as enacting the capital sentence. Claude Rigot, the procureur-général, put it to Servetus that his legal education must have warned him of the provisions of the code of Justinian to this effect; but in 1535 all the old laws on the subject of religion had been set aside at Geneva; the only civil penalty recognized by the edicts of 1543 being banishment. The Swiss churches, while agreeing to condemn Servetus, say nothing of capital punishment in their letters of advice. The extinct law seems to have been revived for the occasion. A controversy followed on the question of executing heretics, in which Beza (for), Mino Selsi (against), and several caustic anonymous writers (especially Castellio) took part.

His Works.—The following is a list of the writings of Servetus:

1. *De Trinitatis erroribus libri septem* (Hagenau, 1531).

2. *Dialogorum de Trinitate libri duo* (Hagenau, 1532); two reprints of 1 and 2, to pass for originals; No. 1 in Dutch version (1620), by Regnier Telle.

3. *Claudii Ptolomaei Alexandrini geographicae enarrationis libri octo; ex Bilibaldi Pirckheymeri translatione, sed ad Graeca et prisca exemplaria a Michaele Villanovano jam primum recogniti. Adjecta insuper ab eodem scholia*, etc., Lyons, Melchior and Gaspar Trechsel (1535; 2nd ed., Lyons, Hugo à Porta, 1542 *seq.;* printed by Caspar Trechsel at Vienne); on this work Tollin founds his high estimate of Servetus as a comparative geographer; the passage incriminated on his trial as attacking the verity of Moses is from Lorenz Friese; the accounts of the language and character of modern nations show original observation.

4. *In Leonardum Fuchsium apologia. Autore Michaele Villanovano* (1536, reproduced by photography, 1909).

5. *Syruporum universa ratio*, etc. (Paris, 1537); four subsequent editions; latest, Venice, 1548 (six lectures on digestion; syrups treated in fifth lecture).

6. *Michaelis Villanovani in quendam medicum apologetica disceptatio pro astrologia* (Paris, 1538; reprinted, Berlin, 1880); the medicus is Jean Tagault, who interrupted Servetus's lectures on astronomy, including meteorology.

7. *Biblia Sacra ex Santis Pagini tralatione . . . recognita et scholiis illustrata*, etc. (Lyons, Hugo à Porta, 1542, *seq.*), remarkable for its theory of prophecy, explained in the preface and illustrated in the notes.

8. D'Artigny says Servetus *fit les argumens* to a Spanish version of the *Summa* of Aquinas; this, and *divers traités de grammaire* from Latin into Spanish have not been identified.

9. *Christianismi restitutio* (1553; perfect copies in Vienna and Paris); a copy in Edinburgh university library is complete except that the missing first 16 pages are replaced by a transcript from the original draft, containing matter not in the print (this supplementary ms. was reproduced by photography, 1909); a transcript of other portions of the draft is in the Bibl. Nat., Paris; partly reprinted (London, 1723) (copies in London and Paris); reprinted (page for page) from the Vienna copy (Nuremberg, Rau, 1790); German version, by B. Spiess (Wiesbaden, 1892–95); the last section *Apologia* to Melanchthon, is given in the original Latin. The book is not strictly anonymous; the initials M.S.V. are given at the end; the name Seruetus on p. 199. The often-cited description of the pulmonary circulation (which occurs in the 1546 draft) begins p. 169; it has escaped even Sigmond that Servetus had an idea of the composition of water and of air; the hint for his researches was the dual form of the Hebrew words for blood, water, etc. Two treatises, *Desiderius* (*ante* 1542) and *De tribus impostoribus* (1598) have been wrongly ascribed to Servetus. Most of his few remaining letters are printed by Mosheim; his letter from Louvain was despatched in duplicate (to evade capture), but both were seized; one is in the Record Office (U. 140), the other in the British Museum (Cotton mss., Galba B. x.).

The literature relating to Servetus is very large; a bibliography is in A. v. d. Linde, *Michael Servet* (1891); the following are among the important pieces. Calvin's *Defensio orthodoxae fidei* (1554) (in French, *Déclaration pour maintenir*, etc., 1554), is the source of prevalent misconceptions as to Servetus's opinions, and attitude on his trial. De la Roche's *Historical Account* in *Mem. of Lit.* (1711–12) (in French, *Biblioth. Ang.* Amsterdam, 1717) was followed by *An Impartial History*, etc., 1724 (said to be by Sir Benjamin or Nathaniel Hodges). Allwoerden's *Historia*, etc. (1728) (materials furnished by Mosheim) is superseded by Mosheim's *Anderweitiger Versuch* (1748, with appendix, *Neue Nachrichten*, etc., 1750), reproducing the records of the Vienne examination (since lost) first printed by D'Artigny. *Nouveaux Mémoires d'hist.*, etc., vol. ii. (1749). Chauffepié's valuable article, *Nouv. Dict. historique*, iv. (1756) (in English, by Rev. James Yair, 1771) makes no use of Mosheim's later researches. Trechsel's *Die Prot. Antitrinitaires vor F. Socin*, bk. i. (1839), uses all available material up to date. The investigations of H. Tollin (40 separate articles in various journals, 1874 to 1885) have thrown much light, mixed with some con-

jecture. The records of the Geneva trial, first published by De la Roche, reproduced in Rilliet's *Relation* etc. (1844), and elsewhere, are best given in vol. viii. (1870) of the *Corpus reformatorum* edition of Calvin's works; Roget's *Hist. du peuple de Genève*, vol. iv. (1877), has a good account of both trials. The passage on the pulmonary circulation, first noticed by W. Wotton, *Reflections upon Anc. and Mod. Learning* (1694), has given rise to a literature of its own; *see*, especially, Tollin, *Die Entdeckung des Blutkreislaufs*, etc. (1876); Huxley, in *Fortnightly Rev.* (Feb. 1878); Tollin, *Kritische Bemerkungen über Harvey und seine Vorgänger* (1882). Other physiological speculations of Servetus are noted by G. Sigmond, *Unnoticed Theories of Servetus* (1826). The best study of Servetus as a theologian is Tollin's *Lehrsystem M. Servets* (3 vols., 1876–78); Pünyer's *De M. Serveti doctrina* (1876) is useful. From a Unitarian point of view, Servetus is treated by R. Wright, *Apology* (1807); W. H. Drummond (1848); R. Wallace, *Antitrin. Biog.* (1850); J. S. Porter, *Servetus and Calvin* (1854). E. Saisset, *Rev. des deux Mondes* (1848), treats Servetus as a pantheist; he is followed by Menendez Pelayo, *Los Heterodoxos españoles* (1880, vol. ii.), and by R. Willis, *Servetus and Calvin* (1877, *cf.* A. Gordon, *Theol. Rev.*, April and July 1878). Of Servetus's personal character the best vindication is Tollin's *Characterbild M. Servets* (1876); *see* also A. Dide, *M. Servet et Calvin* (1907); W. Osler, *Michael Servetus* (N.Y., 1909); J. van der Erde, *M. Servet* (Amsterdam, 1909); A. Gordon, *The Personality of M. Servetus* (1910), and *Servetus and the Spanish Inquisition* (1925). His story has been dramatized by Max Ring, *Die Genfer* (1850), by José Echegaray, *La Muerte en los Labios* (1880), by Albert Hamann, *Servet* (1881), and by Prof. Shields, *The Reformer of Geneva* (1897). (A. Go.; X.)

SERVICE, ROBERT WILLIAM (1874–), Canadian poet and novelist, was born at Preston, England, on Jan. 16, 1874, and educated at Hillhead public school, Glasgow. He went in 1905 to Canada and settled for a short time in Vancouver island. He entered the Canadian Bank of Commerce in Victoria, B.C., and was afterwards transferred first to White Horse in the Yukon and then to Dawson. In all he spent eight years in the Yukon and travelled widely. During his last years with the bank he wrote verse describing life in the North, notably *Songs of a Sourdough* (1907) and *Ballads of a Cheechako*. In 1910 appeared a novel *The Trail of '98* giving a vivid description of men and conditions in the Klondike. During the Balkan War of 1912–13 Service was war correspondent to *The Toronto Star* and served this paper in the same capacity during the World War, in which he spent two years as an ambulance driver in the Canadian Army Medical Corps. He described his war experiences in *Rhymes of a Red Cross Man* (1916). After the War he devoted himself to literary work in Paris. His other works include *Rhymes of a Rolling Stone* (1913); *Ballads of a Bohemian* (1920); *Poisoned Paradise*, a novel of Monte Carlo (1922); *The Roughneck* (1923).

SERVICE STRIPE: *see* STRIPE.

SERVICE TREE (*Pyrus domestica*), a native of the Mediterranean region, not infrequently planted in southern Europe for its fruit. It has been regarded as a native of England on the evidence of a single specimen, which has probably been planted, now existing in the forest of Wyre. The tree is seldom productive till it has arrived at a goodly size and age. The fruit has a peculiar acid flavour, and, like the medlar, is fit for use only when kept till it has become "bletted," *i.e.*, partially rotten. There is a pear-shaped variety, *pyriformis*, and also an apple-shaped variety, *maliformis*, both of which may be propagated by layers, and, better, by grafting on seedling plants of their own kind. The fruit is sometimes brought to market in winter. The service is nearly allied to the mountain ash, *Pyrus Aucuparia*, which it resembles in having regularly primate leaves. *P. torminalis* is the wild service, a small tree occurring in woods and hedges from Lancashire southwards; the fruit is sold in the country markets.

SERVITES or **"SERVANTS OF MARY,"** an order under the rule of St. Augustine, founded in 1233. In this year seven merchants of Florence, recently canonized as "the seven holy Founders," gave up their wealth and position, and with the bishop's sanction established themselves as a religious community on Monte Senario near Florence. They lived an austere life of penance and prayer, and being joined by others, they were in 1240 formed into an order following the Augustinian rule supplemented by constitutions borrowed from the Dominicans. Soon they were able to establish houses in various parts of Italy, France, Germany and Spain. The most illustrious member of the order and its chief propagator and organizer was St. Filippo Benizi, the fifth general, who died in 1285. The order received papal approbation in 1255; in 1424 it was recognized as a Mendicant order, and in 1567 it was ranked with the four great orders of Mendicant friars.

BIBLIOGRAPHY.—The chief work on the Servites is the *Monumenta* by Morini and Soulier, 1897, etc. Max Heimbucher, *Orden u. Kongregationen* (1907), ii. § 73; Wetzer u. Welte, *Kirchenlexicon* (2nd ed.); the *Catholic Encyclopaedia;* Herzog-Hauck, *Realencyklopädie* (3rd ed.). The most interesting part of Servite history is told by P. Soulier, *Vie de S. Philippe Benizi* (1886). (E. C. B.)

SERVITUDE, a right over the property of another. In Roman law, servitudes were classified into (1) personal and (2) praedial. (*See* ROMAN LAW.)

The term "servitude" is in use in Scots law and in other systems which have been much influenced by Roman law. For the English law, *see* EASEMENTS.

SERVIUS HONORATUS, MAURUS (or MARIUS), Roman grammarian and commentator on Virgil, flourished at the end of the 4th century A.D. He is one of the interlocutors in the *Saturnalia* of Macrobius, and allusions in that work and a letter from Symmachus to Servius show that he was a pagan. He was one of the most favourable examples of the Roman "grammatici" and the most learned man of his time. He is chiefly known for his commentary on Virgil, which has come down to us in two distinct forms. The first is a comparatively short commentary, definitely attributed to Servius in the superscription in the mss. and by other evidence. A second class of mss. (all going back to the 10th or 11th century) presents a much expanded commentary, mostly clearly of ancient origin.

The real Servian commentary practically gives the only complete extant edition of a classic author written before the destruction of the empire. It is constructed very much on the principle of a modern edition, and is partly founded on the extensive Virgilian literature of preceding times, much of which is known only from the fragments and facts preserved in the commentary. The notices of Virgil's text supply valuable information concerning the ancient recensions of Virgil. Besides the Virgilian commentary, other works of Servius are extant: a collection of notes on the grammar (*Ars*) of Aelius Donatus; a treatise on metrical endings (*De finalibus*); and a tract on the different metres (*De centum metris*).

Editions of the Virgilian commentary by G. Fabricius (1551); P. Daniel, who first published the enlarged commentary (1600); and G. Thilo and H. Hagen (1878–1902). *See* E. Thomas, *Essai sur Servius* (1880); O. Ribbeck's *Virgil* (1894–95); *Journal of Philology*, x. (1882); W. A. Baehrens, *Cornelius Labeo* (Leipzig, 1918). The smaller works are in Keil's *Grammatici Latini*, vol. iv.

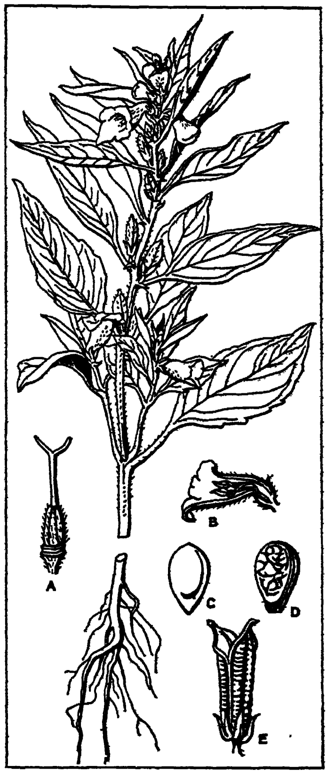
SERVIUS TULLIUS, sixth legendary king of Rome (578–534 B.C.). According to one account he was the son of the household genius (Lar) and a slave named Ocrisia, of the household of Tarquinius Priscus. He married a daughter of Tarquinius and succeeded to the throne by the contrivance of his mother-in-law, Tanaquil, who was skilled in divination and foresaw his greatness. Another legend, alluded to in a speech by the emperor Claudius (fragments of which were discovered on a bronze tablet dug up at Lyons in 1524), represented him as an Etruscan soldier of fortune named Mastarna, who attached himself to Caeles Vibenna (Caelius Vivenna), the founder of an Etruscan city on the Caelian Hill (*see* also Tacitus, *Annals*, iv. 65). An important event of his reign was the conclusion of an alliance with the Latins, whereby Rome and the cities of Latium became members of one great league. His reign of forty-four years was ended by a conspiracy headed by his son-in-law, Tarquinius Superbus.

Servius was regarded as the originator of a new classification of the people, which laid the foundation of the gradual political enfranchisement of the plebeians (for the constitutional alterations with which his name is associated, *see* ROME: *Ancient History;* for the Servian Wall, *see* ROME: *Archaeology*).

For a critical examination of the story *see* Schwegler, *Römische Geschichte*, bks. xvi., xvii.; Sir G. Cornewall Lewis, *Credibility of early Roman History*, ch. xi.; W. Ihne, *History of Rome*, i.; E. Pais, *Storia di Roma*, i. (1898); and *Ancient Legends of Roman History* (Eng. trans., 1906); C. Pascal, *Fatti e legende di Roma antica* (Florence, 1903); also O. Gilbert, *Geschichte und Topographie der Stadt Rom im Altertum* (1883–85), and J. B. Carter, *The Religion of Numa* (1906), on the reorganization of Servius.

SESAME, the most important plant of the genus *Sesamum* (family Pedalineae), is that which is used throughout India and other tropical countries for the sake of the oil expressed from its seeds. *S. indicum* is a herb 2 to 4 ft. high, with the lower leaves on long stalks, broad, coarsely toothed or lobed. The upper leaves are lanceolate, and bear in their axils curved, tubular, two-lipped flowers, each about $\frac{3}{4}$ in. long, and pinkish or yellowish in colour. The four stamens are of unequal length, with a trace of a fifth stamen, and the two-celled ovary ripens into a two-valved pod with numerous seeds. The plant has been cultivated in the tropics from time immemorial and is supposed to have been derived from the Indian archipelago, but at present it is not known with certainty in a wild state. The colour of the flower, and that of the seeds, ranges from light yellow or whitish to black. Sesame oil, otherwise known as gingili or til (not to be confounded with that derived from *Guizotia* [family Compositae], known under the same vernacular name), is very largely used for the same purposes as olive oil, and although less widely known, is commercially much more important. The seeds and leaves are used by the natives as demulcents and for other medicinal purposes. The soot obtained in burning the oil is said to constitute one of the ingredients in Indian or Chinese ink.

For further details *see* G. Watt, *Dictionary of Economical Products of India* (1893).



FROM KOEHLER, "MEDICINAL PLANTS"

SESAME (SESAMUM INDICUM)
A. Flower after removal of corolla and calyx. B. Longitudinal section of flower. C. & D. Seeds of white and black varieties. E. Ripe fruit

SESIA, a river of northern Italy, rising below Monte Rosa, passes Alagna (a favourite mountain resort) and Varallo (*q.v.*) and leaves the mountains at Romagnano; then flows past Vercelli (*q.v.*) and soon falls into the Po.

SESOSTRIS, the name of a legendary king of Egypt. According to Herodotus, Diodorus Siculus (who calls him Sesoosis) and Strabo, he conquered the whole world, even Scythia and Ethiopia, divided Egypt into administrative districts or nomes, was a great lawgiver, and introduced a system of caste and the worship of Serapis. He has been considered a compound of Seti I. and Rameses II., belonging to the XIXth Dynasty. In Manetho, however, he occupied the place of the second Senwosri (formerly read Usertesen) of the XIIth Dynasty, and his name is now usually viewed as a corruption of Senwosri. So far as is known no Egyptian king penetrated a day's journey beyond the Euphrates or into Asia Minor, or touched the continent of Europe. The kings of the XVIIIth and XIXth dynasties were the greatest conquerors that Egypt ever produced, and their records are clear on this point. Senwosri III. raided south Palestine and Ethiopia, and at Semna beyond the second cataract set up a stela of conquest that in its expressions recalls the stelae of Sesostris in Herodotus: Sesostris may, therefore, be the highly magnified portrait of this Pharaoh. Khian, the powerful but obscure Hyksos king of Egypt, whose prenomen might be pronounced Sweserenrē, is perhaps a possible prototype, for objects inscribed with his name have been found from Baghdad to Cnossus. Sesostris is evidently a mythical figure calculated to satisfy the pride of the Egyptians in their ancient achievements, after they had come into contact with the great conquerors of Assyria and Persia.

Herodotus ii. 102–111; Diod. Sic. i. 53–59; Strabo xv. p. 687; *see* also article EGYPT; and Kurt Sethe, "Sesostris," 1900, in his *Unters. z. Gesch. u. Altertumskunde Ägyptens,* tome ii.

SESSA AURUNCA, a town and episcopal see of Campania, Italy, in the province of Rome, on the south-west slope of the extinct volcano of Rocca Monfina, 27 m. by rail W.N.W. of Caserta and $20\frac{1}{2}$ m. E. of Formia by the branch railway to Sparanise, 666 ft. above sea-level. Pop. (1921) 19,202 (town), 21,488 (commune). It is situated on the site of the ancient Suessa Aurunca, on a small affluent of the Liri. The town contains many ancient remains, notably the ruins of an ancient bridge in brickwork of twenty-one arches, of substructures under the church of S. Benedetto, of a very large cryptoporticus, belonging probably to a gymnasium, and of an amphitheatre. The Romanesque cathedral is a basilica with a vaulted portico and a nave and two aisles begun in 1103, a mosaic pavement in the Cosmatesque style, a good ambo resting on columns and decorated with mosaics showing traces of Moorish influence.

The ancient chief town of the Aurunci, Aurunca or Ausona, is believed to have lain on the narrow south-western edge of the extinct crater of Rocca Monfina (3,297 ft.). Here some remains of Cyclopean masonry exist; but the area enclosed is too small for anything but a detached fort of a time prior to Roman supremacy. In 337 B.C. the town was abandoned in favour of the site of the modern Sessa. In 313 a Latin colony under the name Suessa Aurunca was founded here.

See G. Tomassino, *Sessa Aurunca e i suoi avanzi archeologici* (1925).

SESSION, the period or time that a legislature, court or council meets for business, whether for the day or for the full term. A session of the British parliament is reckoned from its assembling till prorogation; usually there is one session each year. The Congress of the United States similarly meets ordinarily once a year, the so-called long session beginning in December of the odd-numbered years and adjourning whenever Congress so decides, generally in the early summer, and the short session beginning in December of the even-numbered years and ending on the succeeding March 4. The president may call an extraordinary session at any time. The term is applied to the sittings of various judicial courts, especially criminal. The sittings of the justices of the peace or magistrates in Great Britain are "sessions of the peace," i. e. quarter sessions or "petty sessions." In the United States a court of general or special sessions is a local criminal court for lesser offences. The supreme court of Scotland is termed the "court of session." The name is also given in the Presbyterian Church to the lowest ecclesiastical court.

SESTETT, the name given to the second division of a sonnet, which must consist of an octave, of eight lines, succeeded by a sestett, of six lines. In the usual course the rhymes are arranged *abc* | *abc*, but this is not necessary. Early Italian sonnets, and in particular those of Dante, often close with the rhyme-arrangement *abc* | *cba*. In the quatorzain, there is properly speaking no sestett, but a quatrain followed by a couplet, as in the case of Shakespeare's so-called "Sonnets." Another form of sestett has only two rhymes, *ab* | *ab* | *ab;* as in Gray's sonnet "On the Death of Richard West." The sestett should mark the turn of emotion in the sonnet; as a rule it may be said that the octave having been more or less objective, in the sestett reflection should make its appearance, with a tendency to the subjective manner.

Wordsworth and Milton are both remarkable for the dignity with which they conduct the downward wave of the sestett in their sonnet. The French sonneteers of the 16th century, with Ronsard at their head, preferred the softer sound of the arrangement *aab* | *ccb* |.

SESTINA, a most elaborate form of verse, employed by the mediaeval poets of Provence and Italy, and occasionally used by modern poets. The scheme was the invention of the troubadour, Arnaut Daniel (d. 1199), who wrote many sestinas in the *lingua di sì.* Dante, a little later, wrote sestinas in Italian, above all that beginning "Al poco giorno ed al gran cerchio d' ombra." In the *Dē vulgari Eloquio,* Dante admits that he imitated Arnaut; "et nos eum secuti sumus," he says. The sestina, in its pure mediaeval form, consists of six stanzas of six lines each of blank verse: hence the name. The final words of the first stanza appear in varied order in all the others, the order laid down by the Provençals being:—*abcdef, faebdc, cfdabe, ecbfad, deacfb, bdfeca.*

On these stanzas followed a *tornada*, or *envoi*, of three lines, in which all the six key-words were repeated in the following order: —*b-e, d-c, f-a.* What symbolism, if any, this rigid form concealed, has been lost. Petrarch cultivated a slightly modified sestina, but later the form fell into disuse, until it was revived by the poets of the Pléiade, in particular by Pontus de Tyard. In the 19th century, it was assiduously cultivated by the Comte de Gramont, who, between 1830 and 1848, wrote a large number of examples, included in his *Chant du passé* (1854). The earliest sestina in English was published in 1877 by Edmund Gosse; this was in the style of Daniel. Since that time it has been frequently employed by English and American writers, particularly by Swinburne, who has composed some beautiful sestinas on the French pattern; of these, that beginning "I saw my soul at rest upon a day" is perhaps the finest specimen in English. His astonishing *tour de force*, "The Complaint of Lisa," is a double sestina of 12 verses of 12 lines each. The sestina was cultivated in Germany in the 17th century, particularly by Opitz and Weckherlin. In the 19th century an attempt was made, not without success, to compose German sestinas in dialogue, or even double sestinas.

SESTRI LEVANTE, seaport of Liguria, Italy, in the province of Genoa (anc. *Segesta Tiguliorum*), from which it is 28½ m. distant by rail, 33 ft. above sea-level. Pop. (1921) 11,333, town; 14,444, commune. It is both a summer and a winter resort, with fine views. Part of the town is situated on a promontory (230 ft.) between two bays. Here the roads for Borgotaro and Spezia turn inland. There is an important shipbuilding yard at Riva Trigoso, in a sheltered bay 3 m. to the south. From this point to Spezia (25 m.) the coast is so precipitous that the railway traverses 46 tunnels with a total length of over 18½ m.

SESTRI PONENTE, a town of Liguria, Italy, in the province of Genoa, 4 m. W. of that town on the coast. Pop. (1921) 26,026, town; 28,269, commune. It has important shipbuilding yards and iron-works, with factories for railway carriages, tanneries, etc., and, in the vicinity, alabaster quarries. A mile and a half west is Pegli, with beautiful walks and fine villas.

SETH or, more correctly, **SHETH,** was according to the "priestly" tradition the firstborn son of Adam and Eve, Genesis v. 3 (*cf.* also I. Chron. i. 1, Luke iii. 38). The main tradition of the Yahwist, on the other hand, makes Cain the firstborn son. But a secondary stratum within this tradition, Genesis iv.25, agrees with the priestly genealogy, and provides for the name an etymology. In the R.V. margin of Numbers xxiv. 17 the Moabites are called "sons of Sheth"; this may be due to confusion with the Sutu of the cuneiform records, a nomad people of the North Syrian desert. Seth is much more prominent in Jewish tradition than in the Old Testament, and many fancies gathered round the name (*see* Josephus, *Ant.* I.ii.3). Ecclesiasticus xlix.16 couples him with Shem as "glorified among men." There was an heretical Jewish sect known as the Sethites, whose doctrines were taken over by a Christian Gnostic sect similarly named.

SETH, ANDREW (ANDREW SETH PRINGLE-PATTISON) (1856–), Scottish philosopher, was born in Edinburgh and educated at Edinburgh high school and university. In 1898 he assumed the name of Pringle-Pattison when he succeeded to Haining estate. He became assistant professor of logic and metaphysics at Edinburgh university in 1880. On the foundation of the University college of Cardiff in 1883 he was appointed professor of logic and philosophy, holding a similar post at St. Andrews from 1887 to 1891, and at Edinburgh from 1891 to 1919. In 1921 he was appointed Hibbert lecturer, and from 1921 to 1923 was Gifford lecturer at Edinburgh university.

His many publications on philosophical subjects include: *The Development from Kant to Hegel* (1882); *Man's Place in the Cosmos* (1897, enlarged ed. 1902); and many lectures and essays.

SETIA (mod. *Sezze*, 44 m. by rail S. E. of Rome), an ancient town of Latium (adjectum), Italy, on the south-west edge of the Volscian mountains, overlooking the Pomptine Marshes, 1,047 ft. above sea-level, and over 900 ft. above the plain. It was an ancient Volscian town, which became a Latin colony in 382 B.C., and, owing to the strength of its position as a frontier fortress, is frequently mentioned in military history. It was captured by Sulla in 82 B.C. Under the empire it was well known for its wine, which Augustus preferred even to Falernian. Considerable remains of the city walls exist, built of large blocks of limestone in the polygonal style. This style may also be seen in several terrace walls belonging to a later date. The modern town, occupying the ancient site, has a much-restored 13th-century Gothic cathedral. Pop. (1921) 6,683, town; 12,391, commune. At the foot of the hill on which the town stands are considerable remains of Roman villas. Here is the railway station, at which the new line from Rome via Cisterna is joined by the old one via Velletri.

See H. H. Armstrong in *American Journal of Archaeology* (1915), 34. (T. A.)

SET-OFF, in law, a statutory defence to the whole or to a portion of a plaintiff's claim. It was created for mutual debts only by 2 Geo. II. ch. 22 for the relief of insolvent debtors. By the rules of the supreme court (O. XIX. r. 3) a defendant in an action may set off or set up any right or claim by way of counterclaim against the claims of a plaintiff, and such set-off or counterclaim has the same effect as a statement of claim in a cross-action. (*See* PLEADING.) The word "compensation" as used in many foreign codes has substantially the same meaning.

SETON (*Family*). The Scottish family of Seton, Seyton or Seatoun, claims descent from a Dougall Seton who lived in the reign of Alexander I. The family honours include the earldoms of Wintoun (cr. 1600) and Dunfermline; of Eglinton through marriage with the Montgomeries; and through alliance with a Gordon heiress a Seton became the ancestor of the earls and marquesses of Huntly and dukes of Gordon. The Setons were connected by marriage with the royal family of Scotland, and also with the Dunbars, Lindsays, Hays and Maitlands.

Sir Christopher Seton, son and heir of John de Seton, a Cumberland gentleman, and his wife Erminia Lascelles, was born probably in 1278, and came into his inheritance in 1299. He had married about 1301 Christian Bruce, sister of King Robert, who was possibly his second cousin. He was present at his brother-in-law's coronation at Scone in 1306, and saved his life at the battle of Methven later in the same year. According to Dugdale he shut himself up in Lochdoon Castle in Ayrshire, and on the surrender of that castle was hanged as a traitor at Dumfries by order of Edward I. He left no heirs. His widow was in March 1307 in receipt of three pence a day from Edward I. for her support at the monastery of Sixhill in Lincolnshire. She was afterwards placed in the custody of Sir Thomas de Gray. His Cumberland estates, with the exception of his mother's dower, were given to Robert de Clifford. Another Seton, John de Seton, described as having no lands or chattels, was hanged for helping in the defence of Tibbers Castle, and for aiding in the murder of John Comyn, with other prisoners of war, at Newcastle in August 1306.

Sir Alexander Seton (d. *c.* 1360) was probably the brother of Sir Christopher. He received grants of land from King Robert Bruce, and was one of the signatories of the letter addressed by the Scottish nobles to the pope to assert the independence of Scotland. He was twice sent on embassies to England, and in 1333 he defended the town of Berwick against the English. He agreed with the English to surrender the town on a certain date unless he received relief before that time, giving his eldest surviving son Thomas as a hostage. On the refusal of the Scots to surrender at the expiry of the term Thomas Seton was hanged in sight of the garrison. This incident is related by Fordun and Boece, but with inconsistencies that have rendered it suspect. An elder son, Alexander, had perished in 1332 in opposing the landing of Edward Baliol; according to some authorities the third son, William, was hanged with his brother, but he is generally said to have been drowned during the siege; his daughter Margaret married Alan de Wintoun. The tragic death of young Thomas Seton was the subject of a ballad of "Seton's Sons," printed in Sheldon's *Minstrelsy of the Scottish Border;* of a tragedy, *The Siege of Berwick* (1794, printed 1882) by Edward Jerningham, and of another by James Miller (1824).

Sir William Seton of Seton (*fl.* 1371–1393) is said to have been ennobled with the title of Lord Seton, and his heirs laid

claim that the barony of Seton was the oldest in Scotland. By his wife Catherine Sinclair he had eight children. John succeeded him; Alexander married Elizabeth, daughter and heiress of Sir Adam de Gordon, by whom he became the ancestor of the Gordons of Huntly.

Sir John of Seton (d *c.* 1441) was taken prisoner at Homildon Hill in 1402. He was hostage in England for the earl of Douglas in 1405, and again in 1423 for James I. He married Lady Janet Dunbar, daughter of the 10th earl of March. His son Sir William was killed at Verneuil, fighting on the French side, leaving as heir GEORGE (d. 1478), 1st Lord Seton, who was created a lord of parliament in 1448 as Lord Seton. By his first marriage with Margaret, daughter of John Stewart, earl of Buchan, he had a son John, who died during his father's lifetime. He was succeeded by his grandson GEORGE, 2nd Lord Seton (d. 1508), who was a scholar of St. Andrews and Paris, and in common report a necromancer. He was captured by the Flemings, and on his release fitted out and maintained a ship for the purpose of harassing Flemish travellers. His son GEORGE, 3rd Lord Seton, was killed at Flodden in 1513. He redeemed estates which his father had sacrificed to support his enterprises against the Flemings. By his marriage with Janet, daughter of Patrick Dunbar, 1st earl of Bothwell, he left a son GEORGE, 4th Lord Seton (d. 1549), who allowed Cardinal Beaton to escape from custody in 1543, and received considerable grants of land in the sequel. The castle and church of Seton were burnt by Hertford in revenge for the part he had taken against the English in 1544.

George, 5th Lord Seton (1530?–1585), was a Catholic and a firm friend of Mary, queen of Scots. He was present at her marriage with the dauphin in 1557, and three years later he was again in France. When Mary returned to Scotland he became privy councillor and master of the household, but four years later he again found it advisable to retire to France. Mary and Darnley spent their honeymoon at Seton Palace, and Mary found a retreat there after the murder of Rizzio and again after the murder of Darnley. She spent the night before Carberry Hill under Seton's roof, and he was waiting for her on her escape from Lochleven in May 1568. He took her to his castle at Niddrie, Linlithgowshire, and thence to Hamilton. A week later he was taken prisoner at Langside. He was set free after the assassination of the regent Moray, and made his way to Flanders, where he was said to have made his living as a wagoner. He was, in fact, entrusted by Mary's supporters with a mission to the duke of Alva, and sought in vain to secure for service in Scotland two regiments of Scots then in Spanish pay. He returned home in 1571, being apparently reconciled with the government, but he retained his Catholicism and his friendship for Mary, who wrote to Elizabeth in 1581 desiring a passport for Lord Seton that he might alleviate her solitude. In 1581 he was one of Morton's judges, and in 1583 he was sent as ambassador to France, where he sought interference on Queen Mary's behalf. He died soon after his return on Jan. 8, 1585. The 5th Lord Seton figures in Sir Walter Scott's *Abbot.* He was succeeded by his second and eldest surviving son, Robert, who became 6th Lord Seton and 1st earl of Wintoun. His third son, Sir John Seton of Barns, was a gentleman of the bedchamber to Philip II. of Spain. He was recalled to Scotland by James VI., and served as lord of session from 1587 to 1594.

Mary Seton, one of the "Four Maries" attendant on the queen, is supposed to have been the 5th Lord Seton's half-sister. She had been educated with Queen Mary in France, being about a year older than her mistress, with whom she returned to Scotland in 1561. She helped Mary to escape from Lochleven by assuming her clothes. Later on she joined her at Carlisle, and remained with her in her various prisons until 1583, when prison life had undermined her health and spirits. She died in poverty at the abbey of St. Pierre at Reims in 1614.

ROBERT SETON (d. 1603) succeeded his father as 6th lord in 1585, and was created earl of Wintoun in 1600. He married, about 1582, Margaret, eldest daughter of Hugh Montgomerie, 3rd earl of Eglinton. His sons Robert and George were successively earls of Wintoun; the third, Alexander, became, in right of his mother, 6th earl of Eglinton; the fourth, Thomas, was the ancestor of the Setons of Oliveston.

GEORGE, 4th earl of Wintoun (1640–1704), succeeded his grandfather, George Seton, 3rd earl, in 1650. He saw some service in the French army, and fought against the Covenanters at Pentland and at Bothwell Bridge. By his second marriage, with Christian Hepburn, he had a son George, who quarrelled with his father and is said to have been working as a journeyman blacksmith abroad when he succeeded to the title in 1704. In 1715 the 5th earl joined Kenmure with 300 men at Moffat, but it was against his advice that the Jacobite army invaded England. He was lying in the Tower under sentence of death when he succeeded in making his escape, and proceeding to the continent, he became well known in Rome, where he was grand master of the Roman lodge of freemasons. He died there in 1749. With him the earldom became extinct, but it was revived in 1840 in favour of the earls of Eglinton.

AUTHORITIES.—Sir Richard Maitland, *History of the House of Seton,* continued by A. Seton, 1st Viscount Kingston (mod. ed., Glasgow 1829, and Edinburgh 1830); G. Seton, *The History of the House of Seton* (2 vols., 1896); Sir R. Douglas, *Scots Peerage,* new ed. by Sir J. B. Paul; *Calendar of Documents relating to Scotland* in the "Rolls" series; and G. E. C(okayne), *Complete Peerage.*

SETON-WATSON, ROBERT WILLIAM (1879–), English historian, was born on Aug. 20, 1879. He was educated at Winchester and at New college, Oxford, afterwards studying at Berlin, Paris and Vienna universities. He made a special study of the history of Austria-Hungary and of the Balkans, and in 1915 became lecturer in East European history at King's college, London. He made many contributions on his subject to various periodicals, and in 1916 founded the *New Europe,* of which he was joint-editor until 1920. In 1922 he was appointed Masaryk professor of Central European history in the University of London.

He has published a number of volumes dealing with European history and politics, among which may be mentioned *Maximilian I.* (1902); *The Future of Austria-Hungary* (1907); *The Southern Slav Question* (1911); *Roumania and the Great War* (1915); *The Balkans, Italy and the Adriatic* (1915); *German, Slav and Magyar* (1916); *The Rise of Nationality in the Balkans* (1917); *Europe in the Melting-pot* (1919); *The New Slovakia* (1924); *Serajēvo* (1926).

SETTEE, a long upholstered seat, usually high-backed and with arms at each end. Its ancestors were the settle and the chair—it has alternately resembled the one and the other. It is broadly distinguished from the many varieties of sofa by being intended for sitting rather than reclining—its seat is of the same height as that of a chair; its arms and much of its detail are chair-like. It dates from about the middle of the 17th century, but examples of that early period are exceedingly rare. There is a famous one at Knole, made about midway between the restoration of Charles II. and the revolution of 1688. By that time the settee had acquired the splendid upholstery and convoluted woodwork which adorned the end of the Stuart period. Early in the 18th century the conjoined double or triple chair form became fashionable. The form was artless, and the absence of upholstery, save on the seat, produced a somewhat angular effect. As the taste for carved furniture waned these sturdy settees were replaced by lighter ones, often graceful enough in outline but partaking more and more of the "stuffed-over" character. Its modern varieties are many, but in all of them the frame, once so lavishly ornamented, is almost concealed by upholstery. (*See* INTERIOR DECORATION: *English.*)

SETTEMBRINI, LUIGI (1813–1877), Italian man of letters and politician, was born in Naples. At the age of twenty-two he was appointed professor of eloquence at Catanzaro, and married Raffaela Luigia Faucitano (1835). He carried on propaganda for Italian unity, and in 1839 was arrested. Although nothing could be proved against him he was kept in prison for three years at Naples. He took part in the movements of 1848 and then once more was arrested as a suspect (June 1849) and imprisoned. After a monstrously unfair trial, he and two other "politicals" were condemned to death, and nineteen others to

varying terms of imprisonment (February 1851). The death sentences were, however, commuted to imprisonment for life, and Settembrini was sent to the dungeons of Santo Stefano. There he remained for eight years. His friends, including Antonio Panizzi, then in England, made various unsuccessful attempts to liberate him, and at last, in 1859, he was deported with sixty-five other political prisoners. Settembrini's son, Raffaello, boarded the ship as a steward at Cadiz, donned a British officer's uniform, and ordered the ship, bound for America, to London. Settembrini, after a short stay in England, joined his family at Florence in 1860. On the formation of the Italian kingdom he was appointed professor of Italian literature at the university of Naples. In 1875 he was nominated senator, but his first and last speech in the Senate, a violent attack on taxation, caused consternation. He died in 1877. His chief work is his *Lezioni di letteratura italiana.*

Bibliography.—L. Settembrini, *Ricordanze*, 2 vols., edited by F. de Sanctis (Naples, 1879–1880); *Epistolario di Luigi Settembrini*, edited by F. Fiorentino; Countess Martinengo Cesaresco, *Italian Characters* (London, 1901); and a notice in P. Villari, *Studies Historical and Critical* (Eng. ed. 1907).

SETTLE, ELKANAH (1648–1724), English poet and playwright, born at Dunstable on Jan. 1, 1648, entered Trinity College, Oxford, in 1666, but left the university without taking a degree. His first tragedy, *Cambyses, King of Persia,* was produced at Lincoln's Inn Fields in 1667. Rochester encouraged the new writer as a rival to Dryden. Through his influence Settle's *Empress of Morocco* (1671) was twice acted at Whitehall, and proved a signal success on the stage. The play was printed with a preface to the earl of Norwich, in which Settle described with scorn the effusive dedications of other dramatic poets. Dryden was obviously aimed at, and he co-operated with Crowne and Shadwell in an abusive pamphlet entitled "Notes and Observations on the Empress of Morocco" (1674), to which Settle replied in "Some Notes and Observations on the Empress of Morocco revised" (1674). In the second part of *Absalom and Achitophel,* in a passage certainly by Dryden's hand, he figures as "Doeg." Neglected by the court party he took an active share in the anti-popish agitation. When this subsided he turned round to expose Titus Oates, and with the revolution he veered towards the Whig party. But he had lost the confidence of both sides, and "recanting Settle" accordingly abandoned politics for the appointment (1691) of city poet. In his old age he kept a booth at Bartholomew Fair, where he is said to have played the part of the dragon in a green leather suit devised by himself. He became a poor brother of the Charterhouse, where he died on Feb. 12, 1724.

Settle's numerous works include, beside numerous political pamphlets and occasional poems, *Ibrahim, the Illustrious Bassa* (1676), a tragedy taken from Madeleine de Scudéry's romance; *The Female Prelate; being the History of the Life and Death of Pope Joan* (1680), a tragedy; *The Ambitious Slave: or A Generous Revenge* (1694); *The World in the Moon* (1697), an opera, of which the first scene was formed by a moon fourteen feet across; and *The Virgin Prophetess, or The Fate of Troy* (1701), an opera.

SETTLE, a market town and parish in the West Riding of Yorkshire, England, 41½ m. N.W. of Leeds, on the L.M.S. railway. Pop. (1921) 2,389. It is situated at the foot of Castleberg, a limestone cliff 300 ft. in height, in the upper portion of the Ribble valley, amid wild scenery. In this district of almost pure limestone are found the characteristic features of a Karst topography, with dry valleys, bare rock surfaces, caves and gorges well developed. The district includes Victoria cave, close to the town, where bones of animals, implements of stone and bone, and ornaments have been discovered; Clapham and Weathercote caves; Malham cove and tarn; the ravine of Gordale scar; the cliffs of Attermyre and Giggleswick scar; the chasms of Helln pot and Gaping Gill and the waterfall of Stainforth foss. In the town are cotton factories and a tannery, and sheep are reared on the pastures of the limestone hills. To the west of the town is the grammar school of Giggleswick, one of the principal public schools in the north of England, founded in 1512.

SETTLE, a wooden bench, usually with arms and a high back, long enough to accommodate three or four sitters. It is most commonly movable, but occasionally fixed as in the "boxes" of those old coffee-houses of which a few examples still remain in London, and perhaps elsewhere. Its high back was a protection from the draughts of mediaeval buildings—a protection which was sometimes increased by the addition of winged ends or a wooden canopy. It was most frequently placed near the fire in the common sitting-room. Constructed of oak, or other hard wood, it was extremely heavy, solid and durable. Few English examples of earlier date than the middle of the 16th century have come down to us; survivals from the Jacobean period are more numerous. Its vogue did not long outlast the first half of the 18th century.

SETTLEMENT, in law, a mutual arrangement between living persons for regulating the enjoyment of property, and the instrument by which such enjoyment is regulated. Settlements may be either for valuable consideration or not. The latter are usually called voluntary, the former are really contracts, and in general their validity depends upon the law of contract governing in such cases.

The elements of the modern settlement are to be found in Roman law. *Substitutio* (consisting in the appointment of successive heirs in case of the death, incapacity or refusal of the heir first nominated) may have suggested the modern mode of giving enjoyment of property in succession. Such a *substitutio* could only have been made by will, while its relation, usufruct, could be made also *inter vivos,* like the settlement of English law The *dos* or *donatio propter nuptias* corresponds to some extent with the marriage settlement. Other modes of settling property in Roman law were the life interest or *usus,* the *fidei-commissum* and the prohibition of alienation of a *legatum.* The most striking point of difference between the Roman and the English law is that under the former the children took no interest in the contributions made by the parents.

The oldest form of settlement in England was perhaps the gift in frankmarriage to the donees in frankmarriage and the heirs between them two begotten (Littleton, s. 17). This was simply a form of gift in special tail, which became up to the reign of Queen Elizabeth the most usual kind of settlement. The time at which the modern form of settlement of real estate came into use seems doubtful. The plan of granting the freehold to trustees to preserve contingent remainders is said to have been invented by Lord Keeper Sir O. Bridgeman in the 17th century, the object being to preserve the estate from forfeiture for treason during the Commonwealth. The appointment of such trustees was rendered unnecessary by acts of 1845 and 1877.

Settlement in English law is, so far as regards real property, used for two inconsistent purposes—to "make an eldest son," as it is called, and to avoid the results of the right of succession to real property of the eldest son by making provision for the younger children. The first result is generally obtained by a strict settlement, the latter by a marriage settlement, which is for valuable consideration if ante-nuptial, voluntary if post-nuptial. But these two kinds of settlement are not mutually exclusive: a marriage settlement may often take the form of a strict settlement and be in substance a resettlement of the family estate. (*See* Entail; Jointure; Trusts and Trustee.)

In Scotland a *disposition and settlement* is a mode of providing for the devolution of property after death, and so corresponds rather to the English will than to the English settlement. The English marriage settlement is represented in Scotland by the *contract of marriage,* which may be ante- or post-nuptial.

In the United States, settlements other than marriage settlements are almost unknown. These usually take the form of an ante-nuptial contract, entered into prior to the marriage, in which the parties waive any dower or other rights to the estates of the other to which they might be entitled under the law. Occasionally, married couples enter into agreements to waive their claims to each other's estates. Marriage settlements are not in common use, owing to the fact that most states long ago adopted the principles of the English Married Women's Property Acts.

SETTLEMENT, ACT OF, the name given to the act of parliament passed in June 1701, which, since that date, has regu-

lated the succession to the throne of Great Britain. Towards the end of 1700 William III. was ill and childless; his sister-in-law, the prospective queen, Anne, had just lost her only surviving child, William, duke of Gloucester; and abroad the supporters of the exiled king, James II., were numerous and active. The need for the act was obvious. It decreed that, in default of issue to either William or Anne, the crown was to pass to "the most excellent princess Sophia, electress and duchess dowager of Hanover," a grand-daughter of James I., and "the heirs of her body being Protestants." The act is thus responsible for the accession of the house of Hanover to the British throne. In addition to settling the crown, the act contained some important constitutional provisions (many of which are manifest censures on the policy of William III.), of which the following are still in force. (1) That whosoever shall hereafter come to the possession of this crown shall join in communion with the Church of England as by law established. (2) That in case the crown and imperial dignity of this realm shall hereafter come to any person not being a native of this kingdom of England, this nation be not obliged to engage in any war for the defence of any dominions or territories which do not belong to the Crown of England, without the consent of parliament. (3) That after the said limitation shall take effect as aforesaid, judges' commissions be made *quamdiu se bene gesserint* (during good behaviour), and their salaries ascertained and established; but upon the address of both Houses of Parliament it may be lawful to remove them. This clause established the independence of the judicial bench. (4) That no pardon under the great seal of England be pleadable to an impeachment by the Commons in parliament.

The act as originally passed contained four other clauses. One of these provided that "all matters properly cognizable in the Privy Council . . . shall be transacted there," and that all resolutions "shall be signed by such of the Privy Council as shall advise and consent to the same." Another declared that all office-holders and pensioners under the Crown shall be incapable of sitting in the House of Commons. The first of these clauses, which was an attempt to destroy the growing power of the Cabinet, was repealed, and the second seriously modified in 1706. Another clause, repealed in the reign of George I., forbade the sovereign to leave England, Scotland, or Ireland without the consent of parliament. Finally a clause said that "no person born out of the kingdoms of England, Scotland, or Ireland, or the dominions thereunto belonging (although he be naturalized or made a denizen), except such as are born of English parents, shall be capable to be of the Privy Council, or a member of either House of Parliament, or enjoy any office or place of trust, either civil or military, or to have any grant of lands, tenements, or hereditaments from the Crown to himself, or to any other or others in trust for him." By the Naturalization Act of 1870 this clause is virtually repealed for all persons who obtain a certificate of naturalization.

The importance of the Act of Settlement appears from the fact that, in all the regency acts, it is mentioned as one of the acts to the repeal of which the regent may not assent. To maintain or affirm the right of any person to the crown, contrary to the provisions of the act, is high treason by an act of 1707.

SETTLEMENT, SOCIAL: *see* SOCIAL SETTLEMENTS.

SETTLEMENT or **SETTLING DAY.** In stock exchange practice days of settlement are fixed officially for which bargains in stocks and shares are made. Thus, on the London Stock Exchange the settlements take place fortnightly and each occupies four days, the fourth of which is settling day, *i.e.*, that on which payments are made. For details *see* STOCK EXCHANGE.

SETUBAL, a seaport of Portugal, 18 m. S.E. of Lisbon. It was formerly called *St. Ubes* in English and *St. Yves* in French. Pop. (1911) 30,346. Setubal is built on the north shore of a deep estuary, formed by the rivers Sado, Marateca and São Martinho. There are five forts for the defence of the harbour; the castle of St. Philip, built by Philip III. of Spain (1578–1621), commands the city. Setubal exports large quantities of fine salt, oranges and muscatel grapes; it has many sardine-curing and boat-building establishments, and manufactures of fish-manure and lace. Under John II. (1481–1495) Setubal was a favourite royal residence and one of the churches dates from this period; but most of the ancient buildings were destroyed by the great earthquake of 1755. In the sandhills of a low-lying promontory in the bay opposite Setubal are the so-called ruins of "Troia," uncovered in part by heavy rains in 1814 and excavated in 1850. These ruins are those of Cetobriga, which flourished A.D. 300–400.

SEURAT, GEORGES (1859–91), French painter, of the Post-Impressionist movement. He was born in Paris on Dec. 2, 1859. At the age of 16 he entered the École des Beaux Arts and worked four years under Henry Lehmann, a pupil of Ingres. He studied the old masters at the Louvre; and, being interested in the problems and theories about colour, read the works of Chevreul, Charles Blanc, Humbert de Superville, Helmholtz and Ogden N. Rood. He carefully analysed the works of Delacroix, and, as a result of these researches, established the law of contrast by complementary colours. During his military service at Brest, he made use of every opportunity to sketch on the quays. Then, on his return to Paris, he at first devoted himself to drawing, seeking to apply to line and tone a law of contrast, analogous to that of complementary colours. In these drawings, done with black crayon on white Ingres paper, light and dark are contrasted in a harmonious scale of values, and the lines are rhythmically arranged at right angles to one another. It was his practice to paint small sketches in oil in the neighbourhood of Paris, at Asnières and on the Île de la Grande Jatte on the Seine, near Neuilly. A sketch of boys bathing in the Seine led to the first of those large canvases, six in number, which, with a few smaller pictures, constitutes his work. The "Baignade" (now at the Tate gallery) was refused at the Salon of 1884, and was shown at the Salon des Independants, which was organized that year. Here Seurat made the acquaintance of Signac, who had been working on similar lines, and through him became acquainted with the Impressionist movement, whose existence he had ignored. Henceforth he adopted their technique of broken colour (*see* IMPRESSIONISM), but systematized their method. In 1886 he exhibited "Un Dimanche à la Grande Jatte" (now in America), a carefully-organized composition, executed entirely in the "pointillist" technique, by which he attained an extraordinary luminosity. The paint was applied in detached specks, each colour and the exact space which it would occupy being planned in advance, a procedure characterized by some critics as the decline of art into scientific impersonality, while others hailed it as the rise of the artist from fumbling to exactitude. Seurat and Signac were the pioneers of Pointillism, or Neo-Impressionism, as it is sometimes called; other distinguished representatives of the movement being Charles Argrand, Henri Edmond Cross, A. Dubois-Pillet, Lucie Cousturier and Theo van Rysselberghe. Such artists as Camille Pissaro, Gauguin, van Gogh, Matisse, Derain and Metzinger experimented for a while on the same lines. But Seurat was not only a pointillist, he was also a great designer, and this quality in his art has only recently been "discovered." In a letter dated 1890 (published in English translation in Walter Pach's book) he set down his artistic creed. He affirmed that "Art is harmony," and explained how harmony is attained in tone, colour and line by the application of laws of contrast. His aim was to extricate from the manifold and confusing aspects of nature a harmonious and unified organization. His mind was intent on the abstract qualities of form and colour; and therein it anticipated the movement which some 20 years later emphasized the essentiality of artistic design. The four great pictures which followed were experiments on similar lines; "Les Poseuses" of 1888 were painted in a higher key; "La Parade" of 1889 displays an obvious geometrical composition. "Le Chahut" of the same year is distinguished for its rhythmic lines. Finally, his last work, "Le Cirque," shows his perfected style. The picture represents a scene in the circus; the design is full of swing, every detail clearly drawn and carefully considered. Soon after its exhibition in the Salon des Indépendants, Seurat died, on March 29, 1891.

See Paul Signac, *D'Eugène Délacroix au Néo-Impressionnisme* (1911); Lucie Cousturier, *Seurat* (1921); Walter Pach, *Seurat* (New York, 1923); Gustave Coquiot, *Seurat* (1924). (I. A. R.)

SEVASTOPOL or SEBASTOPOL, a natural harbour of Russia in the Crimean S.S.R., on the south-west coast, in 44° 37′ N., 33° 35′ E., connected by rail with Moscow via Kharkov. It is available at all times for large steamers, and has a depth of 36 to 240 ft. over the whole port. The estuary, which is one of the best roadsteads in Europe and could accommodate the combined fleets of Europe, is a deep and thoroughly sheltered indentation among chalky cliffs, running east and west for nearly 4 m., with a width of three-quarters of a mile, narrowing to 930 yds. at the entrance. The main inlet has also four smaller indentations, and a small river, the Chornaya, enters the head of the inlet. Since 1890 it has been exclusively a naval arsenal and no foreign vessels call at the por unless they have machinery or coal for the Government or the State railways. Its trade has been diverted to Theodosia and Nikolayev, but it has manufactures of machinery, macaroni, flour, leather, soap and tiles. Sevastopol sustained a memorable 11 months' siege in 1854, when the English, French and Turkish troops bombarded it; it was evacuated by the Russians in September 1855, when the fortifications were blown up by the allies, and barely a dozen buildings escaped uninjured. By the treaty of Paris the Russians were bound not to restore the fortress, but during the Franco-Prussian War, in 1870, Sevastopol was again made a naval arsenal. For many years after the siege the town was practically deserted, but it is now flourishing. Pop. (1926) 67,412. It has numerous sanatoria and is a favourite sea-bathing resort. Its museum of biology and marine biological station are famous, and there are schools of navigation.

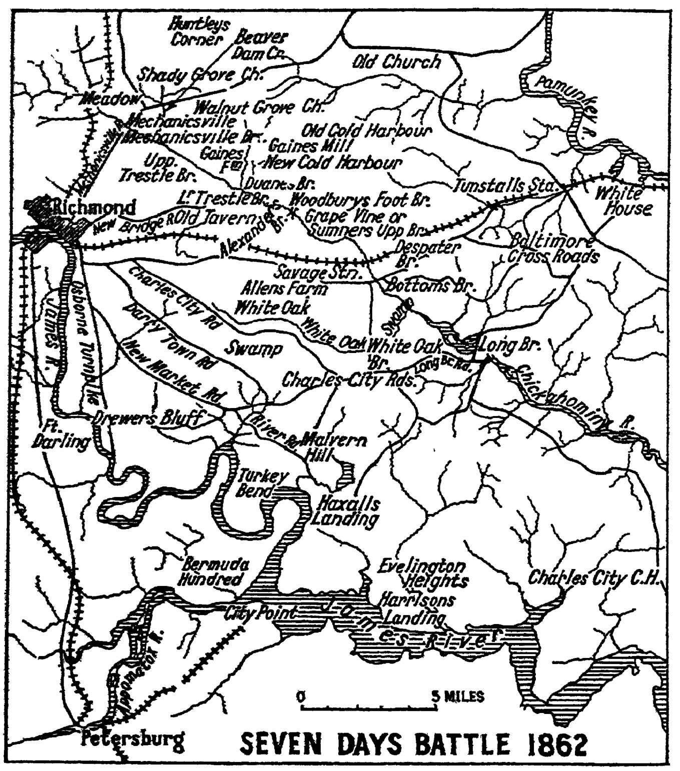
The peninsula between the Bay of Sevastopol and the Black sea was known in the 7th century as the Heracleotic Chersonese. In the 5th century B.C. a Greek colony was founded here and remained independent for three centuries, when it became part of the kingdom of the Bosporus, and subsequently tributary to Rome. Under the Byzantine empire Chersonesus was an administrative centre for its possessions in Taurida. Vladimir, prince of Kiev, conquered Chersonesus (Korsuñ) before being baptized there, and restored it to the Greeks on marrying (988) the princess Anna. Subsequently the Slavs were cut off from relations with Taurida by the Mongols, and only made occasional raids, such as that of the Lithuanian prince Olgierd. In the 16th century a new influx of colonists, the Tatars, occupied Chersonesus and founded a settlement named Akhtyar. This village, after the Russian conquest in 1783, was selected for the chief naval station of the empire in the Black sea and received its present name ("the August City"). In 1826 strong fortifications were begun. Before the Crimean war Sevastopol was a beautiful, well-built city. Some years after the siege an active period of rebuilding began. *See* also CRIMEAN WAR.

SEVČIK, OTTAKAR (b. 1852), Czech violin teacher, was born at Horazdowitz, Bohemia, on March 22, 1852. He studied under Bennewitz at Prague conservatoire until 1870, when he became Konzertmeister of the Mozarteum, Salzburg. In 1873 he accepted a similar post at Vienna, but in the following year went to Russia, where he remained at Kiev until 1892, when he was appointed professor at Prague conservatoire. His system is set forth in his *Method*, and the results which can be achieved by it have been exemplified in the playing of his many famous pupils, including Kubelik, Zimbalist, Marie Hall and many more.

SEVEN CHAMPIONS OF CHRISTENDOM, the name given in mediaeval tales to the seven national saints—of England, Scotland, Ireland, Wales, France, Spain and Italy—*i.e.*, Saints George, Andrew, Patrick, David, Denis, James and Anthony. The classical version of their achievements is that of Richard Johnson (1573–*c.* 1659), *Famous Historie of the Seaven Champions of Christendom* (3 parts, 1596, 1608, 1610).

SEVEN DAYS' BATTLE, a name given to a series of combats in the neighbourhood of Richmond, Va., during the American Civil War, June 26–July 2, 1862. The Federal Army of the Potomac, advancing up the Yorktown peninsula to White House on the Pamunkey and thence over the Chickahominy on Richmond, had come to a standstill after the battle of Seven Pines (or Fair Oaks), and Gen. Robert E. Lee, who succeeded Joseph Johnston in command of the Confederates, initiated the series of counter attacks upon it which constitute the "Seven Days."

McClellan had at his disposal 32 brigades and 67 batteries organized in five corps each of two or three divisions. His cavalry consisted of ten regiments and 22 companies. Lee's army consisted of 40 brigades and 59 batteries organized in 11 divisions and an independent brigade: four divisions were grouped under



SEVEN DAYS BATTLE 1862

Jackson—who, however, did not arrive in the district until June 26—and three under Magruder. The reserve artillery consisted of 23 batteries and Stuart's cavalry corps of 3,000 sabres. McClellan lingered north of Richmond, despite President Lincoln's constant demand that he should "strike a blow" with the force he had organized and taken to the Yorktown peninsula in April, until Gen. Lee had concentrated 73,000 infantry in his front; then the Federal commander, fearing to await the issue of a decisive battle, ended his campaign of invasion in the endeavour to "save his army"; and he so far succeeded that on July 3 he had established himself on the north bank of the James in a position to which reinforcements and supplies could be brought from the north by water without fear of molestation by the enemy. But he lost 15,000 men in the course of his seven days' retreat, and 20% of the remainder became ineffective from disease contracted in the swamps of the Chickahominy, while enormous quantities of valuable stores at White House on the Pamunkey had been burnt to avoid seizure by the enemy. McClellan described this flight to the James as a change of base, a move which, in fact, he had previously contemplated, but the actual impulse was not of his own initiative. Instead, it was the sequel to the action of Gen. Lee, who in the middle of June summoned Jackson's corps from the Shenandoah valley (*q.v.*). The news soon reached McClellan, who thereupon prepared to evacuate White House on June 25 and to move his trains southward to the James covered by his army. Jackson had preceded his troops in order personally to confer with Lee, and had then appointed the morning of June 26 for his appearance north of the Chickahominy to lead the march and attack McClellan's right wing under Gen. Fitzjohn Porter. Jackson was to be supported by the divisions of A. P. Hill, Longstreet and D. H. Hill. Lee's other divisions under Magruder, Huger and Holmes were to defend the lines which covered Richmond from the east and so prevent McClellan effecting a counterstroke. Huger had dem-

onstrated on the Williamsburg road on June 25 in order to draw McClellan's attention to his left wing, and though on June 26 Jackson had failed to appear, Gen. A. P. Hill at 3 P.M. crossed the Chickahominy and attacked the enemy's right wing at Beaver Dam creek assisted by D. H. Hill, while Longstreet crossed at Mechanicsville. Gen. Lee and President Davis were present, and witnessed the loss of 2,000 men in a frontal attack which continued till 9 P.M. Meanwhile Gen. Jackson, with Stuart's cavalry corps, "marched by the fight without giving attention, and went into camp at Hundley's Corner half a mile in rear of the enemy's position."

The Federal detachment retreated during the night to a stronger position in rear at Gaine's Mill near Cold Harbor, and on June 27 the Confederates again attacked Porter's corps. Lee's six divisions formed an échelon. D. H. Hill moving towards the enemy's right was followed by Jackson's corps (three divisions), while A. P. Hill engaged the enemy in front and Longstreet in reserve moved along the left bank of the Chickahominy. The resistance of the Federals was stubborn; at 5 P.M. Gen. Lee required Longstreet to attack the enemy's left, and at this moment he procured the assistance of some part of Jackson's corps, which had become separated from the remainder. About sunset the Federals under Porter (three divisions) yielded to the pressure of the attack at all points, and withdrew after nightfall across the Chickahominy, leaving 5,000 prisoners in the hands of Gen. Lee. That night McClellan issued orders for the movement to the James.

Lee's right wing had in the meantime demonstrated against the main body of the Federals about Fair Oaks, on the south bank of the river. On June 28 complete inactivity supervened among the Confederates north of the Chickahominy save that Stuart's cavalry and Ewell's division were advanced as far as the railway to reconnoitre, but on this day McClellan was making good his retreat southwards to the James with little interference, for Magruder was instructed to "hold his lines at all hazards," and accordingly acted on the defensive except that Jones's division opposed a Federal division under W. F. Smith near Fair Oaks. On June 29 Gen. Lee became aware of the situation and then issued orders for his six divisions to cross the Chickahominy in pursuit. Jackson's corps and D. H. Hill's division were to follow the enemy, while Longstreet and A. P. Hill were to move their divisions via New Bridge to the Darbytown or James river road to cut off McClellan from the James. Stuart was to operate at his discretion north of the Chickahominy, and it seems that he was attracted by the enemy's abandoned depot at White House more than by McClellan's retreating army. On this day Magruder with two divisions attacked superior forces about Fair Oaks and was repulsed, and again attacked at Savage station with like results. Gen. Lee, however, rebuked Magruder for slackness in pursuit. Holmes's division was moving in front of Longstreet on the James river road, but two Federal divisions were holding the route at Willis church and at Jordan's ford. On June 30 Jackson got into action with Whiting's division at White Oak Swamp, while Longstreet encountered the Federals at Frazier's farm (or Glendale). Longstreet was supported by A. P. Hill and together they lost 3,200 men; it was hoped that Jackson's corps would come up during the engagement and attack the enemy's rear, and Huger's division assail his right, but Federal artillery stopped Huger, and of Jackson's three divisions only one came into action. Magruder and Holmes were engaged to their own advantage at Turkey bridge. Longstreet and Hill were thus opposed to five Federal divisions, while Gen. McClellan was pushing his wagons forward to Malvern hill, on which strong position the Army of the Potomac was concentrated at nightfall. On July 1 Jackson's corps and D. H. Hill's division had been drawn again into the main operation and followed the Federal line of retreat to Malvern hill with Huger and Magruder on their right. The divisions of Longstreet and A. P. Hill were in support.

Gen. Lee had thus on the seventh day concentrated his army of ten divisions in the enemy's front; but Jackson's dispositions were unfortunate and Gen. Lee's plan of attack was thus upset; and while seeking a route to turn the enemy's right the Confederate commander was apprised that a battle had been improvised by the divisions in advance. In the result these troops were repulsed with a loss of 6,000 men, a circumstance hardly to be wondered at, as McClellan had entrenched eight divisions on the strongest position in the country, and was aided by his siege artillery and also by a flanking fire from his gunboats on the river near Haxall's Landing. Gen. Lee's offensive operations now ended, though Stuart's cavalry rejoined the main army at night and followed the enemy on July 2 to Evelington Heights, while Lee rested his army. Stuart discovered a position which commanded the Federal camp, and maintained his cavalry and horse artillery in this position until the afternoon of July 3, when, his ammunition being expended, he was compelled to retire before a Federal force of infantry and a battery. Longstreet and Jackson had been despatched to his support, but the former did not arrive before nightfall and the latter failed to appear until the next day (July 4). Stuart afterwards moved farther down the James, and shelled McClellan's supply vessels in the river until recalled by Gen. Lee, who on July 8 withdrew his army towards Richmond.

The operations, indecisive as was their issue, re-established the confidence of the Confederates in their army which Johnston's retreat from Yorktown had shaken, added prestige to President Davis and his Government, and rectified the popular view of Gen. Lee as a commander which had been based upon his failure to recover West Virginia in the autumn of 1861. In the north a feeling of despondency overtook Congress at the "lame and impotent conclusion" of a campaign of invasion which was expected to terminate the war by the defeat of the Confederate army, the capture of Richmond and the immediate overthrow of the Confederacy. (G. W. R.)

SEVENOAKS, a market town in the Sevenoaks parliamentary division of Kent, England, 20 m. S.E. by S. of London by the S. railway. Pop. of urban district (1931) 10,482. It is beautifully situated on high ground among the wooded undulations of the North Downs, above the valley of the river Darent. The town consists principally of two streets which converge at the south end, near which is the church of St. Nicholas, of the 13th, 14th and 15th centuries. The grammar school was founded in 1418 by Sir William Sevenoke, who also founded almshouses in connection with the school. Close to Sevenoaks is Knole park, one of the finest old residences in England, which in the time of King John was possessed by the earl of Pembroke, and at a later date by Archbishop Bourchier (d. 1486).

SEVEN SLEEPERS OF EPHESUS, THE, according to the most common form of a legend first referred to in Western literature by Gregory of Tours (*De glor. mart. c.* 95), seven Christian youths of Ephesus, who, in the Decian persecution (A.D. 250), hid themselves in a cave. Their hiding-place was discovered and its entrance blocked. The martyrs fell asleep in a mutual embrace. Nearly 200 years later a herdsman rediscovered the cave on Mount Coelian, and, letting in the light, awoke the inmates, who sent one of their number to buy food. The lad was astonished to find the cross over the gates of Ephesus, and to hear the name of Christ openly pronounced. By tendering coin of the time of Decius at a baker's shop he roused suspicion, and was taken before the authorities. He confirmed his story by leading his accusers to the cavern where his companions were found, youthful and beaming with a holy radiance. The emperor Theodosius II., hearing what had happened, hastened to the spot and heard from their lips that God had wrought this wonder to confirm his faith in the resurrection of the dead. This message delivered, they again fell asleep.

Gregory says he had the legend from the interpretation of "a certain Syrian"; in point of fact the story is common in Syriac sources. It forms the subject of a homily of Jacob of Sarug (*ob.* A.D. 521), which is given in the *Acta sanctorum*. Another Syriac version is printed in Land's *Anecdota*, iii. 87 *seq.* According to Bīrūnī (*Chronology*, trans. by Sachau, p. 285), certain undecayed corpses of monks were shown in a cave as the sleepers of Ephesus in the 9th century. The story is well told in Gibbon's *Decline and Fall of the Roman Empire*, ch. xxxiii.

SEVEN WEEKS' WAR. This name is given to the war of 1866, fought between Prussia on the one side and Austria, Bavaria,

Saxony, Hanover, and certain minor German States on the other. The issue was decided in Bohemia, where the principal Prussian armies met the main Austrian forces and the Saxon army. A Prussian detachment, known as the Army of the Main, meanwhile dealt with the forces of Bavaria and of the other German States which had sided with Austria. Simultaneously, a campaign was fought in Venetia between the Austrian army of the south and the Italians, who had made an alliance with Prussia; this campaign is described under ITALIAN WARS: *1848–70*.

THE ORIGINS AND OUTBREAK OF THE WAR

The 1866 campaign was a definite and carefully planned stage in the unification of Germany under the Hohenzollern dynasty, of which Bismarck was the principal agent. The issue was clear-cut: Prussia deliberately challenged Austria for the leadership of the Germanic Confederation. And, however unscrupulous the Prussian Government may have been in its methods of designedly provoking a war at its chosen time, Prussia did represent progress and enlightenment in comparison with Austria's intolerance and inefficiency. Prussia had thrown down the glove in 1850, but the complete failure of her mobilization in that year compelled the postponement of the conflict and the acceptance at Olmütz of the somewhat humiliating terms of Austria. Since then Prussia, with Bismarck as statesman, von Moltke as strategist, and von Roon as army organizer, had prepared methodically for a fresh challenge. The actual pretext found by Bismarck in 1866 was a dispute over the administration of Schleswig and Holstein, which Austria and Prussia had seized from Denmark in 1864, and had since held jointly. Diplomatic exchanges began in January and military preparations a little later, but hostilities did not actually break out till the middle of June. By the alliance with Italy, Bismarck contrived to divert part of the Austrian forces to the South. Not only did the majority of the other German States join Austria,

SEVEN WEEKS' WAR: THE GERMANIC CONFEDERATION IN 1866.
English Miles.
Prussian Territory shown thus

but also the war was far from popular with the people of Prussia itself, who did not understand the policy underlying it, and could see no good cause of quarrel with Austria.

The Opposing Forces Compared.—Numerically, the armies of Austria and Prussia were approximately equal. Each mobilized a total of about 550,000 men, of whom some 320,000 constituted the field armies, the remainder being reserves and garrisons. But Austria could also count on the direct support of the Saxons (25,000), and the indirect aid of the forces of Bavaria and other German States (about 150,000). This preponderance in favour of Austria was partly neutralized by the Italian intervention, which withdrew three Austrian corps from the main theatre. Von Moltke, trusting to lack of co-operation between the German States hostile to Prussia, and aware of the comparative inefficiency of their armies, detached a force of under 50,000 to deal with them. Thus in the decisive theatre there was virtually numerical equality; some 270,000 Prussians (if a Reserve Corps of 25,000 be included) opposed 245,000 Austrians and 25,000 Saxons.

Contemporary military opinion held that the Austrian army, with its longer period of active service (seven years against the Prussian three or four) and its recent experience of war, would prove greatly superior to the Prussian army, which had not been engaged in battle for over 50 years. Contemporary military opinion was quite wrong. The Prussians proved to be better trained, better organized, and better led. They had, besides, a great advantage in the possession of a breech-loading rifle. The Austrian muzzle-loading rifle, though a longer-ranging and more accurate weapon, not only had a much slower rate of fire but also could not be re-loaded without exposure of the firer. The superiority conferred by the breech-loader was not, however, recognized at the outbreak of war; and the newer and rather better pattern of gun, with which the Austrian artillery was armed, was fully expected to counterbalance the Prussian advantage of a breech-loading rifle. The Austrian cavalry was considered to be greatly superior in manoeuvre and horsemanship. Though a proportion of the cavalry on both sides was armed with a carbine, little use was made of dismounted action; shock action was held to be the principal, if not the only, rôle of cavalry on the battlefield. The Austrian infantry, also, relied on shock action rather than on fire effect: the Prussians, in spite of their lack of war experience, had arrived at a juster appreciation of the power of the rifle and the possibilities of rapid fire. Both forces were organized into army corps of 25,000 to 30,000 men, comprising four brigades of infantry. But whereas the Prussian corps was subdivided into two divisions each of two brigades, the Austrians had no divisional link, the four brigades working directly under the corps headquarters.

The Rival Commanders.—Since the leadership and strategical handling of the armies in this campaign have been much, even hotly, debated, it is worth while to devote some attention to the personality of the principal commanders on either side. The illustrious von Moltke, who as chief of the general staff to King William, was the virtual leader of the Prussian armies, came later to war than any other of the great captains of history. He was 66 years of age at the beginning of this, his first campaign. He had held the position of C.G.S. since 1857, and had been working at the problem of a war against Austria in the closest detail since 1860 (the date of No. 1 of the famous "Projects"). He was a student of war rather than a battlefield general; the soldiers who won victories under his direction can rarely have set eyes on this quiet, professor-like man, who was calm and inflexible in a crisis. But, though his reputation as a commander in the field has been much and vehemently assailed (the French have never tired of pointing out to their conquerors of 1870 what would have happened had they met the real Napoleon), no more nor greater mistakes have been proved against him than must be made by every leader of large bodies in this blindfold game of war. And, whatever the verdict on his generalship, his fame in military history is secure as the originator of scientific education for war. He was the first to insist on close study of the principles of their profession by all grades of commander.

King William, though he wisely deferred to von Moltke's views on matters of strategy, was no mere figurehead. He was a good judge of men and could make his influence felt. The two royal princes who commanded the I. and II. Prussian armies, Frederick Charles and the Crown Prince, were not great generals, but were both brave soldiers, well grounded in the profession of arms. The Prussian corps commanders and their principal staff officers had all been carefully selected.

The Austrian commander-in-chief, Benedek, was a complete contrast to von Moltke. He had fought with distinction in several campaigns, but had little military education. A Protestant in an almost fanatically Catholic country, of humble origin in an

army where birth was almost the first qualification for high command, he had risen by his personal valour and bold, energetic leadership on the battlefield. He was, in fact, an excellent Corps Commander, but he was no strategist, knew little of the theory of his profession, and had no military imagination. He was only too well aware of his limitations, knew himself unfitted for the handling of large forces, and accepted the command of the Austrian Army of the North with great reluctance, out of loyalty to his emperor. His own wish had been for the command against Italy, a smaller and less responsible task in a theatre of war which he knew well. To trust the fate of an empire to one who so mistrusted himself was obvious folly. Yet Benedek's appointment was very popular with the great mass of the Austrian army, though his relations with his aristocratic corps commanders were never cordial. He needed a really able and tactful chief of staff to supply the necessary technical knowledge and to give him the confidence he lacked.

His nominal chief of the staff was von Henikstein, amicable and rich—civil rather than military virtues—personally brave, but without any real qualification for his important post. He could bring to Benedek neither military knowledge, for he had little, nor confidence, for he was himself of a pessimistic turn of mind. In the actual conduct of operations von Henikstein seems to have been a cipher, and the virtual arbiter of Austrian strategy was Krismanić, head of the operations branch of the general staff. He had been a professor at the staff college and had made a special study of the topography of Bohemia. He was a clever, plausible man, full of self-confidence, and oozed theory of war from every finger-tip. Unfortunately his studies had led him to a conviction of the superiority of the defensive. He based the strategy of this campaign on the successful defensive campaign of the Austrians against Frederick the Great in Bohemia in 1757. He was an arm-chair strategist, a maker of war by rote and by diagram, rather than a practical soldier. The Austrian corps commanders were great nobles, who treated war as a sport and usually troubled themselves little about the theoretical or scientific side of their profession. To sum up, the Austrian army was led by amateurs, the Prussian by professionals.

Topography of the Theatre of Operations.—Bohemia, where the main campaign was fought, is, generally, a country of open rolling plains, highly cultivated. Except the rivers, there are few obstacles to the movements of troops of all arms. But on the northern marches, between Bohemia and Prussia, lies a crescent of mountains, from 2,000 to 4,000ft. in height. These mountains are known in the east, on the Silesian frontier, as the Sudeten Gebirge, in the centre as the Riesen Gebirge, and in the west, on the Saxon frontier, as the Erz Gebirge. The Riesen Gebirge are the most formidable. They constituted a definite barrier, some 36m. in length and 20 in depth, to the movement of large forces. The principal routes from Prussia into Bohemia passed round either end of the Riesen Gebirge, through the lower and less rugged Sudeten and Erz Gebirge,—a fact which had, as will be seen, an important bearing on Prussian strategy. The Sudeten and Erz Gebirge were not steep, troops of all arms could move freely off the roads (except where the country was thickly wooded) and the so-called "passes" were in no sense defiles such as those in the Alps or on the north-west frontier of India. Of the rivers, the Elbe, which rises in the Riesen Gebirge and eventually leaves Bohemia through the Erz Gebirge, is a considerable obstacle, 60 to 70 yards broad at Königgrätz. The Iser, too, is deep, swift and broad, and had some strategical and tactical significance. The other streams in the theatre of operations were unimportant, except the Bistritz, as will be seen, at the battle of Sadowa.

Mobilization and Concentration.—After a long period of diplomatic negotiation, during which both sides had made certain military preparations, Austria ordered the mobilization of her Army of the North on April 27. Prussia followed suit a week later. Mobilization arrangements had not then reached the nicety of timing that in 1914 made a delay of even a few hours dangerous and thus rendered the mobilization of a European state practically equivalent to a declaration of war. The Prussian Corps were originally concentrated in their recruiting areas, a waste of time, since they had again to be broken up for the movement to the frontier by rail, which began on May 16 and was completed by June 5 (the most considerable use of railways in war up to that time).

Much ink has been spilt in criticism and defence of von Moltke's strategical deployment of the Prussian forces for this campaign, of which space permits only the barest possible outline here. The outstanding features of a strategical problem, which von Moltke had been studying in all its bearings for six years, were firstly, the mountain belt, with the almost roadless Riesen Gebirge in the centre, which had to be crossed if an offensive campaign into Bohemia were contemplated, and secondly, the salient formed by the province of Silesia, which greatly complicated the problem of defence should the enemy obtain the initiative. Von Moltke believed that Prussia's better transport arrangements would enable her armies, in spite of their later mobilization, to forestall the Austrians in northern Bohemia, provided they were moved thither with all speed, passing through the mountains on a broad front. Thus the importance of time, which impelled him to use all available railways, motived the original detrainment on a front of 275 miles, from Halle to Neisse. Thence the corps were moved inwards, and by June 8 stood in three groups on a front of about 150 miles: Army of the Elbe (VIII. Corps, 14th Div.) centre about Torgau; I. Army (II., III., IV. Corps) under Prince Frederick Charles, Senftenburg to Gorlitz; II. Army (I., V., VI. Corps) under the Crown Prince, centre about Landshut; the Guard Corps was still at Berlin. Von Moltke would now have liked to unite the armies by a movement into Bohemia. But there followed a delay of nearly a fortnight due to the reluctance of King William to appear the aggressor in the conflict. This delay was almost fatal to the Prussian plan.

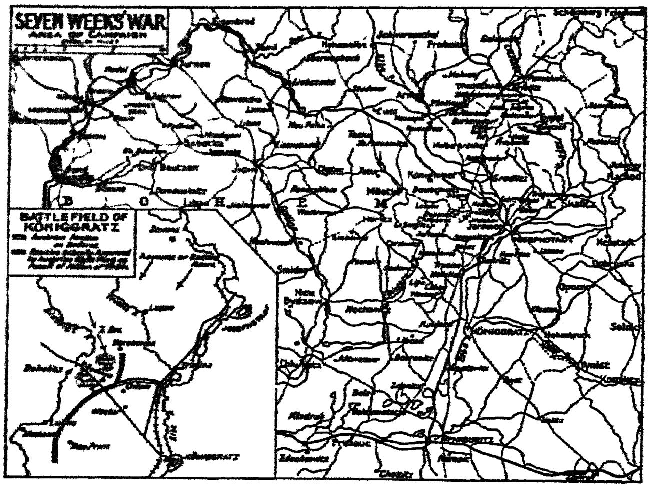
Meanwhile the Austrian army had concentrated round Olmütz in Moravia, near the Silesian frontier, with a detachment of the I. Corps and a cavalry division in northern Bohemia. The Crown Prince, the commander of the Prussian II. Army, convinced that an Austrian invasion of Silesia was imminent, proposed to move his army eastwards to about Neisse, to meet the danger, and also requested the strengthening of his army by the Guard Corps, originally allotted to the I. Army. Moltke was somewhat reluctantly compelled to agree to a move that still further separated the II. Army from the I. and exposed it to the danger of having to meet, unsupported, an attack by the Austrian main forces. This extension of front, for which von Moltke has been criticized, was probably less dangerous than it appeared. Von Moltke was sure of the tactical superiority of the Prussian infantry, with its breech-loading weapon, and could therefore count on the ability of the II. Army to delay any Austrian invasion long enough for the I. Army to intervene; he was also probably aware of the predilection of the Austrian high command for defensive strategy.

On June 15 King William relieved von Moltke of some of his anxieties by sanctioning the invasion of Saxony by the Army of the Elbe. Dresden was occupied on June 19 without fighting, the Saxon Army retiring into Bohemia. This brought the Army of the Elbe into close touch with the I. Army and it was now placed under the command of Prince Frederick Charles. There was still a wide gap between the I. and II. Armies, and a forward concentration in Bohemia was now hazardous, since Benedek had on June 17 ordered the march of the whole Austrian army from Olmütz towards Josefstadt. Nevertheless, Moltke chose the bold part, and on June 22 issued his famous order for the advance of the I. and II. Armies towards a point of junction at Gitschin. The forces of both combatants were thus hurrying towards the same area—the Austrians united, the Prussians seeking to unite.

THE ADVANCE TO KÖNIGGRÄTZ

The Prussian I. Army.—The danger threatening two separated forces which seek to unite within range of an active enemy is obvious. The one may be delayed and held fast by a detachment whilst the other is overwhelmed by the enemy's main mass. It appeared to von Moltke that the II. Army was the more

exposed and had the harder task to win a passage through the mountains; he therefore enjoined on the Commander of the I. Army a rapid advance on Gitschin in order "to shorten the crisis." Prince Frederick Charles with the I. and Elbe Armies had an unexpectedly easy task at first, since he was allowed to pass the defiles of the Erz Gebirge without opposition. The Austrian detachment on this wing (Saxon Corps, I. Corps, 1st Light Cav-



alry Division) had been ordered by Benedek to hold the line of the Iser. In the advanced guard combats of Hühnerwasser and Podol on June 26 the Prussians secured crossings over this river, and the Austrians had their first experiences of the deadliness of the breech-loader. Prince Frederick Charles spent the whole of the 27th in manoeuvring his forces into position for an enveloping battle at Münchengrätz, where he supposed the main body of the Austrian detachment to be, and practically the whole of the 28th in manoeuvring them back into line of march, when he found that the enemy had retired on Gitschin without awaiting his blow. In the battle of Gitschin on the 29th the ground favoured the Austrians, who had an opportunity of crushing the head of one of the Prussian columns before the other could reach the field of battle. But the superior weapon and skilful handling of the Prussian infantry won the day and in the end the Austrians and Saxons suffered a severe defeat. Thus by the 30th the I. and Elbe Armies had reached their original rendezvous. Their commander had, however, been guilty of several errors. Of these the most flagrant was the placing of his cavalry in the rear, with the result that he was always in ignorance of his enemy's dispositions and moves. His unjustified halt of the I. Army on June 25 before it was clear of the mountains, and his faulty dispositions at Gitschin might have been severely punished had the Austrian high command been less inept.

Engagements of the Second Army.—Meanwhile the II. Army had been fighting hard to win through the mountains and to reach the line of the Upper Elbe. The first engagements on this wing took place on June 27. The Prussian advance on that day was in three columns: on the right the I. Corps was to push through Trautenau; on the left the V. Corps was directed on Nachod; in the centre the Guard Corps was given Eipel as its destination, with the task of supporting the Corps on its right or left at need. The advanced guard of the I. Corps drove back a part of the Austrian X. Corps, and early in the afternoon secured the exits from the defile at Parschnitz. But the Prussian Commander, Bonin, thinking the action was over, neglected to hasten the deployment of the remainder of his Corps and refused the proffered assistance of a division of the Guard. Later in the afternoon the remainder of the Austrian X. Corps reached the battlefield, and counterattacked vigorously. They drove in the Prussian advanced troops and caused the I. Corps to retreat in complete disorder across the frontier. On the same day the Prussian V. Corps won an important success at Nachod against the Austrian VI. Corps. Here, as at Trautenau, the Prussian advanced guard was attacked by a greatly superior force before the main body was clear of the defile behind. But von Steinmetz, commander of the V. Corps, a veteran who had fought in the Napoleonic wars, was of more resolute mettle than Bonin, and after a hard struggle won clear of the defile and drove back his enemy. On the following day, the 28th, the Prussians continued their advance and won two successes. The Guard Corps at Soor defeated the Austrian X. Corps, the victors of Trautenau, while Steinmetz's V. Corps at Skalitz drove back the Austrian VIII. Corps, which had relieved the VI. Corps in front of him. The success of the Guard Corps opened the Trautenau defile and enabled the rallied I. Corps to resume its advance. On the 29th Steinmetz won a third success, at Schweinschadel, this time over the Austrian IV. Corps. By the evening of June 30, the II. Army had disposed of the irresolute and unco-ordinated opposition of its enemies and had established itself on the line of the upper Elbe, with its centre about Königinhof. The I. Army and Army of the Elbe, which had received orders to continue their advance beyond Gitschin in the direction of Königgrätz, were now within a day's march of the II. Army. Moltke's first strategical aim, the junction of the Prussian forces, had practically been accomplished. On the same date, the 30th, Benedek gave orders for a retreat of the Austrian Army on Königgrätz, and thus acknowledged that he had forfeited the advantage which a central position between two separated hostile forces might have given him.

Benedek's Vacillation.—Moltke's bold gambit had gone unpunished and had given him a winning strategical position. Let us turn to the Austrian side of the board, consider Benedek's handling of the pieces during these last ten days of June, and enquire whether (as most critics hold) he missed an opportunity of defeating his enemies in detail, and if so, by what false moves. In the first place, he was probably correct in his decision to advance into northern Bohemia rather than to invade Silesia, and his march of some 200,000 men from Olmutz to Josefstadt was well enough ordered. But he had already lost time—the most precious element of war, as of chess—and was always at least one move in the game behind his opponent. Thus while the Prussian armies were widely separated in a lateral direction, the Austrian army as it approached the critical point of Josefstadt was also widely dispersed—from front to rear. If Benedek was to use his central position to strike to right and left alternately, he must first gain time to close up his army. He could gain this time only by his own efforts, by so using detachments from his main force as to impose delay on the forward march of the divided armies of his opponents. This fact he never grasped, he seems hardly to have realised any especial need for haste, but to have assumed that he would be given time to assemble, and even to rest his forces before having to make up his mind and to assume the offensive. Certainly his instructions to his detachments show no sense either of a definite plan or of the importance of keeping elbow-room for manoeuvre. His western detachment (I. Corps and Saxons) properly handled, should have been able seriously to delay the Prussian I. Army in the mountains and on the line of the Iser. But Benedek's instructions were vague, and the Commander of the I. Corps, Clam Gallas, was incompetent, so that the Prussians were able to advance to Gitschin with hardly a check. On the other wing, the opportunity to delay or destroy the Crown Prince's army at the exits from the mountains was also lost through want of clear orders and energetic action.

Military writers who have commented on the campaign have satisfied themselves that Benedek should have delayed the I. Prussian Army and Army of the Elbe and have thrown his whole weight in the first instance against the Crown Prince, before the latter could extricate himself from the mountains. Benedek's own conception, so far as he had any definite plan, seems to have been the opposite—to delay the Crown Prince and to attack the armies of Prince Frederick Charles. But he never formulated a clear-cut scheme either for holding up the one enemy or for offensive action against the other. And under their relentless pressure he presently abandoned his own plans, took up a position and passively awaited attack. Much of Benedek's irresolution can probably be traced to the influence of Krismanić's defen-

sive theories, but it was rooted in his sense of having to perform a task beyond his powers. The result of his half measures had been disastrous. In the engagements between June 26 and June 30, six of the eight Austrian Corps had met defeat and had suffered severely in their massed formations against the fire of the breech-loader. The Austrian losses had been well over 30,000, while those of the Prussians were less than a quarter of that total. It was a disillusioned army that retired on Königgrätz, under a leader who was not far from being demoralized.

THE BATTLE OF KÖNIGGRÄTZ (OR SADOWA)

The Prussian Plans.—On July 1 two great hosts of nearly a quarter of a million men each (the largest forces that met on one battlefield till the World War of 1914) lay within a few miles of each other. It might have been expected that a "set-piece" battle would ensue; that the Austrian army, now thrown on the defensive, would select the most favourable position in which to await attack, and that the Prussians after due reconnaissance would assault, if unable to manoeuvre their enemies out of their selected position. Actually, on July 3, 1866, these two great armies blundered into battle on a field and in circumstances which neither commander had chosen nor foreseen. The incidents which led up to this result deserve some attention. They showed that the art of reconnaissance had been forgotten with the passing of Napoleon. Neither Prussian nor Austrian army had any other employment for its numerous cavalry than to await the opportunity for a charge on the battlefield. Hence, though only a few miles apart, they completely lost touch with each other for more than 48 hours, and made their dispositions blindfold.

To consider first the Prussian plans. Von Moltke had deliberately kept an interval of half a day's march between the I. and II. Armies, though there was no longer any bar to their close assembly. He had realized—he was the first to do so—that the union of two forces from different points *on the field of battle itself,* the one striking the enemy frontally, the other in flank, had been made possible by modern inventions and would lead to decisive results. The method by which he proposed in this instance to put his theories into practice is characteristic. He set himself a tactical problem—to select the best defensive position for the Austrian army—solved it to his own satisfaction by placing his opponents east of the Elbe with flanks on the fortified crossings of Josefstadt and Königgrätz, and issued orders to the Prussian forces accordingly, without ascertaining by reconnaissance whether or not Benedek had arrived at the same able solution of the problem. Moltke's orders for July 3 directed the I. Army and Army of the Elbe towards Königgrätz and Pardubitz, while the II. Army on the left bank of the Elbe was to reconnoitre the line of the Aupa and Mettau rivers with a view to advancing next day against the supposed right flank of the Austrians. Actually, the Austrian army was still west of the Elbe, so that had Moltke's orders been executed the I. Army would have been exposed unsupported to the whole Austrian army, and could hardly have avoided defeat. The chain of events which modified these orders and made a Prussian victory possible was as follows. On the evening of July 2 Prince Frederick Charles sent out reconnaissances and discovered that there was a large Austrian force between the Bistritz and the Elbe, though he did not yet realize that the whole Austrian army was there. He at once made preparations to attack this force on the morning of the 3rd, and sent a letter to the Crown Prince to ask for one of the latter's Corps to cover his left flank. The Crown Prince was asleep when the letter reached his H.Q. at 2 A.M. and his Chief of Staff, Blumenthal, without awakening him refused Prince Frederick Charles' request. Meanwhile, however, duplicates of the I. Army's orders had reached Moltke, who was prompt to realize the situation and instant to decide. Orders were sent forthwith from Imperial H.Q. for the Crown Prince to co-operate with his whole army. These orders did not reach him till 4 A.M. of the morning of the battle.

Austrian Dispositions.—The retreat towards Königgrätz on July 1 had been confused by bad staff work. On July 2 therefore the army halted to rest instead of crossing to the east of the Elbe, as seems to have been the original intention. Meanwhile Benedek, who had now lost all faith in his advisers and in his troops as well as in himself, telegraphed to his emperor advising the immediate conclusion of peace. The emperor's reply "Has a battle been fought?" seems to have resolved Benedek to stand and fight. The full history of his correspondence with the Emperor and of the instructions he received at this crisis has never been disclosed. Pressure was probably brought on him to give battle against his better judgment, but after the disaster he accepted his disgrace and loyally kept silence. Whether in any case he intended to fight a decisive battle west of the Elbe or on July 3 is doubtful. His orders, issued late at night on July 2, are almost incredibly bad judged as orders for a decisive battle. Bonnal, the author of *Sadowa,* says: "Except at Ulm and Sedan, no worse dispositions for an army about to accept battle have ever been made." It is, however, more likely that Benedek's dispositions were made merely with a view to providing for the safety of his army during another day's rest, after which he proposed to take up a position behind the Elbe. If so, he once again showed his disregard of the time factor. The orders provided for the army to occupy a semi-circular position between the Trotina and Bistritz streams with the centre in front of the village of Chlum, about 10 miles north-west of Königgrätz. A mile or so north of Chlum lies the Swiep Wald, in the struggle for which the issue of the battle was decided. The position might have been made a reasonably strong one, but the orders were vague and crude and did not reach some of the Austrian corps till 6 A.M., by which time the advanced troops on both sides were already in contact. Henikstein and Krismanić, as well as Clam Gallas, had been superseded, but the new Chief of Staff, Baumgarten, did not arrive till the morning of the battle.

The Battle.—The numbers engaged were: Prussians 220,000 (including 14,000 cavalry) with 780 guns, Austrians and Saxons 215,000 (including 24,000 cavalry) with 770 guns. Early in the morning (which was dull and rainy) Prince Frederick Charles advanced his force to the Bistritz, intending to hold the line of that river until the II. Army could appear on the field. But his hand was forced by the action of his left division (7th) under Fransecky, which was already across the Bistritz and advanced into the Swiep Wald, where it drew on itself the whole weight of the Austrian right wing, IV. and II. Corps, and caused these Corps to face west instead of north. It fought magnificently against heavy odds, but its danger led to the premature advance of the remainder of the I. Army across the Bistritz. Thus during the whole morning the I. Army was struggling against greatly superior Austrian forces and was hard pressed. Meanwhile the advanced guard of the Army of the Elbe was engaged on the right with the Saxon Army at Nechanitz. Shortly after noon the leading troops of the II. Army appeared on the field and soon decided the conflict. They caught the Austrian II. and IV. Corps in the act of retiring from the Swiep Wald to the positions they had originally been ordered to hold from Chlum and Nedelist to the Elbe, quickly routed them, and seized Chlum. The Austrian reserve corps then made two counter-attacks on Chlum. These failed, and by 4:30 P.M. the Austrians were in full retreat, gallantly covered by the self-sacrificing charges of their cavalry and by the steadiness of their artillery. There was great confusion at the river crossings, but the pursuit was not pressed, the victors themselves being in almost as great confusion as the vanquished owing to the lines of advance of the I. and II. Armies having converged. The Austrian losses were about 45,000, of whom 20,000 were prisoners, and 150 guns; the Prussian losses were under 10,000. The features of the battle were, on the Prussian side, the extraordinary influence of the gallant fighting of Fransecky's division in the Swiep Wald, the deadliness of the breech-loader, and the spirit which animated the swift and resolute march of the II. Army to the rescue of the I. Army. On the Austrian side, the artillery was brilliantly handled throughout the battle, and the cavalry by their devotion at the end made some amends for their failures in reconnaissance.

Benedek withdrew his army unmolested to the fortress of Olmutz to recuperate, thus placing himself on the flank of the

Prussian advance on Vienna. There is no virtue, however, in a flank position unless the troops have the power to issue offensively from it, as these had not. The Archduke Albert, who had succeeded to the chief command, ordered the army from Olmütz to Vienna, to join the two corps brought back from Italy in the direct defence of the capital. The Austrians eventually succeeded in assembling at Vienna, though an engagement with the Prussian II. Army at Tobitschau on July 15 forced the three rear corps from Olmütz to make a wide detour. Prussians and Austrians were facing each other outside Vienna when an armistice was agreed to on July 22, followed by peace on Prussia's terms.

The Campaigns in Western Germany.—Space permits only a brief reference to the operations of the Army of the Main under Gen. von Falkenstein, to whom had been given the task of dealing with the minor German States allied to Austria. The Hanoverian army on its way to join the Bavarians won a success over a Prussian column at Langensalza on June 27, but was surrounded and forced to capitulate two days later. The operations against Bavaria lasted all July and consisted of a series of small actions, as a result of which the territory of the States hostile to Prussia had mostly been over-run when an armistice was concluded early in August.

Comments.—The campaign of 1866 marks the dawn of modern war, and may be said to represent the passing of the military art from an amateur to a professional basis. The characteristic of the professional is constant and assiduous practice at all times, not only when engaged in a match. Similarly, Moltke introduced unceasing preparation in peace for every detail in war and enjoined diligent study on commanders of all grades. Moltke's theories of war (enunciated in his famous "Memorandum for the Guidance of Superior Officers,"—issued in 1868) also mark a stage in the science of strategy, which may be studied in Caemmerer's *Development of Strategical Science*. Historians a century hence may write that Clausewitz and his disciple von Moltke killed war by making it so serious, so dull and so deadly.

Bibliography.—The English translation of Bonnal's *Sadowa* (1907) contains a full bibliography of works published up to that date. Neill Malcolm, *Bohemia 1886* (1912), and translations of Moltke's *Projects* and *Correspondence* are the principal works published in English since that date. (A. P. W.)

SEVEN WISE MASTERS, THE, a cycle of stories of oriental origin. A Roman emperor causes his son to be educated away from the court in the seven liberal arts by seven wise masters. On his return to court his stepmother the empress seeks to seduce him. He is bound over to a week's silence. During this time the empress accuses him and seeks to bring about his death by seven stories which she relates to the emperor; but her narrative is each time confuted by tales of the craft of women related by the sages. Finally the prince's lips are unsealed, the truth exposed, and the wicked empress is executed.

An analogous collection of stories occurs in Sanskrit, but the Indian original is unknown. Travelling from the east by way of Arabic, Persian, Syriac and Greek, it was known as the book of Sindibâd, and was translated from Greek into Latin in the 12th century by Jean de Hauteseille, with the title of *Dolopathos* (edit. H. Oesterley, Strasbourg, 1873). This was translated into French about 1210 by a *trouvère* named Herbers as *Li Romans di Dolopathos*. The German, English, French and Spanish chapbooks of the cycle are generally based on a Latin original. Three metrical romances probably based on the French, and dating from the 14th century, exist in English. The most important of these is *The Sevyn Sages* by John Rolland of Dalkeith, edited for the Bannatyne club (1837).

The Latin romance was frequently printed in the 15th century, and Wynkyn de Worde printed an English version about 1515. *See* G. Paris, *Deux rédactions du roman des sept sages de Rome* (1876, Soc. des. anc. textes fr.); Büchner, *Historia septem sapientium* . . . (Erlangen, 1889); K. Campbell, *A Study of the Romance of the Seven Sages with special reference to the middle English versions* (Baltimore, 1898); D. Comparetti, *Researches respecting the Book of Sindibâd* (Folk-Lore Soc., 1882).

SEVEN WISE MEN OF GREECE, THE, a collective name for certain sages who flourished *c.* 620–550 B.C. The generally accepted list is Bias, Chilon, Cleobulus, Periander, Pittacus, Solon, Thales (*qq.v.*), although ancient authorities differ as to names and number.

See "Septem sapientium carmina et apophthegmata," with short biographies in F. Mullach, *Fragm. philosophorum Graec.*, i. (1860); H. Diels, *Die Fragmente der Vorsokratiker*, Bd. 2 (4th ed., 1922) and Überweg, *Grundriss der Gesch. der Philosophie*, Bd. I. (1926).

SEVEN WONDERS OF THE WORLD, the name conferred on a group of ancient works of art which had obtained pre-eminence among the sight-seers of the Alexandrian era. The earliest extant list, doubtless compiled from the numerous guide books then current in the Greek world, is that of the epigrammatist Antipater of Sidon (2nd century B.C.). A second and slightly divergent list from the hand of a Byzantine rhetorician has been incorporated in the works of Philo of Byzantium. The monuments are as follows:—(1) the pyramids of Egypt, (2) the gardens of Semiramis at Babylon, (3) the statue of Zeus at Olympia (*see* PHEIDIAS), (4) the temple of Artemis at Ephesus, (5) the Mausoleum at Halicarnassus (*see* MAUSOLEUM), (6) the Colossus at Rhodes, (7) the Pharos (lighthouse) of Alexandria, or the Walls of Babylon.

See "Philo," *De septem mundi miraculis* (ed. Hercher, Paris, 1858).

SEVEN YEARS' WAR (1756–1763), the name given to the European war which arose from the formation of a coalition between Austria, France, Russia, Sweden and Saxony against Prussia, with the object of destroying, or at least crippling, the power of Frederick the Great. Prussia was joined by England, and between England and France, as usual, a maritime and colonial war broke out at the first pretext; this war laid the foundations of the British empire, for ere the seven campaigns had been fought in Europe, the French dominion in Canada and the French influence in India, in spite of Dupleix, Lally and Montcalm, had been entirely overthrown by the victories of Clive, Amherst and Wolfe. Great as was the effect of these victories on the history of the world, however, it is at least questionable whether the steadfast resistance of Prussia, almost single-handed as she was—the resistance which laid the solid, if then unseen, foundations of modern Germany—is not as important a phenomenon, and from the technical military standpoint Rossbach and Leuthen, Zorndorf and Kunersdorf possess an interest which it would be possible perhaps to claim for Plassy and for Quebec, but not for border conflicts in Canada and India. It is not only battles, the distinct and tangible military events, that make up the story of Frederick's defence. There are countless marches and manoeuvres, devoid of interest as regards their details; but, as indications of the equilibrium of forces in 18th-century warfare, indispensable to a study of military history as a whole.

Pirna.—Learning of the existence and intentions of the coalition, Frederick determined to strike first, and he concentrated his 150,000 men as follows:—11,000 men in Pomerania to watch the Swedes, 26,000 on the Russian frontier, 37,000 men under Field Marshal Schwerin in Silesia and a main body of 70,000 in three columns ready to advance into Saxony at a moment's notice, the king being in chief command. On Aug. 29, 1756 the Saxon frontier was crossed. Dresden was occupied on Sept. 10, the Saxon army, about 14,000 strong, falling back before the invaders to the entrenched camp of Pirna, an almost inaccessible plateau parallel to the Elbe and close to the Bohemian frontier. The secret of the Prussian intentions had been so well kept that the Austrians were still widely distributed in Bohemia and Moravia. 32,000 men under Field Marshal Browne were at Kolin, and 22,000 under Piccolomini at Olmütz, when on Aug. 31 the news of the invasion arrived, and such was their unreadiness that Browne could not advance till Sept. 6, Piccolomini until Sept. 9. Meanwhile the Prussians, leaving detachments to watch the exits from Pirna, moved up the Elbe and took post at Aussig to cover the investment of the Saxons. Learning of Browne's approach on Sept. 28, the king, assuming the command of the covering force, advanced yet farther up the Elbe to meet him, and the two armies met at Lobositz (opposite Leitmeritz) on the morning of Oct. 1. The battle began in a thick fog, rendering dispositions very difficult, and victory fell to the Prussians, principally owing to the tenacity displayed by their infantry in a series of disconnected

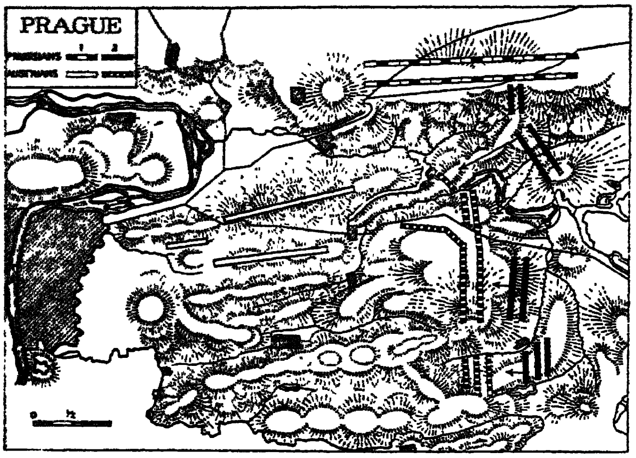
local engagements. The nature of the ground rendered pursuit impossible, and the losses on both sides were approximately equal —viz. 3,000 men—but the result sealed the fate of the Saxons, who after a few half-hearted attempts to escape from their entrenchments, surrendered on Oct. 14, and were taken over bodily into the Prussian service. Prussian administrators were appointed to govern the country, and the troops took up winter quarters.

The coalition had undertaken to provide 500,000 men against Prussia, but at the beginning of the year only 132,000 Austrians stood ready for action in northern Bohemia. Against these the king was organizing some 250,000, 45,000 of whom were paid for by British subsidies and disposed to cover Hanover from a French attack. After leaving detachments to guard his other frontiers, Frederick was able to take the field with nearly 150,000 men, but these also were scattered to guard a frontier some 200 m. in length—the left wing in Silesia under Schwerin and the duke of Brunswick-Bevern, the centre and right under the king. In April the operations began. Schwerin and Bevern crossed the mountains into Bohemia and united at Jung Bunzlau, the Austrians falling back before them and surrendering their magazines. The king marched from Pirna and Prince Maurice of Dessau from Zwickau on Prague, at which point the various Austrian commands were ordered to concentrate.

Battle of Prague.—On the morning of May 5 the whole army, except a column under Field Marshal Daun, was united here under Prince Charles of Lorraine, and the king, realizing the impossibility of storming the heights before him, left a corps under Keith and a few detachments to watch Prague and the fords across the river, and marched during the night upstream and, crossing above the Austrian right, formed his army (about 64,000) for attack at right angles to the Austrian front. The ground had not been reconnoitred, and in the morning mist many mistakes in the deployment had been made, but as Daun was known to be but 20 m. away and the Austrian army was changing its front to meet the unexpected attack, the king threw caution to the winds and sending Zieten with his cavalry by a wide détour to cover his left, he ordered the whole to advance. One of the most savage battles in history was the result. Almost immediately the Prussian infantry became entangled in a series of morasses, the battalion guns had to be left behind and the troops had to correct their alinement under the round shot fired by the Austrians, who had completed their change of front in time and now stood ready to sweep the open glacis before them. Before the storm of bullets and the grape and canister of the heavy and battalion guns the Prussian first line faltered and fell in thousands. Their attempts to prepare the way for the bayonet assault broke down. Schwerin was killed. But the second line carried the survivors on, and in the nick of time Zieten's cavalry drove the Austrian horsemen off the field and broke in on the flank and rear of their infantry. This turned the scale, and the Austrians retreated into Prague in hopeless confusion, leaving some 10,000 men (14.8%) on the ground, and 4,275 prisoners, out of about 66,000, in their enemy's hands. The Prussians lost 11,740 men killed and wounded and 1,560 prisoners, and in all 20.8% of their strength. The actual fighting seems only to have lasted about two hours, though firing did not cease till late at night; 16,000 Austrians managed in the confusion to evade capture and join Daun, who made no movement either on this or succeeding days to come to the assistance of his comrades, but began a leisurely retreat towards Vienna. The Prussians immediately began the siege of the town, and after a month's

delay Daun, now at the head of some 60,000 men, moved forward to the relief of the city. Learning of his approach, the king, taking with him all the men who could be spared from the investment and uniting all available detachments, moved to meet him with only 34,000 men, and on June 18 he found Daun strongly entrenched.

Battle of Kolin.—He immediately endeavoured to march past him and attack him on the right flank—a repetition of the Prague

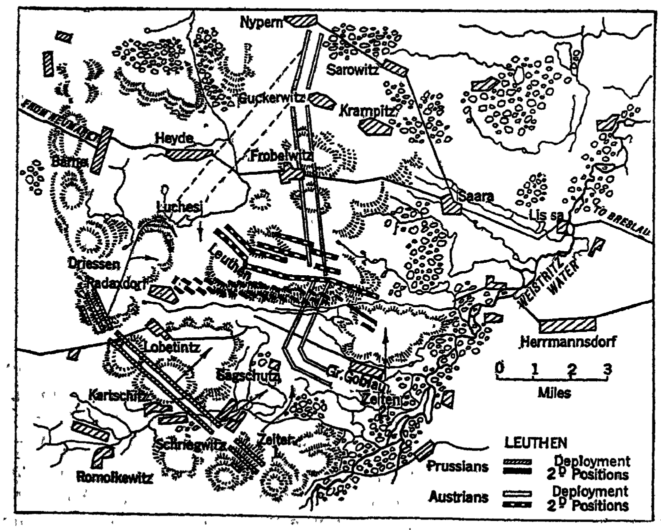


manoeuvre without its concealment—but the Austrian light troops harassed his columns so severely during the movement that without orders they wheeled to drive them off and, being thus thrown into disarray, they took three divergent objectives. Their disunited attacks all fell upon superior numbers, and after a most obstinate struggle they were badly beaten with a loss in killed and wounded of 6,710 (18·6%) and 5,380 prisoners with 45 guns. The fighting lasted 5½ hours. The Austrian loss was only 8,000 out of 53,500, or 15·2%, of whom only 1,500 were taken prisoners.

This disaster entailed raising the siege of Prague, and the Prussians fell back on Leitmeritz. The Austrians, reinforced by the 48,000 troops in Prague, followed them 100,000 strong, and, falling on Prince August Wilhelm of Prussia, who was retreating eccentrically (for commissariat reasons) on Zittau, inflicted a severe check upon him. The king was compelled to abandon Bohemia, falling back on Bautzen. Having re-formed his men and calling in Keith's 27,000 men from Pirna, he again advanced, but found the enemy so strongly posted at Burkersdorf (south of Bischofswerda) that he relinquished his purpose and retreated on Bernstadt.

Frederick in the West.—Meanwhile his enemies had been gathering around him. France had despatched 100,000 men under d'Estrées against Hanover, where Cumberland with 54,000 stood to meet him, and another 24,000 men were marching through Franconia to unite with the "Army of the Holy Roman Empire" under the prince of Saxe-Hildburghausen. Fortunately this latter army was not as formidable as its title, and totalled only some 60,000 most undisciplined and heterogeneous combatants. In the north 100,000 Russians under Apraxin were slowly advancing into East Prussia, where Lehwald with 30,000 was preparing to confront them, and 16,000 Swedes had landed in Pomerania. On June 26 Cumberland had been beaten at Hastenbeck by d'Estrées, and the French overran Hanover and Brunswick. The king, leaving Bevern with only 13,600 men in Silesia to watch the Austrians, began to march across Germany to succour Cumberland. Arrived at Leipzig on Sept. 3, he heard of Lehwald's defeat at Gross-Jägerndorf on Aug. 30, and immediately afterwards of Cumberland's convention of Kloster Seven, which gave up Hanover to the French. Fearing that the French army now set free in Hanover might unite with the Army of the Empire under Hildburghausen and with 150,000 men march direct on Berlin, Frederick, taking with him 23,000 men, marched to join Prince Ferdinand in the district about Halberstadt, hoping to strike his blow before the enemy's junction could be completed. Mobility, therefore, was the first consideration, and arrangements for supply having been made in advance along his road, his troops covered 170 m. in 12 days (September 1–13). But Hildburghausen, not having been joined by d'Estrées, refused to fight and fell back into the wooded districts of Thuringia and Franconia. Bad news now reached Frederick from Silesia; leaving Ferdinand to observe Hildburghausen, he marched with all haste to Eckersberg to support Bevern. Arrived here, he found more bad news from Berlin, which had been entered by a body of Austrian raiders under Hadik and plundered. Prince Maurice and Seydlitz were sent by forced marches to its aid, and before them Hadik retired at once (Oct. 18). Finding the Austrians for the moment quiescent and hearing that Hildburghausen was again advancing, the king now concentrated all available men on Leipzig and marched to support Prince Ferdinand. Hildburghausen took up a position about Meucheln on Nov. 2, and on the 5th moved off to repeat Frederick's manoeuvre of Prague against its inventor.

Rossbach.—The Battle of Rossbach (*q.v.*) followed. In this Seydlitz and the Prussian cavalry won imperishable renown. Aided only by the fire of 18 guns and of 7 battalions of infantry, only two of which fired more than five rounds, the Prussian squadrons swept down upon the marching columns of the Allies and in about 40 minutes the whole 64,000 were in full flight. Never was a victory more timely, for the Prussian army was almost worn out and more bad news was even then on the way. Bevern in Silesia, who had been beaten at Moys near Görlitz (Sept. 7) and in the battle of Breslau on Oct. 22, had been compelled to retire behind the Oder, leaving the fortresses of Schweidnitz and Breslau to their fate, and both had capitulated within a few days. Leaving a small reinforcement for Ferdinand, the king now moved by forced marches to Liegnitz. The distance, about 170 m. through difficult country, was covered again in 12 days, but the numbers were small, only 13,000, which shows how tremendous had been the drain upon the men of the previous six weeks' exertions. On the night of Dec. 4, having joined the beaten forces of Bevern at Parschwitz, making in all 43,000 men of very unequal fighting value, he decided to attack the 72,000 Austrians who lay across the Breslau road, their centre marked by the village of Leuthen (*q.v.*). His position appeared so desperate that he sent for all his generals, laid the facts before them, announced his decision to attack and offered to accept any man's resignation without preju-



dice to his character should he deem the risk too hazardous. Needless to say, not one accepted the offer.

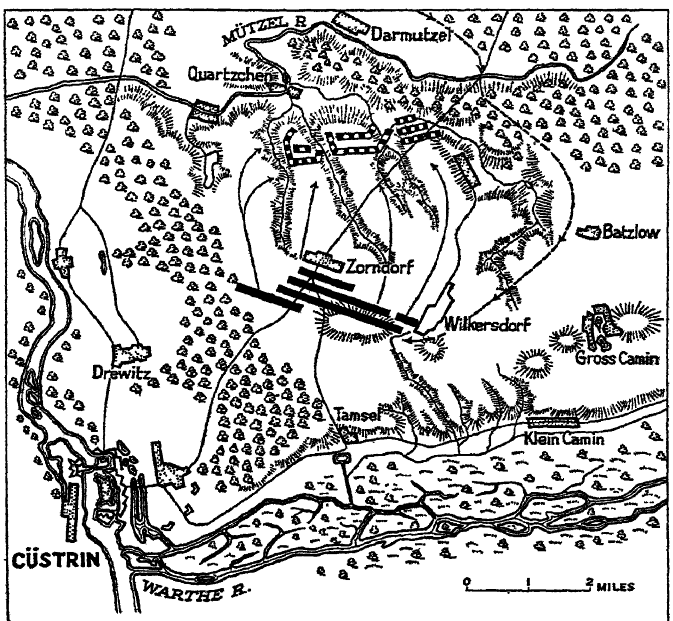
Battle of Leuthen.—Covered by the low rolling hillocks of the district, the army now moved off to its right across the Austrian front, the advance led by Zieten and half the cavalry, the rear covered by Driessen with the remaining half—some 40 weak squadrons. The infantry having gained a position sufficiently on the Austrian flank, now wheeled into line and attacked in échelon of battalions from the right. The battle soon became desperate, and the Austrian cavalry on their right wing under Luchesi,

unaware of Driessen's presence as a flank guard, issued out of their lines, wheeled to their left and swept down upon the refused flank of the Prussian infantry; but they never reached them, for Driessen, seizing his opportunity, set his squadrons in motion and attacked. The Austrians, completely surprised, were ridden down and driven back on to the front of their own infantry, and the pressure of the fugitives threw the rear of their left wing into confusion and in a short time the ruin of their army was completed. When the news of Driessen's charge was brought to the king his astonishment was expressed in the single phrase, "What, that old fool Driessen?" The fighting, however, had been desperate, and though the Austrians out of their 72,000 lost 37% including 20,000 prisoners, with 116 guns, the Prussians lost 6,200 (14%) making with the other battles of the year a total of nearly 75,000 men, and not including losses in minor skirmishes and on the march.

Campaign of 1758.—The raid upon Berlin had accomplished nothing, and the advance of the Russian main body had died out for want of resolution to seize the opportunities offered by Frederick the Great's absence. The Tsaritsa, annoyed by his slowness, recalled Apraxin and appointed Fermor in his place. Utilizing the winter snows, he collected some 31,000 men and crossed the frontiers of East Prussia (Jan. 10, 1758) and attempted to annex the province, driving out all the Prussian officials who refused to swear fealty to Elizabeth. This took time, and when the period of thaw supervened the Russians were immobilized and could not advance until approaching summer had dried the roads again. For the moment, therefore, no danger threatened Frederick from this quarter, and Rossbach had effectually tamed the French. The Swedes, too, showed little energy, the "roadless" period affecting them equally with the Russians.

Frederick therefore resolved to seize the opportunity to renew his invasion of Austria. As a beginning he recaptured Schweidnitz in April with 5,000 prisoners. The Austrian field army under Daun lay about Königgrätz, covering all the passes out of Silesia; but covered by the newly formed "Free Corps" (his answer to the semi-savage Croats, Pandours and Tolpatches of the Austrians), Frederick marched right across their front on Olmütz, whilst a special corps (30,000) under Prince Henry threatened their left from Saxony and the Elbe. He had with him about 40,000 men. But Olmütz lay 90 m. from the Prussian frontier, and the Austrian light troops swarmed in the intervening district. Ultimately a great Prussian convoy was destroyed in the action of Domstädl, and the siege of Olmütz had to be raised (July 1); but instead of marching back the way he had come Frederick led his troops through Bohemia practically in the rear of Daun's army, and on July 14 entered Daun's empty entrenchments at Königgrätz. Fermor's Russians were now again in the field and had reached Posen, burning and plundering horribly. By skilful manoeuvring the king deceived the Austrians till the roads to Silesia by Skalitz and Nachod were open and then by a rapid march passed over into Silesia, reaching Grüssau (near Landshut) on Aug. 8. Leaving Keith with half his force to hold this district, he then marched to Frankfurt-on-the-Oder, taking with him only some 15,000 men, to strengthen the wing already engaged against the Russians. Frankfurt was reached on Aug. 20. Fermor was then besieging Cüstrin with 52,000 men, and hearing of the king's approach he raised the siege and placed himself behind a formidable obstacle facing north, near Zorndorf, from which direction the king was approaching.

Battle of Zorndorf.—Seeing that the same obstacle that prevented him from attacking the Russians prevented them equally from attacking him, the king marched right round Fermor's eastern flank—the Russians gradually forming a fresh front to meet him,—so that when the Prussian attack began on the morning of Aug. 25 they stood in three irregular squares, divided from each other by marshy hollows, and thus unable to render one another support. The king made his first effort against the square on the right,—Seydlitz with his squadrons covering the movement. But the Russian troops fought with far more spirit than the Austrians had ever shown, and things were going very badly with the Prussians when Seydlitz, who in the meanwhile had succeeded in making paths across the Zaberngrund on which the Russian right rested, flung himself upon the great square, and rode over and destroyed the whole mass in a prolonged mêlée in which quarter was neither given nor asked. Relieved by this well-timed charge, the king now re-formed the infantry already engaged, and concentrated all his efforts on the south-west angle of the great centre square. Again the Russians more than held their own, issuing forth from their squares and capturing many field pieces. Some of the Prussian infantry was actually broken and in full flight when Seydlitz, with his ranks re-formed and his horses rested, returned and again threw himself upon the square exactly as on the previous occasion and with the same result—the square, as a formation, was broken, but groups still stood back to back and the most savage butchery ensued. Darkness put a stop to the slaughter. Of 36,000 Prussians 12,500 were killed or wounded, 1,000 prisoners or missing (37·5%), and of 42,000 Russians about 21,000 had fallen (50%).



PRUSSIANS ▬ RUSSIANS ▭

BATTLE OF ZORNDORF

In the night the survivors gradually rallied, and morning found the Russians in a fresh position a couple of miles to the northward, but Frederick's troops were too weary to renew the attack. Gradually the Russians withdrew towards Landsberg and Königsberg, and the king, leaving Dohna to follow them up, marched with the remainder of his forces on Sept. 2 for Saxony, covering 22 m. a day. They arrived only in the nick of time, for Daun had united with portions of the Empire Army and was threatening to crush Prince Henry under the weight of more than twofold numbers. The prince had been driven into an entrenched position above Gahmig near Dresden and Daun was about to attack, but the mere name of Frederick was enough, and learning of his arrival Daun fell back to Stolpen on Sept. 12.

The Prussian army now lay around Grossenhain, Prince Henry's force covering Dresden and the Elbe bridges. The Empire Army was at Pirna, Daun at Stolpen, and in these positions they remained until Sept. 26, the Prussians getting the rest they so urgently needed. On that date, however, the state of truce was broken and the king moved towards Bischofswerda, where Daun's subordinate Loudon was posted. The latter retired, opening the road to Bautzen. The king arrived at Bautzen on Oct. 7 and had to wait until the 10th for provisions from Dresden. He then moved forward to Hochkirch, where he found Daun strongly entrenched across his path at Kittlitz with 90,000 men, the Prussians having only 37,000. The king determined to attack the Austrian right. So confident had the Prussians become in the belief that Daun would never take the offensive himself that the most elementary precautions of safety were forgotten.

Battle of Hochkirch.—During the night of the 13th the Austrians, leaving their watchfires burning and moving silently through the woods, which covered much of the ground, formed up almost all round the Prussian camp. At 5 A.M. the attack was delivered from all quarters simultaneously and a most desperate struggle ensued. Nothing but the superb discipline of the Prussians saved the situation. Zieten with his squadrons managed to keep a way of escape open, and after a most obstinate conflict the wreck of the army succeeded in withdrawing, leaving 101 guns and 9,450 men on the ground or in their enemies' hands (25·5%). The Austrians, in spite of the advantage of a well-conceived surprise, lost 7,590 men and were too shaken for pursuit. They fell back to their old camp, where they remained for a week, thus giving Frederick time to bring up reinforcements from Dresden (6,000 men) and, starting on the 23rd, he marched right round the Austrian right and raised the siege of Neisse, the prime object with which he had set out. Daun, learning that the king had gone past him into Silesia, now laid siege to Dresden. On Nov. 15 he heard that Frederick was marching to its relief through Lusatia and incontinently gave way, retiring on Pirna. The king was in Dresden again on the 20th.

Campaign of 1759.—The drain on Frederick's resources had been prodigious. On the battlefields of the previous three years he had lost at least 75,000 men, not counting the waste of life in his marches and skirmishes; but he still managed to keep 150,000 men in the field, though for want of the old two years' training in loading, firing and manoeuvring the average efficiency had much diminished. In cavalry, too, he was relatively weaker, as there was no time to train the remounts. His enemies felt their losses far less and were beginning to understand his tactics; fortunately they remained incapable of combined action.

After minor operations on the frontiers the Russians took the field. Fermor had been superseded by Soltikov, and Dohna with his 18,000 men proved quite inadequate to arrest the Russians' progress. He was superseded by Wedell, who, on July 23, with 26,000 men boldly attacked the 70,000 Russians whilst on the march near Züllichau. He was defeated with a loss of 6,000 and fell back to Crossen bridge, 5 m. below Crossen, which Soltikov occupied next day, thence he moved down the river towards Frankfurt, keeping on the eastern bank. Daun had detached Loudon and Hadik with 35,000 men to join him, and it became vital to Frederick to prevent the combination. Leaving Prince Henry at Schmöttseifen to watch Daun, he marched with all available forces and joined Wedell on Aug. 6 at Müllrose near Frankfurt, after vainly searching for the Hadik-Loudon force. Here he was joined on the 10th by Finck with 10,000 men, bringing his whole force up to 50,000 against the Russian and Austrian 90,000, who lay entrenched in the sandhills about Kunersdorf.

Battle of Kunersdorf.—On the 11th he crossed his whole force over the Oder at Reitwein and on the 12th marched forward, intending to envelop the Russians on both flanks; but his columns lost their way in the woods and their attacks were delivered successively. In spite of their usual disciplined gallantry, the Prussians were completely beaten, even Seydlitz and his squadrons failed to achieve the impossible, and the night closed down on the greatest calamity Frederick had ever experienced. Of 43,000 men 20,720 (48·2%) were left on the ground and 178 guns fell into the hands of the enemy; and the allied Austro-Russian force only lost 15,700. The battle had only lasted six hours. In the depression following this terrible day he wrote to Schmettau, commanding at Dresden, telling him to expect no help, and on Sept. 4 Dresden fell.

As usual Frederick was saved by the sluggishness of his enemies, who attempted no pursuit, and being reinforced the day after the battle by 23,000 men, and having ordered up Kleist (who had been watching the Swedes), he was again at the head of an army. Week after week went by, during which he countered all attempts of Daun and Soltikov to combine, and ultimately the Russians, having consumed all the food and forage in the districts they occupied, were compelled to fall back on their own frontiers. Then, uniting with Prince Henry, the king turned to fall upon Daun; but his contempt for his adversary proved his own undoing.

Battle of Maxen.—He sent a detachment of 12,000 men under Finck to work round the Austrians' flank by Dippoldiswald to Maxen, but the latter, learning of the movement and calling up a wing of the Empire Army to their assistance, fell upon Finck with 42,000 men and compelled him to surrender after two days' hard fighting. The combination having failed, the two armies stood facing one another till far into the winter. But for Prince Ferdinand's glorious victory at Minden on Aug. 1, the year would have been one catalogue of disaster to the Prussian arms, and these operations must now be mentioned.

In the early part of 1758 Prince Ferdinand with 30,000 men had advanced from Lüneburg and was joined by Prince Henry with 8,600 from Halberstadt. The approach of the latter threatened the right wing of the French army under Clermont, which was posted along the Aller, and the whole line gave way and retreated without making any serious stand behind the Rhine. Prince Ferdinand followed and defeated them on June 23 at Crefeld. Clermont was relieved by Contades and at the same time Soubise, who had at last reorganized his command, shattered by the disaster of Rossbach, moved forward through Hesse and compelled Prince Ferdinand to withdraw from his very advanced position. No engagement followed; Soubise fell back upon Frankfurt and Prince Ferdinand held a line through Münster, Paderborn and Cassel during the winter.

Fortunately events in Canada and the glory of his victories had made Frederick's cause thoroughly popular in Great Britain, and at last it became possible to detach a considerable force of British troops to Prince Ferdinand's assistance, whose conduct turned the scale in the critical moment of the campaign. During the winter the French had organized their forces in two columns—based on Frankfurt and Wesel respectively. Broglie was now in command of the former; Contades still led the latter.

In April Prince Ferdinand advanced to drive the French out of Hesse and Frankfurt, and actually reached Bergen, a village some 10 m. to the north, but here he was defeated by Broglie (April 13) and forced to retreat the way he had come, the French following along their whole front and by sheer weight of numbers manoeuvring him successively out of each position he assumed. On July 10 Broglie surprised Minden, thus securing a bridge over the Weser and free access into Hanover, and light troops overran the south of the electorate. On the 16th Contades with the left column joined Broglie and the French now had some 60,000 men against the 45,000 Ferdinand could muster. The latter's position was extremely difficult, for the French had only to continue in possession of the bridges at Minden to ruin the whole country by their exactions, and the position they held was too well protected on the flanks and too strong in front for direct attack. Nevertheless Prince Ferdinand drew up before it and met the French plundering raids by a threat on their communication with Cassel, and as a further inducement to tempt Contades to attack him, he detached a column under Wangenheim, which entrenched itself across the only outlet by which the right of the French army could debouch from behind the marshes which lie in the angle between the Weser and the Bastau. The bait took, and during the early hours of Aug. 1 the French army moved out to attack Wangenheim.

Battle of Minden.—But Ferdinand's troops had been lying in instant readiness for action, and as soon as the outposts gave the alarm they were in motion in eight columns, *i.e.*, practically deployed for action to meet the French as they emerged from their positions. Unfortunately the outpost reports were delayed by about two hours, owing to the heavy gale and storm that was prevailing, and the French had made far greater progress with their deployment than Ferdinand had reckoned on. An almost front-to-front engagement ensued. Things were going badly with the Prussians when, through a mistake in the delivery of an order, the British brigade (12th, 20th, 23rd, 25th, 37th, 51st regiments), followed by some Hanoverian battalions, began to advance straight upon the masses of French cavalry who stood protected by the crossfire of several batteries. Once launched, neither fire nor

shock could check their progress; halting for a moment to pour volleys into the charging squadrons hastily thrown against them, they swiftly resumed their advance. French infantry too were hurled against them, but were swept away by fire and bayonet, and presently they had pierced right through the French line of battle. Now came the moment when cavalry should have been at hand to complete the victory, and this cavalry, the Blues, the 1st and 3rd Dragoons, Scots Greys and 10th Dragoons under Lord George (afterwards Viscount) Sackville (*q.v.*) stood ready, waiting only the order to advance. This Sackville refused to give, though called on three times by the prince; no satisfactory explanation of his conduct has ever been discovered, but he was tried by a general court-martial and cashiered. Nevertheless, so brilliant had been the conduct of all the troops engaged, especially of the infantry brigade that the victory was won even in spite of this failure of the cavalry, and before evening the French were retreating as a demoralized mass towards Cassel, leaving some 10,000 men and 45 guns in the hands of the victors, who on their side out of 43,000 had lost 2,600 killed and wounded. Of the six British regiments that went into action 4,434 strong, 1,330 (30%) had fallen, but their feat is not to be measured only by the losses victoriously borne—these were not unusual in the period—but by the astounding discipline they maintained throughout the advance, resuming their march after beating off cavalry charges with the cool precision of a review in peace-time. Ferdinand followed up his victory by a pursuit which was vigorous for three days and had all but reached the Rhine when his movement was stayed by the necessity of detaching 12,000 men to the king to make good the losses of Kunersdorf.

Campaign of 1760.—The year opened gloomily for Frederick. His embarrassment both for men and money was extreme, and his enemies had at last agreed on a combined plan against him. They purposed to advance in three columns concentrically upon him: Daun with 100,000 men in Saxony, Loudon with 50,000 from Silesia, Soltikov's Russians from East Prussia; and, against whichever column the king turned, the others were to continue towards Berlin. Only in Hanover were the conditions more favourable, for Ferdinand had 70,000 (20,000 British) against the 125,000 of the French.

Early in April the king stood with 40,000 men, west of the Elbe near Meissen facing Daun, Prince Henry with 34,000 in Silesia from Crossen to Landeshut, 15,000 under Forcade and Jung-Stutterheim in Pomerania facing the Swedes and Russians. Towards the end of May Loudon moved to besiege Glatz, and Fouqué, who commanded at Landeshut, marched with 13,000 to cover Breslau. Loudon at once seized Landeshut, and Fouqué, returning in response to urgent orders from the king, was attacked by Loudon with 31,000 men and almost destroyed. Meanwhile, Prince Henry had moved to Landsberg against the Russians, but failed to seize his opportunities and thus Silesia lay open to the Austrians. Frederick decided to march with his main body against Loudon and attack him if unsupported, but, if his movement induced Daun to move to Loudon's support, then to double back and besiege Dresden. For this purpose a siege train was held in readiness at Magdeburg. He marched rapidly on Bautzen, then hearing that Daun was approaching to support Loudon he returned and besieged Dresden (July 12). The town was bombarded, there being no time for regular siege approaches, but it held out, and by the 28th of July Daun's army returning had almost surrounded Frederick. The siege had to be raised, and during the night of July 29 the Prussians slipped away to Meissen. On the same day Frederick learnt that Glatz, the key to Southern Silesia, had fallen into the hands of the Austrians, but as a set-off the news shortly afterwards arrived of Prince Ferdinand's brilliant victory at Warburg, in which the British cavalry led by the marquis of Granby amply wiped out the disgrace incurred by Sackville.

On Aug. 1 Frederick began his march into Silesia, summoning Prince Henry from Landsberg to join him, which he did by a splendid march of some 90 m. in three days. The king's march was almost as remarkable, for the roads were very bad and the Austrians had freely obstructed them; nevertheless in five days he reached Bautzen, having marched more than 100 m. from his starting-point, and crossed five considerable rivers on his way. Thence he continued more easily to Bunzlau. Daun was in front of him and Lacy with clouds of light troops on his right, the Russians under Czernicheff with Loudon not far away to his left front, 114,000 men in all to his 30,000, but he held to his decision to reach Schweidnitz. With this purpose in view he moved south-east on Jauer, marching 25 m. on Aug. 9, but the enemy was still in front of him and hovering on his flanks. On the 10th he tried the Liegnitz road with the same result, and his position became desperate as his food was almost exhausted. He had already covered 15 m. that day, but at 11 P.M. he called on his men for a night march and formed up again on his old position next morning, Aug. 11. He appeared to be completely surrounded, and things looked so desperate that Mitchell, the British ambassador, burnt his papers and cipher key. At sunset on the 12th, however, Frederick again broke camp and by a night march evaded the enemy's scouts and reached Liegnitz at noon on the 13th, the Austrians appearing a couple of hours later. The troops rested during the 13th and 14th, but at nightfall, leaving their watch-fires burning, marched off by the Glogau road, and the only way of escape still open. The Austrians, however, had planned a night attack, and Loudon's columns were moving to close this last loophole of escape. Fortunately for the Prussians they arrived just a few minutes too late, and in the combat that ensued 15,000 Prussians inflicted a loss of 10,000 men and 82 guns upon their assailants, afterwards resuming their march undisturbed.

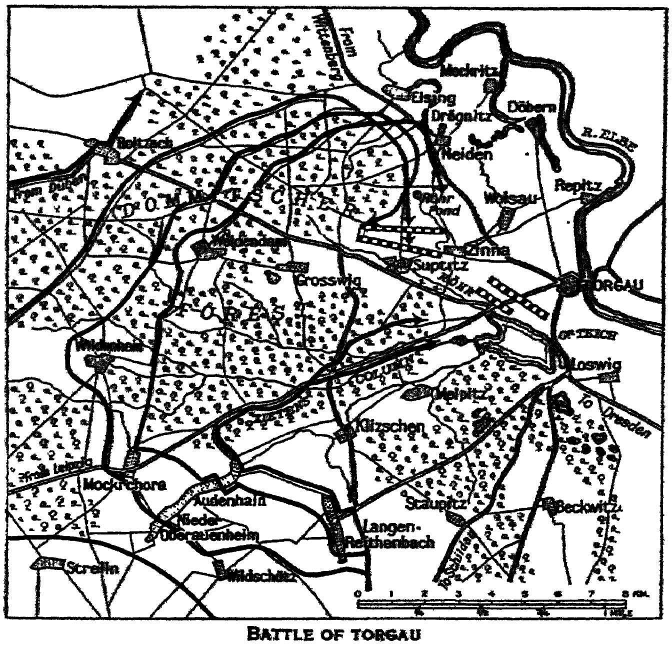
But the danger was not yet over. Czernicheff was known to be in the immediate vicinity; so as to get him out of the way, Frederick gave to a peasant a despatch addressed to Prince Henry containing the words: "Austrians totally defeated to-day, now for the Russians. Do what we agreed upon." The peasant was to take care to be captured by the Russians and only give up the paper to save his life. The plan worked as he had anticipated, the paper duly reached Czernicheff's hands and he immediately evacuated the dangerous neighbourhood. Elated with his success the king now abandoned his retreat on Glogau and determined to press on at all hazards to Breslau, which in spite of many anxious moments he reached on Aug. 17.

The Russians now abandoned the campaign in the open field and besieged Colberg on the Baltic coast. Frederick in Silesia manoeuvred for some weeks between Breslau, Schweidnitz and Glatz, but was suddenly recalled by the news of the capture of Berlin on Oct. 9 by Cossacks and portions of the Empire Army and Austrians from Saxony. On Oct. 11 the king was in full march, but the news of his approach was enough and the enemy dispersed, the Austrians and Empire Army making for Torgau. Daun, relieved of Frederick's pressure, now also moved to Torgau, leaving Loudon in Silesia, and had concentrated over 64,000 men at and around Torgau before Frederick had collected an attacking force of 45,000.

Battle of Torgau.—The position held by the Austrians was an entrenched camp fronting in all directions, but it was too cramped for their numbers and difficult to leave for a counter-stroke. Frederick determined to attack it both front and rear, and leaving Zieten to act against the former, he marched off at 6.30 on Nov. 3 to attack it as soon as Zieten should have thoroughly attracted the enemy's attention. But for once Zieten failed; he allowed himself to be drawn off by the Austrian light troops, and Frederick, in ignorance of the real state of affairs, launched his grenadiers against a thoroughly intact enemy, strongly entrenched, with, it is said, 400 guns in position to sweep the approaches. The grenadiers were simply swept away by grape and case—only 600 out of 6,000 remained, and Prussian batteries hurrying up to their support were destroyed before they had time to load. The attack was, however, renewed by fresh brigades as they came to hand, and the Prussian artillery did something to diminish the intensity of the Austrian case fire. The action began at 2 P.M. At 4.30, as the sun was setting, the king's last reserve of horse and foot at last succeeded in breaking the Austrian line and in the darkness there ensued a confused slaughter as at Zorndorf. The result was still in the balance when at length Zieten reached the field

and attacked at once. For an hour or so the struggle still raged, but the Austrians were by now completely spent and withdrew gradually into the fortress and then across the river. Out of 44,000 the Prussians had lost 13,120 men (30%), out of 65,000 the Austrians only 11,260 (17·3%), but of these over 7,000 were prisoners. Both sides, however, were completely paralysed by the struggle, and the year ended without further serious fighting.

On the western theatre of war Prince Ferdinand after the victory of Warburg had pressed the French back to the Rhine and



BATTLE OF TORGAU

besieged Wesel, but was compelled to raise the siege after suffering the defeat of Kloster-Kamp (Oct. 16) and to withdraw to Lippstadt and Warburg.

Campaign of 1761.—Torgau proved to be Frederick's last great battle. All parties were now so completely exhausted that they no longer were able to face the risks of a decision on the field. In the west Prince Ferdinand was first in the field, and in February and March he drove the French southward as far as Fulda, but an attempt to capture Marburg failed and the gradual pressure of French numerical superiority, together with the reduction of the British contingent on the death of George II., compelled him to retreat gradually until by the beginning of October both Brunswick and Wolfenbüttel fell into their hands. In the east the king had barely 100,000 men against 300,000 Austrians and Russians. Leaving Prince Henry to observe Daun in Saxony he marched to join von der Goltz, who with 23,000 stood about Schweidnitz. The Russians (50,000) under Buturlin were approaching from Posen, and Loudon with 72,000 men starting from Glatz manoeuvred to join them. After two months' skirmishing and marching the Allies effected their junction between Liegnitz and Jauer, having completely severed Frederick's communications with Prussia. But Frederick depended for his food and immediate supplies on Southern Silesia, and not caring to risk a battle with odds of three to one against him he withdrew into the entrenched camp of Bunzelwitz, where the Allies did not dare to attack him. Ultimately, as usual, the Russian commissariat broke down, and in September Buturlin withdrew the way he had come. Relieved of this antagonist, Frederick manoeuvred to draw Loudon out of his positions and compel him to fight in the open, but Loudon refused the challenge and after an attempt to surprise Schweidnitz, which failed, withdrew into winter quarters. Prince Henry in Saxony held his own against Daun.

England now threatened to withdraw her subsidies, and as the Prussian armies had dwindled to 60,000 men the end seemed very near. But a turn of fortune was already at hand. On Jan. 5, 1762, the tsaritsa died, and her successor, Peter III., at once offered peace. On March 16 an armistice was agreed to, and shortly afterwards the treaty of St. Petersburg was signed, by which Pomerania was given back to Prussia and a contingent of 18,000 men placed at Frederick's disposal. The withdrawal of the Russians led in turn to the withdrawal of the Swedes, and thus only France and Austria remained—the former bled white by the strain of her colonial disasters, the latter too weary to make further great exertions. Though the war dragged on for some months, and Prince Henry, assisted by Seydlitz, won the victory of Freiberg over the Empire Army (Oct. 29, 1762), no great battle was attempted, and although a revolution at St. Petersburg deprived Frederick of Russian assistance, in the autumn Ferdinand drove the French back over the Rhine, and thereupon an armistice was agreed upon by all. Final terms of peace were adjusted on *status quo ante* basis at Hubertusburg on Feb. 15, 1763. (F. N. M.)

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NAVAL OPERATIONS

When the Seven Years' War broke out, with the Prussian invasion of Saxony on Aug. 29, 1756, eight years had elapsed since the Peace of Aix-la-Chapelle, 1748, which concluded the War of the Austrian Succession. During the years 1754 and 1755 the French performed a number of hostile acts against the British on land and sea in various parts of the world to which the British retaliated, especially in the Mediterranean and along the frontier between French Canada and British America. Thus there existed during those two years a state of affairs which can be best described as an unofficial war of outposts between the British and French. Although no part of the Seven Years' War, it is convenient to review briefly the naval operations of those three years.

In June 1755 a British squadron under Boscawen was sent into the Straits of Belle Isle to intercept French ships carrying soldiers and stores. On June 8 Boscawen seized two French line-of-battle ships fitted as transports, the "Alcide" and the "Lys." Hawke was sent to sea with the Western Squadron and a general seizure of French merchant ships followed. The Government of Louis XV. did not reply by a declaration of war, but prepared to retaliate by a surprise invasion of the British Isles, which soon degenerated into a threat, which was, however, kept up as a feint to cover an expedition against Minorca.

A squadron of 12 sail of the line was prepared at Toulon under La Galissonière. It escorted transports carrying 15,000 troops under the duc de Richelieu. The danger to Minorca, where the garrison had been allowed to fall below its due strength, was well known to the British ministers. On March 11 they appointed Admiral John Byng to command a squadron which was to carry reinforcements. He had ten sail of the line, and reached Gibraltar on May 2. The French invasion of Minorca had been carried out on April 19. The governor of Gibraltar, Gen. Fowke, refused to part with any of his soldiers to reinforce Minorca, though under orders to do so, and on May 8 Byng sailed, and was off Minorca on the 19th. Before the officers of the garrison, whom he carried, could be landed, the French fleet came in sight. Byng had been joined by three ships of the line at Gibraltar, and had therefore 13 ships to 12. On the morning of May 20 he gained the weather-gauge, and then bore down on the enemy at an angle, the van of the English steering for the van of the French. The sixth ship in his line, the "Intrepid" (74), having lost her foretopmast, became unmanageable and threw the vessels behind her out of order. Thus the six in front were exposed to the fire of all the French, who were with difficulty repulsed. Being now much dis-

turbed by the crippled state of the ships in his van, Byng made no effort either to land the soldiers he had on board or to renew the action; and after holding a council of war on May 24, which confirmed his own desire to retreat, he sailed for Gibraltar, and Minorca surrendered in June, which gave the French a great advantage in the Mediterranean.

In 1757 the naval war began to be pushed with considerable vigour. The elder Pitt became the effective head of the Government, and was able to set about ruining the French power at sea. He sent out, during the last months of 1757 and the whole of 1758, a series of combined expeditions against the French coast which, though costly and for the most part unsuccessful, forced the French to divert large bodies of troops from the Rhine frontier. In the East Indies, the squadron under Vice-admiral Watson, with the assistance of the Company's troops under Clive, recaptured Calcutta in Jan. 1757 and Chandernagore in March. On Watson's death, Rear-admiral George Pocock succeeded to the command, and fought an indecisive action with the French squadron under M. d'Aché on April 29, 1758, off Cuddalore, and again on Aug. 3 off Negapatam, after which M. d'Aché retired to Mauritius. Meanwhile the French were so occupied on their eastern frontier and their Atlantic ports were so well watched, that they were unable to send sufficient reinforcements to their Colonists in Canada. Consequently, Boscawen and Gen. Amherst were able to undertake a combined operation against Louisburg, which capitulated on July 26, 1758, thus giving England control of the whole of Cape Breton island and the mouth of the St. Lawrence.

On the West Coast of Africa, Commodore Henry Marsh captured Senegal in May 1758, and Commodore Augustus Keppel captured Gorée in December. In 1759 the French made a last effort to retrieve their naval position. In European waters they again made plans for an invasion of the British Isles; but the attempted concentration of the Toulon fleet under de la Clue at Brest was defeated by Boscawen in a running fight ending in Lagos bay in August. On Nov. 20 Hawke, in Quiberon bay, defeated the Brest fleet under Conflans, which had slipped out while Hawke had had to withdraw the blockading forces owing to bad weather. Hawke and Boscawen's watch on the French Atlantic and Mediterranean ports had been so close that few ships of the line had been able to leave them during the year, and French colonial possessions had become completely isolated.

Throughout the summer Vice-admiral Charles Saunders conducted operations in the St. Lawrence, which resulted in his enabling General James Wolfe to surprise the French above Quebec, and defeat them on the heights of Abraham. This led to the immediate capitulation of Quebec on Sept. 18 and later to the capture of Montreal and the whole of French Canada. In the East Indies M. d'Aché fought one more action with Pocock, on Sept. 8, and then retired to Pondicherry, which fell in Jan. 1761. In the West Indies Commodore John Moore failed to capture the important French island of Martinique, but took Guadeloupe on May 1, 1759, after which many other islands fell into his hands.

During 1760 and 1761 the French fleet made no attempt to keep the sea. The British navy went on with the work of conquering French possessions. During 1760 it co-operated on the Lakes and on the St. Lawrence in the final conquest of Canada. Between April and June of 1761 it captured the island of Belle-Ile on the French coast, which both strengthened its means for maintaining blockade and gave the British Government a valuable pledge to be used for extorting concessions when the time for making peace arrived. The complete ruin of French merchant shipping and the collapse of the navy left the maritime population free to seek a livelihood in the privateers. Commerce-destroying was carried on by them with considerable success. The number of British merchant ships taken has been put as high as one-tenth of the whole. This was the price paid for the advantage gained by the ruin of the French as commercial rivals.

By the close of 1761 the maritime war was revived for a few months by the intervention of Spain. A close alliance, known as "the family compact," had been cemented with France earlier in the year. The secret was divulged, and Pitt would have made war on Spain at once. He was overruled and resigned. So soon, however, as the treasure ships from America had reached Spain, the Spanish Government declared war. Its navy was incapable of offering a serious resistance to the British, nor did it even attempt to operate at sea. The British Government was left unopposed to carry out the plans which Pitt had already prepared. The only aggressive movement undertaken by the Spanish Government was an attack on Portugal, which was the close ally of Great Britain and gave her the free use of Portuguese ports. Great Britain supported her ally, with a small force, and the Spaniard eventually retired. But the most effective blows against Spain were directed at her colonies. The British troops, left free by the recent success against the French in America, were employed firstly in a combined attack on Martinique under Rear-admiral G. B. Rodney, who captured the whole island by Feb. 1762. This was quickly followed by the capitulation of Grenada and St. Lucia. A powerful fleet left England in March 1762 bringing still more troops, with Pocock, who had recently returned from the East Indies, in supreme command. The expedition was ordered to attack Havana, and was off Cuba by June. The worst losses of the besiegers were due to the climate of Cuba, aided by bad sanitary arrangements. Of the 10,000 troops landed, three-fourths are said to have suffered from fever or dysentery, and the majority of the sick died. Yet the Moro was taken on Sept. 30, and Havana, which could have made a longer resistance, surrendered on Oct. 10. In the East Indies, where the surrender of Pondicherry had left other forces free, a combined expedition under Rear-admiral Cornish and Col. Draper captured Manila in Sept. 1761. The blockade of the French ports, and the defeat of their main battle fleets, had ruined all their hopes of invading the British Isles, and left their colonial possessions completely isolated. These were now practically all lost, and they could only set against them the capture of Minorca. The preliminaries of the peace of Paris were signed on Nov. 3, 1762.

See Sir Julian Corbett, *England in the Seven Years' War* (1918); Sir W. L. Clowes, *The Royal Navy*, vol. iii. (1898); M. Burrows, *Life of Admiral Lord Hawke* (1896). (G. A. R. C.; W. C. B. T.)

SEVERIANA, VIA, an ancient highroad of Italy, running south-east from Ostia to Terracina, 73 m. along the coast, taking its name from the restoration of an existing road by Septimius Severus. It ran along the shore at first, just behind the line of villas which fronted upon the sea, and are now half a mile inland. Further on, the ancient and modern coastlines coincide, and the road ran on the outside of the lagoons which lie to the north of the Circeian promontory.

SEVERING, WILHELM KARL (1875–), German statesman, was born at Herford, Westphalia on June 1, 1875, the son of a cigar-sorter. He worked for ten years in Bielefeld, Barmen and Zürich, as a locksmith, and after acting as secretary to the metal workers' union in Bielefeld (1902–10), obtained a post on the staff of a Socialist newspaper. He was appointed Commissioner for the Rhineland and Westphalia, and was responsible for the negotiations with the workmen who revolted in the Ruhr. He held office as Prussian minister of the interior from 1920 to 1925 (with one short interval), and was a staunch upholder of republican principles, being largely instrumental in suppressing the reactionary disturbances of 1923. The Republican Police force owes its organization chiefly to him. He was again minister of the interior in the Müller cabinet of 1927.

SEVERINUS, pope in 640, successor of Honorius. He occupied the papal chair only three months after his consecration, having had to wait a year and a half for its ratification by the emperor. During this long vacancy the exarch of Ravenna, supported by the military body of Rome (*exercitus Romanus*), occupied the Lateran and seized the treasure of the Church.

SEVERN, JOSEPH (1793–1879), English portrait and subject painter, was born at Hoxton on the 7th of December 1793, the son of a musician, who belonged to an old Gloucestershire family. During his earlier years he practised portraiture as a miniaturist; and, having studied in the schools of the Royal Academy, in 1818 he gained the gold medal for his "Una and the Red Cross Knight in the Cave of Despair." He was an intimate friend of Keats, whom he accompanied to Italy in 1820 and

nursed till his death in 1821. In 1861 he was appointed British consul at Rome, a post which he held till 1872, and during a great part of the time he also acted as Italian consul. His most remarkable work is the "Spectre Ship" from the *Ancient Mariner*. His portraits include several of Keats. He died at Rome on Aug. 3, 1879.

See the *Life and Letters*, by William Sharp (1892).

SEVERN (Welsh, *Hafren*, Roman, *Sabrina*), a river of Wales and England. It rises on the north-east side of Plynlimmon, on the south-west border of Montgomeryshire, and flows with a nearly semicircular course of about 210 m. to the Bristol channel. Its course is at first in a south-east direction, and for the first 15 m. it flows over a rough precipitous bed. At Llanidloes it bends north-east, passing Newtown and Welshpool; this part of the valley bearing the name of the Vale of Powys. It receives the Vyrnwy near Melverley, and forms a mile of the Welsh border, and then turning eastward enters Shropshire and waters the broad plain of Shrewsbury, after which it bends southward past Ironbridge and Bridgnorth to Bewdley in Worcestershire. In Shropshire it receives a number of tributaries, the chief of which is the Tern. In Worcestershire it passes Stourport, where it receives the Stour (left), and Worcester, shortly after which it receives the Teme (right). It enters Gloucestershire close to Tewkesbury, where it receives the Upper Avon (left), after which, bending south-west, it passes Gloucester, below which it becomes estuarine and tidal. A high bore, for which the Severn is notorious, may reverse the flow as high up as Tewkesbury Lock (13½ m. above Gloucester), and has sometimes caused great destruction. The estuary merges into the Bristol Channel at the point where it receives the Lower or Bristol Avon (left) and the Wye (right).

Like the Yorkshire Ouse, the river Severn collects on its right bank a number of streams which have remarkably parallel courses. Of these the Upper Severn, Teme, Wye and Usk flow in a direction a little south of east, whilst the Ebbw, Rhymney and Taff flow generally southward. The whole system drains over a half of Wales. It is assumed by Dr. A. Strahan (*Geology in the Field*, p. 856) that the system originated on a land surface of Upper Cretaceous and Tertiary strata, of which however nothing remains in the area. The eastward flowing streams, which may probably at one time have formed part of the Thames system, were captured one by one and diverted southward into the Bristol channel. The river had reached its base level when, in Pliocene times, the district, along with a much more extensive area, was affected by an uplift of from 400 to 600 feet. The effect of this uplift is seen in the incised meanders of the Wye and the occurrence of rock-steps in most of the valleys themselves. Above these steps the streams present all the characteristics of mature rivers. One such step occurs at the Ironbridge gorge which was considered by Prof. Lapworth (*op. cit.*, p. 768) to be due to river capture during the glacial period. The present Upper Severn and the Vyrnwy he considered were affluents of a river which, flowing northwards, was dammed by ice coming down from north Wales so that the water was ponded back and overflowed at Ironbridge into the Severn. This overflow channel was deepened sufficiently to bring about the permanent diversion of the streams when the ice retreated.

The upper part of Severn estuary is difficult of navigation, and therefore the Gloucester and Berkeley ship canal (16¾ m. long) was constructed, admitting vessels of 350 tons to Gloucester from the docks at Sharpness on the estuary. The navigation extends up to Arley, above Bewdley, 47 m. from Gloucester, and Stourport (43 m.), where the Staffordshire and Worcestershire canal gives access to the Wolverhampton and the Trent and Mersey navigation. There is connection with the Thames by the Stroudwater canal from Framilode, joining the Thames and Severn canal near Stroud. The Wye is in part navigable; the Bristol Avon gives access to the great port of Bristol, and the Upper Avon is in part navigable. The Severn is a good salmon river, and is famous for its lampreys, while many of the tributaries afford fine trout-fishing, such as the Teme and the Vyrnwy.

The Severn tunnel, carrying the G.W. railway under the estuary, forms the direct route between the south of England and south Wales. In order to relieve the pressure of traffic, the G.W. railway sought powers in 1924 to construct a bridge across the estuary. The scheme has been postponed until fuller enquiry can be made into the effects of such a construction upon tidal currents, etc. Another important project which has been postponed indefinitely is the "Severn barrage scheme" to utilize the high tides of the river to generate electrical power.

SEVERUS, LUCIUS SEPTIMIUS (A.D. 146–211), Roman emperor, was born of an equestrian family, on April 11, 146, at Leptis Magna on the coast of Africa. He had to learn Latin as a foreign language, and kept an African pronunciation all his life. Some time between 164 and 170 he came to Rome and studied law under Q. Cervidius Scaevola; he had Papinian as a fellow-pupil. Marcus Aurelius gave him the *latus clavus*, and at the age of 26 he went as *quaestor militaris* to Baetica, in Spain. While he was away in Africa, in consequence of his father's death, the emperor took over Baetica from the Senate, and gave them Sardinia, of which Severus became quaestor. In 174 or 175 he was legate to the proconsul of Africa, and then was tribune of the plebs, an office of dignity rather than importance. In that year he married Marcia, his first wife. In 178 or 179 he was praetor, and went to *Hispania Citerior* as *legatus iuridicus;* after that he commanded a legion in Syria. After the death of Marcus Aurelius he was unemployed for some time, and studied at Athens. He was governor of *Gallia Lugdunensis* in 186, and during his governorship occurred the revolt of Maternus. Niger, with whom he was afterwards to dispute the succession, was sent by Commodus to deal with it, and a letter from Severus to Commodus records his admiration for his future rival. At this period also, probably in 187, he married Iulia Domna, daughter of a priest of Baal at Emesa, and his son Caracalla was probably born on April 4, 188. He was proconsul of Sicily in 189, and *consul suffectus* in 190. Next year he went to Pannonia as governor. Here, in a province recently upset by the wars of the Antonines, he was in command of three legions, with his headquarters at Carnuntum. On the last day of 192 Commodus was murdered; Septimius' complicity is doubtful. His successor Pertinax, appointed by the senate, was murdered on March 28, 193, and another senator, Iulianus, bought the support of the praetorians. But it was not the guard but the legions that had the disposal of the throne. As soon as the news of the death of Pertinax reached him Severus gathered his troops, received their acclamation as emperor, and set out at once for Rome, having already indicated his role of avenger of Pertinax by adopting his name. Meanwhile two other governors had taken the same steps, but they were not his equals in speed, in strength, or in the important factor of proximity to Rome. Roughly, the continent of Europe was his, the legions of Britain had proclaimed for Albinus, and Syria for Niger. Albinus for the moment accepted the offer of the title of Caesar, which made him heir-apparent. Severus' march on Rome was desperately swift; no soldier took off his breastplate between Carnuntum and Rome, according to Dio, and his first success was the surrender of the fleet and town of Ravenna. Iulianus was quite inadequate, and when the praetorians deserted the Senate went over too.

Iulianus was murdered and Severus was immediately proclaimed emperor. Before entering the city he disbanded the guard and exiled them 100 miles from Rome; the new guard he formed was open to soldiers from all provinces of the empire. He then made a magnificent entry, performed funeral and deificatory rites over Pertinax, and before the end of July left for the East. The contest between Severus and Niger was practically decided by two or three engagements fought by Severus' officers. The last battle, at Issus, ended in the defeat and death of Niger (194). After this the emperor spent two years in successful attacks on the peoples bordering on Syria, particularly in Adiabene and Osrhoene. Byzantium, the first to be attacked, was the last to fall, after a glorious defence.

Late in 196 Severus turned westward, to reckon with Albinus, leaving affairs in the East by no means settled. As Severus was nearing Italy he received the news that Albinus had been declared emperor by his soldiers. The first counter-stroke of Severus was to affiliate himself and his elder son to the Antonines by a spurious

and posthumous adoption. Bassianus, the elder son of Severus, thereafter known as Aurelius Antoninus, was named Caesar in place of Albinus, and was thus marked out as successor to his father. Without interrupting the march of his forces, Severus contrived to make an excursion to Rome. Here he availed himself with much subtlety of the sympathy many senators were known to have felt for Niger. Though he was so far faithful to the decree passed by his own advice that he put no senator to death, yet he banished and impoverished many whose presence or influence seemed dangerous or inconvenient to his prospects.

The collision between the forces of Severus and Albinus was the most violent that had taken place between Roman troops since the contest at Philippi. The decisive engagement was fought on February 19 of the year 197 on the plain between the Rhône and the Saône, to the north of Lyons, and resulted in a complete victory for Severus.

Thus, released from all need for disguise, he "poured forth on the civil population all the wrath which he had been storing up for a long time" (Dio). He frightened the senate by calling himself the son of Marcus and brother of Commodus, whom he deified. He read a speech in which he declared that the severity and cruelty of Sulla, Marius and Augustus had proved to be safer policy than the clemency of Pompey and Julius Caesar, which had wrought their ruin. Over 60 senators were arrested on a charge of having adhered to Albinus, and half were put to death.

The next years (197–202) were devoted to war against the Parthians, who had invaded Mesopotamia, and Severus recovered and annexed Mesopotamia, and spent some time in what seems to have been a rather unsuccessful punitive expedition. On his return journey he visited Egypt; Dio observes that he was not the man to leave anything, human or divine, uninvestigated. He returned to a triumph, commemorated still by the arch that bears his name. For the next six years (202–208) Severus lived at Rome. Nothing of great importance happened except the fall of Plautianus, praefect of the guard, an African like his master, who exercised a more complete dominance than any favourite since Seianus. He was thoroughly hated by both Iulia and Caracalla, and Caracalla invented a plot against the emperor's life in which Plautianus was supposed to be implicated, and had him put to death in 205. Severus spent the last three years of his life (208–211) in Britain, which had been unsettled for some time. He seems to have welcomed military service as a chance of healing the strife between his sons Caracalla and Geta, and getting them away from Rome. He died at York on Feb. 4, 211.

Administration.—In military history his reign is important, marking the beginning of the admittedly military despotisms. His main work in this sphere was the throwing open of the praetorian guard to the empire, the establishment of a centralised force in Italy (a long step towards the complete assimilation of Italy to the provinces), and a series of improvements in the conditions and rewards of service, including permission to the soldiers to have their wives with them, and the opening of the equestrian civil service career to the veterans.

In his home administration the chief feature is the further reduction in the importance of the senate, combined with an increase in the powers and duties of the equites, and especially of their chief members, the *praefecti praetorio.*

The Legal Praefect becomes the most important subject in the empire, with administrative as well as judicial powers; the *praefectus annonae* disappears in this reign, and his duties are absorbed by Papinian, the first and most distinguished of a long line of judicial *praefecti.* They repaid their advancement by working the theory of absolutism into Roman law. Severus' laws show a growing humanitarian tendency, and a renewed attempt to carry out the social policy of the *Lex Iulia de adulteriis.* His financial policy is marked by the growth of a new treasury, the *res privata,* the emperor's personal property, distinct from the Crown property.

As a result of his own troubles with the holders of big provincial commands he tended to split up the largest, *e.g.,* Britain, Syria and Africa, into divided commands. On the whole the reign of Severus was one of peace and prosperity in the provinces.

The foregoing account, though mainly confined to undisputed facts, implies a favourable estimate of Severus' administration, and is based on Platnauer (see *inf.*). Mention must be made, however, of the view of Rostovtzev (*infra*), who bases on the same facts a wholly different interpretation, in which Severus appears as responsible for the demoralisation and, if not the barbarisation, yet at least the "democratisation and provincialisation" of the army, as responsible for the abandonment of the policy of the Antonines in favour of a dynasty supported by the army, and as having sacrificed the upper classes of the empire to the peasants, from whom the army was now drawn. Where they differ flatly is in their estimate of the condition of the provinces during the reign.

In literature and philosophy the reign is undistinguished, but interesting on account of Iulia Domna, the philosophic Empress, and her circle, which included Diogenes Laertius, Galen, Aelian, the lawyers Papinian and Ulpian, and Philostratus, the author of that abortive gospel, the *Life of Apollonius of Tyana.* Severus himself was markedly superstitious, but there is nothing to connect him with the surge of Eastern mysticism that his wife fostered. What we have of his is a definite edict against conversion to Christianity.

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SEVERUS, MARCUS AURELIUS ALEXANDER: *see* Alexander Severus; Marcus Aurelius.

SEVERUS, SULPICIUS (*c.* 363–*c.* 425), Christian writer, was a native of Aquitania. He was imbued with the culture of his time and of his country, which was then the only true home of Latin letters and learning. Almost all that we know of Severus' life comes from a few allusions in his own writings, and some passages in the letters of his friend Paulinus, bishop of Nola. In his early days he was famous as a pleader, and his knowledge of Roman law is reflected in parts of his writings. He married a wealthy lady belonging to a consular family, who died young, leaving him no children. At this time Severus came under the powerful influence of St. Martin, bishop of Tours, by whom he was led to devote his wealth to the Christian poor, and his own powers to a life of good works and meditation.

The chief work of Severus is the *Chronica* (*c.* 403), a summary of sacred history from the beginning of the world to his own times, with the omission of the events recorded in the Gospels and the Acts, "lest the form of his brief work should detract from the honour due to those events." The book was a text-book, and was used as such in the schools of Europe for about a century and a half after the *editio princeps* was published by Flacius Illyricus in 1556. As a historian of the past Severus has little value. The real interest of his work lies, first, in the incidental glimpses it affords all through of the history of his own time; and in the information he has preserved concerning the struggle over the Priscillianist heresy, which disorganized and degraded the churches of Spain and Gaul, and particularly affected Aquitaine. The sympathies here betrayed by Severus are wholly those of St. Martin. Severus loses no opportunity for laying stress on the crimes and follies of rulers, and on their cruelty, though he once declares that, cruel as rulers could be, priests could be crueller still. This last statement has reference to the bishops who had left Maximus no peace till he had stained his hands with the blood of Priscillian and his followers. Martin, too, had denounced the worldliness and greed of the Gaulish bishops and clergy. Severus also fully sympathized with the action of St. Martin touching Priscillianism.

After the *Chronica* the chief work of Severus is his *Life of Martin*, a catalogue of miracles, told in all the simplicity of absolute belief. Two *Dialogues* and the *Epistles* on the death of Martin complete the list of Severus' genuine works.

Authorities.—The text of the *Chronica* rests on a single 11th century ms., one of the Palatine collection now in the Vatican; of the other works mss. are abundant, the best being one of the 6th century at Verona. The complete works of Severus were edited by Halm (forming vol. i. of the *Corpus scriptorum ecclesiasticorum Latinorum*, Vienna, 1866).

SEVIER, JOHN (1745–1815), American frontiersman, and first governor of Tennessee, was born in Rockingham county, Va., Sept. 23, 1745. He settled on the Watauga river west of the Alleghanies. When this territory was annexed to Tennessee in 1776, Sevier was elected as its representative to the provincial congress which drew up the first state constitution. He served as captain in Lord Dunmore's War in 1774. He took an active part in the battle of King's Mountains in 1780, and in the following year he served under General Francis Marion against the British in the Carolinas and Georgia. In 1780 he defeated the Cherokees at Boyd's Creek. When North Carolina ceded her western lands to the Federal government in 1784, Sevier took part in the revolt against the parent state which resulted in the formation of the separate state of Franklin and was elected its first governor. By 1786 the Conservative party had regained control, and Sevier was tried for high treason and convicted, but was subsequently pardoned. In 1789 he was a member of the North Carolina Senate, and in 1790–91 of the National House of Representatives. After the final cession of its western territory by North Carolina to the United States in 1790 he was appointed brigadier-general of militia for the eastern district of the "Territory South of the Ohio"; and when Tennessee was admitted into the Union as a state, Sevier became its first governor (1796–1801) and was governor again in 1803–09. He was a member of the National House of Representatives in 1811–15, and then was commissioner to determine the boundary of Creek lands in Georgia. He died near Fort Decatur (Ga.), Sept. 24, 1815.

See J. R. Gilmore, *The Rear-Guard of the Revolution* (New York, 1896), and *John Sevier as a Commonwealth Builder* (New York, 1887); errors in Gilmore's books are pointed out in Theodore Roosevelt's *The Winning of the West* (New York, 1894–96).

SÉVIGNÉ, MARIE DE RABUTIN-CHANTAL, Marquise de (1626–1696), French letter-writer, was born at Paris on Feb. 5, 1626. The family of Rabutin (if not so illustrious as Bussy, Madame de Sévigné's notorious cousin, affected to consider it) was one of great age and distinction in Burgundy. Marie's father, Celse Bénigne de Rabutin, Baron de Chantal, was killed during the English descent on the Isle of Rhé in July 1627. His wife did not long survive him many years, and Marie was left an orphan at the age of seven. At the age of ten she passed into the guardianship of her uncle Christophe de Coulanges, abbé de Livry. Readers of his niece's letters know how well "Le Bien Bon" fulfilled the trust. Long after his nominal duties were ended he was in all matters of business the good angel of the family, while for half a century his abbacy of Livry was the favourite residence both of his niece and her daughter. Coulanges provided his niece with an admirable education. Jean Chapelain and Gilles Ménage are specially mentioned as her tutors, and Ménage at least fell in love with her. Another literary friend of her youth was the poet Denis Sanguin de Saint-Pavin. She was intimate with all the coterie of the Hôtel Rambouillet, and her special ally was Mademoiselle de la Vergne, afterwards Madame de la Fayette. In person she was extremely attractive, though the minute critics of the time objected to her divers deviations from regular beauty. Her long minority, under so careful a guardian as Coulanges, had also raised her fortune to the amount of 100,000 crowns. She married (1644) Henri, marquis de Sévigné, a Breton gentleman of good family, allied to the oldest houses of that province, but of no great estate. They settled at Sévigné's manor-house of Les Rochers, near Vitré. It may be suspected that the happiest days of Madame de Sévigné's brief married life were spent there. For there at any rate her husband had less opportunity than in Paris of neglecting her, and of wasting her money and his own. Henri de Sévigne was one of the innumerable lovers of Ninon de l'Enclos, and made himself even more conspicuous with a certain Madame de Gondran, known in the nickname slang of the time as "La Belle Lolo." He was wildly extravagant. That his wife loved him and that he did not love her was generally admitted. He quarrelled with the Chevalier d'Albret about Madame de Gondran, fought with him and was mortally wounded on Feb. 4, 1651.

There is no reasonable doubt that his wife regretted him a great deal more than he deserved. Though only five and twenty, and more beautiful than ever, she never married again. For the rest of her life she gave herself up to her two children, Françoise Marguerite (b. 1646), and Charles (1648). To Charles Madame de Sévigné was an indulgent, a generous (though not altogether just) and in a way an affectionate mother. Her daughter, the future Madame de Grignan, she worshipped with an almost insane affection. For nearly ten years she lived an uneventful life at Paris in a house she occupied in the Place Royale (not as yet in the famous Hôtel Carnavalet), at Les Rochers, at Livry or at her own estate of Bourbilly in the Mâconnais. She had, however, in 1658, a quarrel with her cousin Bussy over a loan. He gives a malicious portrait of her in his *Histoire amoureuse*. The quarrel was never quite healed, though after Bussy's disgrace in 1666 correspondence was renewed.

In 1661, at the downfall of the Superintendent Fouquet, it was announced on indubitable authority that communications from Madame de Sévigné had been found in the coffer where Fouquet kept his love letters. Bussy obtained from Le Tellier, who as minister had examined the letters, a corroboration of her protest that the letters were merely those of a friend. Nevertheless, there have always been those who held that Madame de Sévigné regarded Fouquet with at least a very warm kind of friendship. During these earlier years Madame de Sévigné had a great affection for the establishment of Port Royal.

Madame de Grignan.—The bulk of Madame de Sévigné's letters are addressed to her daughter, who married in 1668 François d'Adhémar, comte de Grignan, a Provençal, of one of the noblest families of France. He had been twice married, and his great estates were heavily encumbered. Neither did the large dowry (300,000 livres) which Madame de Sévigné, somewhat unfairly to her son, bestowed upon her daughter, suffice to clear encumbrances. In 1669 M. de Grignan, who had previously been lieutenant-governor of Languedoc, was transferred to Provence. The governor-in-chief was the young duke of Vendôme. But at this time he was a boy, and he never really took up the government, so that Grignan for more than forty years was in effect viceroy of this important province. His wife liked the part of vice-queen; but their peculiar situation threw on them the expenses without the emoluments of the office, so that the Grignan money affairs hold a larger place in Madame de Sévigné's letters than might perhaps be wished.

1671–1691.—Madame de Sévigné lived in Paris from 1677 onwards in the Hôtel de Carnavalet, but she spent part of the year usually on her estate at Les Rochers. She was there when the estates of Brittany were convoked at Vitré in 1671, and she was there in 1675 when the province was being punished for its resistance to illegal taxation. Occasionally she was able to enjoy her daughter's society. She spent a year with the de Grignans in Provence in 1672–3, and the whole Grignan family paid a long visit to the Hôtel de Carnavalet in 1677. Between 1680 and 1688 the Grignans were in Paris for a great part of their time. The bulk of the letters from Madame de Sévigné to her daughter therefore belong to the period before 1677.

In 1679 Madame de Sévigné lost La Rochefoucauld, the most eminent and one of the most intimate of her close personal friends and constant associates. In 1684 Charles de Sévigné married a young Breton lady, Jeanne Marguerite de Mauron, who had a considerable fortune. In the arrangements for this marriage Madame de Sévigné practically divided all her fortune between her children (Madame de Grignan of course receiving an unduly large share), and reserved only part of the life interest. In 1687 the Abbé de Coulanges died. In the same year Madame de Sévigné was present at the Saint-Cyr performance of *Esther*,

and some of her most amusing descriptions of court ceremonies and experiences date from this time. 1689 and 1690 were almost entirely spent by her at Les Rochers with her son; and on leaving him she went across France to Provence. 1691 was passed at Grignan and other places in the south, but at the end of it Madame de Sévigné returned to Paris, bringing the Grignans with her; and her daughter stayed with her till 1694.

Last Years.—The year 1693 saw the loss of two of her oldest friends—Bussy Rabutin, her faithless and troublesome but in his own way affectionate cousin, and Madame de la Fayette, her life-long companion, and on the whole perhaps her best and wisest friend. Another friend almost as intimate, Madame de Lavardin, followed in 1694. Madame de Sévigné spent but a few months of this latter year alone, and followed her daughter to Provence. She never revisited Brittany after 1691.

During an illness of her daughter Madame de Sévigné herself was attacked by smallpox in April 1696, and she died on the 17th of that month at Grignan, and was buried there. Her idolized daughter was not present during her illness. But in her will Madame de Sévigné still showed her preference for this not too grateful child. Charles de Sévigné died on March 26, 1713. His widow survived him twenty years. Madame de Grignan had died on August 16, 1705, at a country-house near Marseilles, of the very disease which she had tried to escape by not visiting her dying mother. Her son, who had fought at Blenheim, had died of the same malady at Thionville the year before. Marie Blanche, her eldest daughter, was in a convent, and, as all the comte de Grignan's brothers had either entered the church or died unmarried, the family, already bankrupt in fortune, was extinguished in the male line by Grignan's own death in 1714, at a great age.

The Letters.—Madame de Sévigné was a member of the strong and original group of writers—Retz, La Rochefoucauld, Corneille, Pascal, Saint-Evremond, Descartes and the rest—who escaped the influence of the later 17th century, while they profited by the reforms of the earlier. According to the strictest standard of the Academy her phraseology is sometimes incorrect, and it occasionally shows traces of the quaint and affected style of the *Précieuses;* but these things only add to its savour and piquancy. In lively narration few writers have excelled her, and in the natural expression of domestic and maternal affection none. She had an all-observant eye for trifles and the keenest possible appreciation of the ludicrous, together with a hearty relish for all sorts of amusements, pageants and diversions, and a deep though not voluble or over-sensitive sense of the beauties of nature. But with all this she had an understanding as solid as her temper was gay.

Unlike her daughter, she was not a professed blue-stocking. But she had a strong affection for theology, in which she inclined (like the great majority of the religious and intelligent laity of her time in France) to the Jansenist side. Her favourite author in this class was Nicole. She has been reproached for her fondness for the romances of Mlle. de Scudéry and the rest of her school. But probably many persons who make that reproach have themselves never read the works they despise, and are ignorant of how much merit there is in them. In purely literary criticism Madame de Sévigné was no mean expert. Her preference for Corneille over Racine has much more in it than the fact that the elder poet had been her favourite before the younger began to write; and her remarks on La Fontaine and some other authors are both judicious and independent. Nor is she wanting in original reflections of no ordinary merit. But to enjoy her work in its most enjoyable point—the combination of fluent and easy style with quaint archaisms and tricks of phrase—it must be read as she wrote it, and not in the trimmed and corrected version of Perrin and Madame de Simiane.

BIBLIOGRAPHY.—Madame de Sévigné's correspondence with Bussy Rabutin appeared in his *Memoirs and Correspondence,* partly in the year of her death, partly next year. The remainder was not printed in any form for 30 years. The number of unauthorized editions of the letters which appeared, taken from copies of letters privately circulated caused Madame de Simiane (d. 1737), the daughter of Madame de Grignan, to give an authorized version. This appeared under the care of the Chevalier de Perrin in 6 vols. (1734–37). It contained only the letters to Madame de Grignan, and these were subjected to editing rather more careful than conscientious, the results of which were never thoroughly removed until recently. Madame de Simiane, who possessed her mother's replies, is said to have burnt the whole of these from religious motives; this phrase is explained by Madame de Grignan's Cartesianism, which is supposed to have led her to expressions alarming to orthodoxy. There were numerous omissions and alterations of style and language. Perrin followed up this edition in 1751 with a volume of supplementary letters to other persons, and in 1754 published his last edition of the whole, which was long the standard (8 vols., Paris). During the last half of the 18th century numerous editions of the whole or parts appeared with important additions, such as that of 1756, giving for the first time the letters to Pomponne on the Fouquet trial; that of 1773, giving letters to Moulceau; that of 1775, giving for the first time the Bussy letters separate from his memoirs, etc. An important collected edition of all these fragments, by the Abbé de Vauxcelles, appeared in 1801 (Paris, An. IX.) in 10 vols.; five years later Gouvelle (Paris, 1806, 8 vols.) introduced the improvement of chronological order; this was reprinted in 12 vols. (Paris, 1819) with some more unpublished letters which had separately appeared meanwhile. In the same year appeared the first edition of M. de Monmerqué. From that date continual additions of unpublished letters were made, in great part by the same editor, and at last the whole was remodelled on MS. copies (the originals unfortunately are available for but few) in the edition called *Des Grands Écrivains,* which M. de Monmerqué began, but which owing to his death had to be finished by MM. Regnier, Paul Mesnard and Sommer (1862–68). This, which supersedes all others (even a handsome edition published during its appearance by M. Silvestre de Sacy), consists of 12 volumes of text, notes, etc., two volumes of lexicon and an album of plates. It contains all the published letters to and from Madame de Sévigné, with the replies where they exist, with all those letters to and from Madame de Simiane (many of which had been added to the main body) that contain any interest. To it must be added two volumes (printed uniformly) of *Lettres inédites,* published by M. Ch. Capmas in 1876 and containing numerous variants and additions from a ms. copy discovered in an old curiosity shop at Dijon. Of less elaborate and costly editions that in the collection Didot (6 vols., v.d.) is the best, though, it contains an adulterated text. There are many English translations of the Letters. One of the early English translations, was reprinted, with additions, and with a preface by Madame Ducloux in 1928 (10 vols.). Another edition, with introduction by A. E. Newton (7 vols.) also appeared in 1928.

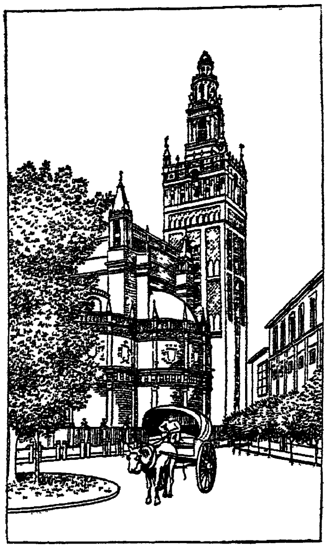
Works on Madame de Sévigné are innumerable. Besides essays by nearly all the great French critics from Sainte-Beuve (*Portraits de femmes*) to M. Brunetière (*Études critiques*), the work of F. Combes, *Madame de Sévigné, historien* (1885), and G. Boissier's volume in the *Grands Écrivains Français* (1881), should be consulted. The biography by Paul Mesnard is nearly exhaustive, but the most elaborate biographical book is that of Walckenaer (3rd ed., Paris, 1856, 5 vols.), to which should be added the remarkable *Histoire de Mme. de Sévigné* of Aubenas (Paris and St. Petersburg, 1842). In English an excellent little book by Miss Thackeray (Lady Ritchie) (1881) may be recommended, and also Janet Aldis's *Mme de Sévigné: The Queen of Letter-writers* (1907). Most of the editions have portraits.

See also E. Angot, *Dames du grand Siècle* (1919); E. Fitzgerald, *Dictionary of Madame de Sévigné* (2 vols. 1914); H. Hallays, *Madame de Sévigné* (1921).

SEVILLE, an inland province of southern Spain, one of the eight provinces into which Andalusia was divided in 1833; bounded on the north by Badajoz, north-east by Cordova, south by Málaga and Cadiz and west by Huelva. Pop. (1920) 703,747; area 5,428 sq. miles. The province is bisected by the navigable river Guadalquivir (*q.v.*), which here receives the Genil and Guadaira on the left, and the Guadalimar on the right. West of the Guadalquivir the surface is broken by low mountain ranges forming part of the Sierra Morena; the eastern districts are comparatively flat and very fertile, except along the frontiers of Cadiz and Málaga, where rise the Sierras of Gibalbin and Algodonales; and there are extensive marshes near the Guadalquivir estuary. Coal, copper, iron ore, silicate of alumina, marble and chalk are the chief mineral products; the province is famous for its oranges, and also exports wheat, barley, oats, maize, olives, oil, wine and chick-peas. Seville is the capital and chief riverport. Other important towns of the province are Écija—pop. 1920—(29,934), Carmona (22,095), Utrera (21,316), Moron de la Frontera (18,758), Osuna (16,374), Marchena (5,309), Lebrija (12,012).

SEVILLE, the capital of the Spanish province of Seville, and the chief city of Andalusia, on the left bank of the river Guadalquivir, 54 m. from the Atlantic Ocean, and 355 m. by rail S.S.W. of Madrid. Pop. (1900) 148,315. Seville is an archiepiscopal

see, a port with many thriving industries, and in size the fourth city in the kingdom, ranking after Madrid, Barcelona and Valencia. Its history and its treasures of art and architecture render it one of the most interesting places in Europe. Few parts of the city are more than 30 feet above sea level and, owing to the frequency of floods, an elaborate system of defences against the Guadalquivir and its affluents the Guadaira, Tamarguillo and Tagarete, was undertaken in 1904. This entailed the construction (spread over many years) of dykes, walls and surface drains, the raising of certain streets and railway embankments and the diversion of the lower Tagarete along a new channel leading into the Tamarguillo. The climate is pleasant at all seasons except in summer, when the heat is excessive.



SEVILLE CATHEDRAL, THE SECOND LARGEST CHURCH IN THE WORLD
Once a mosque, the Giralda, or campanile, for which this church is distinguished, was built by the Moors, A.D. 1196

The townsfolk, and the peasants who have come to town for bull-fights, fairs or carnivals, have preserved many of the curious old customs which tend to die out in the other large cities of Spain; they continue to wear the vivid costumes which suit the sunny climate of Andalusia; and their own gaiety, wit and grace of manner are proverbial. Nowhere else in Spain are great church festivals celebrated with so much splendour. Easter at Seville is especially famous, and at this season the city is usually crowded with foreigners.

Principal Buildings.—The Cathedral, dedicated to Santa Maria de la Sede, is one of the largest churches in the world, being 414 ft. long, 271 ft. wide and 100 ft. high to the roof of the nave. Building began in 1402 and was finished in 1519, so that the one style of Spanish Gothic is fairly preserved throughout the interior, however much the exterior is spoiled by later additions. The interior forms a parallelogram containing a nave and four aisles, a centre dome 121 ft. high, and at the east end a royal sepulchral chapel, which was an addition of the 16th century. The thirty-two immense clustered columns, the marble floor (1787–1795) and the seventy-four windows filled with painted glass, mostly by Flemish artists of the 16th century, produce an unsurpassed effect of magnificence. The reredos is an enormous Gothic work containing forty-four panels of gilt and coloured wood carvings begun by the Fleming Dancart in 1479 and completed by Spanish artists in 1526; the silver statue of the Virgin is by Francisco Alfaro (1596). The Cathedral contains many treasures of 16th century craftsmanship; the tomb of St. Ferdinand of Castile (1200–1252) and a curious life size image of the Virgin, which was presented to St. Ferdinand by St. Louis of France in the 13th century. It is carved wood with movable arms, seated on a silver throne and with hair of spun gold. The chief pictures in the cathedral are the "Guardian Angel," the "St. Anthony," and other works of Murillo; the "Holy Family" of Alphonso Miguel de Tobar (1678–1738); the "Nativity" and "La Generacion" of Luis de Vargas; Valdés Leal's "Marriage of the Virgin," and Guadalupe's "Descent from the Cross." In the Sacristia Alta are three fine paintings of Alexo Fernandez, and in the Sala Capitular are a "Conception" by Murillo and a "St. Ferdinand" by Francesco Pacheco. The organs (1777 and 1827) are among the largest in the world. A curious and unique ritual is observed by the choir boys on the festivals of Corpus Christi and the Immaculate Conception—a solemn dance with castanets being performed by ten of them before the altar; the custom is an old one but its origin is obscure. The Sagrario (1618–1662) on the north of the cathedral, a Baroque addition by Miguel de Zumarraga and Fernandez de Inglesias, which is the parish church. At the north-east corner of the cathedral stands the Giralda, a bell tower of Moorish origin, 295 ft. in height. The lower part of the tower, or about 185 ft., was built in the latter half of the 12th century by Yusuf I.; the upper part of the belfry, which is surmounted by a vane formed of a bronze figure 14 ft. high representing faith, were added (1568) by Fernando Ruiz in the Renaissance style. The ascent is made by a series of inclined planes. The exterior is encrusted with delicate Moorish detail, and the tower is altogether the finest specimen of its kind in Europe. At the base lies the Court of Oranges, of which only two sides now remain; the original Moorish fountain however, is preserved.

On the whole, the chief relic of the Arab dominion in Seville is the Alcazar, a palace comparable in interest and beauty only with the Alhambra of Granada. It was begun in 1181 during the best period of the Almohades, and was surrounded by walls and towers of which the Torre del Oro, a decagonal tower on the river side, is now the principal survival. The Torre del Oro (1220) has an 18th century superstructure. Among other Moorish remains in Seville may be mentioned the Minaret of San Marcos, the Casa de Pilatos, the 15th century Casa de los Pinelos (Casa de Abades) and the 15th century palace of the dukes of Alva (Palacio de las Duenas or de las Pinedas).

The churches of Seville are enriched by paintings or sculptures of Pacheco, Montanes, Alonso Cano, Valdes Leal, Roelas, Campana, Morales, Vargas and Zurbaran. The church of La Caridad has six admirable Murillos. The museum was formerly the church and convent of La Merced. It now contains priceless examples of the Seville school of painting, which flourished during the 16th and 17th centuries. Among the masters represented are Velazquez and Murillo (both natives of Seville), Zurbaran, Roelas, Herrera the Elder, Pacheco, Juan de Castillo, Alonso Cano, Cespedes, Bocanefra, Valdes Leal, Goya and Martin de Vos.

The school founded in 1256 by Alfonso X, became a university in 1502; its present buildings were originally a Jesuit college built in 1567 from designs either by Herrera or by the Jesuit Bartolomé de Bustamente. The Lonja or exchange was designed by Herrera and completed in 1598; a brown and red marble staircase leads to the Achivo de Indias, which contains 30,000 volumes relating to the voyage of Spanish discoverers, many of which are still unexamined. The archbishop's palace dates from 1697; the most notable features are the Churrigueresque doorway and staircase. The palace of San Telmo was formerly the seat of a naval college founded by Ferdinand Columbus. Other noteworthy buildings are the Mudejar palaces of the duke of Osuna and the count of Penaflor; the house occupied by Murillo at the time of his death (1682); the civil hospital built in 1559 and enlarged in 1842; the foundling hospital (1558); the bull-ring with room for 14,000 spectators; and fragments of the city walls, which once had a circumference of more than 10 m., with 12 gateways and 166 towers.

Commerce and Industries.—The port of Seville, in 37° 10′ N. and 5° 10′ W. has always been one of the chief outlets of the wealth of Spain. It is the terminus of three railways to Madrid, and of other lines to Cadiz, Almorchon, Ciudad Real, Huelva, Badajoz and Lisbon. Three of these lines have branches down to the water-side of the quays. The quay on the left bank 4,500 ft. long is provided with powerful cranes, and sheds for merchandise. Navigation up the Guadalquivir from its mouth to Seville (where the river is still tidal) is less dangerous for steamers than for sailing vessels, but is nevertheless uncertain. The construction of a ship-canal 4 m. long from the Punta de los Remedios to the Punta de los Verde—two points between which the windings of the river make navigation especially difficult—was first proposed in 1859 and was undertaken in 1907. Dredging operations were begun at the same time, so that on completion of the canal vessels drawing 25 ft. (instead of 16 ft.) could come up to Seville. The principal exports are Manzanilla, Amontillado and other wines, oranges and lemons, iron and lead ores, mercury, olives, oil, cork and wool. The royal artillery works and iron foundries and the porcelain and earthenware factory in the Carthusian convent are important. Pottery has been the characteristic industry of the Triana from time immemorial; the patron saints of Seville, Justa

and Rufina, are said by tradition to have been potters here. Equally important is the great tobacco and cigar factory.

History.—Seville appears originally to have been an Iberian town. Under the Romans the city was made the capital of Baetica in the second century B.C., and became a favourite resort for wealthy Romans. It was captured in 45 B.C. by Julius Caesar who gave it the name of Colonia Julia Romula, and made it one of the conventus juridici. The emperors Hadrian, Trajan and Theodosius were born in the neighbourhood at Italica (now Santiponce), where are the remains of a considerable amphitheatre. The chief existing monument of the Romans in Seville itself is the remains of an aqueduct, on four hundred and ten arches, by which water from Alcala de Guadaira was supplied to the town. At the beginning of the 5th century the Silingian Vandals made Seville the seat of their empire, until it passed in 531 under the Visigoths, who chose Toledo for their capital. After the defeat of Don Roderick at Guadalete in 712 the Moors took possession of the city after a siege of some months. Under the Moors Seville continued to flourish. Idrisi speaks in particular of its great export trade in the oil of Aljarafe. The district was in great part occupied by Syrian Arabs from Emesa, part of the troops that entered Spain with Balj in 741 at the time of the revolt of the Berbers. It was a scion of one of these Emesan families, Abū 'l-Kāsim Mohammed, cadi of Seville, who on the fall of the Spanish caliphate headed the revolt of his townsmen against their Berber masters (1023) and became the founder of the Abbadid dynasty, of which Seville was capital, and which lasted under his son Mo'tadid (1042–1069) and grandson Mo'tamid (1069–1091) till the city was taken by the Almoravides. The later years of the Almoravide rule were very oppressive to the Muslims of Spain; in 1133 the people of Seville were prepared to welcome the victorious arms of Alphonso VII., and eleven years later Andalusia broke out in general rebellion. Almohade troops now passed over into Spain and took Seville in 1147. Under the Almohades Seville was the seat of government and enjoyed great prosperity; the great mosque (now destroyed) was commenced by Yusuf I. and completed by his son Almanazor. In the decline of the dynasty between 1228 and 1248 Seville underwent various revolutions, and ultimately acknowledged the Hafsite prince, but Ferdinand III. restored it to Christendom in 1248. Ferdinand brought temporary ruin on the city, for it is said that 400,000 of the inhabitants went into voluntary exile. But the position of Seville was too favourable for trade for it to fall into permanent decay, and by the 15th century it was again in a position to derive full benefit from the discovery of America. After the reign of Philip II., its prosperity waned with that of the rest of the Peninsula; yet even in 1700 its silk factories gave employment to thousands of workpeople; their numbers however by the end of the 18th century had fallen to four hundred. In 1800 an outbreak of yellow fever carried off 30,000 of the inhabitants and in 1810 the city suffered severely from the French under Soult, who pillaged to the extent of six millions sterling. Politically Seville has always had the reputation of peculiar loyalty to the throne from the time when, on the death of Ferdinand III., it was the only city which remained faithful to his son Alphonso the Wise. It was consequently favoured by the monarchs, and frequently a seat of the court. For its loyalty during the revolt of the Comuneros it received from Charles V., the motto *Ab Hercule et Caesare nobilitas; a se ipsa fidelitas.* In 1729 the treaty between England, France and Spain was signed in the city; in 1808 the central junta was formed here and removed in 1810 to Cadiz; in 1823 the Cortes brought the king with them from Madrid; and in 1848 Seville combined with Malaga and Granada against Espartero, who bombarded the city but fled on the return of Queen Maria Cristina to Madrid.

See P. de Madrazo, *Sevilla y Cadiz* (Madrid, 1884–86): Contreras, *Estudio de los monum. drabes de Sevilla y Cordova* (Madrid 1885); J. Gestoso y Perez, *Sevilla monumental y artistica* (3 vols., Seville, 1889–92); A. F. Calvert, *Seville* (1907); J. Guichot y Parodi, *Historia del Ayuntamiento de la ciudad de Sevilla* (3 vols., Seville 1896–98); J. Cascales y Munoz, *Sevilla intellectual* (Madrid 1896); W. M. Gallichan, *The Story of Seville* (1903).

SÈVRES, a town of northern France, in the department of Seine-et-Oise, on the left bank of the Seine, midway between Paris and Versailles, about 3 m. from the fortifications of the former. Pop. (1926) 14,171. The town owes its celebrity to the porcelain manufactory established there in 1756 and taken over by the State three years later. The works museum has a general collection of pottery and the whole series of models employed at Sèvres from the beginning of the manufacture, for an account of which *see* POTTERIES AND PORCELAINS. A technical school of ceramics is attached to the factory.

SÈVRES, TREATY OF, the treaty of peace concluded between the Allied and Associated Powers and Turkey on Aug. 10 1920. It was not ratified and was later superseded by the Treaty of Lausanne which was signed on July 24 1923. The principal arrangements of the Treaty of Sèvres were as follows:—

The king of Hejāz was recognized as independent. The boundaries of Turkey were so drawn as to exclude her from control of any other Arabian states or of Syria, Palestine and Mesopotamia, and Turkey renounced in favour of the principal Allied Powers rights over territory outside Europe that lay outside her new frontiers (Egypt, Sudan, Libya [Tripoli], Morocco and Tunis). Palestine was to be entrusted to a Mandatory Power, Syria and Mesopotamia "provisionally recognized as independent states to be advised by Mandatory Powers." Smyrna and the Ionian hinterland were placed under Greek administration for five years, when further arrangements would be made. The Dodecanese islands were ceded to Italy, Imbros and Tenedos to Greece, and Turkey recognized Greece's sovereignty in Lemnos, Samothrace, Mitylene, Chios, Samos, and Nikaria. The zone of the Straits from Constantinople and Scutari to the Dardanelles, and a zone on the Asiatic mainland were handed over to an international commission to be internationalized and demilitarized. Western Thrace, which had already been ceded to the Allies as a whole, was ceded by them to Greece by separate treaty. Turkey ceded to Greece Eastern Thrace, to the Chatalja lines. Turkey agreed to recognize Armenia as "a free and independent state" while Kurdistan was to receive local autonomy. The Turkish army was to be reduced to 50,000, all Turkish aircraft was to be surrendered and all the fleet except a few ships and torpedo boats.

The financial clauses charged Turkey with loss, with damage and with war guilt, but admitted that, as her resources were unequal to payment, such claims should be waived. But immense powers were conferred on a financial commission of British, French and Italian representatives with a Turkish representative in a consultative capacity, which was practically empowered to control the budget and the financial laws and regulations of Turkey. The Council of the Ottoman Public Debt was to be similarly formed and to have complete powers over its administration. The Capitulations were to be re-established for the Allies but not for enemy Powers, and the separate postal system of the Allies was also re-erected. Various Turkish ports, Constantinople, Smyrna, Alexandretta, etc., and the river Maritsa, were to be placed under international control. *See* H. W. V. Temperley, ed. *Hist. of the Peace Conference at Paris,* vol. vi. (1924). For the reversal of some of the terms of this treaty *see* LAUSANNE, CONFERENCE OF.

SEWAGE DISPOSAL. The following methods are utilized for the ultimate disposal of sewage:— (*a*) direct discharge into the sea or tidal estuary, (*b*) treatment on land, (*c*) treatment on artificial beds, (*d*) aeration and agitation, (*e*) tank treatment. Methods (*b*), (*c*), (*d*) and (*e*) are used inland and are necessary before discharge into a stream. Since the term sewage will include trades wastes, any treatment will have to allow for their presence, and this always increases the difficulties of the problem. The quantity received at a disposal works will vary considerably throughout the day, but is very different in different towns. Rainwater and infiltration water will also increase the supply at irregular intervals.

Disposal at Sea.—This method is obviously cheap, simple and complete. No treatment should be required, the dilution being so great as to render the sewage harmless. Care must be taken, however, to choose the site of the outfall so that no sewage is brought back onto the shore and there is no possibility of the pollution

of shell fisheries. The sewage should be carried rapidly out to sea at all states of the tide and no nuisance created by the solids being left on islands or mud flats. Such a method of disposal will probably include the rainwater, and the outfall sewer may have to become a tank at flood tide. If possible, this should be avoided, as otherwise the open end will have to be fitted with a flap valve or penstock to prevent the entrance of sea water. The outlet should, if possible, be always below low water level.

Land Treatment.—Inland towns are compelled in Great Britain to adopt some form of purification as the Rivers Pollution Act forbids the entrance of raw sewage into streams. Purely chemical methods are now obsolete, reliance being to a great extent placed on bacteria. Such organisms live habitually in the upper portion of the soil, and require air for their purifying processes, and hence the first of the modern methods was to turn the screened sewage onto or under suitable land. Clayey and heavy soils are quite unsuitable, the best for the purpose being of a light loamy character. As soils vary very much in their suitability, the proposed site of disposal must be carefully chosen, and must afterwards be given frequent periods of rest for a duration of four or five weeks at least to prevent "sewage-sickness." The process of "broad-irrigation," *i.e.,* flooding the land with sewage at intervals, may now be considered obsolete. "Surface irrigation" is often quite suitable for small rural communities and isolated institutions or houses. The sewage is distributed by carriers which are often only furrows in the ground at anything up to 30 feet apart, and the liquid overflows into the land or soaks through the sides and bottoms of the channels. The quantity treated varies considerably, being from 2,000 to 8,000 gallons per acre *per diem,* according to the quality of the sewage and the suitability of the land. The effluent is either naturally absorbed by the land, or under drains may be installed for the purpose. Evaporation will play a considerable part in this means of disposal, a dry hot climate much increasing the amount treated per acre. Certain crops such as rye-grass, may be grown with profit.

"Fill-and-draw" and Continuous Filters.—The purifying process, due to bacterial action in the upper layer of the soil, can be much more successfully and rapidly accomplished with greater economy of space, by utilizing artificial filters, working either intermittently or constantly. The first type used were on the intermittent contact or "fill-and-draw" principle, *i.e.,* the filter beds were filled with the liquid, after suitable screening and sedimentation, so as to remove, as far as possible, the solid constituents. On common forms of screens will be caught paper, rags, orange peel and similar matter. A screening chamber will also remove large quantities of the mineral grit, which is, however, much less than formerly owing to the decreasing popularity of water-bound macadam roads. It is usual to allow a capacity in detritus chambers of at least $\frac{1}{100}$ of the dry weather flow and there should be at least two to allow of cleaning. If this cannot be done, some form of dredger or worm conveyor should be provided. Disposal works are not designed to deal with more than three times the dry weather flow, the remainder of the flow, up to six times, being treated in storm-water tanks.

The royal commission on sewage disposal, however, states that it is generally only necessary to provide filter capacity up to $1\frac{1}{2}$ times that required for dry weather flow, hence it publishes a table for three strengths of sewage, giving areas desirable for "sprinkling" filters and "contact" or "fill-and draw" filters. (Par. 293, p. 209 of *Report.*) Sewage may be roughly classified by the amount of oxygen absorbed in parts per 100,000 from permanganate of potash at 80° F after four hours. From 7 to 8 parts may be considered weak, from 10 to 13 average, and 17 and over "strong" sewage. Any flow over the six times may generally be passed direct to the streams which must be done before reaching the works.

Sedimentation Tanks.—These are usually on the continuous principle and consist of at least two tanks, the total capacity being not less than 10 to 15 hours dry weather flow. Fig. 1 shows a common type of rectangular tank, of width about one-third to one-fourth the length. The speed of travel through the tank should be slow, not more than one inch a minute, and so that the "detention period" is just sufficient to remove all solid matter possible. The tanks are usually emptied by a "floating arm" (*see* fig. 1) so as to draw the water from the surface, and the sludge is either removed by hand when the tank is emptied or passes to some form of pump. Vertical tanks may be used, where space is valuable or land very expensive. They have the disadvantage of entailing considerable excavation and greater cost of construction. The liquid may be allowed to then pass to filters as it should contain little more than colloidal matter. These filter beds consist of shallow tanks filled with suitable rough material such as slag, coke, clinker, etc. Hard stones such as granite are too liable to polish and so form an unsuitable medium for bacterial culture. The beds are worked in cycles, each cycle consisting of about 1 hour filling and the same time emptying, 2 hours standing full and 4 hours rest, the bulk of the purifying action taking place during the rest period. The beds are usually about 3 feet deep to ensure internal aeration and are never more than 6 feet. About 50 per cent of the space is available initially for the liquid, but this rapidly reduces to about 30 per cent after use. The filling and emptying may be done by hand with penstocks or automatically by syphons or the liquid may be distributed by surface channels, and it is usually considered that the economical limit in size is one acre. The usual size of the broken material is about 2 in. cube, but may be larger or smaller.

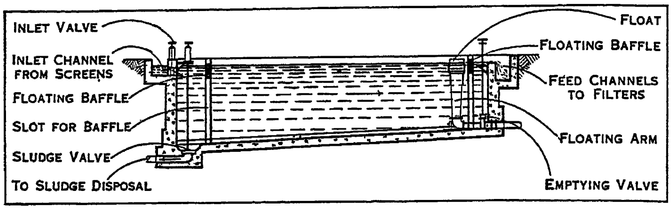


Fig. 1.—Sedimentation Tank

The continuous type of sprinkling or percolating filter is now more common, being more economical in space and time but needing some form of distributor. The commonest form is the rotary shown in fig. 2, the beds being then circular or hexagonal. If the beds are above ground the walls are frequently omitted and consist of large, uncemented blocks of the clinker. In the type shown the effluent leaves the bed by a false floor of tiles or pipes connecting to a drain, but in the elevated type the effluent is generally collected in an open channel surrounding the bed.

Such filters are usually 6 feet in depth and the material is usually not larger than 3 in. cube. It is said that they will treat at least 300,000 gallons per acre when 5 feet deep, but the amount depends on the size of the medium and the amount of the suspended solids. Various other ingenious methods of distribution are in use, but fixed sprinklers with nozzles are now obsolete in Great Britain.

Before the treated liquid can be finally discharged to a stream, it is generally necessary to further pass it through what are known as "humus" tanks or filters. This will be due to the effluent still containing organic matter which has escaped the purifying action of the bacteria on the previous filters, and there will also be a proportion of the filtering medium broken down by the passage of the liquid. These tanks are usually merely repetitions of the sedimentation tanks on a smaller scale, having a capacity equivalent to 4 hours dry weather flow. Shallow sand filters about 12 in. deep have also been used and are considered to be able to deal with not more than 500 gallons per sq.yd. per day. These

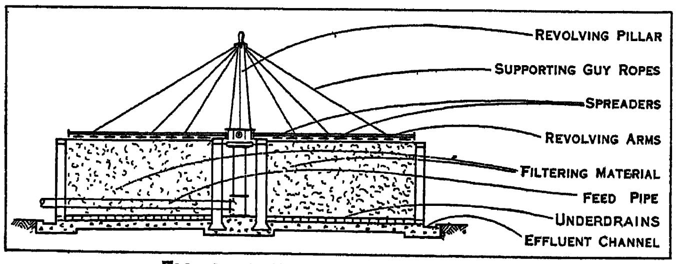


Fig. 2.—Rotary Sprinkling Filter

latter will, however, need constant attention.

The latest methods of treatment utilize the power of air and agitation to increase the bacterial action, it having been also discovered that sludge once treated by air can be utilized to inoculate the untreated sewage after settlement, and to much accelerate the purification. Fig. 3 shows in diagrammatic form the essential feature of the "activated sludge" process, the sewage passing along channels fitted with porous "air diffusers" in the bottom or at the side, and also often being given some form of spiral motion to utilize any surface aeration. Many experts consider that much of the purification is due to the mechanical agitation on the surface by the bursting of the air bubbles, and hence systems causing surface agitation are in growing use. In this method a horizontal agitator draws up sewage by the central tube and throws it to the sides of the tank, thus aerating and agitating at the same time, the liquid finally escaping after several revolutions. In the Sheffield system of "bio-aeration" the liquid travels a long length of narrow channel, being agitated at regular intervals of about 260 feet by skeleton paddle wheels as shown in fig. 4. In these aeration and agitation methods a final settling tank or tanks is required before the liquid is ultimately discharged to the stream. The amount of air used for diffusion is about 1 cu.ft. of free air per gallon of sewage, but this includes air used in the air-lift pumps, which are often utilized to return a portion of "activated" sludge to the commencement of the process. The area of the diffusers varies from $\frac{1}{5}$ to $\frac{1}{17}$ that of the channel floor. The air pressure is usually between 5 and 10 lb. per square inch, specially designed air-compressors being now manufactured. The diffuser area will be smallest for purely domestic sewage and largest for strong sewage with a large proportion of trade waste. The detention period in the channels varies from about 3 hours at least for purely domestic sewage, to as high as 20 for sewage with much trade wastes, the latter being very liable to injure the process. The diffusers are of fine concrete or silica sand and are contained in metal or preferably concrete boxes.

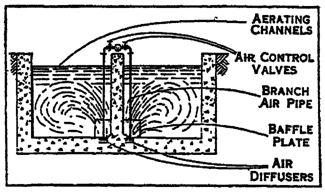


FIG. 3.—ACTIVATED SLUDGE CHANNEL

Sludge Disposal.—This is still the greatest problem connected with sewage treatment, the difficulties of which have been rather increased than diminished by the modern aeration processes, owing to the greater diffusion of the sludge particles by agitation. Formerly it was the custom to either spread the sludge on the land or dig it in, but the great area of land necessary for successful operation has forced this method out of use for large towns. The chief difficulty arises from the fact that the sludge is very retentive of the water, which forms by far the greatest proportion of the mixture, the proportion being greater with the modern aeration processes.

These remarks do not apply to the sludge from detritus tanks, which can be easily handled and hence removed, and which only comprises about one-twelfth of the whole. A further amount will be removed in the sedimentation tanks. Chemical precipitation is successful for clarification purposes but greatly increases the amount of sludge, and has been largely abandoned for that reason, but is once more being tried on improved lines. Pressing the sludge into cake is still in use but is costly and often unsatisfactory. The cake is not appreciated as manure and still contains much moisture. It is usually impracticable to mix the sludge with dry house refuse or street sweepings, as the supply of these is insufficient. Drying by heat is usually too expensive, and removal of the water by vacuum filters has not passed the experimental stage. Centrifugal machines have so far not been successful, and chemical flotation methods do not appear to have come into common use. The most popular method is still the spreading of the sludge on cinder beds termed lagoons, the water passing away into underdrains and being conveyed back by pipes to the sedimentation tanks. Such lagoons may be merely depressions in the ground, the excavated material forming the banks. The sludge should not be more than 9 inches deep and about 10 gallons per square yard can be treated in this manner. The amount is, however, very variable owing to the varying humidity of the atmosphere, and the sludge may take anything from one day to several months before it is dry enough to be lifted by a spade and carted away.

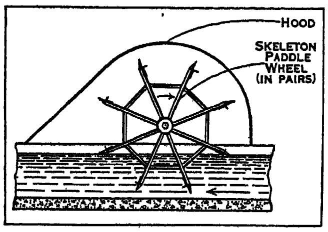


FIG. 4.—BIO-AERATION

Large towns like Manchester, Glasgow and London pump their excess sludge into specially designed steamers of about 1,000 tons capacity and carry it out to sea, where it is dumped.

Attempts have also been successfully made to separate out the sludge by "digestive" methods. Of these, those processes in use on the Ruhr in Germany and at Birmingham are the most noteworthy. At Essen Dr. Imhoff has developed a tank in which the liquid travels continuously through an upper tank at a velocity of from 30 to 1,000 ft. an hour, and the solids fall through slots into a lower quiescent tank where digestion takes place. This sludge is afterwards forced up by the static pressure and spread over cinder drying beds. The water is said to evaporate rapidly and the sludge left to be quite innocuous. The methan gas evolved is now collected and forms a valuable by-product for light and power purposes. Similar gas collection is now in operation at Birmingham. At this latter town the sludge is pumped to separate shallow tanks, the digestion being accomplished in two stages to encourage fomentation. The pumping main is inoculated with digested sludge to encourage bacterial action and heat has also been utilized, and the effluent is returned to the percolating filters. The sludge, originally 18 in. thick, dries down to 6 in. on ash beds, and is then removed by wagons to sheds, spread in thin sheets, air-dried, ground and finally mixed with chemicals to form a fertilizer. The process eliminates grease, preserves the nitrogen and is effective.

Storm Water Treatment.—Storm water to an extent ranging from 3 to 6 times the average dry weather flow, must be treated in special plant after being screened. The total capacity of such plant is usually taken at one quarter the dry weather flow, and there should be at least two units provided for, such units usually consisting of tanks or roughing filters. In dry periods they should be empty, but when full they should act as continuous flow tanks. They are often merely extra sedimentation tanks in which the sludge is dealt with in the usual manner. The roughing filters may be used where much sediment is expected, but cleaning is thus made more difficult. If suitable land is available the screened liquid may be passed on to it and then discharged direct to the stream, after passing through separate detritus tanks.

When sufficient and suitable land is available and nuisance cannot be caused, the Royal Commission's Report suggests that the area of filtration may be half $1\frac{1}{2}$ times the dry weather flow, but that the remainder must be treated on land at a rate of between 3,000 and 30,000 gallons per acre per 24 hours according to the character of the soil.

See G. B. Kershaw, *Sewage Purification and Disposal;* G. M. Flood, *Sewage Treatment and Disposal;* A. J. Martin, *Activated Sludge Process; Report* of Conference on Sanitary Engineering, 1924.

(G. S. Co.)

SEWALL, SAMUEL (1652–1730), American jurist, was born at Bishopstoke, England, on March 28, 1652. He was taken to Newbury in New England in 1661; graduated at Harvard in 1671, receiving his master's degree three years later; studied divinity; and was resident fellow of Harvard in 1673–74, and keeper of the college library in 1674. He had apparently intended to enter the ministry, but his marriage to Judith Hull in 1678 caused him, like his father-in-law, to embark upon a mercantile and public career. In 1683 he was deputy to the general court for Westfield; from 1681 to 1684 he managed the only licensed printing press in Boston; and in 1688 he went to England on business connected with land titles. He was a member of the New England Council in 1692–1725, and in 1692 he was made one of the special commissioners to try persons accused of witchcraft in Suffolk,

Essex, and Middlesex counties (Mass.). This court condemned 19.

Sewall in Jan. 1697 stood in meeting while a bill was read in which he took "the blame and shame" of the "guilt contracted upon the opening of the late commission of oyer and terminer at Salem," and asked pardon; and till the end of his life he annually set apart a day of fasting, meditation and prayer in token of his offence. Later he was judge of probate for Suffolk county and a judge of the superior court, being its chief justice in 1718–28. He died in Boston, Jan. 1, 1730. Of his works the one which appeals most to modern readers, however, is his naïve and delightful diary. The unconscious humour of such parts as the courting, the intimate revelation of a man of distinguished ability and sterling character, and the minutely detailed record of the political, civic and social life of the time make it one of the most valuable and interesting documents left from colonial days.

The diary, like the letter-book of Sewall, was published by the Massachusetts Historical Society in its *Collections*. Selections from it have been edited by Mark Van Doren (1927). *See* also G. E. Ellis, *An Address on the Life and Character of Chief Justice Samuel Sewall* (1885); N. H. Chamberlain, *Samuel Sewall and The World He Lived In* (1885); and articles in J. L. Sibley's *Biographical Sketches of Graduates of Harvard University*, vol. ii. p. 345–371 (1881) and by C. H. C. Howard in *Essex Institute Historical Collections*, vol. xxxvii. (1901).

SEWANEE, a village of Franklin county, Tennessee, U.S.A., on the Dixie highway and served by the Nashville, Chattanooga and St. Louis Railway. Sewanee is the seat of the University of the South (Protestant Episcopal), which was founded in 1857, largely through the efforts of Bishop Leonidas Polk of Louisiana. The tower on the library is modelled after that of Magdalen college, Oxford.

SEWARD, ANNA (1747–1809), English writer, often called the "Swan of Lichfield," was the elder daughter of Thomas Seward (1708–1790), prebendary of Lichfield and of Salisbury, and author. Born at Eyam in Derbyshire, she passed nearly all her life in Lichfield, beginning at an early age to write poetry partly at the instigation of Dr. Erasmus Darwin. Her verses include elegies and sonnets, and she also wrote a poetical novel, *Louisa*, of which five editions were published.

Sir Walter Scott edited her *Poetical Works* in three volumes (Edinburgh, 1810); to these he prefixed a memoir of the authoress, adding extracts from her literary correspondence. *See* also *Letters of Anna Seward 1784–1807* (Edinburgh, 6 vols., 1811). Miss Seward also wrote *Memoirs of the Life of Dr. Darwin* (1804). *See* E. V. Lucas, *A Swan and her Friends* (1907); and S. Martin, *Anna Seward and Classic Lichfield* (1909).

SEWARD, WILLIAM HENRY (1801–1872), American statesman, was born on May 16, 1801, in the village of Florida, New York. He graduated from Union college in 1820, was admitted to the bar at Utica, N.Y., in 1822, and in the following year began the practice of law at Auburn, N.Y., which was his home for the rest of his life. He soon attained distinction in his profession, but drifted into politics, for which he had a greater liking, and early became associated with Thurlow Weed. He was at first an adherent of Daniel D. Tompkins in State, and a National Republican in national politics. After 1828 he became allied with the Anti-Masonic party, attending the national conventions of 1830 and 1831, and as a member of the organization he served four years (1830–34) in the State senate. By 1833 the Anti-Masonic movement had run its course, and Seward allied himself with the other opponents of the Jackson Democrats, becoming a Whig. In 1834 he received the Whig nomination for governor, but was defeated by William L. Marcy. Four years later he was renominated, was elected, was re-elected in 1840, and served from 1839 until 1843. As governor, Seward favoured a continuance of works of internal improvement at public expense. His administration was disturbed by the anti-rent agitation and by the M'Leod incident growing out of the Canadian rebellion of 1837. During this period he attracted much attention by his liberal and humane policy, promoting prison reform, and proposing to admit Roman Catholic and foreign teachers into the public schools of the State. Laws were passed during his term putting obstacles in the way of recovering fugitive slaves. Seward soon became recognized as the leader of the anti-slavery Whigs. He was one of the earliest political opponents of slavery, as distinguished from the radical Abolitionists, or the followers of William Lloyd Garrison, who devoted themselves to a moral agitation.

When the Whigs secured a momentary control of the State legislature in 1849 they sent Seward to the United States Senate. The antagonism between free labour and slave labour became the theme of many of his speeches. In his first set speech in the Senate, on March 11, 1850, in opposing the pending compromise measures, he attracted the attention of the whole country by his assertion that "there is a higher law than the constitution" regulating "our authority over the domain" (*i.e.*, the Territories). When the Democrats, however, declared such language incendiary he tried to explain it away, and by so doing offended his friends without appeasing his opponents. In a speech at Rochester, N.Y., in 1858 he made the famous statement that there was "an irrepressible conflict between opposing and enduring forces, and it means that the United States must and will, sooner or later, become either entirely a slave-holding nation or entirely a free-labour nation." Although this idea had often been expressed by others, and by Seward himself in his speech of 1848, yet he was severely criticized, and four days later he sought to render this statement innocuous also.

In the election of 1852 Seward supported Gen. Winfield Scott, but not his party platform, because it declared the Compromise of 1850 a finality. He naturally opposed the Kansas-Nebraska bill of 1854, which repealed the Missouri Compromise and established the principle of popular sovereignty in the Territories. Subsequently he actively supported in the Senate the free-state cause in Kansas. In 1854–55, when it became evident that the Whig party in the North was moribund, Seward helped to lead its scattered remnants into the Republican fold. As the recognized leader of the new party, his nomination by the Republicans for the presidency in 1856 and in 1860 was regarded as certain; but in each instance he was put aside for another. The heterogeneous elements of the new organization could not be made to unite on a man who for so many years had devoted his energies to purely Whig measures, and he was considered less "available" than Frémont in 1856 and than Lincoln in 1860. After Lincoln was elected in 1860 he chose Seward for his secretary of state. The new president was a man comparatively little known outside the state of Illinois, and many of his supporters, doubtful of his ability to deal with the difficult problems of 1861, looked to Seward as the most experienced man of the administration and the one who should direct its policy. Seward himself, apparently sharing these views, although not out of vanity, at first possessed an unbounded confidence in his ability to influence the president and his cabinet. He believed that the Union could be saved without a war, and that a policy of delay would prevent the secession of the border States, which in turn would gradually coax their more southern neighbours back into their proper relations with the Federal Government. In informal conferences with commissioners from the seceded States he assured them that Fort Sumter should be speedily evacuated. Finding himself overruled by the war party in the cabinet, on April 1, 1861, Seward suggested a war of all America against most of Europe, with himself as the director of the enterprise. Dangers from abroad would destroy the centrifugal forces at home, and the Union would be saved. When this proposal was quietly put aside by the president, and Seward perceived in Lincoln a chief executive in fact as well as in name, he dropped into his proper place, and as secretary of state rendered services of inestimable value to the nation. To prevent foreign states from giving official recognition to the Confederacy was the task of the hour, and in this he was successful. While he did not succeed in preventing the French occupation of Mexico or the escape of the Confederate cruiser "Alabama" from England, his diplomacy prepared the way for a future adjustment satisfactory to the United States of the difficulties with these powers. While his treaty with Lord Lyons in 1862 for the suppression of the slave trade conceded to England the right of search to a limited extent in African and Cuban waters, he secured a similar concession for American war vessels from the British Government, and by his course in the Trent affair he virtually committed Great Britain to the Ameri-

can attitude with regard to this right.

On April 5, 1865, Seward was thrown from his carriage and severely injured. Nine days later, while lying ill at his home at Washington, he was attacked by one Lewis Powell, alias Payne, a fellow-conspirator of John Wilkes Booth, at the same time that Lincoln was assassinated. The secretary's son, Frederick W. Seward, and three other persons who came to his assistance, were also wounded by the assailant. Seward's wife, an invalid, received such a shock that she died within two months, and his only daughter, who witnessed the assault, never recovered from the effects of the scene and died within the year. Seward gradually regained his health, and remained in the cabinet of President Johnson until the expiration of his term in 1869. In the struggle between the Executive and Congress over the method of reconstructing the Southern States, Seward sided with Johnson and thus shared some of the obloquy bestowed upon that unfortunate president. His greatest work in this period was the purchase of Alaska from Russia, in 1867. After returning to private life, Seward spent two years in travel and died at Auburn on Oct. 10, 1872.

His son, FREDERICK WILLIAM SEWARD (1830–1915), was born in Auburn, N.Y., on July 8, 1830, graduated at Union college in 1849 and was admitted to the bar at Rochester, N.Y., in 1851. From 1851 to 1861 he was one of the editors and owners of the Albany *Evening Journal,* and during his father's term at the head of the State Department he was assistant secretary of state. He served in the New York Assembly in 1875, and from 1877 to 1881 was again assistant secretary of state. After 1881 he devoted his time to the practice of his profession and to lecturing and writing. He died at Montrose-on-Hudson, N.Y., on April 26, 1915.

The best biography of Seward is that by Frederic Bancroft, *The Life of William H. Seward* (1900); *see* also, *The Life and Works of William H. Seward* (Boston, 1883), edited by George E. Baker; *William H. Seward: an Autobiography from 1801 to 1834, with a Memoir of his Life and Selections from his Letters* (1891), by his son, Frederick W. Seward; *William H. Seward's Travels around the World* (1873), by his adopted daughter, Olive R. Seward; *Lincoln and Seward* (1874), by Gideon Welles; *William Henry Seward* (Boston, 1899), by T. K. Lothrop, in the "American Statesmen Series"; *Seward and the Declaration of Paris,* by Charles Francis Adams (1912); "Union Portraits: William H. Seward," *Atlantic Monthly,* vol. cxvi., pp. 322–334 (1915); *Recollections of a War-Time Statesman and Diplomat,* by Frederick W. Seward (1916); and "Seward's Far Eastern Policy," in *American History Review,* vol. xxviii., pp. 45–62 (1922).

SEWARD, a town of Alaska, latitude 60° 6′ N., longitude 149° 27′ W., is situated at the head of Resurrection bay, about 1,800 miles north-west from Seattle, 60° 6′ N. and 149° 27′ W. It was founded as the terminus of the Alaska Central railway. This project soon changed hands and at the same time the designation of the road was changed to the Alaska Northern. Under the new organization, considerable construction work was done but the company later fell into the hands of a receiver. The Government railway, Seward to Fairbanks, took over the section which had been constructed, and incorporated it in the main line, with Seward as the ocean terminus. The town is a centre for business in the lower part of Cook inlet and to the westward along the Alaska peninsula and the Aleutian islands. Its population in 1930 was 835.

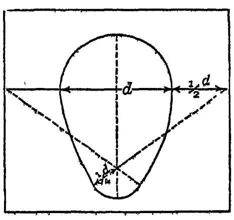


FIG. 1.—EGG-SHAPED SEWER

SEWER CONSTRUCTION. The underground channels provided by the local authority for removing liquid wastes from buildings are termed sewers, and are usually situated in the public thoroughfares. The smaller sizes up to 24in. diameter may be formed of glazed stoneware, but over this size it is more convenient to use brick or concrete. Pipes of artificial stone are also being used. The two commonest forms of cross-section for large sewers are circular and "eggshaped," the latter of the relative dimensions shown in fig. 1. The idea of the "eggshape" is to concentrate low flows and so retain the scouring action of the water. It is, however, much weaker against external pressure than the circular shape. When bricks are used they are made wedge shaped for the smaller sizes so as to lessen the thickness of the joints, and consist usually of at least two rings. The mortar should be made of one part of Portland cement to one part of clean sand. As the invert of eggshaped sewers may be of a sharp curve the "invert block" shown in fig. 2 is often provided. Such sewers are rarely made more than 7 feet in height. With very large sewers, such as those used for intercepting purposes or for outfalls, reinforced concrete is coming into use. For these, semi-elliptical, "horse-shoe," semi-circular and other forms of cross section are common.

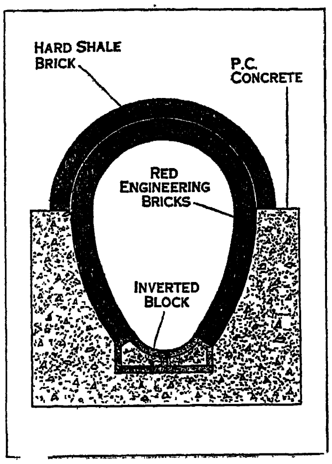


FIG. 2.—EGG-SHAPED SEWER WITH INVERT BLOCK

Gradients.—The sewers should be laid at such gradients that they are self-cleansing at all rates of discharge, and that, on the other hand, the velocity is not so great as to cause erosion of the lining. Sediment is usually deposited at velocities less than 2 feet per second, but the speed is usually limited to about 4 feet per second.

Rainfall Run-off.—Where "combined" sewers are used the channel must be large enough to take the rainwater received as well as house wastes, even if the former liquid is soon afterwards overflowed to a stream. It is now customary to calculate the rainfall run-off from such a formula as:—

$$Q=60{\cdot}5\ Ap\nu$$

where Q is run-off in cubic feet per minute, A is the area drained in acres, p is the coefficient of impermeability, dependent on the

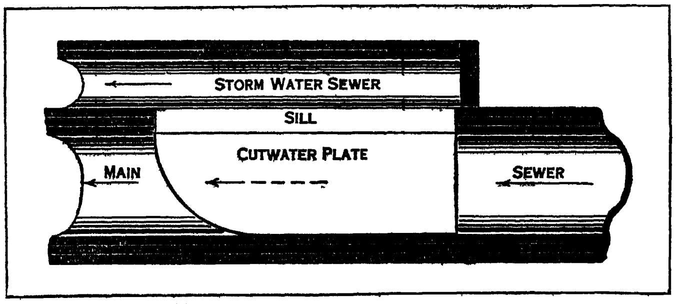


FIG. 3.—STORM WATER OVERFLOW

nature of the ground surface, and ν is the rate of rainfall in inches per hour, and is obtained from a chart plotted from automatic records if possible, and will be of higher value the shorter the storm. It is customary to consider that all combined discharge, diluted more than six times the normal dry weather flow,

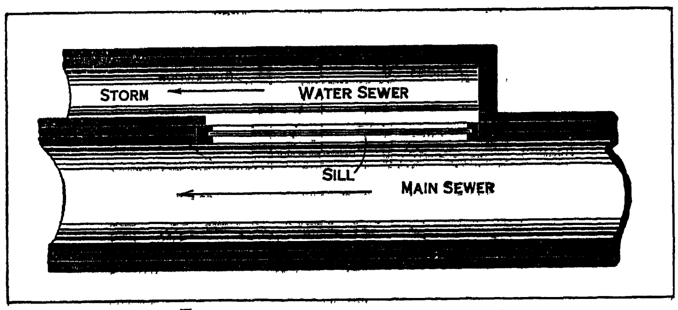


FIG. 4.—STORM WATER OVERFLOW

may be overflowed to a stream, but there is no rule, as the sewage may vary so much in quality. The duration of the storm is assumed equal to the time of travel in the sewer from the highest point in the area to the point of discharge from the area A; p is frequently assumed as the ratio between the unbuilt-up and total areas. The flow of actual sewage is usually taken as equal to the water supply, but the rate at which it is received by the sewer will vary, being often double the mean at maximum periods. It is

customary to calculate the maximum discharging capacity of sewers to be when they are running three-quarters or seven-eighths full and hence never under pressure, and the formula

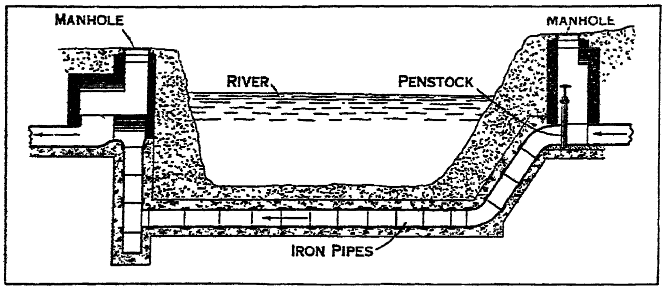


FIG. 5.—INVERTED SYPHON

for the mean velocity is of the type:—

$$v = c\sqrt{mi} \text{ feet per second,}$$

where m is the "hydraulic mean depth" and i is the "hydraulic gradient," c is a constant dependent on the material of the sewer lining and on its condition. (*See* HYDRAULICS.)

Storm-Overflows.—Two types of these are shown in figs. 3 and 4. In fig. 3 the water is intercepted above a predetermined

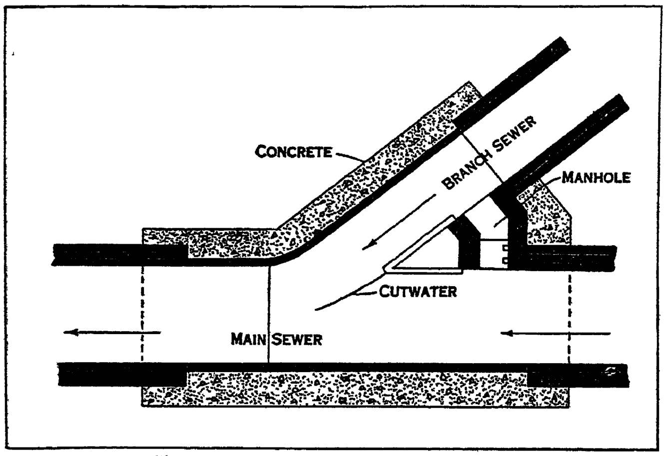


FIG. 6.—BRANCH SEWER CONNECTION

height and turned into a parallel storm-water sewer. In fig. 4 the main sewer has a weir placed on one or both sides and the water above weir level falls into the storm-water sewer alongside. The

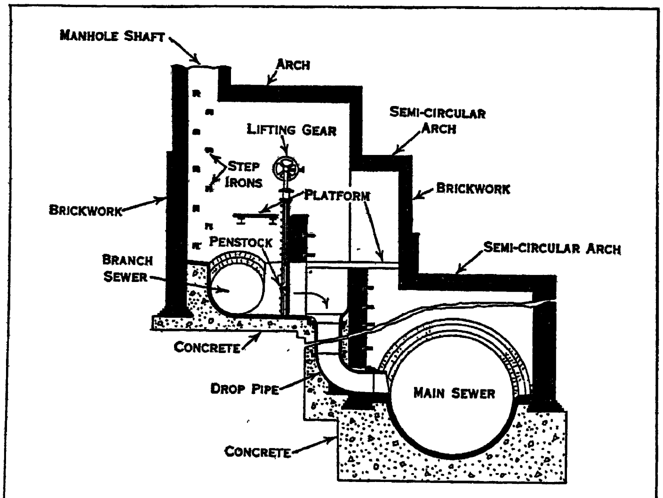


FIG. 7.—SEWER CONNECTIONS ON DIFFERENT LEVELS

latter type has the disadvantage of requiring a great length of sill, and even then a large amount of water escapes into the downstream portion of the main sewer.

Inverted Syphons.—A typical river crossing is shown in fig. 5. There should be at least two pipes in case either becomes blocked, and they are generally of cast iron or steel, and are on the small side so as to ensure scour. Access is necessary at both ends, and the downstream leg is usually vertical and provided with a sump. They may be cleaned by dragging balls or brushes to and fro, attached to chains fastened in the manholes.

Valves are usually penstocks, the leaf working in gun-metal guides. The smaller ones are worked by hand and the larger by power. They require balancing to reduce the effort of lifting and are better placed so that the water forces them against their seats. Hinged flap-valves are common at the ends of sewers, to open when the water presses against the inside.

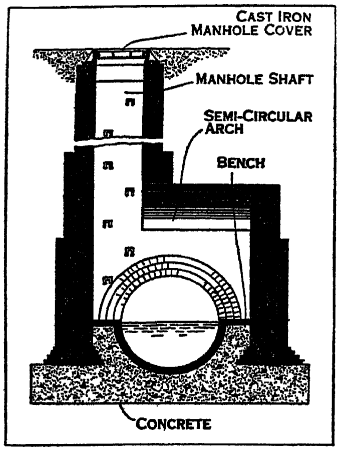


FIG. 8.—MANHOLE

Sewer Connections and Ventilation.—Fig. 6 shows the connection of two large circular sewers at about the same level, with access to either from the surface. Where there is great difference in level a "drop-pipe," fig. 7, or a ramp, may be used, tumbling bays or stairs being unsatisfactory on account of the agitation.

Unless there are objections, it is usual to ventilate the sewer through gratings in the cast-iron cover of the manholes, which latter are usually not more that 150 yards apart. Otherwise, connections are made to shafts on the roadside, such shafts being about 30 feet high. Mechanical and other methods have been tried, but the effect is very local.

Manholes.—Fig. 8 shows a typical form of manhole. The shaft is usually about 2 feet square and provided with step-irons. The floor may be concrete or brick or stone paved. The central channel should carry the maximum rate of dry-weather flow, so that the "benches" are normally free from water and deposits.

Sewers should never be at such a flat gradient as to require flushing to remove sediment, but if this is impossible, such flushing may be accomplished by perambulating water-tanks fitted with a hose, or by underground tanks designed to automatically discharge at regular intervals by means of a syphon. In either case a very large quantity of water is required. *Pumping* should be avoided whenever possible on account of the expense, but if found inevitable, either special types of pumps, or ejectors working by compressed air may be used.

See G. Thomson, *Modern Sanitary Engineering,* pt. II.; Baldwin Leatham, *Sanitary Engineering;* Moore and Silcock, *Sanitary Engineering;* G. S. Coleman, *Hydraulics Applied to Sewer Design.*

(G. S. Co.)

SEWING: *see* HOME SEWING.

SEWING MACHINES. The basic invention in machine-sewing was the double-pointed needle, with the eye in the centre, patented by Charles F. Weisenthal in 1755, with the object of avoiding the necessity for inverting the needle in sewing or embroidering. Many of the features of the sewing machine are distinctly specified in a patent secured in England by Thomas Saint in 1790, in which he, *inter alia,* described a machine for stitching, quilting or sewing. Saint's machine, which appears to have been intended principally for leather work, was fitted with an awl which, working vertically, pierced a hole for the thread. A spindle and projection laid the thread over this hole, and a descending forked needle pressed a loop of thread through it. The loop was caught on the under side by a reciprocating hook; a feed moved the work forward the extent of one stitch; and a second loop was formed by the same motions as the first. It, however, descended within the first, which was thrown off by the hook as it caught the second, and being thus secured and tightened up an ordinary tambour or chain stitch was formed. Had Saint hit on the idea of the eye-pointed needle his machine would have been a complete anticipation of the modern chain stitch machine.

Thimmonier's Sewing Machine.—The inventor who first devised a real working machine was a poor tailor, Barthélemy Thimmonier, of St. Étienne, who obtained letters patent in France in 1830. Though the machine was clumsy, made chiefly of wood, about eighty were being worked in Paris in 1841, making army clothing, when an ignorant and furious crowd wrecked the establishment and nearly murdered the unfortunate inventor. Thimmonier, however, was not discouraged, for in 1845 he twice patented improvements on it, and in 1848 he obtained both in England and the United States patents for further improvements. The machine was then made entirely of metal, and vastly improved on the first model. But the troubles of 1848 blasted the prospects of the resolute inventor. His patent rights for Great Britain were sold; a machine shown in the Great Exhibition of 1851 attracted no attention, and he died in 1857 unfriended and unrewarded.

The most important ideas of an eye-pointed needle and a double thread or lock-stitch are strictly of American origin, and that combination was first conceived by Walter Hunt of New York about 1832–34. Hunt constructed a machine having a vibrating arm, at the extremity of which he fixed a curved needle with an eye near its point. By this needle a loop of thread was formed under the cloth to be sewn, and through that loop a thread carried in an oscillating shuttle was passed, thus making the lock-stitch of all ordinary two-thread machines. Hunt's invention was purchased by a blacksmith named Arrowsmith, but no patent was sought, nor was any serious attempt made to draw attention to the invention. After the success of machines based on his two devices was fully established, Hunt in 1853 applied for a patent; but his claim was disallowed on the ground of abandonment. The most important feature in Hunt's invention—the eye-pointed needle—was first patented in the United Kingdom by Newton and Archbold in 1841, in connection with glove-stitching.

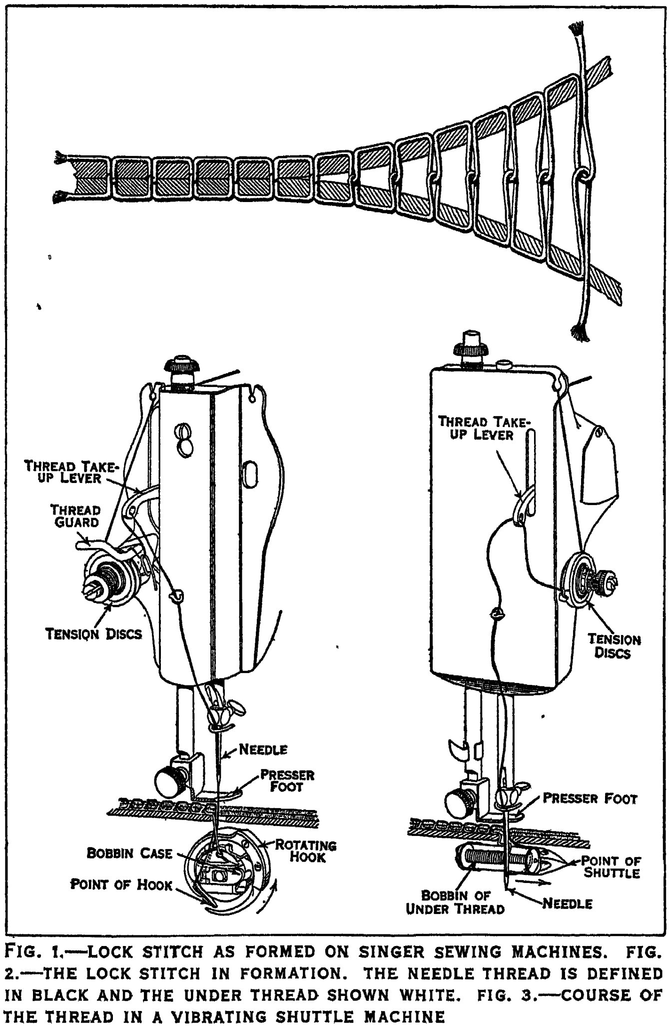


FIG. 1.—LOCK STITCH AS FORMED ON SINGER SEWING MACHINES. FIG. 2.—THE LOCK STITCH IN FORMATION. THE NEEDLE THREAD IS DEFINED IN BLACK AND THE UNDER THREAD SHOWN WHITE. FIG. 3.—COURSE OF THE THREAD IN A VIBRATING SHUTTLE MACHINE

Apparently unaware of Hunt's invention Elias Howe, a native of Spencer, Mass., directed his attention to machine-sewing about 1843. In 1844 he completed a rough model, and in 1846 patented his sewing machine (fig. 1). Howe was thus the first to patent a lock-stitch machine, but his invention had the two essential features—the curved eye-pointed needle and the under-thread shuttle—invented by Hunt twelve years previously. Howe's invention was sold in England to William F. Thomas of Cheapside, London, a corset manufacturer, for £250. Thomas secured in Dec. 1846 the English patent in his own name, and engaged Howe on weekly wages to adapt the machine for his manufacturing purposes. The career of the inventor in London was unsuccessful; and, having pawned his American patent rights in England, he returned in 1849 in poverty to America. There in the meantime the sewing machine was beginning to excite public curiosity, and various persons were making machines which Howe found to trench on his patent rights. The most prominent of the manufacturers, if not of inventors, ultimately appeared in Isaac Merritt Singer (1811–75), who in 1851 secured a patent for his machine. Elias Howe now became alert to vindicate his rights, and, after regaining possession of his pawned patent, he instituted suits against the infringers. An enormous amount of litigation ensued, but ultimately all makers became tributary to Elias Howe.

Allan B. Wilson also worked without knowledge of previous efforts. In 1849 he devised the rotary hook and bobbin combination, forming the special feature of the Wheeler and Wilson machine. Wilson obtained a patent for his machine, which included the important and effective four-motion feed for moving the work after every stitch, in Nov. 1850. In Feb. 1851 William O. Grover, a tailor, of Boston, patented his double chain-stitch action, which formed the basis of the Grover and Baker machine. In 1856 James A. E. Gibbs (1829–1902), a Virginia farmer, devised the chain-stitch machine, improved subsequently by J. Willcox and now known as the Willcox and Gibbs. These together —all American inventions—form the types of the various machines now in common use. Thousands of patents have been issued in the United States and Europe, covering improvements in the sewing machine; but, although its efficiency and usefulness have been greatly increased by numerous accessories and attachments, the main principles have not been affected thereby.

Chain Stitch.—In machine sewing three varieties of stitch are made—(1) the simple chain or tambour stitch, (2) the double chain stitch and (3) the lock stitch. In the first the machine works with a single thread, the other forms use two, an upper and an under.

The Modern Lock Stitch.—The lock stitch is that made by all ordinary two-thread sewing machines, and is a stitch peculiar to machine sewing. It consists of an upper or needle thread and an under thread locked together in the material which is being stitched; the lock being formed by passing the upper around the lower thread and tightening them together in the middle of the fabric, as shown in fig. 1. In fig. 2 the needle thread is shown as a thick black line and the under thread white, the fabric being stippled in order that each may be readily recognized. It shows the head of a lock stitch machine, rotary hook. The loop of needle thread has been taken by the point of the hook and is being passed round the bobbin case containing the bobbin of under thread, sufficient enlargement of the loop having been permitted by the descent of the thread take-up lever.

In fig. 3 is shown the head of a vibrating shuttle machine. The shuttle, containing the bobbin of under thread, has fully entered the loop of needle thread, sufficient enlargement of the loop having been permitted by the descent of the thread take-up lever. The shuttle travels to and fro in a carrier to which it is not fastened, but by which it is held in position. During the forward movement of the shuttle, the loop of needle thread slips between the shuttle and the carrier, then passes out between the heel of the shuttle and the rear part of the carrier. The shuttle thread is thus enclosed in the loop of needle thread and both threads are then drawn up by the action of the thread take-up lever.

There are over 2,000 varieties of modern sewing machines

designed for stitching processes in the great sewing industries making up clothing, boots and shoes, corsets, hats, hosiery, etc. There are machines specially designed for sewing regular or fancy shank buttons on shoes; for sewing sweat leathers into stiff felt, soft felt or straw hats; for trimming, scalloping and over-edging lace curtains; for sewing silk initials, monograms or floral designs upon material at one operation. There is a seven needle machine for making seven parallel rows of fine double chain stitching simultaneously. This machine is fitted with seven needles and seven loopers, and its capacity is over 20,000 stitches per minute.

The increasing use of electricity for domestic purposes has had its effect on the sewing machines. To adapt existing machines to electric operation, small motors are provided. There are also available sewing machines of various types with the motor incorporated in the body of the machine. Foot control or knee control is used. A small electric lamp directly over the work is often furnished.

SEX. Among the higher animals each individual is either male or female. In them maleness is the state associated with the production of spermatozoa; femaleness that associated with the elaboration of ova. A male is an individual that is efficiently equipped for the elaboration of functional spermatozoa and for the conveyance of these towards the site of fertilisation; a female one efficiently equipped for the elaboration of functional ova, for the conveyance of these to the site of fertilisation, and often, as in the mammals, for the prenatal care of the embryo and foetus and for the nurture of the offspring. In certain groups maleness and femaleness are exhibited by one and the same individual either concurrently or in succession: such groups are hermaphrodites.

Where the sexes are distinct, male is to be distinguished from female by differences in (1) the form and structure of the *gonads* or reproductive organs, those of the male being *testes*, those of the female, *ovaries;* (2) the accessory sexual apparatus of ducts and associated glands concerned with the transit of the products of the gonads; (3) the external organs of reproduction, and (4) certain skeletal, cutaneous and other less definite physiological, biochemical and psychological characters.

Sex-differentiation.—It is now established that the sex of the individual is decided at the time of the union of ovum and spermatozoon, *i.e.*, at the time of fertilisation; and the mechanism which determines sex has been disclosed. At the beginning of this century it was generally accepted that at the time of fertilisation the egg was sexually neutral and that the sex of the new individual was determined by the conditions incident to its development. But certain facts are now known which point directly to the conclusion that sex in higher animals at least is predetermined at fertilisation. Identical twins are derived from a single fertilised ovum and are always of the same sex, whereas fraternal twins, originating in two distinct fertilised ova, may or may not be both of the same sex. There is no reason why, if purely environmental factors are at work in determining the sex of the offspring, those produced from one egg should always be of the same sex whereas offspring produced by separate ova may include both males and females.

In all higher bisexual animals so far as is known, and in certain plants, the sexes are to be distinguished by differences in the chromosomal content of the nuclei of the cells of which the body is built. (*See* CYTOLOGY.) In certain forms there is in one sex an unpaired chromosome in place of the equal pair in the case of the other sex. This difference is symbolised thus:—the sex with the unpaired chromosome is the XO; the other the XX. In other forms the number of chromosomes is the same in both sexes, but while in one sex, the XX, the members of one pair are identical in size and shape, in the other, the XY, the single X has an unequal mate, the Y-chromosome. (In still other forms the X-chromosome is represented not by one chromosome but by a group of from 2 to 8 which act together as a compound X-element.) These chromosomes, the X and the Y, since in respect of them the sexes differ, are known as the *sex-chromosomes*.

Into each ripe germ-cell, ovum and spermatozoon, there passes one or other member of each pair of chromosomes. If, as is the case in man, the female is XX, all ova will be alike in that each will contain an X-chromosome, but there will be two kinds of sperm elaborated by the XY male, one carrying the X-chromosome, the other the Y. The female in these groups is *monogametic*, elaborating but one kind of *gamete* (marrying-cell) in respect of chromosome content, the male, *digametic*. When egg and sperm unite, into the fertilised egg there will pass, by way of the sperm, one member of each pair of chromosomes, and, by way of the egg, the other member of each pair. There will thus be two kinds of fertilised ova, one that received an X-chromosome from each parent, to become an XX individual, *i.e.*, a female; the other, which received an X-chromosome from the mother and a Y from the father, to become an XY individual, *i.e.*, a male. This chromosomal difference between the sexes provides a simple yet sufficient mechanism for sex-determination. Similar reasoning will apply to those species in which the X-chromosome in one sex has no mate, and also to those in which the X-element is compound.

In mammals and in most insects the male has the single X; in the butterflies, moths and birds, on the other hand, it is the female that is digametic.

SEX-LINKAGE

In those forms in which the male is digametic, being XO or XY in sex-chromosome constitution, a son receives his single X from his mother, whereas a daughter gets one X from each parent. If on the X-chromosome of the father is borne the hereditary factor for a recessive character (*see* HEREDITY and MENDELISM) the track of the chromosome in inheritance can be followed, provided that in the Y-chromosome there are no factors which affect the action of those borne upon the X. Moreover if the sex-chromosomes are elements of the sex-determining mechanism and if factors for hereditary characters are borne upon them it will be seen that the mechanism that is determining whether the individual shall be male or female is also determining whether or not the individuals shall also exhibit some particular character—the character in its transmission from generation to generation will exhibit a *sex-linked* mode of inheritance.

For example, consider the inheritance of haemophilia (tendency to excessive bleeding). This appears to be a sex-linked recessive character; the interpretation which best fits the facts is as follows. Haemophilia is an hereditary character, the factor for which is X-borne. The male therefore, possessing but one X-chromosome, is either haemophilic or else is normal: the female on the other hand can be normal, a carrier (*i.e.*, with the factor on one of her X's only), or haemophilic (*i.e.*, with the factor on each of her X's). Let an italicised *X* indicate that on this particular X the factor for this recessive sex-linked character is borne. The following matings and results are possible:—

The marriage of a haemophilic man (*X*Y) with a haemophilic woman (*XX*) can yield only haemophilic sons (*X*Y) and haemophilic daughters (*XX*).

The marriage of a haemophilic man (*X*Y) with a carrier woman (X*X*) can yield normal sons (XY): haemophilic sons (*X*Y): carrier daughters (X*X*): haemophilic daughters (*XX*).

The marriage of a haemophilic man (*X*Y) with a normal woman (XX) can yield normal sons (XY) and carrier daughters (*X*X).

The marriage of a normal man (XY) with a haemophilic woman (*XX*) can yield haemophilic sons (*X*Y) and carrier daughters (X*X*).

The marriage of a normal man (XY) with a carrier woman (X*X*) can yield normal sons (XY): haemophilic sons (*X*Y): normal daughters (XX): carrier daughters (X*X*).

On the other hand the facts concerning the inheritance of certain characters in butterflies, moths and birds require that here the female shall be digametic. These facts can be illustrated by reference to the fowl. A black (non-barred) cock mated with barred hens will throw barred sons and black (non-barred) daughters. A barred cock mated with black hens will throw barred sons and daughters and if these are interbred they will in their turn produce barred and black offspring, but every black indi-

vidual in this generation will be a male. These facts can only be explained on the assumptions that sex in this form is decided by the simplex or duplex condition of some element which when present in duplicate leads to the establishment of maleness and that the factors for the sex-linked characters are borne upon the X-chromosomes.

Non-disjunction.—So far the evidence derived from breeding experiments and also from microscopical examination of the cell is in entire agreement: it is exceedingly strong but it is indirect. But direct proof of the chromosomal determination of sex and of the location of the hereditary factors in the chromosomes is available, for it has been shown by Bridges (1916) that certain exceptions to the normal course of sex-linked inheritance in *Drosophila* depend upon abnormality in the distribution of the X-chromosomes.

In *Drosophila melanogaster* white eye-colour is a sex-linked recessive character. Using the symbols w for the factor for this and W for the alternative dominant normal red eye and writing these as affixes to the X-chromosomes, the result of a cross between a red-eyed male and a white-eyed female can be shown.

Red-eyed male .	(WX)Y	x (wX) (wX)	white-eyed female
Spermatozoa .	WX.Y	: wX . wX	ova
Red-eyed daughters .	(WX)(wX) .	(wX)Y	white-eyed sons.

It is to be noted that during the process of the formation of the ova and spermatozoa the members of the pair of sex-chromosomes (as do all the rest) disjoin so that only one passes into each gamete.

In a particular sex-linked experiment Bridges got unexpected results: there were some red-eyed sons and white-eyed daughters. On cytological examination of such exceptional white-eyed females Bridges found that their cells displayed a Y-chromosome in addition to the normal pair of X's. This is what would occur if, during the maturation of the egg in which such an individual had had its origin, the X-chromosomes had failed to disjoin so that instead of coming to possess but one X it would contain two and if this non-disjunctional egg had then been fertilised by a spermatozoon bearing a Y-chromosome. If a non-disjunctional female is used in experiments involving a sex-linked character such as white-eye, the mode of inheritance of such characters will be obscured, as can be shown in the following scheme. She will elaborate four sorts of eggs instead of one. These can be fertilised either by the (WX)-bearing or by the Y-bearing spermatozoon of the red-eyed male.

The exceptional white-eyed daughters are white-eyed because they do not get one of their X-chromosomes from their red-eyed

Non-disjunctional white-eyed female
(wX) (wX)Y
ova

Sperm WX
(WX) (wX) — (wX) — (wX)Y
red female — white male
(WX) (wX) (wX) — (wX) (wX) — (wX) (wX) Y
red female — *white female exceptional*
(WX) (wX)Y — (wX)Y — (wX)YY
red female — white male
(WX)Y — Y — YY
red male exceptional — dies
Y Sperm

father: the exceptional red-eyed males are red-eyed because each gets his Y-chromosome from his mother and his X from his father.

The aberration in the chromosome distribution can explain the entire series of exceptional results. The evidence derived from breeding and from cytological investigation turned what seemed to be a direct contradiction of the chromosomal interpretation of sex-linked inheritance into a spectacular confirmation. The evidence confirms the conclusion that sex-linked characters are associated with the sex-determining mechanism because their factors are located in the sex-chromosomes and that sex is determined at the time of fertilisation by the XX-XY mechanism. In *Drosophila* certainly the Y-chromosome has no influence upon sex-determination, XXY and even XXYY individuals develop into females of normal appearance whilst X individuals lacking the Y develop into unexceptional looking males (but are sterile). XXX individuals either die or else grow up into sterile females and Y individuals without an X never appear—they must be non-viable.

Gynandromorphism.—Another line of argument pointing to the same conclusion has been derived by Morgan and his associates from the study of gynandromorphism in *Drosophila*. A gynandromorph is an individual of a bisexual species which exhibits a mosaic of male and female characters. Most specimens are lateral gynandromorphs, male on one side of the mid-line of the body, female on the other, with a sharp demarcation between the two kinds of tissue. In other instances one-quarter of the body is male, the other three-quarters female; in yet others the head is female and the rest of the body male. Morgan and Bridges (1919) have shown that if in the mating, which produces the gynandromorphs, sex-linked characters are involved and if the sex-linked characters of the two parents are dissimilar, then the sex-linked characters of the male parts are those either of the father or of the mother, whereas the sex-linked characters of the female parts are a combination of those of both parents. These facts point to the conclusion that gynandromorphism results from aberration in the distribution of the X-chromosomes. If it is assumed that the gynandromorph starts life as a female, XX in constitution, and that at some stage during the early divisions of the fertilised egg a daughter X-chromosome fails to enter one of the daughter cells, then this cell, unlike its sister, will contain one X instead of two, becoming XO instead of XX. It thus will come to possess the sex-chromosome constitution of male tissue. If the X-chromosome of paternal origin is lost the sex-linked characterisation of the male part of the gynandromorph will be like the mother's.

BALANCE OF SEX-DETERMINING FACTORS

Since the difference in sex-chromosome content is the only apparent difference in the constitution of the sexes it follows that the X or something lodged in it is female-determining (in cases similar to man or *Drosophila*), whilst male-determination is an affair of the rest of the chromosomes (exclusive of the Y) or *autosomes*. If the female-determining factor in the X be symbolised as F and the sum of the male-determining factors in one set of autosomes as M, then whilst both male and female possess 2M, the females possess 2F, the males 1F. Thus 2F must be $>2M$ and 1F must be $<2M$.

Triploid Forms.—Bridges found a strain of *Drosophila* which was *triploid, i.e.*, which possessed some or all of its chromosomes in triplicate instead of the normal duplicate. In the individuals produced by the triploid strain, three sets of autosomes (3A containing 3M) were in some individuals associated with 1X, in others with 2Xs, in others with 3Xs. Investigation revealed the following sex types. By representing the efficiency of the female-determining factors (X-borne) as 100 and that of the male-determining factor complex as 80, a series of sex-indices can be made.

Chromosome relation	Sex types	Numerical ratio X(100) A(80)	Sex index	Interval %	X=−6 A=+2
3X:2A	Super-female (triple-X) .	1·5:1	1·88	50	−14
4X:4A	4N female (N=the number of chromosomes in the gamete) . . .	1:1	1·25	..	−16
3X:3A	3N female	1:1	1·25	..	−12
2X:2A	2N female (normal constitution) . . .	1:1	1·25	..	−8
1X:1A	1N female . . .	1:1	1·25	50	−4
2X:3A	Intersex, female type .	1:1·5	·083	..	−6
2X:3A (−IV)	Intersex, male type .	1:>1·5	·083	33	−6
1X:2A	Male (normal constitution)	1:2	0·63	50	−2
1X:3A	Super-male (triple-A) .	1:3	0·42	..	0

Thus sex-determination cannot be the function of sex-chromosomes alone; on the contrary, sex must be determined by the interaction of factors borne upon sex-chromosomes and autosomes. The addition of more autosomal factors to the usual 2X:2A balance so disturbs this that femaleness is transformed into intersexuality. The difference in the sexual characters of individuals possessing 2X chromosomes associated with 3 of each autosome (2X:3A) and of those which have but two IV chromosomes instead of three (2X:3A—IV) is to be regarded as an indication that the IV chromosome carries, like the X-chromosome, a net balance of female-determining factors. Sex-determination is thus a matter of the correct quantitative balance between the amount of male and of female determining factors of the fertilised egg and if one does not exceed the other by a certain amount intersexual forms result.

The monogametic female is a female because she has the constitution (FX)(FX)MM and because $2F>2M$, whilst a male is a male because he has the constitution (FX)Y MM and because $1F<2M$. In forms with digametic female the male-determining factors must be borne upon the X-chromosomes. Then a male is a male because his constitution is (MX)(MX)FF and because $2M>2F$, a female is a female because her constitution is (MX)YFF and because $1M<2F$. In either case when $M=F$, intersexuality will result. Of course, these formulae must not be taken too literally: they are but convenient symbolism. But it is clear that in *Drosophila* the effective factor in the establishment of maleness, femaleness and intersexuality is the numerical ratio of X-chromosomes to autosomes.

The end-result of the interaction of male and female differentiating substances is the establishment of a particular physiological state, maleness or else femaleness, within the developing fertilised egg and in this or that internal environment the development of the individual proceeds. In *Drosophila* an individual is a male and develops the attributes of the male because in its beginning it had a chromosome constitution symbolised as XY; because in this XY individual the relation of male and female determining factors was such that an internal environment of maleness became established within the developing egg; because in this environment the structures pertaining to the XY sex equipment developed; and because the impress of the external environment did not or could not affect the developing individual so as to override the action of the sex-determining mechanism. For similar reasons the XX individual becomes possessed of typical female characterisation.

Developmental Physiology.—So far this discussion has concerned itself with the location of sex-determining factors within the chromosomes and with their correlation with the adult sex-characters. It is necessary to consider the methods by which the one becomes translated into the other during development.

In the vertebrates the initial sexuality, the expression of the hereditary constitution of the individual, is strongly reinforced when the reproductive organs become differentiated. The first trace of sexual differentiation in the mammal is to be seen in the sex-gland which appears early in embryonic life and when once the testes or the ovaries have developed they, through their physiological activities, control the differentiation of the accessory sexual apparatus and of much else besides. The results of castration and of implantation of sex-gland tissues have clearly demonstrated the intimate relation that exists between the type and degree of sexual differentiation and the functional activity and structure of the sex-glands and have proved that for complete differentiation and maintenance of the sex characters functional sex-gland is essential.

But among insects this is not so. All the sex characters of the insect are the direct expressions of the action of the chromosomes and owe nothing to the physiological activity of the sex-gland. The differentiation of each cell is pursued under the control of its own set of chromosome-borne factors: in mammals, though each cell of the female body is chromosomally, genetically different from each cell of the male body, this chromosomal difference does not bring about the whole differentiation of sex-characters locally, within the individual cell, but, once the sex-glands have become differentiated, the testes and the ovaries take charge.

Goldschmidt it was who made the first serious attempt to demonstrate the method by which the sex-determining factors in their action lead to the production of the sex-characters of the adult. He started from the fact, long known to entomologists, that when species or even geographical races of moths are crossed, sexual abnormalities are commonly found among the hybrid offspring. For his material he chose the gypsy moth, *Lymantria dispar*, which has a wide distribution and is very variable. If European specimens of this forest pest are bred among themselves the offspring are unremarkable in every way. The same is true of the Japanese variety, *Lymantria japonica*. But if a Japanese male is mated with a European female, normal male offspring and females which show a number of modifications in the direction of the male type are produced. When such female *intersexes* are mated with their brothers, of the females of the generation thus produced half are normal, half are intersexual. The reciprocal cross, European male Japanese female, produces normal females and males in the first hybrid generation, but if the individuals of this are then interbred they produce a certain proportion of males with female characters.

Further investigation demonstrated that there were many different sub-races of European and of Japanese gypsy moths that were quite distinct in respect of intersexuality, in that the degree or grade of intersexuality was definite and typical for a particular mating. Goldschmidt classified strains as relatively "strong" or "weak." For example, a "strong" male mated to a "weak" female gives 50 per cent. normal males and 50 per cent. intersexual females. A "very strong" male mated to a "weak" female would give offspring all male. A mated to B gave a low grade of intersexuality, C×D a high grade, E×F a grade intermediate between these, and so on. If strong race A gave moderate sexuality with weak race P, whilst with race Q it gave strong intersexuality, and if strong race B gave moderate intersexuality with Q, then it could be predicted that B with P would give only a slight grade. Similar males from one culture mated with females from different cultures gave intersexes that could be arranged in a series according to the degree of their abnormality and so on. It was possible, by calling on experience, to produce every stage from an almost complete male to an almost complete female intersex at will by making the appropriate mating. In fact, it was as possible to turn the "determined" females into fully equipped males as to ensure the regular production of normal males and females.

Influences of Intersexuality.—It was noticed that the condition of intersexuality did not affect all the structures of the sexual organisation equally. Further investigation demonstrated that the different structures could be arranged in a definite series as regards degree of intersexuality in characterisation and that this series was exactly the opposite of the order of the embryonic differentiation of these structures. Those organs which are first developed and differentiated are the last to be modified; those that appear last are the first to be changed. From these considerations there arose the Time-Law of Intersexuality. An intersex is an individual that has developed as a male (or female) up to a certain point in its life-history and thereafter has continued its development as a female (or male). The degree of intersexuality is determined by the time at which this switch-over occurs.

Intersexual females start their development as females and then at a certain point in development change their differentiation and finish as males, and since the hard parts of an insect are external and composed of chitin any of them that have hardened before the switch-over remain unaltered by it. From an examination of the parts which are sexually dimorphic, it is possible to decide in the case of any particular individual exactly when the change-over took place. These intersexes are sex-mosaics in time.

From these facts Goldschmidt deduced the following conclusions:

(1) Each sex possesses the potentialities of the other since either can become intersexual.

(2) The type of sexual differentiation that the fertilised egg will pursue is determined at the time of, and by the mechanism

of, fertilisation. If the constituents of intersexuality are in the fertilised egg, then the individual will inevitably become an intersexual form.

(3) The normal determination of sex is bound up with the X:2X mechanism. But as this does not prevent the occurrence of intersexuality and sex-reversal, it cannot be the mere presence of these chromosomes or the factors contained within them that counts, but rather their quantitative effect during development.

(4) The mode of inheritance of this intersexuality shows that since the female in *Lymantria* is XY, and since her single X-chromosome is received from her father, the male-determining factors in sex-determination are transmitted in the X-chromosome.

(5) Other factors concerned in sex-determination in *Lymantria* are purely maternal in inheritance, being resident in the Y-chromosome. A daughter receives her Y-chromosome from her mother. But since a male has no Y-chromosome, the factors in the Y-chromosome must have exerted their action on the unripe egg when this contained both X- and Y-chromosomes. If all eggs are to be alike in respect of the Y-borne genes, these must have acted and their products must have specifically affected the cytoplasm before the X and Y became disjoined.

(6) The fact that the females of similar constitution give different results when mated with males of dissimilar constitution shows that the sex-determining genes in the X-chromosome differ quantitatively in the different races. The fact that males of similar constitution give different results when mated with females of dissimilar constitution shows also that the sex-determining factors resident in the Y-chromosome can be different quantitatively.

It will be seen that if both X-borne and Y-borne sex-determining genes can so vary quantitatively among themselves, an infinite variety of different combinations can be made, deliberately or by chance.

Goldschmidt infers with reason that the sexual characterisation of any particular organ of the sex-equipment depends on whether one or the other type of sex-differentiating substance is effectively in excess at the time when the organ arises in development. He interprets the mosaic character of the intersex on the assumption that the amount of sex-differentiating substances produced in virtue of the presence of the corresponding sex-determining factors is not constant throughout life: that at one time the male-differentiating substance is in excess, at another the female. In the male of the moth M>F and the male-differentiating substance is effectively in excess until the period of development is complete. In the female M<F and the female-differentiating substance is effectively in excess during development. But if it should so happen that the sex-differentiating substances are produced at different rates, and if some genes possess the property of producing more sex-differentiating substance in a given time than others, then there exists the possibility that sex-mosaics in time will be produced.

A male of a race whose sex-determining genes work at a faster rate is crossed with a female of a race in which these factors work slower. The female-determining factor F is always inherited through the mother and in all the offspring there will be this factor F and the female-differentiating substance will be produced in all at the same rate. But the male offspring will receive one M from their mother, and the other, the quick-acting M, from their father, so that in a given time the male-differentiating substance will be effectively in excess during development. The female offspring will have only the paternal M, and therefore the amount of male-differentiating substance will increase relatively to the amount of the female-differentiating substance, overtake it, and finally supplant it, and from this point onwards any sex characters which still have to develop will be male. The individual will be a female intersex. It is not the absolute but the relative rates of production of male- and female-differentiating substances that control the modelling of the sex-equipment. Sex-reversal in these cases is due to genetic causes—the fertilised egg contains inevitably within itself the seed of its eventual transformation in the form of a quantitative disharmony of the sex-determining factors.

This work of Goldschmidt shows definitely that intersexuality in *Lymantria* depends upon variations in the relative rate of production of definite instances and that this again is correlated with differences in the sex-determining factors that can be interpreted in Mendelian terms. (*See* HEREDITY.)

In the case of the sexually abnormal types of *Drosophila* it is seen that the abnormality is the result of a disharmony in the *distribution* of the elements of the hereditary constitution of the individual. In the case of *Lymantria* intersexuality and sex-reversal are due to a disharmony in the *composition* of the hereditary constitution. The sexually abnormal individuals of *Drosophila* are spatial intersexes; those of *Lymantria* and of the frog and of the small Crustacean *Gammarus* (Sexton and Huxley, 1927), are consecutive intersexes, sex-mosaics in time.

No spatial intersex is possible in mammals since the control of sex-differentiation lies not in the cells but is relegated to the sex-hormone. No *certain* case of consecutive intersexuality is known in mammals although there is no theoretical objection to its occurrence. But intersexuality, though its causes may not yet be exactly recognised, does exist quite commonly.

One form of sexual abnormality possibly results from delayed hormone-production. In man and in most domesticated mammals a peculiar type of sex abnormality is sometimes encountered. Examination shows (1) that testes only are present but often occupy the position of ovaries or are at least abdominal; (2) that both male and female sets of internal accessory sexual organs are present; (3) that the external organs of reproduction are mainly female in type; (4) that male secondary sex-characters and instincts develop at puberty. Crew (1923) has adduced reasons for regarding these abnormal forms as males in which, for some reason, the testis has not been secreting its controlling hormone during embryonic life or at least until the main internal and external accessory sexual organs have been laid down. This interpretation presupposes that the differentiation of the accessory organs occurs during a limited period of embryonic life and that the process is more or less irreversible. In the absence of testicular hormone both male and female accessory organs can become differentiated up to a point and thus a neutral type results. The various accessory organs have slightly different periods of differentiation and according to this and to the degree of delay in the production of testicular hormone the individual will be intermediate or predominantly male. Such individuals owing to the appearance of the external organs of reproduction are usually classified as females at birth but prove to be males at puberty. The condition is hereditary.

THE BOVINE FREE-MARTIN

The part played by the sex-hormones in mammalian intersexuality is best illustrated by the bovine free-martin, a genetic female (XX) co-twin to a normal male, the reproductive system of which becomes abnormal during the period of sexual differentiation as a result of the action of the sex-hormone of a male co-twin *in utero*. Twins in cattle may consist of two normal males, two normal females, one male and one female each normal, or one male and the other an individual with an abnormal reproductive system and known as a "free-martin." In all save one of 126 cases of twins in cattle thoroughly examined by Lillie, two *corpora lutea* (yellow scars on the surface of the ovaries at the points at which ova have been extruded) were found. This shows that twins are almost invariably binovular (fraternal) in this animal.

The two fertilised ova pass into the bicornuate uterus and become attached. As the zygotes increase in size, the embryonic membranes of the two foetuses meet and in many cases fuse. If so, an intermingling of their blood vessels can result. In the case of twinning involving one normal male and one normal female it is found that fusion of the blood systems does not occur.

Thus the sex-hormone of each developing individual is at liberty to pass into the tissues of its co-twin. The sex-hormone is the instrument which models the sex-organisation. The internal

secretions of other organs can also pass from each individual to the other, but these are mainly concerned in the general and not in the special development of the individual and will be alike in both twins. But if the twins are bisexual and if vascular intercommunication becomes established (as it does in seven cases out of eight), the sex-differentiation of both individuals will be directed by that sex-hormone which is more potent or formed earlier. The testis becomes differentiated earlier than the ovary, and so the male sex-hormone is liberated before the female. The female twin will pursue her sex-differentiation under the direction of the male sex-hormone of her co-twin and will therefore come to possess more or less completely a male organisation. The assumption of the male characters in the case of the foetuses examined is imperfect; the external genitalia are of female pattern, the internal organs more or less completely male. The male sex-hormone is liberated before the embryonic gonads of the female have undergone differentiation into ovaries; such differentiation is prevented and so there is no question of a competitive action between male and female sex-hormones. Hartman (1920) has produced evidence which may mean that the reverse type of hormonic intersex—a male rendered abnormal by the sex-hormone of the female—may occur in the opossum and in man.

THE CASE OF BONELLIA

The marine worm, *Bonellia viridis,* displays a remarkable degree of sex-dimorphism. The female has a body about the size of a plum. The male is a microscopic pigmy whose internal organs, save those concerned with reproduction, are degenerate and who lives as a parasite within the body of the female. The fertilised eggs hatch out as free-swimming larvae. If a larva settles down upon the sea bottom, it becomes, with few exceptions, and after a short neuter period, a female; but if it settles upon the proboscis of a female it becomes a male. Baltzer (1914) took larvae at various periods after they had settled upon a female but before they had become completely male and forced them to lead an independent life, and as a result he obtained intersexes, the degree of intersexuality varying with the length of time the larva had been upon the female's proboscis. It has been shown that the larvae absorb material from the proboscis and that this is responsible for the arrest of growth and the direction of the sexual differentiation. The arrested pigmy male passes from the proboscis of the female into her mouth and then emerges and ensconces himself in her reproductive duct.

An ingenious hypothesis has been advanced to cover the observed facts concerning the case of Bonellia. Goldschmidt (1923) supposes that in all the individuals there is at first an excess of male-differentiating substance, but that the production of female-differentiating substance after a time overtakes this. Further, he supposes that the secretion of the proboscis of the female of *Bonellia* has the effect of accelerating the processes of differentiation as opposed to the processes of growth, antedating, as it were, the period during development when sexual differentiation occurs. When differentiation is rapid, the sex-organisation matures under the influence of the male-differentiating substance; when it is not accelerated, under that of the female-differentiating substance. The mode of sex-differentiation is determined by a varying physiological state in connection with varying environment and secretions from other individuals.

Baltzer (1925) agrees in principle with this physiological interpretation of the case of *Bonellia* but holds that the cause of the intersexuality cannot be an acceleration of the rate of development but is rather a retardation. He points out that in experimental cultures of *Bonellia* there first appear normal females, then females with sperm, and lastly intersexes and males; and that the male organisation, compared with that of the female, is to be regarded as a lower grade of development, being characterised by the absence of various organs.

THE EFFECTS OF PARASITISM

Giard (1887) and later Smith (1906) have described in detail the changes that occur in crabs parasitised by *Sacculina* and other parasitic crustacea. Sacculina, an internal parasite, is a cirripede crustacean, and part of its body projects to the exterior under the abdomen of its host, while root-like processes ramify to all parts of the crab's body, avoiding the vital organs and absorbing nourishment chiefly from the blood. It attacks males and females and in both causes atrophy of the sex-glands and consequent sterility. The only effect of this in females is an acceleration in assumption of adult sex-characters. Parasitised males, however, gradually take on more and more of the female characters, their great claws become relatively smaller, the abdomen broader, the swimmerets enlarge and become fringed with the hairs to which, in females, the eggs are attached. Most of the affected crabs die, but in a few the parasite disappears and the reproductive organs are regenerated. In a female a normal ovary develops, in a slightly feminised male, a normal testis, but in some males a sex-gland is regenerated, in which both ova and sperm are found; real male hermaphroditism is produced.

Geoffrey Smith (1906) who investigated this problem found that the blood of the normal female crab differs in chemical constitution from that of the male. It contains fatty substances which are used in the production of the yolk of the egg. These fatty substances form an important part of the food of the parasite *Sacculina.* That which *Sacculina* absorbs cannot be used in yolk formation, and as the eggs cannot develop, the ovary degenerates. In the male these fatty substances are present in but small quantities. The parasite demands more and the whole physiology of the male crab is altered to meet this demand; the male thus assumes the female type of metabolism, and consequently female characters.

The interest of this case is that it permitted Smith to question the validity of the conception that in all forms the gonads functioned as organs of internal secretion, contributing a peculiar product to the blood streams. Smith argued that the gonad, far from adding anything to the blood stream, removed something from it.

Sex-reversal.—It is somewhat difficult, when one first approaches this subject of the transformation of sex, to grant that reversal is possible in the higher forms in which the sexual differences, morphological, physiological, and mental, are so sharply emphasized. But when one remembers that what is rare and exceptional in one form can be facultative in others, and that all forms have much in common, the difficulty vanishes. It is readily conceded that the oyster, for example, may regularly change its sex. The native oyster begins its life as a male and then, when one or two years old, may and indeed commonly does, become a female. But that is not all, for Orton (1921) has shown that such an oyster, after becoming "white sick," *i.e.,* after shedding its ova into the mantle cavity, and whilst still carrying its own embryos, can, within the space of a month, become equipped as a male once more. That which is usual in the oyster may be, under certain conditions, not rare in the more highly organised forms. Similar instances of facultative sex-transformation are those furnished by *Crepidula plana,* parasitized Cymotheids and Epicarids, the starfish, *Asterina gibbosa,* and the slug *Limax maximus.* In all these cases the direction of the transformation is male $\rightarrow$ hermaphrodite $\rightarrow$ female.

SEX-REVERSAL AS DIRECT EXPRESSION OF GENETIC ACTION

If the genetic components of sex-reversal are present in the hereditary constitution of an individual, if the physiological equilibrium of the embryo established by the action of the hereditary factors is not profoundly modified by the physiological influence of the glands of internal secretion during development, and if the impress of external agencies upon the embryo does not or cannot override the hereditary constitution, *i.e.,* does not or cannot profoundly alter the physiological state established by the hereditary factors, then sex-transformation will occur as development and differentiation proceed.

Thus in the case of the moth, *Lymantria,* and similarly constituted forms, the same general forces which lead to intersexuality lead also to sex-reversal. Intersexuality is in such cases merely incomplete reversal. Complete reversal will occur when in a male

the quantitative disharmony between the male and the female sex-differentiating reactions is such that the female reactions are in excess throughout the whole of the period of differentiation, or in the case of a female when the male reactions are in efficient excess throughout this time.

In the *Lepidoptera* Goldschmidt (1910, 1923), Harrison, (1919), and others, have obtained species hybrid broods that were largely or entirely of one sex. Harrison was able to show that in one of his cases the mortality was not sufficiently high to account for the results obtained; it was not a case of a sexually selective prenatal mortality, and both Goldschmidt and Harrison have presented evidence which strongly indicates that the results are due to a sex-transformation of half the individuals concerned.

Essenberg (1925) records that sex-reversal occurs in the viviparous teleost fish, *Xiphophorus helleri*, (the sword-tailed minnow), and that many instances of this have been reported by fish breeders and fanciers. In Essenberg's cases two females ceased to produce young when about three years old, and during the course of several weeks took on the sex-characters of the male. Cytological examination revealed the presence of ripe sperm in all parts of the gonad which, however, was juvenile in relation to the size and age of the fish. Essenberg was able to show that there is a type of development in the female which readily provides a morphological basis for the change-over. He also shows that there is a complete reversal of the sex-ratio in a population, males being rare among the immature and plentiful among the old. It would seem from Essenberg's observations that sex-reversal is extremely common in this fish and that it is genetic in origin, there being a form which through genetic action is destined merely to pass through a female phase and later to proceed to a male type of sex-differentiation.

Harms (1926) also has observed the transformation of females of *Xiphophorus* into males at different ages, especially among old sterile females. He records that during this process of sex-reversal the female when mated still produces young, though when the process is completed, the individual is a functional male, larger than the normal male, broader and heavier. Harms observed that the older the animal is at the time of the change-over, the more female the general body build remains. The process occupies about 3–4 months and in the case of old females may remain incomplete. The cause of the transformation is regarded by Harms as being a physiological exhaustion of the ovary with a consequent alteration in the general metabolism which invokes the differentiation of testicular tissue.

Harms bred from transformed females when they were functioning as males and got none but females, as would be expected if the female of the fish is monogametic (XX).

SEX-REVERSAL AND HEREDITARY CONSTITUTION

Sex-reversal can be the result of the overriding of the hereditary constitution by agencies which sufficiently disturb the general physiological conditions of the zygote at some stage or other of its development. It can result from a disturbance of the physiological condition within the ovum before fertilisation. The work of Hertwig, Kushakevitch and Witschi has shown that delayed fertilization and also the exposure of frogs' eggs before fertilization to high temperature (27° C) lead to a profound disturbance of sex-ratio. A male frog was permitted to fertilise half the eggs of a female and then was removed, to be replaced after an interval to fertilise the remainder. After an interval of 89 hours none but male offspring were obtained. This result is not due to selective fertilisation, to a sexually selective mortality among the embryos, or to the abnormal extrusion of an X-chromosome during the maturation of the eggs. The correct interpretation of the results would seem to be that some 50 per cent of the eggs were fertilised by X-chromosome-bearing spermatozoa, females (XX) being produced, but that the conditions of the experiment were such as to transform these into functional males, the sex-chromosome constitution of the zygote being overridden by the effects of delayed fertilisation upon the metabolism of the egg. The results obtained by Mrsić on the effect of over-ripeness upon trout eggs are probably to be explained in a similar fashion.

The observations of Adler (1920), who has shown that the thyroids of individuals from these late fertilised eggs are markedly hypertrophied, would seem to be of significance. Adler suggests that in these individuals the thyroid comes into action earlier than does the gonad and so affects the internal environment that the gonads, when they do differentiate, become testes.

These observations are closely in line with those of Whitman (1919) and of Riddle, (1912, 1916) upon the pigeon. It was found by Whitman that the matings of birds belonging to the *Columbidae* with species of two distinct zoological families of birds resulted in the production of male offspring only, and that females alone were obtained from the eggs of doves which had been forced to lay excessively and at an abnormally rapid rate. Riddle carried these observations further and was able to show that the eggs that yield males can be distinguished from those which yield females, that maleness is associated with eggs of smaller size, higher water content, and less stored energy, and that the production of all males or of all females was associated with the production of eggs of one or of the other type. He was able to dismiss the possibility of selective fertilisation and of differential maturation, and was driven to the conclusion that the conditions of the experiments were such as to induce sex-reversal in the egg itself (1914, 1919).

It is a simple matter to interpret these results in terms of a metabolic theory of sex as elaborated by Riddle. Delayed fertilisation implies an increased metabolic rate in the egg and a high metabolic rate implies maleness. Desiccation implies a decreased metabolic rate and femaleness. The hypertrophy of the thyroid implies an increased metabolism and an internal environment of maleness. The production of offspring all of one sex by matings of wide crosses is to be interpreted as the result of the pooling of hereditary factors which in their action lead to the establishment of one kind or the other of metabolic level in the zygote.

In this connection it should be noted that Guyer's (1909) data on species hybrids among birds show that there is a decided excess of males in the F_1 generation. Riddle (1916) recorded an excess of females in the cross *Streptopelia risoria* × *S. alba* (doves) under certain conditions and concluded that this excess was the result of a transformation of some of the males. It has been shown, however, that this conclusion is not justified, for the cross involved a sex-linked character and of the hybrids the males are dark, the females white in colour, and examination of the date for sex and also for colour shows that the only possible explanation of the excess of females is that which postulates that the conditions of the experiment were such as to cause the X-chromosome to pass into a polar body at the time of the reduction divisions more often than to remain in the egg.

Sex-reversal can result from a disturbance of the general physiology of the individual during embryonic life.

Burns (1925) joined young embryos of *Amblystoma* in the tailbud stage in parabiosis and instead of getting the expected chance combinations of the sexes, 1♂♂, 1♂♀, 1♀♂, 1♀♀, he obtained exclusively one sexed pairs. He suggested that the reason for this 44 ♂♂ : 36 ♀♀ or 1 : 1 ratio was that in one-half of the original ♂♀ and ♀♂ associations the males became transformed into females, whereas in the other half the females became transformed into males.

Witschi (1927), using four different species of frogs, joined embryos 50–70 hours old, and shortly after the closure of the medullary tube, in parabiosis. The controls exhibited the first signs of sex-differentiation during the third week of development; in the case of the parabiotic twins it was somewhat delayed. The twins were preserved at intervals during the larval period and the stage of metamorphosis. The sex-ratio among the controls was 96♂♂ : 100 ♀♀ or 1 : 1. Among the 56 twins there would be expected the following sex-combinations: 14♂♂, 14♂♀, 14♀♀. There was found on examination 16♂♂, 17♂♀ (with 7 of the ♀♀ exhibiting some stage in sex-reversal), 10♀♂ (with 4 of the ♀♀ undergoing sex-reversal), 13♀♀.[1] The combination of a female with a male twin undergoing sex-reversal was not encountered.

Witschi therefore concluded that the male sex-differentiating agencies predominated and that sex-reversal did not take place before the time of sex-differentiation.

Disharmonies in the development time-relationships of sex-differentiation may provide opportunity for sex-reversal. For example, in *Myxine* (Schreiner, 1904), growth would seem to proceed undirected to the stage when the individual is hermaphroditic, before the processes of sex-differentiation set in to convert the individual either into a functional male or else into a functional female. In the young males of the Stone-fly *Perla* both ovarian and testicular tissues are to be found but the ovarian tissue undergoes atrophy, so that in the adult none but testicular remains (Junker, 1923). In such circumstances as these the morphological basis of a possible sex-reversal is revealed and it becomes entirely conceivable how physiological disturbances during embryonic and early post-embryonic life can change the course of differentiation and lead to the conversion of a genetic male into a functional female, and *vice versa.*

Sex-reversal can result from a disturbance of the general physiology of the post-embryonic individual. The conditions necessary for such sex-transformation are (1) there must be a switch-over from one type of metabolism to the other, from the female to the male, or *vice versa;* (2) the component structures of the sex-equipment must be capable of transformation or replacement, one kind of sex-gland tissue must be replaced by the other, ovary must become or be replaced by testis, or *vice versa,* the accessory sexual apparatus, the external organ of reproduction, the rest of the secondary sex characters must be remodelled or replaced.

Complete sex-reversal therefore cannot occur in any individual or form in which the internal and external organs of reproduction, being fashioned early in embryonic life, thereafter lose their plasticity and become unresponsive to any stimulus which, had it been exhibited at the time of their differentiation, would have controlled these processes. Nor can it occur in those cases in which the differences between male and female sex-equipments are based upon the differential development of two different sets of structures, one of which, in either sex, undergoes complete atrophy. No more can it take place in those forms in which sex-dimorphism involves a differential mode of development of one and the same set of structures, for if one plan of differentiation is pursued, the steps cannot be retraced and the alternative route then followed.

Harms (1923) and Guyènot and Ponse (1923, 1925) have shown that if young castrated male toads are fed on a diet containing an excess of fat, lipoids, and lecithin for a considerable period of time, the hind portion of Bidder's organ becomes differentiated as an ovary and the fore portion as a new organ of Bidder, and that oviducts and uteri are developed while the pointed head becomes transformed into the blunted characteristic of the female. Ponse (1925) succeeded in rearing 9 metamorphosed offspring of one such transformed male functioning as a female and of these 6 were males and 3 females. Harms raised 184 such offspring and of the 161 the sex of which could be identified there were 104 males and 57 females. If in the toad the male is digametic, and if the YY zygote is non-viable, the expected sex-ratio is 2♂♂ :1♀.

Champy (1921) records that when a male triton (*T. alpestris*) was fed intensively after the winter's starvation period, he assumed the external characters of a female, and that within the pre-existing testicular tissue there were to be found immature, but unquestionable ova. He had previously shown that the annual process of spermatogenesis in tritons could be inhibited by starvation and that in the absence of spermatogenesis there was no development of external sexual characters, the animal exhibiting the "neuter" state characteristic of winter. In this "neuter" state there are to be found in the testes primitive gonocytes and spermatogonia. In animals killed in the spring, following starvation, the testis was represented by a longitudinal strip of fat. Two of these starved "neuter" tritons, when fed intensively, lost the dark blue coloration of the back and assumed a greenish shade mottled with distinct blue marks, as in the female, whilst the yellow dorsal line became more and more attenuated. One of these animals was killed in January and there was found the expected strip of fat with a few spermatogonia. The other was kept alive and in February was female in appearance. It was kept until April when post-mortem examination revealed within each of the strips of fat an elongated organ of granular appearance resembling an ovary, together with an oviduct.

In addition to these experimental studies in sex-reversal, the following cases have been observed. In the case of one of the frogs resulting from the "egg-overripeness" experiments, Witschi (1923) was able to show that indeed it was a transformed female, for when mated with a normal female it sired only female offspring. This is as would be expected, if in its fundamental chromosome constitution it still remained XX, for then all its spermatozoa would be X-chromosome-bearing and on fertilising X-bearing eggs would yield none but XX zygotes. Crew (1921) had previously encountered a similar case in the frog.

Riddle observed a case of complete sex-reversal in the ring-dove (*Streptopelia risoria*) an adult female laid eleven eggs between January 17 and April 15, 1914. During the six months following she and a male mated three times, began sitting on a nest without producing eggs, and raised young of other parents. During the following nineteen months her sex-behaviour and mode of growing changed to that of a male, frequently forcing her male mate to act as a female in copulation. At twenty-two and a half months after producing her last egg, this bird and mate were transferred to a pen with a few other spent inactive doves. The male of this pair died three and a half months later, and weights and dimensions of testes were obtained. Twenty-one months after transfer, the bird died, showing advanced abdominal tuberculosis. Two testes were found, removed and weighed. If any residue of the original ovary remained it was wholly included in a tuberculous mass, involving spleen and liver. At the time of autopsy this bird was supposed to be the original male of the pair, and therefore the testes were not saved for demonstration. The bird had lived forty-four and a half months after producing the last egg, became tuberculous, assumed male behaviour, the curve for the body weight during the three years undergoing a remarkable change, and at death it possessed two unmistakable testes. Riddle interprets this transformation as the result of the increased metabolism which followed the destruction of the ovarian tissue and the presence of tuberculosis.

Crew (1923) described the case of a Buff Orpington hen, the reputed mother of many chickens, which when three years old was attacked by tuberculosis and developed male characters, to become a fecund male and the father of two chickens. Post-mortem examination revealed the presence of two functional testes and a highly degenerate mass of ovarian tissue destroyed by tubercular disease. This case alone could not be regarded as providing conclusive proof of sex-reversal in the fowl, for during the earlier part of its life this bird had been in the possession of a private breeder concerning whose integrity there is no doubt but whose powers of critical observation can, of course, be held up to question. However, Crew (1923) and Fell (1923) examined a series of sexually abnormal fowls and were able to demonstrate that the condition found in these could logically be interpreted as stages in the process of transformation from a female type of sex-organisation to a complete male type.

In the mammal complete sex-reversal cannot occur in post-embryonic life, because of the differential mode of development of the internal and external sex organs.

A consideration of these instances of sex-reversal will show that in the egg stage and in the post-embryonic stage of Amphibia and in the case of fish also, if Huxley's interpretation of Boulenger's results is correct, reversal can occur in either direction, female to male, and *vice versa,* whereas in the post-embryonic stage of birds it has thus far been demonstrated in one direction only, from digametic sex to monogametic. In this connection it is of interest to note that in the instances of intersexuality in *Lebistes* observed by Winge (1927) the change occurred in old females which assumed male characters though still breeding as normal females. That this is so is provocative of thought. It is possible that the balance between male and female sex-differ-

entiating reactions is more easily disturbed in the case of the sex which possesses but a single X-chromosome, a suggestion which is in line with the observation of Haldane (1921) that in the case of specific and wide varietal crosses if among the offspring one sex is absent, rare or sterile, that sex is the digametic.

In the case of Amphibia, fishes and birds, the conditions required for complete sex-reversal are readily met. In the Amphibians and birds it has been shown that it is possible experimentally to masculinise a female and to feminise a male by appropriate sex-gland implantation. Male and female accessory sexual apparatuses and external sex-organs are very similar, the sexual differences commonly being nothing more than differences in the degree of development of common structures, or, in the case of such as are developed from different rudiments, the set appropriate to the alternative sex becoming completely atrophied. All that is required is that one kind of sex-gland tissue shall be replaced by the alternative kind. In the case of the Amphibia if, as seems the case, at the end of the breeding season the sex-glands are physiologically exhausted, if the differentiated tissues undergo complete involution so that a new proliferation of germinal epithelium is required for the provision of gametes for the following breeding season, or if only a portion of the primordial germ cells develop each year, then the mode of differentiation of each season's crop can be determined by the impress of varying environmental agencies, if these are of such a nature as to disturb sufficiently the general metabolism of the individual. Such would appear to be the explanation of Champy's results. Surgical removal of the gonad will lead to the same result if following gonadectomy the general metabolism of the individual is influenced by special feeding (Harms, 1923).

It is to be emphasised that, although the processes of sex-differentiation are reversible, the chromosome constitution of an individual is not thereby affected. The form and function of the gamete are not determined by its chromosome content: they are determined by the structure and function of the gonad in which the gamete is elaborated. In forms in which sex-reversal is usual it seems that the physiological state established by the hereditary constitution is readily overridden through the environment. Reversal is an adaptive response to a changing environment—the individual is a female when it may be and a male when it must.

THE SEX-RATIO

The sex-ratio is the numerical proportion of the sexes within a group. In biological literature it is commonly recorded as the number of males per hundred females: in biometrical papers it is expressed as the percentage of males in the data examined. A third and somewhat elaborate method is one that shows the proportion of males as a decimal of unity. In any bisexual species there must be a sex-ratio at all times after the sex-determining mechanism has operated. For purposes of discussion it is convenient to take conception, birth, and maturity as the three salient points in the life-history of the individual at which to compute the sex-ratio of the species, and the proportions which obtain at these three stages are known as the primary, the secondary, and the tertiary sex-ratio respectively. Of these the secondary sex-ratio has received most attention. In most animals only the tertiary sex-ratio is known.

The Tertiary Sex-ratio.—The tertiary sex-ratio will be identical with the secondary unless during the period birth–maturity sex-reversal commonly occurs or unless a sexually selective mortality has been operating. Any difference between the secondary and tertiary ratios can simply be the result of a selective postnatal mortality and can serve as an indication of the relative postnatal survival value of the sexes.

The only material available for examination is the human. The returns of the Registrar-General for 1913 reveal the following facts. In the age groups 0–5 years the sex-ratio of infantile mortality is 113·4; in the 5–10 group it is 100·7; in the 10–15 group it is 93·3. This period, 10–15, is, in fact, the only one during which more females than males die, and this is held to be the result of the exhaustion of puberty in the female and the incidence of tuberculosis (Schultz, 1918, and Stewart, 1910–1911). From 15 years on the sex-ratio of mortality rises steadily to the age of 50, when a slight decline sets in. This excess of male mortality is probably mainly due to occupational stress. The effect of this selective mortality is seen in the swing of the sex-ratio of the population; 104:100 at birth, it is reduced to 102:100 at the end of the first year, and to 101·5:100 at the end of the second. In the third to fifth years it falls to 101·3:100. From 5–10 it becomes 99·9:100; from 10–15 it becomes 94·2:100. During the 15–20 age period there is a rise following upon the increased mortality of females during the 10–15 age group. From this point on there is a continuous drop, with the exception of a slight rise between 40 and 50 during which period there is an increased mortality of females from reproductive disorders during the period 40–45 years. In old age (85 years) the sex-ratio is only 55·2:100.

It is impossible as yet to define the causes of this postnatal sexually selective mortality. The action of semi-lethal factors (*see* on), differences in occupational risks, and such like, cannot explain all the facts, and all that can be said at present is that for reasons as yet unknown the male exhibits an inherently inferior resistance to the stresses of the acts of living.

The Secondary Sex-ratio.—The secondary sex-ratio in a group will be the same as the primary unless during the period conception–birth (hatching) sex-reversal is common, or else a sexually selective mortality among male and female embryos operates. Any differences between primary and secondary ratio will suggest that the sexes possess different prenatal survival values.

It is known that while the secondary sex-ratio of a species is fairly constant and not far from equality it is distinctly variable. It varies with the species.

Man	103–107	100	*Mammalia*
Horse	98·3	100	,,
Dog	118·5	100	,,
Cattle	107·3	100	,,
Sheep	97·7	100	,,
Pig	111·8	100	,,
Rabbit	104·6	100	,,
Mice	100–118	100	,,
Fowl	93·4–94·7	100	*Aves*
Pigeon	115·0	100	,,
Cottus	188·0	100	*Teleostei*
Lophius	385·0	100	,,
Loligo	16·6	100	*Cephalopoda*
Octopus	33·3	100	,,
Latrodectes	819·0	100	*Arachnoidea*
Lucilia	95·13	100	*Diptera*
Drosophila	100·0	100	,,
Macrodactylus	131·0	100	*Coleoptera*

It varies with the race, breed and strain.

Sex-ratio of Entire Populations

Country	Males per 100 females	Country	Males per 100 females
Great Britain	93·5	Belgium	98·4
Norway	94·0	Italy	99·0
Denmark	94·5	Poland	100·5
Sweden	95·3	Greenland	101·5
Spain	95·3	Japan	102·0
Austria	96·6	India	104·1
Germany	96·9	Bulgaria	104·5
European Russia	97·2	Serbia	106·0
Switzerland	97·2	Siberia	106·0
Hungary	97·7	Caucasus	111·0
France	97·9	Korea	113·0
Holland	98·2	Asiatic Russia	117·5
Ireland	98·3	China	125·0

It varies among different races living under the same conditions.

Locality	Authority	Ratio for whites	Ratio for coloured
U.S.A.	Jastrzebski	105·7	100·0
Cape Colony	,,	105·4	102·6
Columbia	,,	105·0	100·0
New York	,,	104·5	101·6
New Orleans	,,	102·0	98·2
U.S.A. (1st births)	Little (1920)	115·51	93·61
Columbia	Nichols (1907)	106·2	103·0
Cuba	Heape (1909)	108·42	101·2

It is possible by selection to obtain strains differing widely in respect of their secondary sex-ratios. King (1918) has found that in the case of the albino rat it was possible, starting with two pairs of rats from the same litter, to found two strains, one of which produced a high proportion of males, the other a preponderance of females. The progeny of one pair (pair A) were bred brother to sister without selection for six generations in order to build up a homozygous and uniform race. After this, selection was practised, the brothers and sisters being chosen from litters which showed a preponderance of males. In line B the selection after the sixth generation was made from litters showing a preponderance of females. After fifteen generations of such inbreeding and selection, the sex-ratio at birth in line A was 125:100, in line B 83:100. The habitual production of an unusual sex-ratio can be the expression of the hereditary constitution of a stock. It is possible to breed for a preponderance of one sex. If this process can be developed successfully in the case of domestic animals, breeding for sex preponderance will assume economic importance.

It varies with the seasons of the year. It is not improbable that the breeding season is one in which the general physiological condition of the individual is above the average, and it is of interest therefore to compare the secondary sex-ratio following conception during the breeding season with that following conception at other times. The human birth-rate actually shows a slight variation in spite of the fact that nearly all traces of the primitive breeding season have been obliterated by social habits. It is found that the sex-ratio is low for births resulting from conceptions at the seasons of greatest fertility and high at the time of lowest birth-rate. In the case of the fowl there is evidence to show that there is a swing in the secondary sex-ratio with the chronological order of the egg. Jull (1923), using a sex-linked cross in order to preclude errors, recorded the sex of the chickens hatched from eggs of 45 hens during their first year of production. The observations were repeated for three years and the secondary sex-ratio was found to be 48·41 expressed as a percentage. Analysis of the figures gave the following table:

Eggs	Secondary sex-ratio
0 to 20	62·91 ± 1·44
11 „ 40	57·46
41 „ 60	45·00
61 „ 80	44·61
81 „ 100	37·65
101 „ 120	32·53 ± 1·15

The secondary sex-ratio is profoundly disturbed as a result of interspecific and intervarietal crosses. Haldane (1922) has pointed out that in any such cross the sex that is absent, rare, or sterile is the digametic sex.

The effects of hybridisation upon the sex-ratio is a subject of considerable anthropological interest. Three types of hybridisation are possible: (1) between white races, (2) between coloured races, and (3) between white and coloured races. As a result of an investigation of the effect of hybridisation, Little (1920) concluded that a higher preponderance of males resulted from hybrid white matings than from pure white matings, and that hybrid coloured matings gave a higher preponderance of females than did pure coloured matings. This is in agreement with Lewis' results in the Argentine (1906). Powers (1877) states that, in the case of black and white hybrids, there is a large excess of girls among half-breeds in California and Kohl (1859) notes that in the northern parts of the United States females preponderate in the progeny of French men with Indian women. Starkweather (1883) found in the mulatto a 12 to 15 per cent. excess of females, while in the whole population males were in excess. An excess of females is reported by Görtz and Waitz among the offspring of Dutch men and Malay women in Java (1859). Jastrzebski states that for the years 1910-1915 the ratios of males to 100 females in New York were: whites, 104·0; negroes, 99·9; and mulattoes, 97·9. Bugnion (1910) states that in a hybrid race formed by settlers in a colony of negroes there was a marked preponderance of females. It seems therefore possible to conclude (1) that crosses between white races produce an ex-

Mother	Father	Males	Females	Author
Insects (in *Lepidoptera* the female is digametic; in *Drosophila*, the male)				
Nyssia graecoria	*Lycia hirtaria*	65	0	Harrison (1916)
N. zonaria	„ „	208	0	„ (1919)
„	*Poecilopsis isabellae*	32	0	„
„	„ *pomonaria*	90	0	„
„	„ „ (inbred)	71	7	„
„	„ *lapponaria*	93	0	„
„	„ „ (inbred)	62	3	„
Lycia hirtaria	„ *pomonaria*	86	75	„ (1916)
„ „	„ „	190	14	„
Poecilopsis isabellae	*Lycia hirtaria*	38	32	„
P. lapponaria	*Poecilopsis pomonaria*	38	39	„ (1917)
Oporabia dilutata	*Oporabia autumnata*	6	0	„ (1920a)
Tephrosia bistortata	*Tephrosia crepuscularis*	378	12	„ (1920b)
Drosophila melanogaster	*Drosophila melanogaster*	..	..	Lynch (1919)
(fused)	(normal)	0	823	„
(fused XXY)	„	9	744	„
(rudimentary)	„	10	923	„
(rudimentary XXY)	„	93	649	„
Drosophila melanogaster	*Drosophila melanogaster*	2	3552	Sturtevant (1920)
Birds (female digametic)				
Turtur orientalis	*Columba livia*	13	1	Whitman and Riddle (1919)
Streptopelia risoria	„ „	38	0	
S. alba-risoria	„ „	11	0	
S. risoria	*Zenaidura carolinensis*	16	0	
Gallus domesticus	*Phasianus colchicus*	100	..	Lewis Jones (quoted by Haldane)
Phasianus reevesi	„ *torquatus*	161	6	Smith and Thomas (1913)
„ „	„ *versicolor*			
Tetrao urogallus	*Tetrao tetrix*	40	8	Suchetet (1897)
Gallus domesticus	*Pavo nigripennis*	2	0	Trouessart (1907)
Mammals (male digametic)				
Bos taurus	*Bison americanus*	6	39	Boyd (1914)
„ „	*B. bonasus*	1	3	Ivanov (1913)

cess of males over pure white matings; (2) that hybridisation between coloured races produces an excess of females above pure coloured matings; and (3) that hybrids of white and coloured races show an excess of females above the pure matings of either race.

The secondary sex-ratio varies with the parity, *i.e.,* the chronological number of the pregnancy. In the case of the human, the dog, and the mouse, it has many times been noted that there is a continuous drop in the sex-ratio at each succeeding pregnancy (Wilckens, Punnett, Bidder, Copeman and Parsons). King and Stotsenburg found that the same rule obtained in the rat.

Parkes points out, however, that most of the second and higher births occurred at the end of the breeding season when the sex-ratio is at its highest, and that too much must not be inferred from his figures until the experiment has been repeated.

It has been suggested that the sex-ratio varies with the time relation of successive conceptions. Rumley Dawson (1921), for instance, maintained that in the case of the female producing one young at a time the right ovary elaborated only male-producing ova, the left only female-producing, and that the ovaries function alternately, ovulation occurring in one ovary at one oestrous period, in the other at the next. This view cannot be brought into harmony with established facts, and therefore cannot be accepted on its present-day evidence. The theory is supported by a collection of selected statistical data applied without proper statistical treatment, and those cases which do not fit into the scheme are airily dismissed, whilst the great body of established facts which supports other theories and cannot support this particular one is neglected. Variations of this theory are numerous, and like it are based upon the conception that in the human, horse, and cattle, the female is digametic. Many believe that offspring of either sex can be obtained at will by persuading the semen of the male to flow to the right or the left of the body of the female, towards the left ovary or to the right, that is. This is ensured by the female lying on one side or the other after coitus, or standing on a slope. The matter has been tested experimentally and found wanting. Doncaster and Marshall (1910) have shown that unilateral ovariotomy in the rat does not result in the production of offspring of one sex only, and the cogency of these experimental results cannot be dismissed by the statement that it is too far a cry from the rat to the human female. If the breeder really desires to have this theory tested, the way is simple, for it can readily be shown that unilateral ovariotomy in the horse or in the cow is not followed by the production of offspring of one sex only, and that the production of both male and female progeny is not to be explained by any regeneration of the imperfectly removed ovary.

Statistical evidence has been presented, sometimes supporting, at other times contradicting, the suggestion that the sex-ratio is affected by the relative ages of the parents, the offspring being mostly of the same sex (or of the opposite sex) as the older (or as the younger) parent. Hofacker (1828) and Sadler's (1830) law—that the sex of the offspring is that of the older parent—finds no support in the result of critical inquiry: it is contradicted by the work of Schultze (1903) on mice, for example. According to some data, the age of the mother has a relation to the sex of the offspring, younger mothers producing a preponderance of males (or of females). In the majority of cases the data upon which these theories are based have not been collected by biometrical experts, nor can their genuineness be absolutely guaranteed. Other data seem to suggest that the sex of the offspring tends to be that of the more (or the less) vigorous parent. For example, the theory of Starkweather (1883) suggested that the "superior" parent tended to beget offspring of the opposite sex, but since it is impossible as yet to define "vigour" and "superiority" in accurate physiological terms, such theories are not suitable for scientific discussion. There is no experimental basis for such conceptions.

It has been suggested that the sex-ratio varies with the time of service during the oestrous period. This is not supported by the elaborate data of Pearl (1917).

It has often been stated that as a result of war more males are born. Savorgnan (1921) and others have supported this contention. (*See* SEX-RATIO AT BIRTH AND DEATH.)

Causes of Inequality of Secondary Sex-ratio.—The secondary sex-ratio is probably always above 100, whereas the tertiary is almost invariably below 100. If the sex-ratio of still-births is examined it will be found to be higher than that of live births. If the sex-ratio of abortions is next examined it will be found to be considerably higher than that of still-births. The empirical data only extend back to about the third month of pregnancy, but it is well established that the relative male mortality increases the nearer conception is approached so that the primary sex-ratio must be considerably higher than that encountered in the latter part of pregnancy. Gunther (1923) has calculated that the early wastage of males must be very considerable indeed.

It is seen, then, that there exists a very considerable prenatal sexually selective mortality. Far more males than females are conceived in those forms *in which the male is the digametic sex,* and far more males than females perish prenatally so that the secondary sex-ratio approaches equality.

It is highly probable that much of this sexually selective mortality is due to the action of hereditary sex-linked factors, lethal or semi-lethal in their effects in that they lead to the development of characters which render the further development or the continued existence of the individual impossible. Since the male is digametic any recessive factors borne in the X-chromosome will take effect in all males carrying them whereas in females both X-chromosomes must carry the factor before the corresponding character can appear. It is well known that many recessive characters in animals are harmful to their exhibitors: when markedly so they may not permit the organism to live; when slightly so they may yield but a slight reduction in viability. If such recessive characters are sex-linked then the male embryo and foetus will suffer far more often than will the female. It is reasonable to assume that such recessive sex-linked factors should in man, as in other forms, frequently reduced viability. If so, a complete formal explanation of the excess of male infant mortality is provided.

This selective elimination is also affected by favourable and unfavourable conditions during pregnancy. Savorgnan concluded from an examination of his data concerning the sex-ratio and the war that it was not privation but absence of husbands which determined the rise in the sex-ratio. He explains the relatively low sex-ratio of still-births by suggesting that long absences of husbands imply less frequent pregnancies and therefore healthier mothers. It is not improbable that the lower male ratio in still-births and the increase in still-births are but reflections of privation during the latter part of pregnancy.

The same explanation can be applied to the fact that the secondary sex-ratio among illegitimate children is lower than that among legitimate—the lack of prenatal care and hygiene resulting in an intensification of the forces that always make it relatively difficult for the mammal to beget male offspring and for the bird to produce as many females as males. The secondary sex-ratio is highest among those people and those herds in which the highest degree of prenatal hygiene is practised. It is probable that amongst the coloured people there is a higher prenatal mortality and that this is the case also among the hybrids of coloured races and of white and coloured, whereas the mortality of hybrids of two white races is relatively very low in consequence of the hybrid vigour or heterosis that results from such a mating.

The Primary Sex-ratio.—If the two forms of gametes elaborated by the digametic sex are produced in equal numbers, if the two forms are equally viable and functional and if fertilisation is at random, then the primary sex-ratio will be equality.

But in certain forms the two forms of gamete elaborated by the digametic sex are not produced in equal numbers. In the case of bird and moth the egg contains the X- and Y-chromosomes in conjugation before the polar bodies are formed. Into the first polar body goes either the X or the Y. If it is but a matter of chance which way this chromosome pair lies on the spindle,

then equal numbers of X-bearing and Y-bearing eggs will result. But if in a particular line this pair should habitually be so orientated on the spindle that the X passes into the polar body more often than the Y, then in this line a preponderance of female offspring (XY) would be observed. Such a differential production can be obtained experimentally, as is shown by the work of Seiler (1920) on the Psychid *Talaeporia tubulosa* in which the female is the heterogametic sex. Seiler was able to show that the ratio of the eggs in which the X-chromosome passed into the polar body to those in which it remained in the egg, was exactly the same as the sex-ratio. Moreover, since in the course of these observations it was possible to detect the moment of the disjunction of the sex-chromosomes, it became possible to attempt to influence this disjunction experimentally and so to disturb the sex-ratio. Seiler by varying the temperature during the period of maturation division obtained the following highly interesting and significant results:

Temperature	X-chromosome remained in the egg	X-chromosome passed into the polar-body	Sex-ratio
18 C . .	61	45	136:100
35–37 C . .	52	84	62:100
3·5 C . .	48	31	155:100

The fact that there is competition between sperm is illustrated in the results of an experiment by Cole and Davies (1914). A rabbit was served by two bucks, and it was found that the majority of the offspring claimed one of these bucks as their sire. In repeated matings this was always so. But when the sperm of this buck was alcoholised it could not compete with that of the other buck, though it was shown that when employed alone it could and did fertilise ova. It is reasonable to assume that if differences in the size of the sperm are associated with differences in motility, activity or resistance to unfavourable conditions within the genital passages of the female, then chance would favour fertilisation by one rather than by the other kind of sperm.

Sex in Plants.—In the case of plants two sexual forms are recognised, the dioecious (bisexual) and the hermaphroditic. In the former the whole plant generally bears flowers of one kind only, either staminate or pistillate, and these are often referred to as male and female respectively (*e.g.*, hemp, hops). In the hermaphrodite plants staminate and pistillate parts may be borne in the same flower to give the "perfect" flower (*e.g.*, the rose) or they may be borne in different clusters on the same plant (the condition of monoecism) *e.g.*, maize, begonia. It has been argued that monoecism represents a somatic segregation of maleness and femaleness (Bond 1922) but most authorities agree with Emerson (1924) that both the perfect-flowered and the monoecious plants are alike in that the individual plant is hermaphroditic, the difference being merely one of time at which differentiation occurs.

Early genetical study of the dioecious forms showed that in certain of these the "male" is the heterozygous sex (Correns–*Bryonia dioica* 1907; Shull–*Lychnis dioica* 1910–11). In 1924 cytological evidence was presented showing that in several species of dioecious plants the male is digametic, *i.e.*, that the sex-determining mechanism is of the X–2X type. (Winge and also Blackburn—*Lychnis*, Kihara and Ono—*Rumex acetosa;* Santos—*Elodea canadensis;* Winge—*Vallisneria spiralis, Humulus Lupulus, Humulus japonica.*) In no case thus far has the female proved to be digametic.

There is one type of sex-determining mechanism in plants which is not known in animals. In the liverworts and kindred forms the gametophyte generation is the important and conspicuous one. Allen (1917) found in *Sphaerocarpus* that the male gametophyte has a Y-chromosome, the female gametophyte an X, whereas the sporophyte has the 2N number of chromosomes including the very unequal XY pair.

Two sex-linked characters have been identified (Shull, 1914), a narrow rosette leaf in *Lychnis* and (Winge, 1928) and a chlorophyll deficiency in the same plant. Winge considers that the gene for this character is Y-borne.

Sex-reversal has been reported frequently in dioecious plants (Schaffner, 1918–23). The transformation is conditioned by age, nutrition, length of day, etc.

Correns (1918–22) has investigated aberrant sex-ratios in *Lychnis dioica* and explained the excess of females on the basis of a more rapid growth of the pollen-tubes from grains bearing the X-chromosome.

Emerson (1924) has adduced evidence showing that in maize, as in *Drosophila*, it is the genic balance which is the effective factor in sex-determination. He suggests that in most dioecious plants this balance is decisive in the usual environments so that the individual is either a male or else a female whilst in the hermaphrodite it is so delicate that the characters of both sexes are expressed.

Chemical Tests and Sex-identification.—A chemical test for the identification of sex was introduced by Manoiloff (1922–23). The method is based upon the assumption that there are specifically different chemical substances in the blood of male and female. Subsequent work by others has seemed to show that different concentrations of serum proteins in the blood can explain the Manoiloff reaction. Schratz (1926) concludes that the reaction does not show a greater accumulation of oxides in female blood and that the reaction of Bernatzki (1924) is of greater value. Galwialo and others (1926) are of opinion that the test is not specific but is dependent entirely upon the protein content of the substance investigated. Luttge and v. Mertz (1926) describe a technique for the serological identification of sex, which, judging on the basis of early investigations, apparently gives satisfactory results.

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SEXAGESIMAL FRACTION: *see* Fraction.

SEXBY, EDWARD (d. 1658), English soldier, "leveller" and conspirator. About 1657 he wrote the apology for tyrannicide entitled "Killing No Murder," under the pseudonym William Allen. In July 1657 he was arrested and he died in the Tower of London on Jan. 13, 1658.

SEXPARTITE VAULT, six part vault, in architecture, a type of vault used in late Romanesque and early Gothic structures, in which each bay of the vault is divided by ribs into six portions. The form was one of many attempts to solve the problem of vaulting a church nave without too great difference in the heights of the cross, diagonal and wall ribs. This was accomplished by making two bays of the aisle equal to one bay of the nave, thus creating an almost square bay which was given the normal cross and diagonal ribs. Then an additional cross rib was carried across the nave at the intermediate piers, crossing the diagonal ribs at their intersection. The wall ribs over the clerestorey windows were only as wide as the side aisle bay, thus giving two on each side, and the ridges of the cross vaults, instead of running at right angles to the main ridge, ran at an angle from the apex of the wall arches to the common intersection of the diagonals and the central cross rib. The sexpartite vault appears in an awkward and transitional form in the Abbaye aux Hommes at Caen (nave vaulting 12th century) and in another experimental form with one semi-circular wall arch on each side, the intermediate cross rib merely carrying web walls up to its ridge, in the Abbaye aux Dames at Caen (same period). In a fully developed form it is found in the cathedrals of Senlis (1150–65), Sens (1143–68), Noyon (1150–1200), Laon (1160–1205), Notre Dame at Paris (1177–1223), Bourges (begun *c.* 1200) and in England in that portion of Canterbury cathedral begun by William of Sens, 1174–80. (*See* Gothic Architecture; Vault.)

SEX-RATIO AT BIRTH AND DEATH. The fact that, so far as statistical evidence is forthcoming, there is a preponderance of males at birth throughout the human race, has given rise to endless theories as to its cause. The further fact that this preponderance is not equally spread, there being a considerable variation in its amount, has multiplied the attempts to explain this seeming anomaly.

Some interesting figures are given below. The first and probably the most important of the factors affecting the sex-ratio at birth is that of race. This term is used in its proper sense and not as a synonym to nationality, as a physical and not a political distinction. In that congerie of peoples making up the former empire of Austria were to be found political divisions inhabited by populations of which the great majority had more or less clearly differentiated racial characteristics. An investigation into the births for the three years 1904, 1907 and 1910 showed that among the Jews inhabiting the whole of the empire there were 1,091 males born to 1,000 females. In Dalmatia, with a preponderating Serbo-Croat population the male plurality was only 1,037. Bohemia and Moravia (Czechs) had a ratio of 1,056; Galicia (Poles) one of 1,060 and the coast-lands (Italians) one of 1,065.

These figures relate to racial rather than political divisions, to populations living under strictly comparable conditions, and they show a well marked variation in masculinity at birth. A similar investigation into the births recorded in the Indian empire for the years 1912–14, showed that in the Central Provinces, Berar and Madras with a preponderance of the Dravidian element, the ratio of males to females at birth was 1,045–6; in Assam (predominantly Mongoloid) it was 1,070; in the Punjab (mainly Indo-Aryan) it was 1,097. Here again we are dealing with racial types, and the result is similar to that shown for Europe. Again in the Japanese empire, the recent sex-ratios have been (1921–24), in Japan proper 1,041 males to 1,000 females; in Formosa 1,053; in Corea 1,124. Figures for the negro peoples are as yet somewhat exiguous, but they point to a much lower relative masculinity. In the Cape Colony the ratios were: whites 1,054, blacks 1,026. In New York the white ratio was 1,045, the black 1,016; in New Orleans whites 1,020, blacks 982. These figures, drawn from a very wide area may be said to prove conclusively that race is an important factor in affecting masculinity at birth.

Urbanization.—It appears that urbanization lowers masculinity, the ratios in rural areas being generally higher than those for urban areas in the same countries. The following table gives a selection from different parts of the world:

Births by Sex—Urban and Rural Areas

Country.	Period.	Number of births.	Males to 1,000 females.	
			Urban.	Rural.
England & Wales	1911–15	4,300,000	1,038	1,043
Ireland	1906–14	600,000	1,048	1,052
Austria	1904–7–10	2,800,000	1,057	1,062
Netherlands	1911–15	850,000	1,045	1,055
U.S.A.	1915	800,000	1,054	1,058
Uruguay	1912–16	170,000	1,044	1,068
South Africa (Wh.)	1912–16	200,000	1,037	1,075
Cape Colony (Bl.)	1906–08	100,000	1,023	1,033

There is reason to expect, it is suggested, a slightly higher male ratio among first than subsequently born children. The figures for Australia and also for the city of Budapest, which are reliable, give a male ratio for the first born of 1,052 and 1,051 respectively as against 1,050 and 1,049 for the subsequently born.

Influence of War.—The question as to whether a state of war did or did not raise masculinity at birth was one over which controversy raged furiously. Neither supporters of the contention that it did nor opponents had much sound material on which to draw. (*See* also the previous article on SEX and the observations of Savorgnan.) The following table has been specially prepared to show the effect of the World War on eight of the belligerent and four of the non-belligerent countries of Europe:

Sex-Ratio at Birth

Period.	England and Wales.	Scotland.	Belgium	Bulgaria.	Finland.	France.
1876–1905	1,035	1,050	1,045	1,075	1,053	1,044
1906–14	1,039	1,042	1,042	1,054	1,061	1,045
1915–19	1,048	1,053	1,054	1,072	1,061	1,054
1921–25	1,047	1,051	1,049	1,062	1,063	1,049

Period.	Germany.	Italy.	Netherlands.	Norway.	Sweden.	Switzerland.
1876–1905	1,053	1,059	1,053	1,060	1,055	1,048
1906–14	1,055	1,056	1,051	1,060	1,061	1,036
1915–19	1,068	1,056*	1,059	1,059	1,058	1,049
1921–25	1,068	1,053	1,056	1,055	1,059	1,048

*1916–19.

It will be seen that the war-period was marked by substantial increases of masculinity in Great Britain, Belgium, France, Germany and in the two non-belligerent countries most closely affected, viz., the Netherlands and Switzerland, both of which had large bodies of troops under arms. Finland was less affected by the war in every way, and Italy is the only other belligerent showing no increase. It appears abundantly proved that, for some unknown reason, a war on such a scale does increase masculinity at birth. Moreover, the effect is seen in the last period shown, where all the countries showing a higher war-time masculinity have a ratio higher than they had in the pre-war decade.

Other Factors.—Many other factors have been alleged to exercise an influence, greater or less, on masculinity at birth, among them being cross-breeding and illegitimacy. In each of these, the position must be held to be not proven. In 1915 in the United States birth registration area the children of mixed parentage showed a much lower masculinity than those of native or foreign parentage—while in New York the births for five years showed a higher masculinity for children of mixed parentage. In British Guiana, the masculinity of children of mixed parentage for the decade 1903–12 was lower than that of the East Indians or blacks, while in Rio de Janeiro from 1910–15 the ratios were whites 1,049, mulattos 979, blacks 999. It is probable that the effects of cross-breeding are determined by the nature of the cross. As for illegitimacy the evidence is also conflicting, but in the majority of countries the legitimate births show a greater ratio of males. To be of real value, however, the figures should relate not to the numbers born out of wedlock, but to those resulting from casual unions. Some proportion (often a considerable one) of the births classed as illegitimate is the result of unions which, though not recognized by the law or the Church, are, from the physiological point of view, marriages.

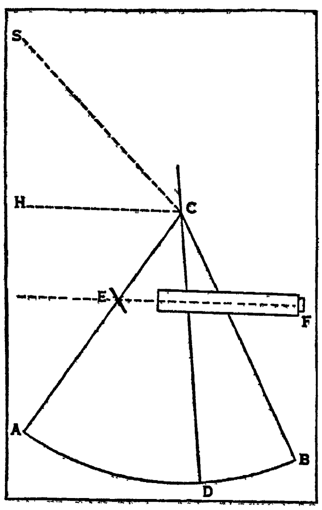
Sex-ratio at Death.—As at birth, it is a pretty general rule that the ratio of males at death is higher than that of females; indeed, the disparity in mortality is much more marked than in natality. In this case, however, the causes are by no means so obscure and doubtful as when dealing with masculinity at birth. Those of primary importance are the more persistent vitality of the female and the fact that the specially dangerous pursuits are mainly in the hands of males. A very simple proof of the former is the very marked disparity in deaths of males and females in the first few days of life, of the latter the disproportionate number of male deaths from external or violent causes. The ratio of male to female deaths is not spread equally over the whole of life; it is, generally speaking, very high in the first year and much lower at ages 1 to 5, while at ages 5 to 15 the ratio of female mortality is in most countries higher than that of males. As age advances the female advantage becomes more and more marked. It differs considerably from country to country. The following table gives the male and female death rates and the ratio of male deaths to 1,000 deaths of females in a number of countries for the triennium 1920–22, the years being those around the last census taken, when the respective numbers of the sexes had been definitely ascertained. (*Note:* The data given is confined to eleven countries in which white predominate.)

Country.	Death-rate 1920–22.		Ratio of male deaths to 1,000 female deaths.
	Males.	Females.	
England & Wales	13·3	11·6	1,146
Scotland	14·8	13·6	1,088
Belgium	14·6	13·5	1,082
Denmark	11·8	11·8	1,000
Finland	15·7	14·2	1,106
Germany	15·4	14·0	1,100
Italy	17·6	16·6	1,060
Netherlands	11·7	11·5	1,017
Norway	12·4	11·8	1,051
Sweden	12·8	12·9	992
Switzerland	13·7	13·5	1,015

It will be seen that in Sweden alone the deaths among an equal number of males and females show a slight advantage on the male side, that in Denmark the sex mortality was equal, while in all the other countries the male mortality showed excess in varying degree. In England and Wales, Finland and Germany the excess is very heavy indeed. Going outside Europe, it may be mentioned that in Chile the ratio of male to female deaths in equal numbers for the same period was 1,060, in Japan 978, in British India 1,082. In the United States for the year 1924 the ratio was 1,144, a figure almost identical with that shown for England and Wales in the foregoing table. It may be as well to say that the rates and ratios given in this section of this article are calculated on the census populations of the census taken at the end of 1920 or early in 1921. (S. de J.)

SEXTANT, a sixth part of a circle. The name is applied especially to an optical instrument for measuring angular distances, invented by John Hadley in 1731. Hadley's original instrument was, strictly, an octant, employing a graduated arc of one-eighth of a circle. The arc was enlarged to one-sixth, to meet the needs of navigation, by Capt. Campbell in 1757.

The instrument is mainly used at sea, and the angle that is measured is the altitude of the sun (or a star) above the horizon (*see* Navigation). A familiar sight on an ocean steamer is the officer on the bridge "shooting the sun" at noon, in order to determine his latitude. The officer is looking through a small telescope straight at the sea horizon; but he sees also an image of the sun (dimmed by an interposed dark glass) which has been reflected into his field of view by an arrangement of mirrors described below. He is slowly moving an arm which turns one of the mirrors until the solar image appears just to touch the sea-horizon.



The figure shows the construction of the sextant. ABC is a light framework of brass in the shape of a sector of 60°, the limb AB having a graduated arc of silver inlaid. It is held in the hand by a small handle at the back, either vertically in a position in front of the eye to measure the altitude of an object, or in the plane passing through two objects the angular distance of which is to be found. It may also be mounted on a stand. CD is a radius movable round C, where a small plane mirror of silvered plate-glass (called the "index glass") is fixed perpendicular to the plane of the sextant and in the line CD. At D is a vernier read through a microscope, also a clamp and a tangent screw for giving the arm CD a slow motion. At E is another mirror "the horizon glass," also perpendicular to the plane of the sextant and parallel to CB. F is a small telescope fixed across CB, and pointed to the mirror E. As only the lower half of E is silvered, the observer can see the horizon in the telescope through the unsilvered half, while the light from the sun or a star S may be reflected from the index glass C to the silvered half of E and thence through F to the observer's eye. If CD has been moved so as to make the image of a star or of the limb of the sun coincide with that of the horizon, it is seen that the angle SCH (the altitude of the star or solar limb) equals twice the angle BCD. The limb AB is graduated so as to avoid the necessity of doubling the measured angle, a space marked as a degree on AB being in reality only 30′.

If the sextant is used on land an "artificial horizon" is required instead of the sea-horizon. This consists of a trough containing a shallow layer of mercury, which gives a truly horizontal reflecting surface. The telescope F is now pointed downwards so as to view the sun's image reflected in the mercury trough; an image of the sun reflected by the sextant mirrors appears as before, and the two images are made to touch. The reading now gives the angle between the sun and its image in the mercury trough, which is double the angle between the sun and the horizon. In the air, however, the visible horizon is of no use, since its "dip" (below the truly horizontal direction) is large and unknown. The mercury trough is obviously unsuitable for use in an aeroplane. Hence some form of "bubble sextant" (*see* Aerial Navigation) is used, in which a spirit level is reflected into the field of view in such a way that the centre of the bubble indicates the true horizon.

SEXUAL SELECTION: *see* Selection: *Sexual Selection.*

SEYCHELLES (sā-shĕl), an archipelago in the Indian ocean, islands and islets—situated between 3° 38′ and 5° 45′ S., and 52° 55′ and 53° 50′ E. Together with the Amirantes, Cosmoledo, Aldabra and other islands they form the British colony of Seychelles. The outlying islands lie south-west of the Seychelles group and between that archipelago and Madagascar. The islands under the Seychelles government have a total area of 156 sq.m. There are in addition 40,000 to 50,000 sq.m. of coral banks within the bounds of the colony.

The Seychelles lie, with two exceptions, towards the centre of a large submarine bank and are all within the 50 fathoms line. Mahé, the largest and most central island, is 600 m. north-east of the northernmost point of Madagascar. The other chief islands form two principal groups: (i.) Praslin, with La Digue, Félicité, East Silver, West Silver, Curieuse and Aride; (ii.) Silhouette, and North Island. The most easterly island is Frigate, the most southerly Platte; on the northern edge of the reef are Bird and Denis islands.

Mahé is 17 m. long, and from 4 to 7 broad and of highly irregular shape. There are small areas of lowlands, chiefly at the mouths of the rivers but most of the island is mountainous, and in general the hills rise abruptly from the sea. The highest peaks are Morne Seychellois, 2,993 ft., and Trois Frères, 2,390 ft. The main ridge runs north and south and from the heights descend many torrents, the whole island being well watered. The principal harbour, Port Victoria, is on the north-east coast and is approached by a deep channel through the coral reef which fringes the entire eastern side of the island. Of the small islands close to Mahé the chief are St. Anne and Cerf, off the east, and Conception and Thérèse off the west coast.

Praslin island is 8 m. long and from 1 to 3 m. broad and its highest point is 1,260 ft.; La Digue covers 4 sq.m., and its greatest height is 1,175 ft.; Silhouette, roughly circular, covers 8 sq.m. and culminates in Mon Plaisir, 2,473 ft. None of the other islands exceeds $1\frac{1}{2}$ sq.m.

Geology.—Most of the islands are of granite (hornblende or hornblende-biotite variety) in places fringed by coral reefs; Silhouette and Long islands are of typical syenite whilst there are dykes and sheets of a younger vogesite, dolerite, porphyrite suite. Bird and Denis islands are of coral limestones while the basement rocks are represented by clay slates on Silhouette island and hornstones on Stag's island. The group is probably a detached and partially submerged portion of Gondwanaland. Inland cliffs indicate a recent uplift of about 200 ft.

Climate.—The climate is healthy and equable, and the temperature varies on the coast from about 68° to 88° F, falling at

night in the higher regions to 60° or 55° F. The mean coast temperature exceeds 79° F. The south-east monsoon blows from May to October, which is the dry season, and the west-north-west monsoon from December to March. During April and November the winds are variable. The average annual rainfall on the coast is 100·8 in.; it increases to about 120 in. at a height of 600 ft. and at heights exceeding 2,000 ft. is about 150 in. The Seychelles lie outside the track of the hurricanes which occasionally devastate Réunion and Mauritius. The public health is good.

Flora and Fauna.—Both flora and fauna include species and genera peculiar to the Seychelles. Of these the best known is the *Lodoicea sechellarum,* a palm tree indigenous only in Praslin island, but since introduced into Curieuse—noted for its fruit, the so-called Maldive double coco-nut or *coco de mer.* Another tree found only in the islands is the capucin (*Northea sechellarum*), now ravaged by an introduced green beetle. Characteristic of the forests of the coastal belt are the mangrove and *Pandanus,* and, a little inland, the banyan (*Ficus*), *Pisonia* and *Hernandia.* The coco-nut is a characteristic feature of the coast. The forests of the granitic land have the characteristics of a tropical moist region, palms, shrubs, climbing and tree ferns growing luxuriantly, the trees on the mountain sides, such as the *Pandanus sechellarum* sending down roots over the rocks and boulders from 70 to 100 ft. Of timber trees the bois gayac has disappeared, but bois de fer (*Stadtmannia sideroxylon*) and bois de natte (*Maba sechellarum*) still flourish on Silhouette Island. Besides cutting for building, the jungle was largely cleared for the plantation of vanilla; while a multitude of other tropical plants have been introduced. The most important of the trees introduced since 1900 are various kinds of rubber, including Para (*Hevea Brasiliensis*), which grows well. For other introduced plants *see* below, *Industries.*

The indigenous fauna resembles that of Madagascar. The only varieties of mammals are the rat and bat. The dugong, which formerly frequented the waters of the islands, does so no longer. The reptiles include certain lizards and snakes; the crocodile, once common, has been exterminated. Land tortoises have also disappeared; a freshwater tortoise (*Sternothaerus sinuatus*) is still found. The giant tortoise, *Testudo elephantina,* is found only in the Aldabra Islands; and the adjacent seas contain many turtles. Three coecilians, three batrachians (including a mountain-frequenting frog) and three fresh-water crustaceans are also indigenous, and about twenty-six species of land shells. The islands are the home of a large number of birds, including terns, gannets and white egrets.

Inhabitants.—The Seychelles were uninhabited when first visited by Europeans. The islands were colonized by Mauritian and Bourbon creoles; the white element, still prevailingly French, has been strengthened by British families. The first planters introduced slaves from Mauritius, and the negro element has been increased by the introduction of freed slaves from East Africa. There has been also an immigration of Chinese and, in larger numbers, of Indians (mainly from the Malabar coast). An official report issued in 1910 stated that the greater part of the valuable town property had passed into the hands of Indians, and that Indians and Chinese had the bulk of the retail trade. A rude creole patois, based on French but with a large admixture of Indian, Bantu and English words, is in general use. The Seychellois are excellent sailors. On Dec. 31st 1925 the population was officially estimated at 26,185. The pure white population is less than 1,000. About two-thirds of the inhabitants are Roman Catholics.

Agriculture, Industries, Towns and Communications.—The most important occupations are fishing and agriculture. Before 1850 the islands produced spices, cotton, coffee, tobacco, sugar, maize, rice, bananas, yams, coco-nut oil, timber, fish and fish oil and tortoise-shell. Whaling is carried on, chiefly by Americans and French, in the neighbouring seas. Subsequently cocoa was cultivated extensively, and from about 1890 vanilla largely superseded the other crops. Owing to increased competition, and to careless harvesting, the Seychellois, though still producing vanilla in large quantities, pay greater attention to the products of the coco-nut palm—copra, soap, coco-nut oil and coco-nuts—the mangrove bark industry, the collection of guano, the cultivation of rubber trees, the preparation of banana flour, the growing of sugar canes, and the distillation of rum and essential oils. The tortoise-shell and calipee fisheries and the export of salt fish are important industries. Minor exports are cocoa, coco-de-mer and bêche-de-mer. From the leaves of the coco-de-mer are made baskets and hats.

The imports consist chiefly of cotton goods and hardware, rice, sugar, flour, boots and shoes, wines and beer, tobacco, machinery. The imports in 1925 were £129,541 and exports £167,169. The bulk of the trade is with the countries of the British Empire. The medium of exchange is the Indian rupee (=16d.), with the subsidiary coinage of Mauritius.

The only town of any size is the capital, Port Victoria (or Mahé), picturesquely situated at the head of an excellent harbour. Many of the houses are built of massive coral, *Porites gaimardi,* hewn into square building blocks which at a distance glisten like white marble. The port is a coaling station of the British navy and is connected by telegraphic cables with Zanzibar and Mauritius. All the islands are well provided with metalled roads. The government employ steam vessels for passenger and mail services between the islands and there are large numbers of sailing craft belonging to the islanders; there is communication with Great Britain, France, India and South Africa.

Government and Revenue.—Seychelles is a crown colony administered by a governor, assisted by nominated executive and legislative councils. In 1925 revenue was £51,384, expenditure £43,801 and debt of £6,886. Education is free but not compulsory.

History.—The Seychelles are marked on Portuguese charts dated 1502. The first recorded visit to the islands was made in 1609 by an English ship. The second recorded visit, in 1742, was made by Captain Lazare Picault, who, returning two years later, formally annexed the islands to France. Picault, who acted as agent of Mahé de la Bourdonnais, governor of Mauritius, named the principal island Mahé and the group Îles de la Bourdonnais, a style changed in 1756, when the islands were renamed after Moreau de Séchelles, at that time *contrôleur des finances* under Louis XV. The first permanent settlement was made about 1768, when the town of Mahé was founded. Soon afterwards Pierre Poivre, intendant of Île de France, seeing the freedom of the Seychelles archipelago from hurricanes, caused spice plantations to be made there, with the object of wresting from the Dutch the monopoly of the spice trade they then enjoyed. The existence of these plantations was kept secret, and it was with that object that they were destroyed by fire by the French on the appearance in the harbour in 1778 of a vessel flying the British flag. The ship, however, proved to be a French slaver which had hoisted the Union Jack fearing to find the British in possession. The islands were occupied in 1810 by the British, to whom they were ceded by the treaty of Paris in 1814. J. B. Quéau de Quincy (1748–1827), governor under the Monarchy, the Republic and the Empire, was appointed by the British agent-civil. In all he governed the islands 38 years, dying in 1827. The over-dependence placed on vanilla caused waves of depression to alternate with waves of prosperity, and the depression following the fall in the price of vanilla was aggravated by periods of drought, "agricultural sloth and careless extravagance."[1] But during 1905–10 successful efforts were made to broaden the economic resources of the colony. Since that date direct telegraphic communication with Mauritius, Zanzibar, Aden, and Colombo has been installed and a Government wireless telephone service was opened in 1926 between Victoria and the Praslin islands.

Dependencies.—The outlying islands forming part of the colony of Seychelles consist of several widely scattered groups. The Amirante archipelago is situated on a submarine bank west and south-west of the Seychelles, the nearest island being about 120m. from Mahé. The archipelago consists of a number of coral islets and atolls comprising the African islands (4), the St. Joseph group (8), the Poivre islands (9) and the Alphonso group (3). Farther south and within 170m. of Madagascar is

[1] *Colonial Reports . . . Seychelles* (1907).

the Providence group (3) formed by the piling up of sand on a surface reef which is of crescent shape. The Farquhar islands lie to the south of these. The Cosmoledo islands, which are 12 in number, lie some 210m. W. of Providence island, while 70m. farther west are the Aldabra islands (*q.v.*). Assumption island lies to the south of the Aldabra. The chief island in the Cosmoledo group is 9m. long by 6m. broad. South of this group of islands lies Astove. Coetivy (transferred from Mauritius to the Seychelles in 1908) lies about 100m. S.S.E. of Platte. The majority of the outlying islands are extremely fertile, coco-nut trees and maize growing luxuriantly. Several of the islands contain valuable deposits of guano and phosphate of lime, and their waters are frequented by edible and shell turtle. Like the Amirantes, all the other islands named are of coral formation.

See A. A. Fauvel, *Unpublished Documents on the History of the Seychelles Islands Anterior to 1810,* with a bibliography (Mahé 1909); *Ancient Maps of Seychelles Archipelago* (Mahé 1909). *See* also the annual reports on the Seychelles issued by the Colonial Office. For the dependencies *see* R. Dupont, *Report on a Visit of Investigation to St. Pierre, Astove, Cosmoledo, Assumption and the Aldabra Group of the Seychelles Islands* (Seychelles, 1907).

SEYDLITZ, FRIEDRICH WILHELM, Freiherr von (1721–1773), Prussian soldier, one of the greatest cavalry generals of history, was born on Feb. 3, 1721 at Calcar, in the duchy of Cleve. At the age of thirteen he went as a page to the court of the margrave of Schwedt, who had been his father's colonel. Here he acquired a superb mastery of horsemanship, and many stories are told of his feats, the best known of which was his riding between the sails of a wind-mill in full swing. In 1740 he was commissioned a cornet in the margrave's regiment of Prussian cuirassiers. He served through the first and second Silesian wars, and in 1753 became lieutenant-colonel of the 8th cuirassiers. Under his hands this regiment soon became a pattern to the rest of the army. The Seven Years' War gave Seydlitz his opportunity. . In 1757, regardless of the custom of keeping back the heavy cavalry in reserve, he took his regiment to join the advanced guard; at Prague he nearly lost his life in attempting to ride through a marshy pool, and at Kolin, at the head of a cavalry brigade, he distinguished himself in checking the Austrian pursuit by a brilliant charge. Two days later the king made him major-general and gave him the order *pour le mérite.* In reply to Zieten's congratulations he said: "It was high time, Excellency, if they wanted more work out of me. I am already thirty-six." Four times in the dismal weeks that followed the disaster of Kolin, Seydlitz asserted his energy and spirit in cavalry encounters, and on the morning of Rossbach Frederick, superseding two senior generals, placed Seydlitz in command of the whole of his cavalry. The result of the battle was the complete rout and disorganization of the enemy, and in achieving that result only seven battalions of Frederick's army had fired a shot. The rest was the work of Seydlitz and his 38 squadrons. The same night the king gave him the order of the Black Eagle, and promoted him lieutenant-general. Seydlitz was wounded, but rejoined the king in 1758, and at the battle of Zorndorf his cavalry again won the victory. At Hochkirch with 108 squadrons he covered the Prussian retreat, and in the great disaster of Kunersdorf he was severely wounded in a hopeless attempt to storm a hill held by the Russians. During his convalescence he married Countess Albertine Hacke. In 1761 he reappeared at the front. He now commanded a wing of Prince Henry's army, composed of troops of all arms, and many doubts were expressed as to his fitness for this command, as his service had hitherto been with the cavalry exclusively. But he answered his critics by his conduct at the battle of Freyburg (Oct. 29, 1762), in which, leading his infantry and his cavalry in turn, he decided the day. After the peace of Hubertusburg he was made inspector-general of the cavalry in Silesia, where eleven regiments were permanently stationed and whither Frederick sent all his most promising officers to be trained by him. In 1767 he was made a general of cavalry. But his later years were clouded by domestic unhappiness. His wife was unfaithful to him, and his two daughters, each several times married, were both divorced, the elder once and the younger twice. His formerly close friendship with the king was brought to an end by some misunderstanding, and it was only a few weeks before his death that they met again. Seydlitz died at Ohlau on Aug. 27, 1773.

See Varnhagen von Ense, *Das Leben des Generals von Seydlitz* (Berlin, 1834); and Bismarck, *Die kgl. preussische Reiterei unter Friedrich dem Grossen* (Karlsruhe, 1837).

SEYMOUR or St. Maur, the name of an English family in which several titles of nobility have from time to time been created, and of which the duke of Somerset is the head. *See* Hertford, Earls and Marquesses of; and Somerset, Earls and Dukes of.

SEYMOUR, HORATIO (1810–1886), American statesman, was born in Pompey, Onondaga county (N.Y.), on May 31, 1810. He studied at Geneva academy (afterwards Hobart college) and at a military school in Middletown (Conn.), and was admitted to the bar in 1832. He was military secretary to Governor W. L. Marcy in 1833–39, was a member of the New York Assembly in 1842, in 1844, and in 1845, and was speaker in 1845; mayor of Utica in 1843, and in 1852 was elected governor of New York State. He vetoed in 1854 a bill prohibiting the sale of intoxicating liquors, which was declared unconstitutional almost immediately after its re-enactment in 1855, and in consequence he was defeated in 1854 for re-election as governor. Seymour was a Conservative on national issues, and supported the administrations of Pierce and Buchanan; he advocated compromise to avoid secession in 1860–61; but when war started he supported the Union. In 1863–65 he was again governor of New York State.

His opposition to President Lincoln's policy was mainly in respect to emancipation, military arrests and conscription. Although he responded immediately to the call for militia in June, he thought the Conscription Act unnecessary and unconstitutional and urged the President to postpone the draft until its legality could be tested. During the draft riots in July he proclaimed the city and county of New York in a state of insurrection, but in a speech to the rioters adopted a tone of conciliation—a political error which injured his career. He was defeated as Democratic candidate for governor in 1864. In 1868 he was nominated presidential candidate by the Democratic national convention, but carried only eight States (including New York, New Jersey, and Oregon), and received only 80 electoral votes to 214 for Grant. He died on Feb. 12, 1886, in Utica.

The Public Record of Horatio Seymour (1868) includes his speeches and official papers between 1856 and 1868.

SEYMOUR, a city of Jackson county, Indiana, U.S.A., 60 m. S. by E. of Indianapolis, near the East Fork of the White river; on Federal highways 31 and 50, and served by the Baltimore and Ohio, the Chicago, Milwaukee, St. Paul and Pacific, the Pennsylvania and electric railways, and by motor-bus lines in all directions. The population was 7,348 in 1920 (97% native white) and was 7,508 in 1930 by the Federal census. Seymour was laid out about 1850, incorporated as a town in 1864, and chartered as a city in 1867.

SEYMOUR OF SUDELEY, THOMAS SEYMOUR, Baron (*c.* 1508–1549), lord high admiral of England, was fourth son of Sir John Seymour of Wolf Hall, Wiltshire, and younger brother of the Protector Edward Seymour, 1st duke of Somerset. His sister Jane Seymour became the third wife of Henry VIII. in 1536, and another sister, Elizabeth, married Thomas Cromwell's son. Seymour was employed in the royal household and on diplomatic missions abroad. He was for a short time in command of the English army in the Netherlands. In 1544 he received the post of master of the ordnance for life, becoming admiral of the fleet a few months later, in which capacity he was charged with guarding the Channel against French invasion. In 1547 he was created Baron Seymour of Sudeley and appointed lord high admiral. From this time forward he was mainly occupied in intrigue against his brother the Protector; and he aimed at procuring for himself the position of guardian of the young king, Edward VI. The lord high admiral tried to secure the princess (afterwards queen) Elizabeth in marriage; and when this project was frustrated he secretly married the late king's widow, Catherine Parr. He ingratiated himself with Edward, and proposed a marriage between the king and the Lady Jane Grey. He

entered into relations with pirates on the western coasts, whom it was his duty as lord high admiral to suppress, with a view to securing their support; and when the Protector invaded Scotland in the summer of 1547 Seymour fomented opposition to his authority in his absence. On the death of his wife in September of the next year he made renewed attempts to marry the princess Elizabeth. Somerset strove ineffectually to save his brother from ruin, and in January 1549 Seymour was arrested and sent to the Tower; he was convicted of treason, and executed on March 20, 1549.

See Sir John Maclean, *Life of Sir Thomas Seymour* (London, 1869); *Chronicle of Henry VIII.*, translated from the Spanish, with notes by M. A. S. Hume (London, 1889); *Literary Remains of Edward VI.*, with notes and memoir by J. G. Nichols (2 vols., London, 1857); Mary A. E. Green, *Letters of Royal and Illustrious Ladies of Great Britain to the Close of the Reign of Mary* (3 vols., London, 1846). *See* also SOMERSET, EDWARD SEYMOUR, 1st DUKE OF, and the authorities there cited.

SEYNE SUR MER or **LA SEYENE,** industrial suburb of Toulon, France, south-west of that port, connected with it by rail and steamer. Pop. (1926) 18,339. It has a large shipbuilding trade with fine shipbuilding yards.

SFAX, a city of Tunisia, 78 m. due S. of Susa, on the Gulf of Qabes (Syrtis Minor) opposite the Kerkenna islands, in 34° 43′ N., 10° 46′ E. The town consists of a European quarter, with streets regularly laid out and fine houses, and the Arab town, with its kasba or citadel, and tower-flanked walls pierced by three gates. Many of the private houses, mosques and *zawias* are good specimens of native art of the 17th and 18th centuries. Sfax is the market for the phosphates of the Qafsa region, with which it is connected by a railway; other railways and good roads link it also with Susa and Tunis on the one hand and with Qabes on the other. Olive oil is manufactured, and the fisheries are important, notably those of sponges and of octopuses (exported to Greece). The prosperity of the town is largely due to the export trade in phosphates, esparto grass, oil, almonds, pistachio nuts, sponges, wool, etc. There is, in the Gulf of Qabes, a rise and fall of 5 ft. at spring tides, which is rare in the Mediterranean. A harbour, to which a channel, 3 km. long and 22 metres wide, gives access, was built 1895–97, and has since been deepened at different times. The phosphates company of Qafsa has built huge stores there; the loading of ships is effected by apparatus with endless chains worked by electricity. Sfax has the greatest tonnage of any Tunisian port; its trade exceeds two million tons (especially phosphates). It is also an important fishing port. The population of the town itself is 27,723, of whom 17,574 are Muslims, 3,265 Jews and 6,884 Europeans (3,237 French and 2,590 Italians). One must add 44,000 natives, who live in the outskirts and in the gardens in the neighbourhood of Sfax, which brings the total population of Sfax to more than 70,000. The local museum contains mosaics and other antiquities from Thaenae (mod. Thyra, marked by a lofty lighthouse), 8 m. south-west.

Sfax is on the site of a Roman settlement called *Taparura,* of which few traces remain. Many of its Arab inhabitants claim descent from Mohammed. The Sicilians under Roger the Norman took it in the 12th century, and in the 16th the Spaniards occupied it for a brief period. The bombardment of the town in 1881 was one of the principal events of the French conquest of Tunisia.

SFORZA, the name of a famous Italian family. They were descended from a peasant condottiere, Giacomo or Muzio (sometimes abbreviated into Giacomuzzo) Attendolo, who was born at Cotignola in the Romagna on June 10, 1369, gained command of a band of adventurers by whom he had been kidnapped, took the name of Sforza in the field, became constable of Naples under Joanna II., fought bravely against the Spaniards, served Pope Martin V., by whom he was created a Roman count, and was drowned on Jan. 4, 1424 in the Pescara near Aquila while engaged in a military expedition. His natural son FRANCESCO (1401–1466) served the Visconti against the Venetians and then the Venetians against the Visconti; he attacked the pope, deprived him of the Romagna, and later defended him; he married in 1441 Bianca, the only daughter of Filippo Maria Visconti, duke of Milan, and received Pontremoli and Cremona as dowry and the promise of succession to the duchy of Milan. The short-lived Ambrosian republic, which was established by the Milanese on the death of Visconti (1447), was overthrown by Francesco, who made his triumphal entry as duke of Milan on March 25, 1450. His court, filled with Italian scholars and Greek exiles, speedily became one of the most splendid in Italy. His daughter Ippolita was renowned for her Latin discourses.

Francesco left several sons, among whom were Galeazzo Maria, Lodovico, and Ascagnio, who became a cardinal.

GALEAZZO MARIA, who succeeded to the duchy, was born in 1444, and was a lover of art, eloquent in speech, but dissolute and cruel. He was assassinated at the porch of the cathedral on Dec. 26, 1476 by three young Milanese noblemen desirous of imitating Brutus and Cassius. His daughter Caterina is separately noticed. GIAN GALEAZZO (1469–1494), son of Galeazzo, succeeded to the duchy under the regency of his mother, Bona of Savoy, who was supplanted in her power (1481) by the boy's uncle, Lodovico the Moor. Gian Galeazzo married Isabella of Aragon, granddaughter of the king of Naples, and his sudden death was attributed by some to poiscn administered by the regent. His daughter, BONA SFORZA (1493–1557), married King Sigismund of Poland in 1518. On the death of her husband she returned to Italy and was poisoned (1557) by her paramour Pappacoda.

LODOVICO THE MOOR [Lodovico il Moro] (1451–1508), who is famed as patron of Leonardo da Vinci and other artists, had summoned Charles VIII. of France to his aid (1494) and received the ducal crown from the Milanese nobles on Oct. 22, in the same year, but finding his own position endangered by the French policy, he joined the league against Charles VIII., giving his niece Bianca in marriage to Maximilian I. and receiving in return imperial investiture of the duchy. Lodovico was driven from Milan by Louis XII. in 1499, and although reinstated for a short time by the Swiss he was eventually delivered over by them to the French (April 1500) and died a prisoner in the castle of Loches. FRANCESCO, the son of Gian Galeazzo, was also taken to France by Louis XII., became abbot of Marmoutiers, and died in 1511.

The two sons of Lodovico, MASSIMILIANO and FRANCESCO MARIA, took refuge in Germany; the former was restored to the duchy of Milan by the Swiss in 1512, but after the overwhelming defeat of his allies at Marignano (1515) he abandoned his rights to Francis I., and died at Paris in 1530; the latter was put in possession of Milan after the defeat of the French at La Bicocca in 1522. His death (Oct. 24, 1535) marked the extinction of the direct male line of the Sforza. The duchy went to Charles V.

The dukes of Sforza-Cesarini and the counts of Santa Fiora are descended from collateral branches of the Sforza family.

See A. Segre, "Lodovico Sforza, duca di Milano," in *R. Accad. d. Sci. Atti,* vol. 36 (Turin, 1901); G. Clausse, *Les Sforza et les arts en Milanais, 1450–1530* (1909); F. Malaguzzi Valeri, *La corte di Lodovico il Moro* (2 vols., 1913–15). There is a critical bibliography by Otto von Schleinitz in *Zeitschrift für Bücherfreunde,* vol. v. (Bielefeld, 1901).

SFORZA, COUNT CARLO (1872–), Italian statesman, knight of the Annunziata, was born at Lucca. He entered the diplomatic service, was secretary of embassy in London, then minister at Peking (1911), at Belgrade (1916), Italian high commissioner in Turkey (1918), and under secretary for foreign affairs (1919). In that year he was created senator. He became minister of foreign affairs in the Giolitti cabinet of June 16, 1920, was present at Spa (July, 1920), and negotiated the treaty of Rapallo between Italy and Yugoslavia (Nov. 12, 1920). He remained foreign minister until the formation of the Giolitti cabinet on July 4, 1921, and in February, 1922 was appointed ambassador in Paris. On Mussolini's accession to power he resigned, and became one of the chief leaders of the anti-Fascist opposition in the senate. He is a member of the Order of the Annunziata.

SFORZA, CATERINA (1463–1509), countess of Forlì, was an illegitimate daughter of Galeazzo Maria Sforza. (*See* above.) In 1473 she was betrothed to Girolamo Riario, a son of Pope Sixtus IV., who was thus able to regain possession of Imola, that city being made a fief of the Riario family. After a triumphal entry into Imola in 1477 Caterina Sforza went to Rome with her

husband, who, with the help of the pope, wrested the lordship of Forlì from the Ordelaffi. Riario, by means of many crimes, for which his wife seems to have blamed him, succeeded in accumulating great wealth, and on the death of Sixtus in August 1484, he sent Caterina to Rome to occupy the castle of St. Angelo, which she defended gallantly until, on Oct. 25, she surrendered it by his order to the Sacred College. They then returned to their fiefs of Imola and Forlì, where they tried in vain to win the favour of the people. Riario's enemies conspired against him with a view to making Franceschetto Cybò, nephew of Pope Innocent VIII., lord of Imola and Forlì in his stead. Riario thereupon instituted a system of persecution, in which Caterina was implicated, against all whom he suspected of treachery. In 1488 he was murdered by three conspirators, his palace was sacked, and his wife and children were taken prisoners. The castle of Forlì, however, held out in Caterina's interest, and every inducement and threat to make her order its surrender proved useless; having managed to escape from her captors she penetrated into the castle, whence she threatened to bombard the city, refusing to come to terms even when the besiegers threatened to murder her children. With the assistance of Lodovico il Moro she regained possession of all her dominions; she wreaked vengeance on those who had opposed her and re-established her power. She had several lovers, and by one of them, Giacomo Feo, whom she afterwards married, she had a son. Feo, who made himself hated for his cruelty and insolence, was murdered before the eyes of his wife in August 1495; Caterina had all the conspirators and their families, including the women and children, massacred. She established friendly relations with the new pope, Alexander VI., and with the Florentines, whose ambassador, Giovanni de' Medici, she secretly married in 1496. Giovanni died in 1498, but Caterina managed with the aid of Lodovico il Moro and of the Florentines to save her dominions from the attacks of the Venetians.

Alexander VI., however, angered at her refusal to agree to a union between his daughter Lucrezia Borgia and her son Ottaviano, and coveting her territories as well as the rest of Romagna for his son Cesare, issued a bull on March 9, 1499, declaring that the house of Riario had forfeited the lordship of Imola and Forlì and conferring those fiefs on Cesare Borgia. Cesare attacked her with his whole army, reinforced by 14,000 French troops and by Louis XII. Caterina placed her children in safety and took strenuous measures for defence. The castle of Imola surrendered (December 1499) with the honours of war. Caterina absolved the citizens of Forlì from their oath of fealty, and defended herself in the citadel. Finally when the situation had become untenable and having in vain given orders for the magazine to be blown up, she surrendered to Antoine Bissey, *bailli* of Dijon, entrusting herself to the honour of France (January 12, 1500). She was afterwards taken to Rome and held a prisoner for a year in the castle of St. Angelo, whence she was liberated by the same *bailli* of Dijon to whom she had surrendered at Forlì. She took refuge in Florence until the death of Alexander VI. in 1503, when she attempted without success to regain possession of her dominions. She died in the convent of Annalena on May 20, 1509.

See Buriel, *Vita di Caterina Sforza-Riario* (Bologna, 1785); F. Oliva, *Vita di C. Sforza, signora di Forlì* (Forlì, 1821); Pietro Desiderio Pesolini Dall' Onda, *Caterina Sforza* (Rome, 1893); English translation by P. Sylvester (1898).

SGAMBATI, GIOVANNI (1843–1914), Italian composer, was born in Rome on May 28, 1843, of an Italian father and an English mother. In 1860 he took up the work of winning acceptance for the best German music, which was at that time neglected in Italy. His compositions of this period (1864–1865) included a quartet, two piano quintets, an octet, and an overture. He conducted Liszt's *Dante* symphony in 1866, and made the acquaintance of Wagner's music for the first time at Munich, whither he travelled in Liszt's company. His first symphony and a piano concerto were performed in the course of his first visit to England in 1882; and at his second visit, in 1891, his *Sinfonia epitalamio* was given at the Philharmonic. His largest work, a Requiem Mass, was performed in Rome 1901. His influence on Italian musical taste has been perhaps greater than the merits of his compositions, which, though poetical and generally effective, are often slight in style. He died at Rome on Dec. 15, 1914.

SGRAFFITO. A form of ornamental plastering, originating in Italy, *sgraffito* being Italian for scratched. The essence of the method lies in applying two coats of plaster of different colours laid one upon the other, and then scratching through the outer coat to reveal the inner coat and thus producing a design.

A first rough coat is applied to give a fair surface in the ordinary way. Then follows the colour coat, the plaster being coloured with pigments such as umber, ochre, bone-black or Indian red. This colour coat may be in bands or patches to suit the designer. The final coat, which may be white or cream or coloured, is then thinly applied. The design is then transferred by pricking. By working upon this outline, the outer coat is scratched away to reveal the inner coloured coat. The effects obtained are often very beautiful, and it is perhaps surprising that the method has not found more favour outside Italy. Some of the examples found in Lombardy are very fine. The method is successfully used for both internal plastering and outdoor stucco.

SHACKLETON, SIR ERNEST HENRY (1874–1922), British explorer, was born in Kilkee, Ireland, on Feb. 15, 1874. Educated at Dulwich college, he entered the mercantile marine service. In Scott's Antarctic expedition of 1901–04 Shackleton acted as lieutenant, but had to return home on account of illness. On Jan. 1, 1908 he sailed from New Zealand in the "Nimrod" in command of an expedition which reached a point about 97 m. from the South Pole (*see* ANTARCTIC REGIONS). On his return in 1909 he was knighted and received the C.V.O. On Aug. 1, 1914, he sailed from England on "Endurance" in command of the expedition of 1914–17 with its unfortunate outcome. Finally, in Sept. 1921 he set out a third time, in the "Quest." On Jan. 5, 1922, off South Georgia island, he succumbed to an attack of angina pectoris following influenza. He was buried on South Georgia island. Shackleton gave an account of the 1907–09 expedition in *Heart of the Antarctic* (1909); and of the 1914–17 expedition in *South* (1919).

See H. R. Mill, *The Life of Sir Ernest Shackleton* (1923, new ed. 1924).

SHAD (*Alosa*), the name of a genus of fishes of the herring family, with the upper jaw notched in front, found in the Mediterranean and on both sides of the north Atlantic. They enter rivers to breed, generally from April to June, and the fry live for a year or two in fresh water. The Allis shad, *A. alosa*, of the coasts of Europe has very numerous, long and slender gill-rakers; it attains a length of 30 in. and a weight of 8 lb. The twaite shad (*A. finta*) is smaller, and has the gill-rakers much fewer and shorter; the Mediterranean form (*A. f. nilotica*) is distinct from that of the Atlantic, and the species also includes some well-marked forms permanently resident in fresh water, one from Killarney, two from lakes in northern Italy. The American shad (*A. sapidissima*) is a valued food-fish, and has been successfully introduced on the Pacific coast. The shad of the Black and Caspian seas (*Caspialosa*) have teeth on the vomer, like the herring. Another important related genus of anadromous fishes is *Hilsa*, with six species, ranging from east Africa to China.

SHADDOCK (*Citrus maxima, C. decumana*, or *C. grandis*), a tree, 20–40 ft. in height, allied to the orange and the lemon, presumably native to the Malay and Polynesian islands. The leaves are like those of the orange, but downy on the under surface, as are also the young shoots. The flowers are large and white, and are succeeded by very large globose fruits like oranges, but paler in colour, and with a more pungent flavour. The name "shaddock" is asserted to be that of a captain who introduced the tree to the West Indies. The fruit is also known under the name of pommelo. *See* also GRAPEFRUIT.

For further details, *see* R. Hume, *Florida Agric. Expt. Stat. Bull.* (1901), and *Citrus Fruits and their Culture* (1918); S. Coit, *Citrus Fruits* (1915).

SHADOW. When an opaque body is placed between a screen and a luminous source, it casts a "shadow" on the screen. If the source be a point, the outline of the shadow is to be found by drawing straight lines from the luminous point so as to

envelop the opaque body. These lines form a cone. The points of contact form a line on the opaque body separating the illuminated from the non-illuminated portion of its surface. Similarly, when these lines are produced to meet the screen, their points of intersection with it form a line which separates the illuminated from the non-illuminated parts of the screen. This line is called the boundary of the *geometrical shadow*, and its construction is based on the assumption that light travels (in homogeneous media) in straight lines and suffers no deviation on meeting an obstacle. But a deviation, termed *diffraction*, does occur, and consequently the complete theory of shadows involves considerations based on the nature of the rays themselves; this aspect is treated in LIGHT.

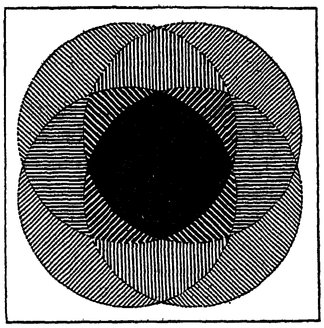


FIG. 1.—SHADOW OF DISC CAST BY FOUR EQUALLY LUMINOUS POINTS ARRANGED AS CORNERS OF A SQUARE

When there are more luminous points than one, we have only to draw separately the geometrical shadows due to each of the sources, and then superpose them. A new consideration now comes in. There will be, in general, portions of all the separate geometrical shadows which overlap one another in some particular regions of the screen. In such regions we still have full shadow; but around them there will be other regions, some illuminated by one of the sources alone, some by two, etc., until finally we come to the parts of the screen which are illuminated directly by all the sources. There will still be a definite boundary of the parts wholly unilluminated, *i.e.*, the true shadow or *umbra*, and also a definite boundary of the parts wholly illuminated. The region between these boundaries—*i.e.*, the partially illumined portion—is called the *penumbra*.

Fig. 1 represents the shadow of a circular disk cast by four equal luminous points arranged as the corners of a square—the disk being large enough to admit of a free overlapping of the separate shadows. The amount of want of illumination in each portion of the penumbra is roughly indicated by the shading. The separate shadows are circular, if the disk is parallel to the screen. If we suppose the number of sources to increase indefinitely, so as finally to give the appearance of a luminous surface as the source of light, it is obvious that the degrees of darkness at different portions of the penumbra will also increase indefinitely; *i.e.*, there will be a gradual increase of brightness in the penumbra from total darkness at the edge next the geometrical shadow to full illumination at the outer edge.

Thus we see at once why the shadows cast by the sun or moon are in general so much less sharp than those cast by the electric arc. For, practically, at moderate distances the arc appears as a mere luminous point. But if we place a body at a distance of a foot or two only from the arc, the shadow cast will have as much of penumbra as if the sun had been the source. The breadth of the penumbra when the source and screen are nearly equidistant from the opaque body is equal to the diameter of the luminous source. The notions of the penumbra and umbra are important in considering eclipses (*q.v.*). When the eclipse is total, there is a real geometrical shadow—very small compared with the penumbra (for the apparent diameters of the sun and moon are nearly equal, but their distances are as 370:1); when the eclipse is annular, the shadow is all penumbra. In a lunar eclipse the earth is the shadow-casting body, and the moon is the screen, and we observe things according to our first point of view.

Suppose, next, that the body which casts the shadow is a large one, such as a wall, with a hole in it. If we were to plug the hole, the whole screen would be in geometrical shadow. Hence the illumination of the screen by the light passing through the hole is precisely what would be cut off by a disk which fits the hole, and the complement of fig. 1, in which the light and shade are interchanged, would give therefore the effect of four equal sources of light shining on a wall through a circular hole. The umbra in the former case becomes the fully illuminated portion, and vice versa. The penumbra remains the penumbra, but it is now darkest where before it was brightest, and vice versa.

Thus we see how, when a small hole is cut in the window-shutter of a dark room, a picture of the sun, and bright clouds about it, is formed on the opposite wall. The smaller the hole (so far at least as geometrical optics is concerned) the less confused will the picture be. As the hole is made larger the illuminated portions from different sources gradually overlap; and when the hole becomes a window we have no indications of such a picture except from a body (like the sun) much brighter than the other external objects. Here the picture has ceased to be one of the sun, it is now a picture of the window. But if the wall could be placed 100 m. off, the picture would be one of the sun. To prevent this overlapping of images, and yet to admit a good deal of light, is one main object of the lens which usually forms part of the camera. (*See* PHOTOGRAPHY: *Apparatus*.)

The formation of pictures of the sun in this way is well seen on a calm sunny day under trees, where the sunlight penetrating through small chinks forms elliptic spots on the ground. During a partial eclipse of the sun, the images formed by such chinks, or by truly plane spots on a glass window pane (which act as chinks) take the form of crescents that are images of the partly obscured disc of the sun. (*See* also *Nature*, 89, 1912, p. 216.)

Another curious phenomenon may fitly be referred to in this connection, viz., the phantoms which are seen when we look at two parallel sets of palisades or railings, one behind the other, or look through two parallel sides of a meat-safe formed of perforated zinc. The appearance presented is that of a magnified set of bars or apertures which appear to move rapidly as we slowly walk past. Their origin is the fact that where the bars appear nearly to coincide the apparent gaps bear the greatest ratio to the dark spaces; *i.e.*, these parts of the field are the most highly illuminated. The exact determination of the appearances in any given case is a mere problem of convergents to a continued fraction. But the fact that the apparent rapidity of motion of this phantom may exceed in any ratio that of the spectator is of importance—enabling us to see how velocities, apparently of impossible magnitude, may be accounted for by the mere running along of the condition of visibility among a group of objects no one of which is moving at an extravagant rate.

SHADWELL, THOMAS (*c.* 1642–1692) English playwright and miscellaneous writer, was born about 1642, at Santon Hall, Norfolk, according to his son's account. He was educated at Bury St. Edmund's School, and at Caius College, Cambridge, where he was entered in 1656. He then joined the Middle Temple. Shadwell's best plays are *Epsom Wells* (1672), for which Sir Charles Sedley wrote a prologue, and the *Squire of Alsatia* (1688). For fourteen years from the production of his first comedy to his memorable encounter with Dryden, Shadwell produced a play nearly every year. These productions display a genuine hatred of shams, and a rough but honest moral purpose. They are disfigured by indecencies, but present a vivid picture of contemporary manners.

Shadwell is chiefly remembered—rather unjustly—as the unfortunate Mac Flecknoe of Dryden's satire, the "last great prophet of tautology," and the literary son and heir of Richard Flecknoe:—

> The rest to some faint meaning make pretence,
> But Shadwell never deviates into sense.

Dryden had furnished Shadwell with a prologue to his *True Widow* (1679), and in spite of momentary differences, the two had been apparently on friendly terms. But when Dryden joined the court party, and produced *Absalom and Achitophel* and *The Medal*, Shadwell became the champion of the true-blue Protestants, and made a scurrilous attack on the poet in *The Medal of John Bayes: a Satire against Folly and Knavery* (1682). Dryden immediately retorted in *Mac Flecknoe, or a Satire on the True Blue Protestant Poet, T.S.* (1682), in which Shadwell's personalities were returned with interest. A month later he contributed to Nahum Tate's continuation of *Absalom and Achitophel* satirical portraits of Elkanah Settle as Doeg and of Shadwell as Og. In

1687 Shadwell attempted to answer these attacks in a version of the tenth satire of Juvenal. At the Whig triumph in 1688 he superseded his enemy as poet laureate and historiographer royal. He died at Chelsea on Nov. 19, 1692.

A complete edition of Shadwell's works was published by his son Sir John Shadwell in 1720. But *see* the modern critical edition, *The Complete Works of Thomas Shadwell* (5 vols., 1928), edited by Montague Summers.

SHAFI'I [Mahommed ibn Idrīs ash-Shāfi'ī] (767–820), the founder of the Shāfi'ite school of canon law, was born in A.H. 150 (A.D. 767) of a Koreishite (Quraishite) family at Gaza or Ascalon, and was brought up by his mother in poor circumstances at Mecca. There, and especially in intercourse with the desert tribe of Hudhail, he gained a knowledge of classical Arabic and old Arabian poetry for which he was afterwards famous. About 170 he went to Medina and studied canon law (*fiqh*) under Malik ibn Anas. After the death of Malik in 179 legend takes him to Yemen, where he is involved in an 'Alid conspiracy, carried prisoner to Baghdad, but pardoned by Hārūn al-Rashīd. He was certainly pursuing his studies, and he seems to have come to Baghdad in some such way as this and then to have studied under Ḥanifite teachers. He had not yet formulated his own system. After a journey to Egypt, however, we find him in Baghdad again, as a teacher, between 195 and 198. There he had great success and turned the tide against the Ḥanifite school. His method was to restore the sources of canon law which Abū Ḥanīfa had destroyed by inclining too much to speculative deduction. Instead, he laid equal emphasis upon the four—Koran, tradition, analogy, and agreement. *See* further, under MOHAMMEDAN LAW. In 198 he went to Egypt in the train of a new governor, and this time was received as the leading orthodox authority in law of his time. There he developed and somewhat changed the details of his system, and died in 204 (A.D. 820). He was buried to the southeast of what is now Cairo, and a great dome (erected *c.* A.D. 1240) is conspicuous over his tomb.

See F. Wüstenfeld, *Schāfi'iten,* 31 ff.; M. J. de Goeje in *ZDMG.* xlvii. 106 ff.; C. Brockelmann, *Geschichte,* i. 178 ff.; M'G. de Slane's transl. of Ibn Khallikan, ii. 569 ff., *Fihrist,* 209, Nawawi's *Biogr. Dict.* 56 ff. (D. B. M.)

SHAFT. In architecture shaft is the part of a column between the base and the capital (*q.v.*). The word is also used of any long, slender, cylindrical or polygonal form of generally columnar shape, as in the expression vaulting shaft for a colonnette or moulding attached or applied to a pier in a mediaeval church to carry, or give the appearance of carrying, a vaulting rib. In the classic and Byzantine styles the shafts are usually tapered with a curved taper known as entasis (*q.v.*) and may also be fluted with concave channels. (*See* FLUTE.) Occasional late Roman examples are spiralled. Romanesque shafts are usually cylindrical and without taper, but occasional polygonal examples are found and in certain late Romanesque styles, especially the English Norman, and the Italian Romanesque, the shafts are decorated with grooves or even richly moulded. Particularly rich are the 13th century Italian Romanesque shafts, spirally fluted and moulded, with geometric glass mosaics of the type known as Cosmati work (*see* MOSAIC) inlaid in the flutes; *e.g.,* the cloisters of S. John Lateran in Rome (in the early 13th century).

(T. F. H.)

SHAFT, DRIVING, is a bar of steel revolving in bearings and part of a mechanical power transmission system. It drives a machine or a set of machines, and is distinguished from a spindle which is incorporated in the machine itself (*e.g.,* a drill-spindle) to carry some tool or appliance, and from an axle, which carries road wheels. The shaft is necessary to transmit power from a hand drive, or a power unit, and may be located overhead in a factory, or on the ground or below it. Some machines have several shafts incorporated in the construction, conveying power by means of belts, couplings, clutches or gears. Overhead shafting is usually chosen as a matter of convenience for driving several machines by means of belts. Two essentials apply to all shafts: (1) sufficient rigidity to withstand twisting and bending under load, and (2) running with the minimum of friction. The first requirement is a matter of sufficient diameter and suitable material, generally a good class of steel, and bearings placed close enough together, especially where there is a heavy lateral pull. The frictional difficulty is not troublesome with only two bearings located close together, but when a shaft is long, and the bearings are numerous, alinement is not always easy to ensure or maintain. Settlements in buildings and foundations cause bearings to alter their position. Wedges or other adjusting devices are therefore necessary, while a swivel fitting with ball-and-socket action allows the bearings to float and automatically adjust themselves to the shaft.

The three classes of shaft bearings (*q.v.*) are the *journal,* or peripheral, the *thrust* or end pressure type, and the *footstep,* which sustains the bottom end of a vertical shaft, such as that of a water turbine. When it is necessary to drive a spindle at different heights, as with the rolling-mills, the shaft connection must be made with a universal coupling, permitting the varying angular positions. Much greater flexibility occurs in the small *flexible* shafts, which are so constructed that they will bend freely in any direction and transmit the power. These are utilized for driving portable tools for drilling, reaming, grinding, polishing, boiler-tube expanding and so on.

Special machinery is laid down for the manufacturing of shafting, which may be rolled, drawn or finished accurately, by turning or grinding. To make up lengths as required from stock sizes couplings are used, or if frequent disconnection should be desired a clutch is fitted instead. To a considerable extent shafting has been eliminated in many factories, machines being driven by self-contained electric motors, so that overhead lighting is improved, and costs for installations and the frictional losses are reduced.

(F. H.)

SHAFTESBURY, ANTHONY ASHLEY COOPER, 1ST EARL OF (1621–1683), son of Sir John Cooper and Anne, the daughter of Sir Anthony Ashley, Bart., was born at Wimborne St. Giles, Dorset, on July 22, 1621. His parents died before he was ten years of age, and he inherited extensive estates in Hampshire, Wiltshire, Dorsetshire and Somersetshire, much reduced, however, by litigation in Chancery. He married Margaret, daughter of Lord Coventry, with whom he and his wife lived at Durham House in the Strand and at Canonbury House in Islington. Though still a minor, he was elected for Tewkesbury in 1640, but he took no part in parliamentary proceedings. In 1640 Lord Coventry died, and Cooper then lived with his brother-in-law at Dorchester House in Covent Garden. For the Long Parliament, which met on Nov. 3, 1640, he was elected for Downton, Wiltshire, but the return being disputed, he did not take his seat until the last days of the Rump. He was present as a spectator at Nottingham on Aug. 25, 1642; and in 1643 he appeared openly on Charles's side in Dorsetshire, where he raised at his own expense a regiment of foot and a troop of horse, of both of which he took command. He was also appointed governor of Weymouth, sheriff of Dorsetshire for the king and president of the king's council of war in the county. In January 1644, however, he resigned his governorship and commissions and went over to the parliament, because, as he explained to a committee of the two Houses, he saw danger to the Protestant religion in the king's service. In July 1644 he went to Dorsetshire on military service, and on Aug. 3, received a commission as field-marshal general. He assisted at the taking of Wareham, and shortly afterwards compounded for his estates by a fine of £500 from which he was afterwards relieved by Cromwell. On Oct. 25, he was made commander-in-chief in Dorsetshire; in November he took Abbotsbury, the house of Sir John Strangways; and in December he relieved Taunton. His military service terminated at the time of the Self-denying Ordinance in 1645; and as he had associated himself with the Presbyterian faction, he was not included in the New Model. For the next seven or eight years he lived in comparative privacy, only carrying out his duties as high sheriff of Wiltshire (1646–48). Upon the execution of Charles, Cooper took the Engagement, and was a commissioner to administer it in Dorsetshire. In 1652 he was named on the commission for law reform, of which Hale was the chief and on March 17, 1653, he

was pardoned of all delinquency and thus at last made capable of sitting in parliament. He sat for Wiltshire in the Barebones Parliament, where he supported Cromwell against the extreme section, was appointed on the council of thirty, and on the resignation of this parliament he became a member of the council of state named in the "Instrument." In 1654 he left the privy council, and henceforward is found with the Presbyterians and Republicans in opposition to Cromwell.

Cooper was again elected for Wiltshire in 1656, but Cromwell refused to allow him, with many others of his opponents, to sit. In the parliament of 1658, however, he took his seat, and was active in opposition to the new constitution of the two Houses. He also led the opposition in Richard Cromwell's parliament, especially on the matter of the limitation of the power of the protector, and against the House of Lords.

In 1659 Cooper was arrested on a charge of corresponding with the leader of the Cheshire rising, but he was unanimously acquitted by the Council. In the disputes between Lambert at the head of the military party and the Rump in union with the council of State, he supported the latter, and upon the temporary supremacy of Lambert's party worked indefatigably to restore the Rump. He co-operated with Monk, whom he assisted to the post of commander-in-chief of the forces, was instrumental in securing the Tower for the parliament, and in obtaining the adhesion of Admiral Lawson and the fleet. On the restoration of the parliament Cooper was one of the commissioners to command the army, and was made one of the new council of State. On Jan. 7, 1660, he took his seat on his election for Downton in 1640, and was made colonel of Fleetwood's regiment of horse. He secured the admission of the secluded members, was again one of the fresh council of State, consisting entirely of friends of the Restoration, and accepted from Monk a commission to be governor of the Isle of Wight and captain of a company of foot. He now steadily pursued the design of the Restoration, and was one of the 12 commissioners who went to Charles at Breda to invite him to return. In the Convention Parliament he sat for Wiltshire.

Cooper was at once placed on the privy council, receiving also a formal pardon for former delinquencies. In the discussions regarding the Bill of Indemnity he was instrumental in saving the life of Haselrig, and opposed the clause compelling all officers who had served under Cromwell to refund their salaries. He was one of the commissioners for conducting the trials of the regicides, but was himself attacked by Prynne for having acted with Cromwell. He was named on the council of plantations and on that of trade. At the coronation in April 1661 Cooper had been made a peer, as Baron Ashley of Wimborne St. Giles, in recognition of his services at the Restoration; and on the meeting of the new parliament in May he was appointed chancellor of the exchequer and under-treasurer. He opposed the persecuting acts now passed —the Corporation Act, the Uniformity Bill, against which he is said to have spoken three hundred times, and the Militia Act. He is stated also to have influenced the king in issuing his dispensing declaration of Dec. 26, 1662, and he zealously supported a bill for the purpose of confirming the declaration. He was himself the author of a treatise on tolerance. He was now recognized as one of the chief opponents of Clarendon and the High Anglican policy. On the outbreak of the Dutch War in 1664 he was made treasurer of the prizes, being accountable to the king alone for all sums received or spent. He was also one of the grantees of the province of Carolina and took a leading part in its management. On the death of Southampton, Ashley was placed on the commission of the treasury, Clifford and William Coventry being his principal colleagues. He appears to have taken no part in the attempt to impeach Clarendon on a general charge of treason.

The new administration was headed by Buckingham, whose toleration and comprehension principles Ashley shared to the full. An able paper written by him to the king in support of these principles, on the ground of their advantage to trade, has been preserved. He excepts, however, from toleration Roman Catholics and Fifth Monarchy men. His attention to all trade questions was close and constant; he was a member of the council of trade and plantations appointed in 1670, and was its president from 1672–76; he also co-operated in the design of legitimizing Monmouth as a rival to James. In the intrigues which led to the infamous treaty of Dover he had no part, for as a Protestant he could not be trusted with the knowledge of the clause binding Charles to declare himself a Catholic. In order to blind the Protestant members of the Cabal a sham treaty was arranged in which this clause did not appear, and under this misunderstanding he signed the sham Dover treaty on Dec. 31, 1670. This treaty, however, was kept from public knowledge. He opposed the "Stop of the Exchequer," the responsibility for which rests with Clifford, but in the other great measure of the Cabal ministry, Charles's Declaration of Indulgence, he concurred. He was rewarded by being made earl of Shaftesbury and Baron Cooper of Pawlett by a patent dated April 23, 1672. It is stated too that he was offered, but refused, the lord treasurership. On Nov. 17, 1672, however, he became lord chancellor, in which position he offended the House of Commons by issuing writs to fill the vacant seats. This, though grounded on precedent, was regarded as an attempt to fortify Charles. The writs were cancelled, and the principle was established that the issuing of writs rested with the House itself. It was at the opening of parliament that Shaftesbury made his celebrated "delenda est Carthago" speech against Holland, in which he urged the Second Dutch War, on the ground of the necessity of destroying so formidable a commercial rival to England, excused the Stop of the Exchequer which he had opposed, and vindicated the Declaration of Indulgence. On March 8, he announced to parliament that the declaration had been cancelled, and for affixing the great seal to this declaration he was threatened with impeachment by the Commons. The Test Act was now brought forward, and Shaftesbury, who appears to have heard how he had been duped in 1670, supported it, with the object probably of getting rid of Clifford. He now began to be regarded as the chief upholder of Protestantism in the ministry; he lost favour with Charles, and on Sept. 9, 1673, was dismissed from the chancellorship. Among the reasons for this dismissal is probably the fact that he opposed grants to the king's mistresses.

Charles soon regretted the loss of Shaftesbury, and endeavoured, unsuccessfully, as did also Louis, to induce him to return. He now became the popular leader against the measures of the court, and may be regarded as the intellectual chief of the opposition. At the meeting of parliament on Jan. 8, 1674, he carried a motion for a proclamation banishing Catholics to a distance of 10 m. from London. During the session he organized and directed the opposition in their attacks on the king's ministers. On May 19 he was dismissed from the privy council and retired to Wimborne, where he continued to urge the necessity of a new parliament. He was in the House of Lords, however, in 1675, when Danby brought forward his famous Non-resisting Test Bill, and headed the opposition during this session with ability, supporting the right of the Lords to hear appeal cases, even where the defendant was a member of the Lower House. Parliament was prorogued for 15 months until Feb. 15, 1677, but the opposition maintained that a prorogation for more than a year was illegal. In reply Shaftesbury, with three others, was sent to the Tower. In June Shaftesbury applied for a writ of *habeas corpus,* but was only released on Feb. 26, 1678, after his letter and three petitions to the king. Being brought before the bar of the House of Lords he made submission as to his conduct in declaring parliament dissolved by the prorogation, and in violating the Lords' privileges by bringing a *habeas corpus* in the King's Bench.

The outbreak of the Popish Terror in 1678 provided an opportunity for Shaftesbury to attack the government by fanning the popular frenzy. Under his advice the opposition made an alliance with Louis whereby the French king promised to help them to ruin Danby on condition that they would compel Charles, by stopping the supplies, to make peace with France, doing thus a grave injury to Protestantism abroad for the sake of a temporary party advantage at home. Upon the refusal in November of the Lords to concur in the address of the Commons requesting the removal of the queen from court, he joined in a protest and was foremost in all the violent acts of the session. He urged on the bill by which

Catholics were prohibited from sitting in either House of Parliament, and was bitter in his expressions of disappointment when the Commons passed a proviso excepting James, against whom the bill was especially aimed, from its operation. A new parliament met on March 6, 1679. Shaftesbury had meanwhile warned the king that unless he followed his advice there would be no peace with the people. On March 25, he made a striking speech upon the state of the nation, especially upon the dangers to Protestantism and the misgovernment of Scotland and Ireland. He was suspected, too, of fostering a revolt in Scotland. By the advice of Temple, Charles now tried the experiment of forming a new privy council in which the chief members of the opposition were included, and Shaftesbury was made president, being also a member of the committee for foreign affairs. He did not, however, change his opinions or his action, and opposed the compelling of Protestant Nonconformists to take the oath required of Roman Catholics. The question of the succession was now again prominent, and Shaftesbury hastened his fall by putting forward Monmouth as his nominee, thus alienating a large number of his supporters. He pressed on the Exclusion Bill, and, when that and the inquiry into the payments for secret service and the trial of the five peers were brought to an end by a sudden prorogation, he is reported to have declared aloud that he would have the heads of those who were the king's advisers to this course. Before the prorogation, however, he saw the invaluable Act of Habeas Corpus, which he had carried through parliament, receive the royal assent. In pursuance of his patronage of Monmouth, Shaftesbury now secured for him the command of the army sent to suppress the insurrection in Scotland. In October 1679, Shaftesbury was dismissed from the presidency and from the privy council, and when applied to by Sunderland to return to office he made as conditions the divorce of the queen and the exclusion of James.

With other peers he presented a petition to the king in November, praying for the meeting of parliament, of which Charles took no notice. In April, upon the king's declaration that he was resolved to send for James from Scotland, Shaftesbury advised the popular leaders to leave the council, and they followed his advice. In March we find him unscrupulously eager in the prosecution of the alleged Irish Catholic plot. On June 26, accompanied by fourteen others, he presented to the grand jury of Westminster an indictment of the duke of York as a Popish recusant. The Exclusion Bill, having passed the Commons, was brought up to the Lords, and an historic debate took place, on Nov. 15, in which Halifax and Shaftesbury were the leaders on opposite sides. The bill was thrown out, and Shaftesbury signed the protest against its rejection. The next day he urged upon the House the divorce of the queen, and on Dec. 7, he voted for the condemnation of Lord Stafford. He continued to advocate exclusion but all opposition was checked by the dissolution of parliament. A new parliament was called to meet at Oxford, to avoid the influences of the city of London, where Shaftesbury was popular. Shaftesbury, with fifteen other peers, petitioned the king that it might as usual be held in the capital. At this parliament, which lasted but a few days, he again made a personal appeal to Charles, which was rejected, to permit the legitimizing of Monmouth. The king's advisers now urged him to arrest Shaftesbury; he was seized on July 2, 1681, and committed to the Tower, the judges refusing his petition to be tried or admitted to bail. This refusal was twice repeated in September and October, the court hoping to obtain evidence sufficient to ensure his ruin. In October he wrote offering to retire to Carolina if he were released. On Nov. 24, he was indicted for high treason at the Old Bailey, but was released on bail on Dec. 1. In 1682, however, Charles secured the appointment of Tory sheriffs for London; and, as the juries were chosen by the sheriffs, Shaftesbury felt that he was no longer safe from the vengeance of the court. Failing health and the disappointment of his political plans led him into violent courses. He appears to have entered into treasonable consultation with Monmouth and others, and after lying concealed in London, he fled to Harwich, and reached Amsterdam in the beginning of December. Here he was made a citizen of Amsterdam, but died there on Jan. 21, 1683. His body was sent in February to Poole, in Dorset, and was buried at Wimborne St. Giles.

Few politicians have been so abused as Shaftesbury. Dryden satirised him, Macaulay condemned him, but Christie did much to rehabilitate him. Christie's *Life* (1871), however, should be read with caution. Finally, in his monograph (1886) in the series of "English Worthies," H. D. Traill professes to hold the scales equally. He makes an interesting addition to our conception of Shaftesbury's place in English politics, by insisting on his position as the first great party leader in the modern sense, and as the founder of modern parliamentary oratory.

SHAFTESBURY, ANTHONY ASHLEY COOPER, 3RD EARL OF (1671–1713), was born at Exeter House, London, on Feb. 26, 1671. He was grandson of the first earl (the friend of Locke), and son of the second earl. His mother was Lady Dorothy Manners, daughter of John, earl of Rutland. At the age of three the boy was made over to the formal guardianship of his grandfather, and Locke was entrusted with the superintendence of his education. This was conducted according to the principles enunciated in Locke's *Thoughts concerning Education.* In 1683 his father entered him at Winchester as a warden's boarder. Being shy and constantly taunted with the opinions and fate of his grandfather, he appears to have been miserable, and to have left Winchester in 1686 for a course of foreign travel.

In 1689, the year after the Revolution, Ashley returned to England, and for nearly five years led a studious life. In 1695 he entered parliament as M.P. for Poole. Though a Whig by descent, by education and by conviction, Ashley could by no means be depended on to give a party vote; he supported any proposals which appeared to promote the liberty of the subject and the independence of parliament. On the dissolution of July 1698, ill health compelled his retirement from parliamentary life. He spent a year in Holland, where he met Le Clerc, Bayle, Benjamin Furly, the English Quaker merchant, at whose house Locke had resided during his stay at Rotterdam, and probably Limborch and the rest of the literary circle of which Locke had been an honoured member nine or ten years before. To the period of this sojourn must probably be referred the surreptitious publication, by Toland, of an edition of the *Inquiry concerning Virtue,* from a rough draught, sketched when he was 20 years of age.

Ashley succeeded his father as earl of Shaftesbury in 1699. He took an active part, on the Whig side, in the general election of 1700–01, and again, with more success, in that of the autumn of 1701. William III. offered him a secretaryship of state, which he declined for reasons of health. After the accession of Anne, Shaftesbury, who had been deprived of the vice-admiralty of Dorset, returned to his retired life, but retained a keen interest in politics. In 1703 he again went to Rotterdam for a year, living as he says in a letter to his steward Wheelock, at the rate of less than £200 a year, and yet having much "to dispose of and spend beyond convenient living." From this time forward he was engaged in writing or revising the treatises afterwards included in the *Characteristics.* In 1709 he married Jane Ewer. His only child and heir, the fourth earl, to whose manuscript accounts we are indebted for the details of his father's life, was born on Feb. 9, 1711.

With the exception of a *Preface to the Sermons of Dr. Whichcote,* the Cambridge Platonist, published in 1698, Shaftesbury printed nothing till 1708. About this time repressive measures were proposed against the French Camisards (*q.v.*). Shaftesbury maintained that fanaticism was best encountered by "raillery" and "good-humour"; he wrote a letter *Concerning Enthusiasm* (anon. 1708) to Lord Somers, dated Sept. 1707, which provoked several replies. In May 1709 he returned to the subject in *Sensus Communis, an Essay on the Freedom of Wit and Humour.* In the same year appeared *The Moralists, a Philosophical Rhapsody;* in 1710, *Soliloquy, or Advice to an Author,* and in 1711 *Characteristics of Men, Manners, Opinions, Times* (3 vols.), all published anonymously. These volumes contain in addition to the four treatises already mentioned, *Miscellaneous Reflections,* now first printed, and the *Inquiry concerning Virtue or Merit,* described as "printed first in the year 1699."

In July 1711 Shaftesbury set out for Italy in search of health. He spent a year in Naples, where he prepared a second edition (1713) of the *Characteristics,* the little treatise (afterwards

included in the *Characteristics*) entitled *A Notion of the Historical Draught or Tablature of the Judgment of Hercules*, and the letter concerning *Design*. "Medals, and pictures, and antiquities," he writes to Furly, "are our chief entertainments here." His conversation was with men of art and science, "the virtuosi of this place." Shaftesbury died on Feb. 4, 1713 and was buried at St. Giles's, the family seat in Dorsetshire.

Shaftesbury's philosophical importance is due mainly to his ethical speculations, in which his motive was primarily the refutation of Hobbes' egoistic doctrine. He continually laid stress on the importance of beauty and harmony in the daily life of the individual and of society, and declared virtue to be the subordination of the self-regarding to the social affections. Just as there is a faculty which apprehends beauty in the sphere of art, so there is in the sphere of ethics a faculty which apprehends the beauty or deformity of actions. This faculty he described (for the first time in English thought) as the Moral Sense (*see* HUTCHESON, FRANCIS) or Conscience (*see* BUTLER, JOSEPH). In its essence, it is primarily emotional and non-reflective; in process of development it becomes rationalized by education and use. The emotional and the rational elements in the "moral sense" Shaftesbury did not fully analyse (*see* HUME, DAVID).

From this principle, it follows (1) that the distinction between right and wrong is part of the constitution of human nature; (2) that morality stands apart from theology, and the moral qualities of actions neither depend upon the arbitrary will of God nor upon custom, fancy or will; (3) that the ultimate test of an action is its tendency to promote the general harmony or welfare; (4) that appetite and reason concur in the determination of action; and (5) that the moralist is not concerned to solve the problem of freewill and determinism. From these results we see that Shaftesbury, opposed to Hobbes and Locke, is in close agreement with Hutcheson, and that he is ultimately a deeply religious thinker, inasmuch as he discards the moral sanction of public opinion, the terrors of future punishment, the authority of the civil authority, as the main incentives to goodness, and substitutes the voice of conscience and the love of God. These two alone move men to aim at perfect harmony for its own sake in the man and in the universe.

The main object of the *Moralists* is to propound a system of natural theology, and to vindicate, so far as natural religion is concerned, the ways of God to man. His scheme of natural religion was popularized in Pope's *Essay on Man,* several lines of which, especially of the first epistle, are simply statements from the *Moralists* done into verse. Whether, however, these were taken immediately by Pope from Shaftesbury, or whether they came to him through the papers which Bolingbroke had prepared for his use is uncertain. Shaftesbury's ethical system was reproduced, though in a more precise and philosophical form, by Hutcheson, and from him descended, with certain variations, to Hume and Adam Smith. Nor was it without effect even on Butler. Of the so-called deists Shaftesbury was probably the most important, as he was certainly the most plausible. No sooner had the *Characteristics* appeared than they were welcomed by Le Clerc and Leibnitz. In 1745 Diderot adapted the *Inquiry concerning Virtue* in what was afterwards known as his *Essai sur le Mérite et la Vertu.* In 1769 a French translation of the whole of Shaftesbury's works, including the *Letters,* was published at Geneva; in 1776–79 there appeared a complete German translation of the *Characteristics.* Hermann Hettner says that not only Leibnitz, Voltaire and Diderot, but Lessing, Mendelssohn, Wieland and Herder, drew the most stimulating nutriment from Shaftesbury. Herder, in the *Adrastea,* pronounces the *Moralists* to be in form well-nigh worthy of Grecian antiquity, and in content almost superior to it.

Most of Shaftesbury's writings have been already mentioned. In addition, fourteen letters from Shaftesbury to Molesworth were edited by Toland in 1721; some letters to Benjamin Furly, his sons and his clerk Harry Wilkinson, included in *Original Letters of Locke, Sidney and Shaftesbury,* were published by Mr. T. Forster in 1830 and 1847; three letters to Stringer, Lord Oxford and Lord Godolphin appeared, for the first time, in the *General Dictionary;* and lastly a letter to Le Clerc, in his recollections of Locke, was first published in *Notes and Queries,* Feb. 8, 1851. The *Letters to a Young Man at the University* (Michael Ainsworth), already mentioned, were first published in 1716. The Letter on Design was first published in the 1732 edition of the *Characteristics.* Besides the published writings, there are the Shaftesbury papers in the Record Office.

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SHAFTESBURY, ANTHONY ASHLEY COOPER, 7TH EARL OF (1801–1885), son of Cropley, 6th earl (a younger brother of the 5th earl; succeeded 1811), and Anne, daughter of the 3rd duke of Marlborough, was born on April 28, 1801. He was educated at Harrow and Christ Church, Oxford, and entered parliament in 1826. He succeeded his father as earl in 1851. Although giving a general support to the Conservatives, his parliamentary conduct was greatly modified by his intense interest in the improvement of the social condition of the working classes, his efforts in behalf of whom have made his name a household word. He opposed the Reform Bill of 1832, but was a supporter of Catholic emancipation, and his objection to the continuance of resistance to the abolition of the Corn Laws led him to resign his seat for Dorset in 1846. In parliament his name, more than any other, is associated with the new factory legislation. He was a lord of the admiralty under Sir Robert Peel (1834–35), but on being invited to join Peel's administration in 1841 refused, having been unable to obtain Peel's support for the Ten Hours' bill. Chiefly by his persistent efforts a Ten Hours' bill was carried in 1847, but its operation was impeded by legal difficulties, which were only removed by successive acts, instigated chiefly by him, until the law was consolidated by the Factory Act of 1874.

The part which Shaftesbury took in the legislation bearing on coal mines was equally prominent. In 1846, after the resignation of his seat for Dorset, he explored the slums of the metropolis, and not only gave a new impulse to the movement for the establishment of ragged schools, but was able to make it more widely beneficial. For 40 years he was president of the Ragged School Union. He was also one of the principal founders of reformatory and refuge unions, young men's Christian associations and working men's institutes. He took an active interest in foreign missions, and was president of several of the most important philanthropic and religious societies of London. He died on Oct. 1, 1885. By his marriage (1830) to Lady Emily (d. 1872), daughter of the 5th earl Cowper, he left a large family, and was succeeded by his eldest son Anthony, who committed suicide in 1886, his son (b. 1869) becoming 9th earl.

See J. L. and B. Hammond, *Lord Shaftesbury* (1923); and J. W. Bready, *Lord Shaftesbury and Industrial Progress* (1926).

SHAFTESBURY, a market town and municipal borough in the northern parliamentary division of Dorsetshire, England, 103 m. W.S.W. from London by the S. railway (Semley station). Pop. (1931) 2,366. It lies high on a hill above a rich agricultural district. Although there are traces of both British and Roman occupation in the immediate neighbourhood, the site of Shaftesbury (Caer Palladur, Caer Septon, Seaftonia, Sceafstesbyrig, Shafton) was probably first occupied in Saxon times; Matthew Paris speaks of its foundation by the mythical king Rudhudibras, while Asser ascribes it to Alfred, who made his daughter Ethelgeofu the first abbess. It is probable that a small religious house had existed here before the time of Alfred, and that it and the town were destroyed by the Danes, being both rebuilt about 888. The site of the Saxon abbey and nunnery was excavated between 1907 and 1910. In 980 Dunstan brought St. Edward's body here from Wareham for burial, and here Canute died in 1035.

In 1252 the burgesses received their first charter from Henry III. There is no evidence that Elizabeth granted Shaftesbury a charter as has been asserted, but she confiscated the common lands in 1585, the town only recovering them by purchase. This probably led to the granting of a new charter by James I. in 1604. Yet another charter was granted to the town in 1684. Shaftesbury returned two members to parliament from 1294 to 1832,

when the representation was reduced to one, and it was lost in 1885.

See Charles Hubert Mayo, *The Municipal Records of the Borough of Shaftesbury* (Sherborne, 1889); Victoria County History of Dorset II. pp. 72 to 79.

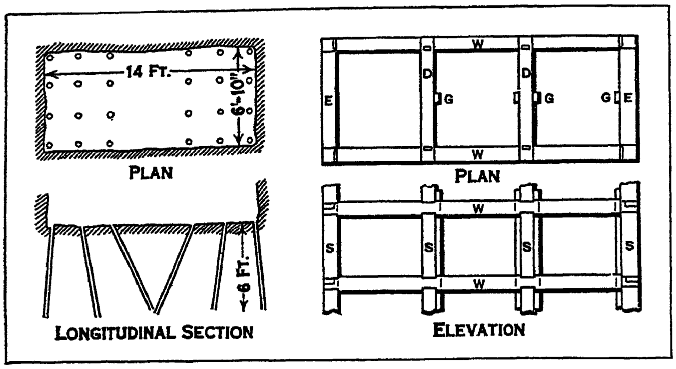
SHAFT-SINKING is an important mining operation for reaching and working mineral deposits situated at a depth below the surface, whenever the topography does not admit of driving adits or tunnels (*q.v.*). Shafts are also often sunk in connection with certain civil engineering works, *e.g.*, at intervals along the line of a railway tunnel for starting intermediate headings, thus securing more points of attack than if the entire work were carried on from the end headings only. Sundry modifications of shaft-sinking are adopted in excavating for deep foundations of heavy buildings, bridge piers and other engineering structures. If in solid rock carrying but little water, shaft-sinking is a comparatively simple operation. But when the formation penetrated comprises unstable, watery strata, special forms of lining are necessary and the work is slow and expensive. Mine shafts are often very deep, notably in the Witwatersrand, South Africa; at Bendigo, Australia; and in some of the coal fields of Europe. Several inclined shafts in Michigan approximate 8,600 ft. at an inclination of 39° to the horizontal.

Shape of Shafts.—Vertical shafts may be either rectangular or cylindrical; when inclined they are always rectangular. In Europe shafts are generally cylindrical, sometimes of elliptical cross-section, lined with masonry, concrete, cast iron or steel. In the United States and elsewhere rectangular sections are the rule for sinking in rock, the shaft walls being supported by timbering, occasionally by steel framing. For sinking in loose, water-bearing soils, the cross-section is almost invariably circular to resist crushing or caving of the shaft walls. The cheaper timber or steel-lined, rectangular shaft, however, is generally appropriate in rocky strata, in view of the temporary character of mining operations. Rectangular shafts are usually divided longitudinally into compartments; one or more of these are for the cages or skips, which run in guides bolted to the shaft timbering or by wire ropes stretched from top to bottom (*see* MINING, METALLIFEROUS); another is provided for a ladder- and pipe-way and for ventilation. When much water is encountered a separate pump compartment is desirable. Cylindrical shafts may be similarly divided.

The cross-sectional area of shafts depends mainly on the size of the cages or skips. Rectangular shafts of one or two compartments measure, inside of timbers, say 4 by 6 ft. to 7 by 12 ft.; larger shafts of three compartments, from 5 by 12 ft. to 8 or 10 ft. by 20 ft. Shafts of four to seven compartments, as in the deep-level mines of the Witwatersrand, range from 6 by 20 ft. to 6 or 8 by 30 ft., and for some of the Pennsylvania colliery shafts, up to 13 by 52 ft. Cylindrical shafts rarely have more than two hoisting compartments and vary from 10 to 21 ft. diameter.

Sinking in Rock.—If the rock be overlaid by loose soil carrying little water, excavation is begun by pick and shovel, and after the rock is reached is continued by drilling and blasting. The plant usually comprises a small hoist and boiler, several buckets or a skip, one or more sinking pumps according to the quantity of water, occasionally a ventilating fan and a timber derrick or head-frame over the shaft mouth. In some cases a portion of the permanent hoisting plant is erected for sinking. For very hard rock or for rapid work, machine drilling is advisable, a compressor and additional boiler capacity being then required. Many shafts in South Africa and the United States have been sunk at a speed of from 200 to 250 ft. per month. Inclined shafts when nearly vertical can be sunk about as fast as vertical shafts; but for inclinations between 75° and 30° to the horizontal, inclines are generally slower, due to the greater inconvenience of carrying on excavation and timbering. Very flat shafts can be sunk faster, unless there is much water. The highest speed on record for a flat incline (10°) is 267 ft. in one month (Howard shaft, South Africa). The speed of sinking depends mainly on the time required to hoist out the broken rock and therefore generally diminishes with increase of depth. Furthermore, omitting shafts of small area, the cost per foot of depth does not increase proportionately to the cross-sectional dimensions. For the same rock the rate of advance in wet formations is always much slower than in dry and the cost greater.

A round of holes is drilled, usually 3 to 4 ft. deep if by hand, or 5 to 8 ft. if by machine (*see* BLASTING). A common mode of placing machine drill holes in shown in fig. 1. The holes are charged with dynamite and fired preferably by electricity, as the



FIGS. 1 AND 2

men may have to be hoisted a long distance to a place of safety. After the smoke has cleared away, hastened by sprays or by compressed air if available, the broken rock is hoisted out and drilling resumed. In rectangular shafts not over 6 or 8 ft. wide, machine drills are usually mounted on horizontal bars stretching across from wall to wall; in wider or cylindrical shafts, on tripods or special sinking-frames. Small quantities of water are bailed but when the inflow is large, a sinking pump is employed (*see* MINING, METALLIFEROUS).

Shaft Lining.—For rectangular vertical shafts under normal conditions the excavation through surface soil is commonly lined with cribbing, inside of which a concrete curb is sometimes built to dam out surface water. After reaching rock the lining is generally of horizontal sets of 8 by 8 in. to 12 by 12 in. squared timber, wedged against the walls by smaller pieces, with lagging, put behind the sets. In firm rock lagging may be omitted. Each set (fig. 2) consists of two long timbers (wall-plates) W, W, two shorter pieces (end-plates) E, E, and one or more cross pieces (dividers or buntons) D, D, to form the compartments, strengthen the sets and support the cage guides, G, G. The sets are 4 to 6 ft. apart, with vertical posts (studdles) S, S, between them. At intervals of 80 to 120 ft., longer timbers (bearers) are notched into the walls under a set to prevent displacement of the lining. A series of shaft sets, with their posts, are either built up from a bearing-set, or suspended from the latter by hanger-bolts. In firm rock, a considerable depth of shaft may be sunk and then timbered; generally it is safer to put in a few sets at a time as sinking advances. Inclined shafts in solid ground are often timbered as described above, though sometimes longitudinal rows of posts support the roof and divide the shaft into compartments.

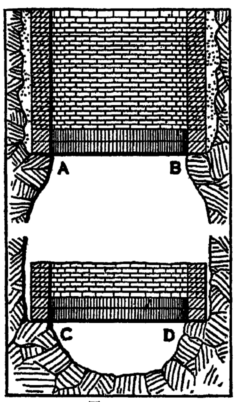


FIG. 3

A cylindrical shaft of any importance is lined with masonry, concrete or cast-iron "tubbing." Linings are generally built in sections, as sinking advances, each section being based on a walling-crib AB, CD (fig. 3). The thickness of the walling depends on the pressure anticipated; it is usually from 13 in. to 2 ft. Such linings shut out much of the water present in the surrounding rock. Iron tubbing is employed when the inflow of water is large. It consists of cast-iron flanged rings, cast in segments bolted together. To permit the rings to adjust themselves to the pressure, the horizontal joints are rarely bolted; they are best packed with sheet-lead or thin strips of dry pine, any leaks appearing subsequently being stopped with wedges. The space

between the tubbing and the rock is filled with concrete or cement grouting. The lowermost tubbing ring is based upon a "wedging-crib." This is a heavy ring of cast-iron segments bolted together, and set on a projecting shelf of rock, carefully dressed. The space behind the crib is driven full of wooden wedges, which expand on becoming water-soaked and make a water-tight joint. By using this method very little pumping is necessary, so the cost is materially reduced.

Cost of Shaft Sinking.—In rock the cost varies greatly with the size and depth of the shaft, inflow of water and character of rock. Under favourable conditions, in 1927, small, shallow shafts cost £12 to £20 per ft.; larger, deep shafts, £25 to £40. Under unfavourable conditions costs may range from £50 per ft. up. Costs in soft, watery soil are always relatively higher.

The **Kind-Chaudron process** of sinking in rock, introduced in 1852, has been confined to Europe. Many shafts have been sunk thus, some to depths of 1,000 ft. or more, without one instance of failure. It is applicable only to firm rock and was devised for cases where the quantity of water is too great to be pumped out while excavation is in progress; that is, for inflows greater than 1,000 or 1,200 gal. per min. This system is most successful when the water-bearing rocks rest on an impervious stratum, overlying the mineral deposit. The entire excavation is carried on under water. Instead of ordinary tools, massive trepans are employed, consisting of a heavy iron frame, in the lower edge of which are set a number of separate cutters. Shafts not exceeding about 8 ft. diameter are bored in one operation; for larger diameters an advance bore is usually made with a small trepan and afterwards enlarged to full size; or the small and large trepans may be used alternately, the advance being kept 30 to 60 ft. ahead of enlargement. An 8-ft. trepan weighs about 12 tons; those of 14 or 15 ft., 25 to 30 tons. The trepan is attached to a heavy rod, suspended from a walking-beam operated by an engine on the surface. A derrick is erected over the shaft, with a hoisting engine for raising and lowering the tools. Average rock is bored at a speed of about 1½ ft. per 24 hours. The advance bore is cleaned of debris at intervals by a bailer similar to that used for boreholes (*q.v.*). The enlarging trepan is so shaped that the cuttings, assisted by the agitation of the water, run into the advance bore. Owing to the difficulty of bailing, the advance bore is sometimes omitted even for large shafts, the debris being removed by a special dredger. For rather loose rock another somewhat similar system of drilling, the Pattberg, has been satisfactorily employed (see *Coll. Guardian*, Nov. 14, 1902). When the shaft has passed through the watery strata the cast-iron lining (*cc, dd*) is bolted together at the shaft mouth and lowered through the water (fig. 4). Sometimes, the first two rings (*aa, bb*) are designed to telescope together with dry moss packed between their flanges. When the lowermost ring reaches the bottom, the weight of the lining compresses the moss and forces it against the surrounding rock, making a tight joint. The lining is suspended from the surface by threaded rods, and to reduce its weight while it is being lowered the bottom may be closed by a diaphragm (*ff*), in the centre of which is an open pipe (*g*). This pipe is provided with cocks for admitting enough water to overcome buoyancy. Finally, concrete is filled in behind the lining, the diaphragm removed and the completed shaft pumped out. The moss-box is now usually omitted, the concreting being relied on to make the lining water-tight. The cost of this method (generally £50 to £80 per ft.), as well as the speed, compares favourably with results obtainable under the same conditions by other means; in many cases it is the only practicable method.

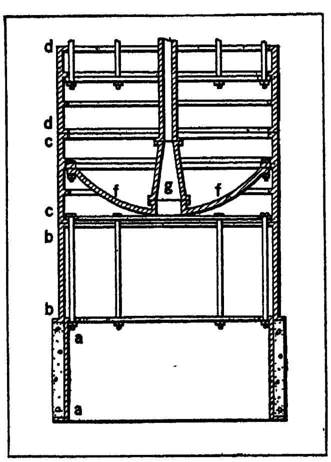


FIG. 4

Sinking in Unstable Soils.—Unstable or watery soils often cause serious engineering difficulties. Shaft sinking is then accomplished by: (1) spiling, vertical or inclined; (2) drop-shaft; (3) caisson and compressed air; (4) the freezing process. Vertical spiling consists in driving series of spiles around the sides of the excavation, each series supported by horizontal timber cribs. When the first spiles have been driven, and the enclosed soil removed, a second set follows inside, and so on. Steel sheet spiling is also used for small depths in silt, quicksand and other very watery soil. Inclined spiling (fig. 5) is limited to small depths. Cribs are put in every few feet; around them, driven ahead of the excavation, are short planks, sharpened to a chisel edge. The spiles incline outward, being driven inside of one crib and outside of that next below. The shaft bottom also may have to be sheathed with planking, which is braced against the lowest crib and advanced to new positions as sinking of the shaft progresses.

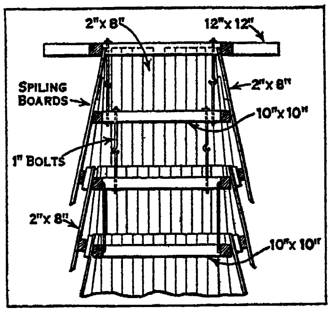


FIG. 5

Drop-shafts have been used for depths of nearly 500 ft. A heavy timber, iron or concrete lining (usually cylindrical) is sunk through the soil, new sections being successively added at the surface, while excavation goes on inside. In quite soft soil the drop-shaft sinks with its own weight; when necessary, added weights of pig-iron, rails, etc., are applied at the top. If the first lining refuses to sink farther a second is lowered inside of it. The drop-shaft rests on a massive wooden or iron shoe, generally of triangular cross-section, which cuts into the soil as the weight of the structure increases and the excavation proceeds. When the drop-shaft is built of concrete, its great weight may become unmanageable in very soft soil, and it is hung from a framework on the surface. For deep shafts the lining must be of iron or steel, as wood is too weak and concrete too heavy. When only a reasonable amount of pumping is required, the soil is excavated by hand; otherwise dredging is resorted to. The leakage of water under the shoe may be stopped by concreting the shaft bottom or by various other methods. There are many modifications of the drop-shaft which cannot here be detailed. Sinking with caisson (*q.v.*) and compressed air is rarely adopted except in civil engineering operations where deep foundations are necessary; *e.g.*, bridge piers.

Watery soil in which a shaft is to be sunk is sometimes artificially frozen and excavated like rock. A number of drive-pipes are put down (*see* BORING), usually 6 to 8 in. diameter and about 3 ft. apart, in a circle whose radius is, say, 3 ft. greater than that of the shaft, and reaching to bed-rock or other firm formation. Each pipe is then plugged at the lower end and within it is placed an open pipe, 1½ in. in diameter, extending nearly to the bottom. Or, preferably, after the drive-pipes are down and cleaned out, a slightly smaller pipe, closed at its lower end, is inserted in each drive-pipe, the latter being afterwards pulled out. The inner 1½-in. open pipes are then inserted. The outer and inner pipes are connected with a refrigerating machine (*see* REFRIGERATION) and brine at a temperature of 0° is passed down the inner pipes and up through the outer pipes. The cold solution rising in the large pipes absorbs the heat from the surrounding watery soil, freezing concentrically round each pipe. The frozen masses finally join (in say 3 to 4 weeks), forming an unbroken wall. The enclosed soft soil may then be excavated by dredging. Generally freezing is continued until the solidification reaches the centre and to some distance beyond the circle of pipes, after which the frozen ground is drilled and blasted and the shaft is lined. This process has been successfully employed in stages to depths of about 2,000 ft. Nearly 100 shafts have been sunk by this process. In 1924 two shafts were sunk in Belgium by freezing to 2,025 ft. at a cost, including lining, of £230 per foot.

The cementation process (grouting) is applicable for both fissured rock and soft ground carrying much water, and has been used successfully in sinking a number of shafts, chiefly in Great Britain, Belgium and South Africa. Some of this work has been at depths of 1,200 to 1,600 ft. The process consists in injecting cement grout, under pressures of 1,000 to 3,000 lb. per sq.in., through boreholes into the watery strata. The cement on setting consolidates the ground, which is then drilled and blasted with little trouble from water. Two methods are employed: (1) the boreholes are put down inside of the perimeter of the projected shaft; (2) the boreholes are outside of the perimeter, as for the freezing process. In the first method the ground is treated to a predetermined depth, the shaft being sunk and lined to that depth, after which another set of holes is drilled from the shaft bottom to a greater depth and the process repeated.

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SHAGALL, MARC (1888–), Russian painter, was born in Vitebsk, of a family of Jewish artisans. He became a pupil of Leon Bakst in St. Petersburg. He went to Paris in 1910, where he exhibited in the "Salon des Indépendants." Under the influence of cubism he painted a series of fantastic pictures, in which he showed extraordinary gifts for colour. He was in Russia from 1914 to 1922, when he went to Berlin and later settled in Paris. He engraved a cycle of prints entitled "My Life," and made a series of 100 etchings to illustrate Gogol's *Dead Souls.* Exhibitions of Shagall's work have been held in Paris, Berlin and other German cities and New York.

SHAGĪA (SHAIGIA, SHAIKĪYEH), a tribe of Semitic origin living on both banks of the Nile from Korti to the Third Cataract, and in parts of the Bayuda desert and partly nomad, partly agricultural. They claim descent from one Shayig Ibn Hamaidan of the Beni Abbas, and came from Arabia at the conquest of Egypt in the 7th century. Settled originally south of their present country they moved northward after 1772. For their services in the suppression of the Jā'alin revolt (1822), they obtained lands between Shendi and Khartum. At that time they were far more civilized than the neighbouring tribes. They had schools in which all Muslim science was taught, and were rich in corn and cattle. Their fighting men, mounted on horses of the Dongola breed, were feared throughout the eastern Sudan. Their chiefs wore coats of mail and carried shields of hippopotamus or crocodile skin. Their arms were lance, sword or javelin. The Shagīa are divided into twelve clans. They speak Arabic and generally preserve the Semitic type, though they are obviously of very mixed blood. The typical Shagīa has a sloping forehead, aquiline nose and receding chin. They gash the chests of their children.

See *Anglo-Egyptian Sudan,* edited by Count Gleichen (1905); A. H. Keane, *Ethnology of the Egyptian Sudan* (1884).

SHAGREEN. A species of untanned leather with a roughened, granular surface. The word is the English form; *cf.* Ger. *Schagrin,* Fr. *chagrin,* Ital. *zagrin, zigrino;* these are usually referred to Turkish and Persian *saghri,* lit. the back of a horse, and so applied to leather made from this part. The skin of the wild ass was especially used. The method of preparing the skins to secure the rough, granular surface is as follows. The seeds of a plant, usually some species of *Chinopodium,* are embedded in the skin while soft; the surface is then shaved down and soaked in water, when the edges of the indentations swell up. The leather is then dyed, green being a favourite colour. Shagreen is now commonly made of the skins of sharks and rays; the placoid scales of the shark skin giving the necessary roughened surface. Shagreen is used as an ornamental leather for making pocket-books, small cases and the like, and for the handles of swords, daggers, etc.

SHAHABAD, a district of British India, in the Patna division of Bihar and Orissa; area, 4,373 sq.m.; pop. (1921) 1,816,821. To the north is an alluvial flat constituting about three-fourths of the district, closely cultivated and thickly populated. The southern portion is occupied by the Kaimur hills, a branch of the great Vindhyan range. These hills consist of an undulating plateau largely covered with jungle, about 800 sq.m. in area; at Rohtasgarh they attain a height of 1,490 ft. above sea-level. The chief rivers are the Ganges and the Son, which unite in the north-eastern corner of Shahabad, and the Karamnasa, which divides it from the United Provinces. The chief crops are rice, millets, wheat, pulses, oilseeds, and sugar-cane. Shahabad is protected against drought by a system of canals which obtains its supply of water from the Son at Dehri, where a weir or *anicut,* 2½ m. long, has been built across the broad bed of the river; the irrigated area averages about 500,000 acres. The district is traversed by the main line of the East Indian railway, by the Grand Chord line which crosses the Son at Dehri-on-Son, and by two light railways, one connecting Arrah and Sasaram, the other Dehri and Rohtasgarh. The northern part of Shahabad is known as Bhojpur, which has given its name to a dialect of the Bihari language. Its inhabitants, the Bhojpuri, were formerly notorious for turbulence and predatory habits. Before 1857 they were recruited largely for the army, and during the Mutiny they broke out into a rebellion which was not put down till the end of 1858. There was an outbreak of lawlessness among the Hindus of this area in 1917, when they attacked their Mohammedan neighbours, pillaged 139 villages and were only checked by the use of military force. The administrative headquarters are at Arrah.

SHAH ALAM (1728–1806), Mogul emperor of Delhi, son of Alamgir II., was born on June 15, 1728, and was originally known as the Shahzada Ali Gohar. Being proclaimed a rebel by his father, he fled to Shuja-ud-Dowlah, wazir of Oudh, and on the death of his father in 1759 assumed the name of Shah Alam. He joined Shuja-ud-Dowlah against the British, but after his defeat at the battle of Buxar, he sought British protection. In 1765 he granted the *diwani* (superintendence of the revenue) of Bengal to Lord Clive for the East India Company in return for a payment of 26 lakhs a year. In 1771 he fell into the power of the Mahrattas, was installed emperor of Delhi, and lost the British subsidy. In 1788 the Rohilla chief Ghulam Kadir seized Delhi and put out Shah Alam's eyes. Sindhia restored him to the throne, and after the Mahratta war of 1803 he was again taken under British protection. He died on Nov. 10, 1806. (*See* also INDIA: *History.*)

See W. Francklin, *History of the Reign of Shah Alam* (Calcutta, 1798).

SHAH JAHAN (*fl.* 1627–1658), Mogul emperor of Delhi, the fifth of the dynasty. After revolting against his father Jahangir, as the latter had revolted against Akbar, he succeeded to the throne on his father's death in 1627. It was during his reign that the Mogul power attained its greatest prosperity. The chief events of his reign were the destruction of the kingdom of Ahmadnagar (1636), the loss of Kandahar to the Persians (1653), and a second war against the Deccan princes (1655). In 1658 he fell ill, and was confined by his son Aurangzeb in the citadel of Agra until his death in 1666. The period of his reign was the golden age of Indian architecture. Shah Jahan erected many splendid monuments, the most famous of which is the Taj Mahal at Agra, built as a tomb for his wife Mumtaz Mahal; while the Pearl Mosque at Agra and the palace and great mosque at Delhi also commemorate him. The celebrated "Peacock Throne," said

to have been worth £6,000,000, also dates from his reign; and he was the founder of the modern city of Delhi, the native name of which is Shahjahanabad.

SHAHJAHANPUR, a city and district of British India, in the Bareilly division of the United Provinces. The city is on the left bank of the river Deoha, and is a military cantonment. Pop. (1921), 72,616. It was founded in 1647 during the reign of Shah Jahan, whose name it bears, by Nawab Bahadur Khan, a Pathan. His mosque is the only building of antiquarian interest.

The District of Shahjahanpur has an area of 1,726 sq.m. It consists of a long and narrow tract running up from the Ganges towards the Himalayas, and is for the most part level. The principal rivers are the Gumti, Khanaut, Garai and Ramganga. To the north-east waste and forest preponderate over cultivated land. Between the Gumti and the Khanaut the country varies from a rather wild and unhealthy northern region to a densely inhabited tract in the south, with a productive soil cultivated with sugar-cane and other remunerative crops. From the Ramganga to the Ganges in the south is a continuous low country of marshy patches, alternating with a hard clayey soil that requires much irrigation in parts. In 1921 the population was 839,115.

Shahjahanpur was ceded to the English by the nawab of Oudh in 1801.

SHA-HO, BATTLE OF THE. This was the second of the three great battles which marked the main advance of the Japanese armies in Manchuria during the Russo-Japanese War, and is described under that heading. It was the only one in which the Russians succeeded in taking the offensive. The real battle was joined on Oct. 11, 1904, and ended on the 13th, with Kuropatkin's suspension of the Russian offensive, but fighting continued until the 18th as the Russians were first pressed back, then attempted a fresh offensive, and abandoned their effort after heavy losses.

SHAHPUR, a town and district of British India, in the Punjab. The town is near the left bank of the river Jhelum. The district of Shahpur has an area of 4,476 sq.m. Its most important physical subdivisions are the Salt range in the north, the valleys of the Chenab and Jhelum, and the plains between those rivers and between the Jhelum and the Salt range. In 1921 the population was 719,918. The chief commercial centre is Bhera. The district is traversed by two branches of the North-Western railway.

Shahpur passed into the hands of the English along with the rest of the Punjab in 1849. Since the introduction of irrigation from the Lower Jhelum Canal in 1901 the character of the district south of the Jhelum has entirely altered and the headquarters of the district has been transferred to the Colony town of Sargodha (pop. 17,728).

SHAH SHUJA (1780?–1842), king of Afghanistan, was the son of Timur Shah, and grandson of Ahmad Shah, founder of the Durani dynasty. After conspiracies that caused the dethronement of two brothers, Taman Shah and Mahmud Shah, he became king in 1803. He was, however, in his turn driven out of Afghanistan in 1809 by Mahmud Shah, and found refuge and a pension in British territory. Distrusting the attitude of the Amir Dost Mahommed towards Russia, Lord Auckland in 1839 attempted to restore Shah Shuja to the throne against the wishes of the Afghan people. This policy led to the disastrous first Afghan War. After the retreat of the British troops from Kabul, Shah Shuja shut himself up in the Bala Hissar. He left this retreat on April 5, 1842, and was immediately killed by the adherents of Dost Mahommed and his son Akbar Khan.

SHAIKIA: *see* Arabs.

SHAKERS, an American celibate and communistic sect, known as "The United Society of Believers in Christ's Second Appearing" and as "The Millennial Church." Some of the leaders prefer the name "Alethians," for they consider themselves children of the truth. The society had its beginning in a Quaker revival in England (1747) which resulted in the organization of a sect of which Jane and James Wardley were the leaders. They were succeeded by Ann Lee. The distinctive merit of celibacy became an original tenet of the Shakers in England. They did not prohibit marriage but refused to accept it as a Christian institution and considered it less perfect than the celibate state.

Under stress of persecution and in response to a revelation, "Mother" Ann led a band of six men and two women to America. They arrived in New York city on Aug. 6, 1774, and after two years' stay there, settled in the woods of Watervliet, not far from Albany, N.Y. In 1780 there was a religious revival in New Lebanon, N.Y., and some of the converts became disciples of Ann Lee. At this place, in 1787, the first Shaker society in the United States was organized; the society at Watervliet organized immediately afterwards. Ann Lee went from place to place preaching her new doctrine and became known as a faith-healer. At the time of her death (1784) she had disciples in New York, Massachusetts and Connecticut.

A group of Shakers came out of the Kentucky revival of 1800–02. The community at Mount Lebanon, N.Y. sent three of their number to Kentucky to bear witness to the people. Though at first bitterly opposed, these Shaker preachers made a sufficient number of converts to found five societies, "two in Ohio, two in Kentucky and one in Indiana." In 1894 the Mount Lebanon Society, N.Y., founded a colony at Narcoosee, Fla., called the Union Village Society. In 1910 it went into the hands of a receiver.

The Shakers held that God was both male and female, that Adam, having been created in the image of God, had in him the nature of both sexes, that even angels and spirits are both male and female. Christ, they believe, was one of the superior spirits and appeared in Jesus, the son of a Jewish carpenter, representing the male principle. In Mother Ann, daughter of an English blacksmith, the female principle in Christ was manifested, and in her the promise of the Second Coming was fulfilled. Christ's kingdom on earth began with the establishment of the Shaker Church.

The practical ideals of the community are the common possession of property, a life of celibacy, confession of sin, without which no one can become a member of the community, power over physical disease, and separation from the world. Disease they regard as a sin against God. Their separateness from the world is indicated by their manner of living in families of 30 to 90 individuals. Each family has its own house, the storeys being divided between the men and women. They make no room for adornments in the way of pictures or other works of art. In their prescribed mode of dress for men and women, they also protest against the fashions of a vain world. For a time they made their own clothing and wove their own cloth. They made leather in New York for several years; but were more successful in selling herbs and garden seeds, and in making apple sauce, weaving linen and knitting underwear. Many of them, however, considered it a mistake to have left agriculture and entered into manufacturing.

In 1874 there were 58 Shaker communities with 2,415 souls, owning 100,000 ac. of land; in 1905 the membership was reduced to about 1,000.

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SHAKESPEARE, WILLIAM (1564–1616), English poet, player and playwright, was baptized in the parish church of Stratford-on-Avon in Warwickshire on April 26, 1564. The exact date of his birth is not known. Two 18th-century antiquaries, William Oldys and Joseph Greene, gave it as April 23, but without quoting authority for their statements, and the fact that April 23 was the day of Shakespeare's death in 1616 suggests a possible source of error. In any case his birthday cannot have been later than April 23, since the inscription upon his monument is evidence that on April 23, 1616, he had already begun his 53rd year. His father, John Shakespeare, was a burgess of the recently constituted corporation of Stratford, and had already filled certain

minor municipal offices. From 1561 to 1563 he had been one of the two chamberlains to whom the finance of the town was entrusted. Aubrey (1681) called him a butcher and Rowe (1709) a wool-dealer, but it is clear from formal documents that by occupation he was a glover, although he appears to have dealt from time to time in various kinds of agricultural produce, such as barley, timber and wool. He is also described as a yeoman, and it is possible that he combined a certain amount of farming with the practice of his trade. He was living in Stratford as early as 1552, in which year he was fined for having a dunghill in Henley street, but he does not appear to have been a native of the town, in whose records the name is not found before his time; and he may reasonably be identified with a John Shakespeare of Snitterfield, who administered the goods of his father, Richard Shakespeare, in 1561. Snitterfield is a village in the immediate neighbourhood of Stratford, and here Richard Shakespeare had been settled as a farmer since 1529. He may have come from Hampton Corley in Budbrooke, where a Richard Shakespeare is on the subsidy roll for 1525. It is probable that John Shakespeare carried on the farm for some time after his father's death, and possible that by 1570 he had acquired a small holding called Ingon in Hampton Lucy. But the Snitterfield farm seems to have passed subsequently to his brother Henry, who was buried there in 1596. There were also at Snitterfield a Thomas Shakespeare and an Anthony Shakespeare, who seems to have moved to Hampton Corley; and these may have been of the same family. A John Shakespeare, who dwelt at Clifford Chambers, another village close to Stratford, is clearly distinct. Strenuous efforts have been made to trace Shakespeare's genealogy beyond Richard of Snitterfield, but so far without success. Certain drafts of heraldic grants of the Shakespeare arms speak, in one case of John Shakespeare's grandfather, in another of his great-grandfather, as having been rewarded with lands and tenements in Warwickshire for service to Henry VII. No such grants, however, have been traced, and even in the 16th century statements as to "antiquity and service" in heraldic preambles were looked upon with suspicion.

The name Shakespeare is extremely widespread, and is spelt in an astonishing variety of ways. The verdict of competent palaeographers is to the effect that Shakespeare himself, in the extant examples of his signature, generally wrote "Shakspere" in full or in an abbreviated form, but possibly, in the main signature to his will, "Shakspeare." In the printed signatures to the dedications of his poems, on the title-pages of nearly all the contemporary editions of his plays that bear his name, and in many formal documents it appears as Shakespeare. This may be in part due to the martial derivation which the poet's literary contemporaries were fond of assigning to his name, and which is acknowledged in the arms that he bore. Certain forms often used at Stratford, however, such as Shaxpere and Schackspere, suggest a short pronunciation of the first syllable, and thus tend to support Dr. Henry Bradley's derivation from the Anglo-Saxon personal name, Seaxberht. It is interesting, and even amusing, to record that in 1487 Hugh Shakspere of Merton college, Oxford, changed his name to Sawndare, because his former name *vile reputatum est.* The earliest record of a Shakespeare that has yet been traced is in 1248 at Clapton in Gloucestershire. The name also occurs during the 13th century in Kent, Essex and Surrey, and during the 14th in Cumberland, Yorkshire, Cheshire, Nottinghamshire, Essex, Warwickshire and as far away as Youghal in Ireland. Thereafter it is found in London and most of the English counties, particularly those of the midlands; and nowhere more freely than in Warwickshire. There were Shakespeares in Warwick and in Coventry, as well as around Stratford; and the clan appears to have been very numerous in a group of villages about 12 miles north of Stratford, which includes Baddesley Clinton, Wroxall, Rowington, Haseley, Hatton, Lapworth, Packwood, Balsall and Knowle. William was in common use as a personal name, and Williams from more than one other family have from time to time been confounded with the dramatist. Many Shakespeares are upon the register of the gild of St. Anne at Knowle from about 1457 to about 1526. Amongst these were Isabella Shakespeare, prioress of the Benedictine convent of Wroxall, and Jane Shakespeare, a nun of the same convent. Shakespeares are also found as tenants on the manors belonging to the convent, and at the time of the Dissolution in 1534 one Richard Shakespeare was its bailiff and collector of rents. Conjectural attempts have been made on the one hand to connect the ancestors of this Richard Shakespeare with a family of the same name who held land by military tenure at Baddesley Clinton in the 14th and 15th centuries, and on the other to identify him with the poet's grandfather, Richard Shakespeare of Snitterfield. But Shakespeares are to be traced at Wroxall nearly as far back as at Baddesley Clinton, and Richard the bailiff seems to have retired to a farm at Haseley, which he had held since 1523. Probably he died there about 1558. It is not likely that he had also since 1529 been farming land at Snitterfield.

With the breaking of this link, the hope of giving Shakespeare anything more than a grandfather on the father's side must be laid aside for the present. On the mother's side he was connected with a family of some distinction. Part at least of Richard Shakespeare's land at Snitterfield was held from Robert Arden of Wilmcote in the adjoining parish of Aston Cantlow, probably a cadet of the Ardens of Parkhall, who counted amongst the leading gentry of Warwickshire. Robert Arden married his second wife, Agnes Hill, formerly Webbe, in 1548, and had then no less than eight daughters by his first wife. To the youngest of these, Mary Arden, he left in 1556 a freehold in Aston Cantlow consisting of a farm of about 50 or 60 acres in extent, known as Asbies. It is possible that he had already settled upon her other property in Wilmcote. At some date later than Nov. 1556, and probably before the end of 1557, Mary Arden became the wife of John Shakespeare. In Oct. 1556 John Shakespeare had bought two freehold houses, one in Greenhill street, the other in Henley street. The latter, known as the wool shop, was the easternmost of the two tenements now combined in the so-called Shakespeare's birthplace. The western tenement, locally regarded as the birthplace proper, may have been already in John Shakespeare's hands, as he seems to have been living in Henley street in 1552. It has sometimes been thought to have been one of two houses which formed a later purchase in 1575, but there is no evidence that these were in Henley street at all.

William Shakespeare was not the first child. A Joan was baptized in 1558 and a Margaret in 1562. The latter was buried in 1563 and the former must also have died young, although her burial is not recorded, as a second Joan was baptized in 1569. A Gilbert was baptized in 1566, an Anne in 1571, a Richard in 1574 and an Edmund in 1580. Anne died in 1579; Edmund, who, like his brother, became an actor, in 1607; Gilbert in 1612; Richard in 1613. Tradition has it that a relative of Shakespeare's used to visit London in the 17th century as quite an old man. One form of this makes him a brother, which is impossible.

During the years that followed his marriage, John Shakespeare became prominent in Stratford life. In 1565 he was chosen as an alderman, and in 1568 he held the chief municipal office, that of high bailiff. This carried with it the dignity of justice of the peace. John Shakespeare seems to have contemplated the assumption of arms, and usually appears in corporation documents as "Mr." Shakespeare, whereby he may be distinguished from another John Shakespeare, a "corviser" or shoemaker, who dwelt in Stratford about 1586–92. In 1571 as an ex-bailiff he began another year of office as chief alderman.

One may think, therefore, of Shakespeare in his boyhood as the son of one of the leading citizens of a not unimportant provincial market-town, with a vigorous life of its own, which, in spite of the dunghills, was probably not much unlike the life of a similar town to-day, and with constant reminders of its past in the shape of the stately buildings formerly belonging to its college and its gild, both of which had been suppressed at the Reformation. Stratford stands on the Avon, in the midst of an agricultural country, throughout which in those days enclosed orchards and meadows alternated with open fields for tillage, and not far from the wilder and wooded district known as the Forest of Arden. The middle ages had left it an heritage in the shape of a

free grammar-school, and here it is natural to suppose that William Shakespeare obtained a sound enough education, with a working knowledge of "Mantuan" and Ovid in the original, even though to such a thorough scholar as Ben Jonson it might seem no more than "small Latin and less Greek." In 1577, when Shakespeare was about 13, his father's fortunes began to take a turn for the worse. He became irregular in his contributions to town levies, and had to give a mortgage on property of his wife at Wilmcote as security for a loan from her brother-in-law, Edmund Lambert. Money was raised to pay this off, partly by the sale of a small interest in land at Snitterfield which had come to Mary Shakespeare from her sisters, partly perhaps by that of the Greenhill street house and other property in Stratford outside Henley street, none of which seems to have ever come into William Shakespeare's hands. Lambert, however, refused to surrender the mortgage on the plea of older debts, and an attempt to recover the Wilmcote property by litigation proved ineffectual. John Shakespeare's difficulties increased. He had long ceased to attend the meetings of the corporation, and as a consequence he was removed in 1586 from the list of aldermen. In this state of domestic affairs it is not likely that Shakespeare's school life was unduly prolonged. The chances are that he was apprenticed to some local trade. Aubrey says that he killed calves for his father, and "would do it in a high style, and make a speech."

Marriage.—Whatever his circumstances, they did not deter him at the early age of 18 from the adventure of marriage. Rowe recorded the name of Shakespeare's wife as Hathaway, and Joseph Greene succeeded in tracing her to a family of that name dwelling in Shottery, one of the hamlets of Stratford. Her monument gives her first name as Anne, and her age as 67 in 1623. She must, therefore, have been about eight years older than Shakespeare. Various small trains of evidence point to her identification with the daughter Agnes mentioned in the will of a Richard Hathaway of Shottery, who died in 1581, being then in possession of the farmhouse now known as "Anne Hathaway's Cottage." Agnes was legally a distinct name from Anne, but there can be no doubt that ordinary custom treated them as identical. The principal record of the marriage is a bond dated Nov. 28, 1582, and executed by Fulk Sandells and John Richardson, two yeomen of Stratford who also figure in Richard Hathaway's will, as a security to the bishop for the issue of a licence for the marriage of William Shakespeare and "Anne Hathwey of Stratford," upon the consent of her friends, with one asking of the banns. There is no reason to suppose, as has been suggested, that the procedure adopted was due to dislike of the marriage on the part of John Shakespeare, since, the bridegroom being a minor, it would not have been in accordance with the practice of the bishop's officials to issue the licence without evidence of the father's consent. The explanation probably lies in the fact that Anne was already with child, and in the near neighbourhood of Advent, within which marriages were prohibited, so that the ordinary procedure by banns would have entailed a delay until after Christmas. A kindly sentiment has suggested that some form of civil marriage, or at least contract of espousals, had already taken place, so that a canonical marriage was really only required in order to enable Anne to secure the legacy left her by her father "at the day of her marriage." But such a theory is not rigidly required by the facts. It is singular that, upon the day before that on which the bond was executed, an entry was made in the bishop's register of the issue of a licence for a marriage between William Shakespeare and "Annam Whateley de Temple Grafton." Of this it can only be said that the bond, as an original document, is infinitely the better authority, and that a scribal error of "Whateley" for "Hathaway" is quite a possible solution. Temple Grafton may have been indicated in the licence as the place of marriage, although Worcester licences usually named the place of residence of the bride. There are no contemporary registers for Temple Grafton, and there is no entry of the marriage in those for Stratford-on-Avon. There is a tradition that such a record was seen during the 19th century in the registers for Luddington, a chapelry within the parish, which are now destroyed. Shakespeare's first child, Susanna, was baptized on May 26, 1583, and was followed on Feb. 2, 1585, by twins, Hamnet and Judith.

Departure from Stratford.—In or after 1584 Shakespeare's career in Stratford seems to have come to a tempestuous close. An 18th century story of a drinking-bout in a neighbouring village is of no importance, except as indicating a local impression that a distinguished citizen had had a wildish youth. But there is a tradition which comes from a double source and which there is no reason to reject in substance, to the effect that Shakespeare got into trouble through poaching on the estates of a considerable Warwickshire magnate, Sir Thomas Lucy, and found it necessary to leave Stratford in order to escape the results of his misdemeanour. It is added that he afterwards took his revenge on Lucy by satirizing him as the Justice Shallow, with the dozen white louses in his old coat, of *The Merry Wives of Windsor*. From this event until he emerges as an actor and rising playwright in 1592 his history is a blank, and it is impossible to say what experience may not have helped to fill it. Much might indeed be done in eight years of crowded Elizabethan life. Conjecture has not been idle, and has assigned him in turns during this or some other period to the occupations of a scrivener, an apothecary, a dyer, a printer, a soldier and the like. The suggestion that he saw military service rests largely on a confusion with another William Shakespeare of Rowington. Aubrey had heard that "he had been in his younger years a schoolmaster in the country." The mention in *Henry IV.* of certain obscure yeomen families, Visor of Woncote and Perkes of Stinchcombe Hill, near Dursley in Gloucestershire, has been thought to suggest a sojourn in that district, where indeed Shakespeares were to be found from an early date. Ultimately, of course, he drifted to London and the theatre, where, according to the stage tradition, he found employment in a menial capacity, perhaps even as a holder of horses at the doors, before he was admitted into a company as an actor and so found his way to his true vocation as a writer of plays. Malone thought that he might have left Stratford with one of the travelling companies of players which from time to time visited the town. Later biographers have fixed upon Leicester's men, who were at Stratford in 1586–87, and have held that Shakespeare remained to the end in the same company, passing with it on Leicester's death in 1588 under the patronage of Ferdinando, Lord Strange and afterwards earl of Derby, and on Derby's death in 1594 under that of the lord chamberlain, Henry Carey, Lord Hunsdon. This theory hardly takes sufficient account of the shifting combinations and recombinations of actors, especially during the disastrous plague years of 1592 to 1594. It is not possible to establish a continuity between Strange's company and Leicester's, and while the names of many members of Strange's company in and about 1593 are on record, Shakespeare's is not amongst them. It is at least possible, as will be seen later, that he had about this time relations with the earl of Pembroke's men, or with the earl of Sussex's men, or with both of these organizations.

Earliest Writings.—What is clear is that by the summer of 1592, when he was 28, he had begun to emerge as a playwright, and had evoked the jealousy of one at least of the group of scholar poets who in recent years had claimed a monopoly of the stage. This was Robert Greene, who, in an invective on behalf of the play-makers against the play-actors which forms part of his *Groats-worth of Wit,* speaks of "an upstart Crow, beautified with our feathers, that with his *Tygers heart wrapt in a Players hide,* supposes he is as well able to bumbast out a blank verse as the best of you: and being an absolute *Iohannes fac totum,* is in his owne conceit the onely Shake-scene in a countrie." The play upon Shakespeare's name and the parody of a line from *Henry VI.* make the reference unmistakable. The London theatres were closed first through riots and then through plague, from June 1592 to April 1594, with the exception of about a month at each Christmas during that period; and the companies were dissolved or driven to the provinces. Even if Shakespeare had been connected with Strange's men during their London seasons of 1592 and 1593, it does not seem that he travelled with them. Other activities may have been sufficient to occupy the interval. The most important of these was probably an attempt to win

a reputation in the world of non-dramatic poetry. *Venus and Adonis* was published about April 1593, and *Lucrece* about May 1594. The poems were printed by Richard Field, in whom Shakespeare would have found an old Stratford acquaintance; and each has a dedication to Henry Wriothesley, earl of Southampton, a brilliant and accomplished favourite of the court, still in his nonage. A possibly super-subtle criticism discerns an increased warmth in the tone of the later dedication, which is supposed to argue a marked growth of intimacy. The fact of this intimacy is vouched for by the story handed down from Sir William Davenant to Rowe (who published in 1709 the first regular biography of Shakespeare) that Southampton gave Shakespeare £1,000 "to enable him to go through with a purchase which he heard he had a mind to." The date of this generosity is not specified, and there is no known purchase by Shakespeare which can have cost anything like the sum named. The mention of Southampton leads naturally to the most difficult problem which a biographer has to handle, that of the *Sonnets*. But this will be more conveniently taken up at a later point, and it is only necessary here to put on record the probability that the earliest of the sonnets belong to the period now under discussion. There is a surmise, which is not in itself other than plausible, and which has certainly been supported with a good deal of ingenious argument, that Shakespeare's enforced leisure enabled him to make of 1593 a *Wanderjahr,* and in particular that the traces of a visit to northern Italy may be seen in the local colouring of *Lucrece* as compared with *Venus and Adonis,* and in that of the group of plays which may be dated in or about 1594 and 1595 as compared with those that preceded. It must, however, be borne in mind that, while Shakespeare may perfectly well, at this or at some earlier time, have voyaged to Italy, and possibly Denmark and even Germany as well, there is no direct evidence to rely upon, and that inference from internal evidence is a dangerous guide when a writer of so assimilative a temperament as that of Shakespeare is concerned.

Connection with the Chamberlain's Company of Actors.—From the reopening of the theatres in the summer of 1594 onwards Shakespeare's status is in many ways clearer. He had certainly become a leading member of the Chamberlain's company by the following winter, when his name appears for the first and only time in the treasurer of the chamber's accounts as one of the recipients of payment for their performances at court; and there is every reason to suppose that he continued to act with and write for the same associates to the close of his career. The history of the company may be briefly told. At the death of the lord chamberlain on July 22, 1596, it passed under the protection of his successor, George, 2nd Lord Hunsdon, and once more became "the Lord Chamberlain's men" when he was appointed to that office on March 17, 1597. James I. on his accession took this company under his patronage as grooms of the chamber, and during the remainder of Shakespeare's connection with the stage they were "the King's men." The records of performances at court show that they were by far the most favoured of the companies, their nearest rivals being the company known during the reign of Elizabeth as "the Admiral's," and afterwards as "Prince Henry's men." From the summer of 1594 to March 1603 they appear to have played almost continuously in London, although they undertook a provincial tour during the autumn of 1597, when the London theatres were for a short time closed owing to the interference of some of the players in politics. They travelled again during 1603 when the plague was in London, and during at any rate portions of the summers or autumns of most years thereafter. In 1594 they were playing at Newington Butts, and probably afterwards at the Cross Keys in the city. It is natural to suppose that in later years they used the Theatre in Shoreditch, since this was the property of James Burbadge, the father of their principal actor, Richard Burbadge. The Theatre was pulled down in 1598, and, after a short interval during which the company may have played at the Curtain, also in Shoreditch, Richard Burbadge and his brother Cuthbert rehoused them in the Globe on Bankside, built in part out of the materials of the Theatre. Here the profits of the enterprise were divided between the members of the company as such and the owners of the building as "housekeepers," and shares in the "house" were held by Shakespeare and some of his leading "fellows." About 1608 another playhouse became available for the company in the "private" or winter house of the Blackfriars. This was also the property of the Burbadges, but had previously been leased to a company of boy players. A somewhat similar arrangement as to profits was made.

Shakespeare is reported by Aubrey to have been a good actor, but Adam in *As You Like It,* and the Ghost in *Hamlet* indicate the type of part which he played. As a dramatist, however, he was the mainstay of the company for at least some 15 years, during which Ben Jonson, Dekker, Beaumont and Fletcher, and Tourneur also contributed to their repertory. On an average he must have written for them about two plays a year, although his rapidity of production seems to have been greatest during the opening years of the period. He sometimes took his plots from earlier plays, but any theory which represents him as largely a "patcher" of the work of other men, or of his own, is open to grave doubt. Similarly, while the texts of his plays contain some theatrical interpolations, there is no reason to suppose that they were substantially revised by other hands before the Restoration. Occasionally he may have entered into collaboration, as, for example, at the end of his career, with Fletcher.

Stratford Affairs.—In a worldly sense he clearly flourished, and about 1596, if not earlier, he was able to resume relations as a moneyed man with Stratford-on-Avon. There is no evidence to show whether he had visited the town in the interval, or whether he had brought his wife and family to London. His son Hamnet died and was buried at Stratford in 1596. During the last ten years John Shakespeare's affairs had remained unprosperous. He incurred debts, partly through becoming surety for his brother Henry; and in 1592 his name was included in a list of recusants dwelling at or near Stratford-on-Avon, with a note by the commissioners that in his case the cause was believed to be the fear of process for debt. There is no reason to doubt this explanation, or to seek a religious motive in John Shakespeare's abstinence from church. William Shakespeare's purse must have made a considerable difference. The prosecutions for debt ceased, and in 1597 a fresh action was brought in Chancery for the recovery of the Wilmcote property from the Lamberts. Like the last, it seems to have been without result. Another step was taken to secure the dignity of the family by an application in the course of 1596 to the heralds for the confirmation of a coat of arms said to have been granted to John Shakespeare while he was bailiff of Stratford. The bearings were *or* on a bend *sable* a spear *or* steeled *argent,* the crest a falcon his wings displayed *argent* supporting a spear *or* steeled *argent,* and the motto *Non sanz droict.* The grant was duly made, and in 1599 there was a further application for leave to impale the arms of Arden, in right of Shakespeare's mother. No use, however, of the Arden arms by the Shakespeares can be traced. In 1597 Shakespeare made an important purchase for £60 of the house and gardens of New Place in Chapel street. This was one of the largest houses in Stratford, and its acquisition an obvious triumph for the ex-poacher. Presumably John Shakespeare ended his days in peace. A visitor to his shop remembered him as "a merry-cheekt old man" always ready to crack a jest with his son. He died in 1601, and his wife in 1608, and the Henley street houses passed to Shakespeare. Aubrey records that he paid annual visits to Stratford, and there is evidence that he kept in touch with the life of the place. The correspondence of his neighbours, the Quineys, in 1598 contains an application to him for a loan to Richard Quiney upon a visit to London, and a discussion of possible investments for him in the neighbourhood of Stratford. In 1602 he took, at a rent of 2s. 6d. a year, a copyhold cottage in Chapel lane, perhaps for the use of his gardener. In the same year he invested £320 in the purchase of an estate consisting of 107 acres in the open fields of Old Stratford, together with 20 acres of pasture and common rights; and in 1605 he spent another £440 in the outstanding term of a lease of certain tithes in Stratford parish, which brought in an income of about £60 a year.

London Associations.—Meanwhile London remained his headquarters. Here Malone thought that he had evidence, now lost, of his residence in Southwark as early as 1596, and as late as 1608. It is known that payments of subsidy were due from him in 1597 and 1599 in the parish of St. Helen's, Bishopsgate, and that an arrear was ultimately collected in the liberty of the Clink. He had no doubt migrated from Bishopsgate when the Globe upon Bankside was opened by the Chamberlain's men. There is evidence that about 1604 he "lay," temporarily or permanently, in the house of Christopher Mountjoy, a tire-maker of French extraction, at the corner of Silver street and Monkwell street in Cripplegate. A note by Aubrey, if it really refers to Shakespeare (which is almost certain), is of value as throwing light not only upon his abode, but upon his personality. Aubrey seems to have derived it from William Beeston the actor. It is as follows: "The more to be admired q[uod] he was not a company keeper, lived in Shoreditch, wouldn't be debauched, & if invited to court; he was in paine." Against this testimony to the correctness of Shakespeare's morals are to be placed an anecdote of a tiring-house amour picked up by a Middle Temple student in 1602 and a Restoration scandal which made him the father by the hostess of the Crown tavern at Oxford, where he baited on his visits to Stratford, of Sir William Davenant, who was born in Feb. 1606. His credit at court is implied by Ben Jonson's references to his flights "that so did take Eliza and our James," and by stories of the origin of *The Merry Wives of Windsor* in Elizabeth's desire to see Falstaff in love, and of an autograph letter written to honour him by King James. It was noticed with some surprise by Henry Chettle that his "honied muse" dropped no "sable tear" to celebrate the death of the queen. Southampton's patronage may have introduced him to the brilliant circle that gathered round the earl of Essex, but there is no reason to suppose that he or his company were held personally responsible for the performance of *Richard II.* at the command of some of the followers of Essex as a prelude to the disastrous rising of Feb. 1601. The editors of the First Folio speak also of favours received by the author in his lifetime from William Herbert, earl of Pembroke, and his brother Philip Herbert, earl of Montgomery.

He appears to have been on cordial terms with his fellows of the stage. One of them, Augustine Phillips, left him a small legacy in 1605, and in his own will he paid a similar compliment to Richard Burbadge, and to John Heminge and Henry Condell, who afterwards edited his plays. His relations with Ben Jonson, whom he is said by Rowe to have introduced to the world as a playwright, have been much canvassed. Jests are preserved which, even if apocryphal, indicate considerable intimacy between the two. This is not inconsistent with occasional passages of arms. The anonymous author of *The Return from Parnassus* (2nd part: 1602), for example, makes Kempe, the actor, allude to a "purge" which Shakespeare gave Jonson, in return for his attack on some of his rivals in *The Poetaster.*[1] It has been conjectured that this purge was the description of Ajax and his humours in *Troilus and Cressida.* Jonson, on the other hand, who was criticism incarnate, did not spare Shakespeare either in his prologues or in his private conversation. He told Drummond of Hawthornden that "Shaksperr wanted arte." But the verses which he contributed to the First Folio are generous enough to make all amends, and in his *Discoveries* (1623–37), while regretting Shakespeare's excessive facility and the fact that he often "fell into those things, could not escape laughter," he declares him to have been "honest and of an open, and free nature," and says that, for his own part, "I lov'd the man and do honour his memory (on this side idolatry) as much as any." According to a memorandum-book (1661–63) of the Rev. John Ward (who became vicar of Stratford in 1662), Jonson and Michael Drayton, himself a Warwickshire poet, had been drinking with Shakespeare when he caught the fever of which he died; and Thomas Fuller (1608–61), whose *Worthies* was published in 1662, gives an imaginative description of the wit combats, of which many took place between the two mighty contemporaries.

[1]Kempe (speaking to Burbadge), "Few of the university men pen plays well. They smell too much of that writer Ovid and that writer (*sic*) Metamorphosis, and talk too much of Proserpina and Jupiter. Why here's our fellow Shakespeare puts them all down; aye, and Ben Jonson too. O that Ben Jonson is a pestilent fellow. He brought up Horace giving the Poets a pill, but our fellow Shakespeare hath given him a purge that made him beray his credit."

Contemporary Reputation.—Of Shakespeare's literary reputation during his lifetime there is ample evidence. He is probably neither the "Willy" of Spenser's *Tears of the Muses,* nor the "Aetion" of his *Colin Clout's Come Home Again.* But from the time of the publication of *Venus and Adonis* and *Lucrece* honorific allusions to his work both as poet and dramatist, and often to himself by name, come thick and fast from writers of every kind and degree. Perhaps the most interesting of these from the biographical point of view are those contained in the *Palladis Tamia,* a kind of literary handbook published by Francis Meres in 1598; for Meres not only extols him as "the most excellent in both kinds (*i.e.,* comedy and tragedy) for the state," and one of "the most passionate among us to bewaile and bemoane the perplexities of Love," but also takes the trouble to give a list of 12 plays already written, which serves as a starting-point for all modern attempts at a chronological arrangement of his work. It is moreover from Meres that we first hear of "his sugred sonnets among his private friends." Two of these sonnets were printed in 1599 in a volume of miscellaneous verse called *The Passionate Pilgrim.* This was ascribed upon the title-page to Shakespeare, but probably, so far as most of its contents were concerned, without justification. The bulk of Shakespeare's sonnets remained unpublished until 1609.

About 1610 Shakespeare seems to have left London, and entered upon the definite occupation of his house at New Place, Stratford. Here he lived the life of a retired gentleman, on friendly if satirical terms with the richest of his neighbours, the Combes, and interested in local affairs, such as a bill for the improvement of the highways in 1611, or a proposed enclosure of the open fields at Welcombe in 1614, which might affect his income or his comfort. He had his garden with its mulberry tree, and his farm in the immediate neighbourhood. His brothers Gilbert and Richard were still alive. His sister Joan had married William Hart, a hatter, and in 1616 was dwelling in one of his houses in Henley street. Of his daughters, the eldest, Susanna, had married in 1607 John Hall (d. 1635), a physician of some reputation. They dwelt in Stratford, and had one child, Elizabeth, born in 1608. The younger, Judith, married Thomas Quiney, a vintner, also of Stratford, two months before her father's death. At Stratford the last few of the plays may have been written, but it is reasonable to suppose that Shakespeare's connection with the king's company ended when the Globe was burnt down during a performance of *Henry VIII.* on June 29, 1613. Certainly his retirement did not imply an absolute break with London life. In 1613 he devised an *impresa,* or emblem, to be painted by Richard Burbadge, and worn in the tilt on Accession day by the earl of Rutland, who had been one of the old circle of Southampton and Essex. In the same year he purchased for £140 a freehold house in the Blackfriars, near the Wardrobe, once a gate-house to the lodging of the prior of Blackfriars. This was conveyed to trustees, apparently in order to bar the right which his widow would otherwise have had to dower. In 1615 this purchase involved Shakespeare in a lawsuit to obtain the surrender of the title-deeds. Richard Davis, a Gloucestershire clergyman of the end of the 17th century, reports that the poet "died a papist," and the statement deserves more attention than it has received from biographers. There is indeed little to corroborate it; for an alleged "spiritual testament" of John Shakespeare is of doubtful origin, and Davis's own words suggest a late conversion rather than an hereditary faith. On the other hand, there is little to refute it beyond an entry in the accounts of Stratford corporation for drink given in 1614 to "a preacher at the Newe Place."

Will.—Shakespeare made his will on March 25, 1616, apparently in some haste, as the executed deed is a draft with many erasures and interlineations. There were legacies to his daughter Judith Quiney and his sister Joan Hart, and remembrances to friends both in Warwickshire and in London; but the real estate was left to his daughter Susanna Hall under a strict entail which

points to a desire on the part of the testator to found a family. Shakespeare's wife, who had of course dower in most of the real estate, is only mentioned in an interlineation, by which the "second best bed with the furniture" was bequeathed to her. Much nonsense has been written about this, but it seems quite natural. The best bed was an important chattel, which would go with the house. The estate was after all not a large one. Aubrey's estimate of its annual value as £200 or £300 a year sounds reasonable enough, and John Ward's statement that Shakespeare spent £1,000 a year must surely be an exaggeration. The sum-total of his known investments amounts to £960. Sir Sidney Lee calculates that his theatrical income must have reached £600 a year, but this is a considerable overestimate; it can hardly have been more than about £200. It must be remembered that the purchasing value of money in the 17th century was many times greater than at present. Shakespeare's interest in the "houses" of the Globe and Blackfriars probably determined on or before his death.

A month after his will was signed, on April 23, 1616, Shakespeare died, and as a tithe-owner was buried in the chancel of the parish church. Some doggerel upon the stone that covers the grave has been assigned by local tradition to his own pen. A more elaborate monument, with a bust by the sculptor Gerard Johnson, was in due course set up on the chancel wall. Anne Shakespeare followed her husband on Aug. 6, 1623. The family was never founded. Shakespeare's granddaughter, Elizabeth Hall, made two childless marriages, the first with Thomas Nash of Stratford, the second with John, afterwards Sir John, Barnard of Abington Manor, Northants. His daughter Judith Quiney had three sons, all of whom had died unmarried by 1639. There were, therefore, no direct descendants of Shakespeare in existence after Lady Barnard's death in 1670. Those of his sister, Joan Hart, could, however, still be traced in 1864. On Lady Barnard's death the Henley street houses passed to the Harts, in whose family they remained until 1806. They were then sold, and in 1847 were bought for the public. They are now held with Anne Hathaway's Cottage at Shottery as the Birthplace Trust. Lady Barnard had disposed of the Blackfriars house. The rest of the property was sold under the terms of her will, and New Place passed, first to the Cloptons, who rebuilt it; then to the Rev. Francis Gastrell, who pulled it down in 1759. The site now forms a public recreation-ground, and hard by is a memorial building with a theatre (recently burnt, but to be replaced) in which performances of Shakespeare's plays are given annually in April. Both the Memorial and the Birthplace contain museums, in which books, documents and portraits of Shakespearian interest, together with relics of greater or less authenticity, are stored.

No letter or other writing in Shakespeare's hand can be proved to exist, with the exception of three signatures upon his will, one upon a deposition (May 11, 1612) in a lawsuit with which he was remotely concerned, and two upon deeds (March 10 and 11, 1613) in connection with the purchase of his Blackfriars house. A copy of Florio's translation of Montaigne (1603) in the British Museum, a copy of the Aldine edition of Ovid's *Metamorphoses* (1502) in the Bodleian, and a copy of the 1612 edition of Sir Thomas North's translation of Plutarch's *Lives of the Noble Grecians and Romaines* in the Greenock Library, have all been put forward with more or less plausibility as bearing his autograph name or initials, and, in the third case, a marginal note by him. Aubrey records that he was "a handsome, well-shap't man," and the lameness attributed to him by some writers has its origin only in a too literal interpretation of certain references to spiritual disabilities in the *Sonnets*.

The Plays.—A collection of *Mr. William Shakespeare's Comedies, Histories and Tragedies* was printed at the press of William and Isaac Jaggard, and issued by a group of booksellers in 1623. This volume is known as the First Folio. It has dedications to the earls of Pembroke and Montgomery, and to "the great Variety of Readers," both of which are signed by two of Shakespeare's "fellows" at the Globe, John Heminge and Henry Condell, and commendatory verses by Ben Jonson, Hugh Holland, Leonard Digges and an unidentified I.M. The Droeshout engraving forms part of the title-page. The contents include, with the exception of *Pericles,* all of the 37 plays now ordinarily printed in editions of Shakespeare's works. Of these 18 were here published for the first time. The other 18 had already appeared in one or more separate editions, known as the Quartos.

The following list gives the date of the First Quarto of each such play, and also that of any later Quarto which differs materially from the First.

The Quarto Editions

Titus Andronicus (1594).
2 Henry VI. (1594).
3 Henry VI. (1595).
Richard II. (1597, 1608).
Richard III. (1597).
Romeo and Juliet (1597, 1599).
Love's Labour's Lost (1598).
1 Henry IV. (1598).
2 Henry IV. (1600).
Henry V. (1600).
A Midsummer Night's Dream (1600).
The Merchant of Venice (1600).
Much Ado About Nothing (1600).
The Merry Wives of Windsor (1602).
Hamlet (1603, 1604).
King Lear (1608).
Troilus and Cressida (1609).
Othello (1622).

Entries in the *Register* of copyrights kept by the Company of Stationers indicate that editions of *As You Like It* and *Antony and Cleopatra* were contemplated but not published in 1600 and 1608 respectively.

The Quartos differ very much in character. Some of them contain texts which are practically identical with those of the First Folio; others show variations so material as to suggest that some alteration, generally by way of shortening for stage purposes, took place. A group of First Quartos, including *Romeo and Juliet, Henry V., The Merry Wives of Windsor* and *Hamlet,* are generally known as the "Bad" Quartos, and to these should possibly be added *King Lear,* and almost certainly 2, 3 *Henry VI.,* entitled in this form *The Contention betwixt the two Famous Houses of York and Lancaster.* These are mostly shortened versions. They are also textually corrupt, and have probably a "surreptitious" origin in "reports" of playhouse performances, printed without the consent of the theatrical companies who owned the plays. Some scholars have supposed that the reporting was done by shorthand, but in most cases a memorized reconstruction by an actor or prompter seems more likely. There are those who also believe that they represent "early versions" of the plays. A similar desire to exploit the commercial value of Shakespeare's reputation probably led to the appearance of his name or initials upon the title-pages of *Locrine* (1595), *Sir John Oldcastle* (1600), *Thomas Lord Cromwell* (1602), *The London Prodigal* (1605), *The Puritan* (1607), *A Yorkshire Tragedy* (1608) and *Pericles* (1609). It is not likely that, with the exception of the last three acts of *Pericles,* he wrote any part of these plays, some of which were not even produced by his company. They were not included in the First Folio of 1623, or in a reprint of it in 1632, known as the Second Folio; but all seven were appended to the second issue (1664) of the Third Folio (1663) and to the Fourth Folio of 1685. Shakespeare is named as joint author with John Fletcher on the title-page of *The Two Noble Kinsmen* (1634), and with William Rowley on that of *The Birth of Merlin* (1662); there is no reason for rejecting the former ascription or for accepting the latter. Late entries in the Stationers' *Register* assign to him *Cardenio* (with Fletcher), *Henry I.* and *Henry II.* (both with Robert Davenport), *King Stephen, Duke Humphrey* and *Iphis and Ianthe;* but none of these plays is now extant. Modern conjecture has attempted to trace his hand in other plays, of which *Arden of Feversham* (1592), *Edward III.* (1596), *Mucedorus* (1598) and *The Merry Devil of Edmonton* (1608) are the most important; it is quite possible that he may have had a share in *Edward III.* A play on *Sir Thomas More,* which has been handed down in manuscript, contains a number of passages interpolated in various handwritings; and a theory that one of those is in that of Shakespeare, and gives indications of his orthography and methods of composition, has been the subject of much recent discussion. There is much to be said for it, but it can hardly be regarded as securely established.

Chronology.—Unfortunately the First Folio does not give the dates at which the plays contained in it were written or produced; and the endeavour to supply this deficiency has been one

of the main preoccupations of more than a century of Shakespearian scholarship, since the pioneer essay of Edmund Malone in his *An Attempt to Ascertain the Order in which the Plays of Shakespeare were Written* (1778). The investigation is not a mere piece of barren antiquarianism, for on it depends the possibility of appreciating the work of the world's greatest poet, not as if it were an articulated whole like a philosophical system, but in its true aspect as the reflex of a vital and constantly developing personality. A starting-point is afforded by the dates of the Quartos and the entries in the Stationers' *Register* which refer to them, and by the list of plays already in existence in 1598 which is inserted by Francis Meres in his *Palladis Tamia* of that year, and which, while not necessarily exhaustive of Shakespeare's pre-1598 writing, includes *The Two Gentlemen of Verona, The Comedy of Errors, Love's Labour's Lost, A Midsummer Night's Dream, The Merchant of Venice, Richard II., Richard III., Henry IV., King John, Titus Andronicus* and *Romeo and Juliet,* as well as a mysterious *Love's Labour's Won,* which has been conjecturally identified with several plays, but most plausibly with *The Taming of the Shrew.* There is a mass of supplementary evidence, drawn partly from definite notices in other writings or in diaries, letters, account-books and similar records, partly from allusions to contemporary persons and events in the plays themselves, partly from parallels of thought and expression between each play and those near to it in point of time, and partly from considerations of style, including the so-called metrical tests, which depend upon an analysis of Shakespeare's varying feeling for rhythm at different stages of his career. The total result is certainly not a demonstration, but in the logical sense an hypothesis which serves to colligate the facts and is consistent with itself and with the known events of Shakespeare's external life.

The following table is an attempt to arrange the original dates of production of the plays according to the theatrical seasons, from autumn to autumn, in which they may have fallen. It is framed on the assumption that, as indeed John Ward tells us was the case, Shakespeare ordinarily wrote two plays a year; but some slackening of production in the later years seems probable. It will be understood that neither the order in which the plays are given nor the distribution of them over the years lays claim to more than approximate accuracy.

CHRONOLOGY OF THE PLAYS

1590–91
(1, 2) 2, 3, *Henry VI.*

1591–92
(3) 1 *Henry VI.*

1592–93
(4) *Richard III.*
(5) *Comedy of Errors.*

1593–94
(6) *Titus Andronicus.*
(7) *Taming of the Shrew.*

1594–95
(8) *Two Gentlemen of Verona.*
(9) *Love's Labour's Lost.*
(10) *Romeo and Juliet.*

1595–96
(11) *Richard II.*
(12) *Midsummer Night's Dream.*

1596–97
(13) *John.*
(14) *Merchant of Venice.*

1597–98
(15, 16) 1, 2 *Henry IV.*

1598–99
(17) *Much Ado About Nothing.*
(18) *Henry V.*

1599–1600
(19) *Julius Caesar.*
(20) *Merry Wives of Windsor.*
(21) *As You Like it.*

1600–01
(22) *Twelfth Night.*
(23) *Hamlet.*

1601–02
(24) *Troilus and Cressida.*

1602–03
(25) *All's Well that Ends Well.*

1604–05
(26) *Measure for Measure.*
(27) *Othello.*

1605–06
(28) *Macbeth.*
(29) *Lear.*

1606–07
(30) *Antony and Cleopatra.*

1607–08
(31) *Coriolanus,*
(32) *Timon of Athens.*

1608–09
(33) *Pericles.*

1609–10
(34) *Cymbeline.*

1610–11
(35) *Winter's Tale.*

1611–12
(36) *Tempest.*

1612–13
(37) *Henry VIII.*
(38) *Two Noble Kinsmen.*

Composition.—A more detailed account of the individual plays may now be attempted. The figures here prefixed correspond to those in the table above.

1, 2. The relation of *The Contention of York and Lancaster* to 2, 3 *Henry VI.* and the extent of Shakespeare's responsibility for either or both works have long been subjects of controversy. The extremes of critical opinion are to be found in a theory which regards Shakespeare as the sole author of 2, 3 *Henry VI.* and *The Contention* as a shortened and surreptitious version of the original plays, and in a theory which regards *The Contention* as written in collaboration by Marlowe, Greene and possibly Peele, and 2, 3 *Henry VI.* as a revision of *The Contention* written, also in collaboration, by Marlowe and Shakespeare. A comparison of the two texts leaves it hardly possible to doubt that the differences between them are to be explained by reporting rather than by revision; but the question of authorship is more difficult. Greene's parody, in the "Shakescene" passage of his *Groats-worth of Wit* (1592), of a line which occurs both in *The Contention* and in 3 *Henry VI.,* while it clearly suggests Shakespeare's connection with the plays, is evidence neither for nor against the participation of other men, and no sufficient criterion exists for distinguishing between Shakespeare's earliest writing and that of possible collaborators on grounds of style. But the blank verse style of 2, 3 *Henry VI.* may quite well be an earlier stage of that found more fully developed in *Richard III.,* and it is difficult to assign to any one except Shakespeare the humour of the Jack Cade scenes. Views which exclude Shakespeare altogether may be left out of account. *Henry VI.* is not in Meres's list of his plays, but its inclusion in the First Folio is an almost certain ground for assigning to him some share in the work.

3. A rather different problem is afforded by 1 *Henry VI.,* and here it is difficult, in view of the variety of style in the play, and the poor level of much of it, to hold by Shakespeare's sole responsibility. The Temple Gardens Scene (ii. 4), which is that most obviously his, was probably a later addition. Thomas Nashe refers to the representation of Talbot on the stage in his *Pierce Penilesse, his Supplication to the Divell* (1592), and it is probable that 1 *Henry VI.* is to be identified with the "Harey the vj." recorded in Henslowe's *Diary* to have been acted as a new play by Lord Strange's men, probably at the Rose, on March 3, 1592. If so, it is a reasonable conjecture that 2, 3 *Henry VI.* were originally written at some date before the beginning of Henslowe's record in the previous February, and that 1 *Henry VI.* was added later as an introduction to them.

4. The *Henry VI.* series can only be intended to lead directly up to *Richard III.,* and this relationship, together with its style as compared with that of the plays of 1594–96, suggests the short winter season of 1592–93 as the most likely time for the production of *Richard III.* There is a difficulty in that it is not included in Henslowe's list of the plays acted by Lord Strange's men during that season. But it may quite well have been produced by the only other company which appeared at court during the Christmas festivities, Lord Pembroke's. The mere fact that Shakespeare wrote a play, or more than one play, for Lord Strange's men during 1592–94 does not prove that he never wrote for any other company during the same period; and indeed there is plenty of room for guesswork as to the relations between Strange's and Pembroke's men. The latter are not known to have existed before the latter part of 1592, and many difficulties would be solved by the assumption that they originated out of a division of Strange's, who had amalgamated with the Admiral's, and may have found their numbers too much inflated to enable them to undertake as a whole the autumn tour of that year. If so, Pembroke's probably took over the *Henry VI.* series of plays, since part of *The Contention,* under the name of the *True Tragedy of Richard Duke of York,* was published as performed by them, and completed it with *Richard III.* at Christmas. It will be necessary to return to this theory in connection with the discussion of *Titus Andronicus* and *The Taming of the Shrew.* The principal historical source for *Henry VI.* was Edward Hall's *The Union of the Noble and Illustre Families of Lancaster and York* (1542), and for *Richard III.,* as for most of Shakespeare's later historical plays,

the second edition (1587) of Raphael Holinshed's *Chronicles of England, Scotland and Ireland* (1577). An earlier play, *The True Tragedy of Richard the Third* (1594), seems to have contributed little if anything to *Richard III.*

5. To the winter season of 1592–93 may also be assigned with fair probability Shakespeare's first experimental comedy, *The Comedy of Errors,* and if his writing at one and the same time for Pembroke's and for another company is not regarded as beyond the bounds of conjecture, it becomes tempting to identify this with "the gelyous comodey" produced, probably by Strange's men, for Henslowe as a new play on Jan. 5, 1593. The play contains a reference to the wars of succession in France which would fit any date from 1589 to 1594. The plot is taken from the *Menaechmi* and to a smaller extent from the *Amphitruo* of Plautus. William Warner's translation of the *Menaechmi* was entered in the Stationers' *Register* on June 10, 1594. A performance of *The Comedy of Errors* by "a company of base and common fellows" (including Shakespeare?) is recorded in the *Gesta Grayorum* as taking place in Gray's Inn hall on Dec. 28, 1594.

6. *Titus Andronicus* is another play in which many scholars have refused to see the hand of Shakespeare, but the double testimony of its inclusion in Meres's list and in the First Folio makes it unreasonable to deny him some part in it. This may, however, only have been the part of a reviser, working upon the dialogue rather than the structure of a crude tragedy of the school of Kyd. In fact a stage tradition is reported by Edward Ravenscroft, a late 17th century adapter of the play, to the effect that Shakespeare did no more than give a few "master-touches" to the work of a "private author." The play was entered in the Stationers' *Register* on Feb. 6, 1594, and was published in the same year with a title-page setting out that it had been acted by the companies of Lords Derby (*i.e.,* Strange, who had succeeded to his father's title on Sept. 25, 1593), Pembroke and Sussex. It is natural to take this list as indicating the order in which the three companies named had to do with it, but it is probable that only Sussex's had played the extant version. Henslowe records the production by this company of *Titus Andronicus* as a new play on Jan. 23, 1594, only a few days before the theatres were closed by plague. For the purposes of Henslowe's financial arrangements with the company a rewritten play may have been classed as new. Two years earlier he had appended the same description to a play of *Tittus and Vespacia,* produced by Strange's men on April 11, 1592. At first sight the title suggests a piece founded on the lives of the emperors Titus and Vespasian, but there are some grounds, although far from conclusive, for supposing the play to have been an early version of *Titus Andronicus.* It is difficult to explain the company names on the title-page unless there had been some version earlier than that of 1594. Pembroke's men are known from a letter of Henslowe's to have been ruined by Aug. 1593, and it is to be suspected that Sussex's, who appeared in London for the first time at the Christmas of 1593, acquired their stock of plays and transferred these to the Chamberlain's men, when the companies were again reconstituted in the summer of 1594. Whatever work Shakespeare did on *Titus Andronicus* may have been accomplished in the interval between these two transactions. The Chamberlain's men were apparently playing *Andronicus* in June. The stock of Pembroke's men probably included, as well as *Titus and Vespasian,* both *Henry VI.* and *Richard III.,* which also thus passed to the Chamberlain's company. The source of the plot is unknown; there are only slight hints for it in Byzantine chronicles.

7. An old play of *The Taming of a Shrew,* which can be traced back as far as 1589, was published as acted by Pembroke's men in 1594. In June of that year it was being acted by the Chamberlain's, but more probably in the version by Shakespeare, which bears the slightly altered title of *The Taming of the Shrew.* This is a much more free adaptation of its original than had been attempted in the case of *Henry VI.,* and the Warwickshire allusions in the Induction are noteworthy. Some critics have doubted, probably with justice, whether Shakespeare was the sole author of *The Shrew,* and others have assigned him a share in *A Shrew,* but this theory has no substantial foundation. The origins of the play, which is to be classed as a farce rather than a comedy, are to be found ultimately in widely distributed folk-tales, and more immediately in Ariosto's *I Suppositi* (1509) as translated in George Gascoigne's *The Supposes* (1566). It may have been Shakespeare's first task for the newly established Chamberlain's company of 1594 to furbish up the old farce. Thenceforward there is no reason to think that he ever wrote for any other company.

8. No very definite evidence exists for the date of *The Two Gentlemen of Verona,* other than the mention of it in *Palladis Tamia.* It is evidently a more rudimentary essay in the *genre* of romantic comedy than *The Merchant of Venice,* with which it has other affinities in its Italian colouring and its use of the interrelations of love and friendship as a theme; and it may be roughly assigned to the winter of 1594–95. The plot is drawn from various examples of contemporary fiction, especially from the story of the shepherdess Filismena in Jorge de Montemayor's *Diana* (1559). A play of *Felix and Philiomena* had already been given at court in 1585.

9. *Love's Labour's Lost* has often been regarded as the first of Shakespeare's plays, and has sometimes been placed as early as 1589. There is, however, no proof that Shakespeare was writing so soon. The characters of *Love's Labour's Lost* are evidently suggested by Henry of Navarre, his followers Biron, Longueville and D'Aumont, who has probably been confused with the Catholic League leader, the duc de Maine. These personages would have been familiar at any time from 1591 onwards, but Navarrese history of 1578 has also been drawn upon, and the channel of transmission to Shakespeare is unknown. The absence of the play from the lists in Henslowe's *Diary* does not leave it impossible that it should have preceded the formation of the Chamberlain's company, but certainly renders this less likely; and its lyric character perhaps justifies its being grouped with the other lyric plays of 1594–96. No entry of the play is found in the Stationers' *Register,* and it is quite possible that the present First Quarto of 1598 was not really the first edition. The title-page professes to give the play as "corrected and augmented" and as given at the Christmas of 1597. It was again revived for that of 1604. No literary source is known for its incidents.

10. *Romeo and Juliet,* which was published in 1597 as played by Lord Hunsdon's men, was probably produced somewhat before *A Midsummer Night's Dream,* as its incidents seem to have suggested the parody of the Pyramus and Thisbe interlude. An attempt to date it in 1591 is hardly justified by the Nurse's reference to an earthquake 11 years before and the fact that there was a real earthquake in London in 1580. The text of the First Quarto is surreptitious, and was "corrected, augmented and amended" in the Second Quarto of 1599. There had been an earlier play on the subject, but the immediate source used by Shakespeare was Arthur Brooke's narrative poem *Romeus and Juliet* (1562).

11. *Richard II.* can be dated with some accuracy by a comparison of the two editions of Samuel Daniel's narrative poem on *The Civil Wars Between the Two Houses of Lancaster and York,* both of which bear the date of 1595 and were therefore issued between March 25, 1595, and March 24, 1596, of the modern reckoning. It is possible that a performance was given before Sir Robert Cecil in Dec. 1595. The second of these editions, but not the first, contains some close parallels to the play. From the first two quartos of *Richard II.,* published in 1597 and 1598, the deposition scene was omitted, although it was clearly part of the original structure of the play, and its removal leaves an obvious mutilation in the text. There is some reason to suppose that this was due to a popular tendency to draw seditious parallels between Richard and Elizabeth; and it became one of the charges against the earl of Essex and his fellow-conspirators in the abortive *émeute* of Feb. 1601, that they had procured a performance of a play on Richard's fate in order to stimulate their followers. As the actors were the Lord Chamberlain's men, this play can hardly have been any other than Shakespeare's. The deposition scene was not printed until after Elizabeth's death, in the Third Quarto of 1608.

12. *A Midsummer Night's Dream,* with its masque-like scenes of fairydom and the epithalamium at its close, has all the air of having been written less for the public stage than for some courtly wedding; and the compliment paid by Oberon to the "fair vestal throned by the west" makes it possible that it was a wedding at which Elizabeth was present. Many more or less plausible occasions have been suggested. The wedding of Mary countess of Southampton with Sir Thomas Heneage on May 2, 1594, would fit the May-day setting of the plot; but a widowed countess hardly answers to the "little western flower" of the allegory, and there are allusions to later events and in particular to the rainy weather of 1594–95. The wedding of William Stanley, earl of Derby, brother of the lord Strange for whose players Shakespeare had written, and Elizabeth Vere, daughter of the earl of Oxford, which took place at Greenwich on Jan. 26, 1595, would meet the conditions. But that of Thomas Berkeley and Elizabeth Carey, granddaughter of the company's patron Lord Hunsdon, on Feb. 19, 1596, is at least as likely. It has been fancied that Shakespeare was present when "certain stars shot madly from their spheres" in the Kenilworth fireworks of 1575, but if he had any particular recorded entertainment in mind it is more likely to have been the more recent one given to Elizabeth by the earl of Hertford at Elvetham in 1591. There appears to be no special source for the play beyond Chaucer's *Knight's Tale* and the widespread fairy lore of western Europe.

13. *King John* has no very clear indications of date, but 1596 seems likely, on account of its style, in spite of the *a priori* improbability of a play on an independent subject drawn from English history being interpolated in the middle of the Lancastrian series. It would seem that Shakespeare had before him an old play of the queen's men, called *The Troublesome Reign of King John.* This was published in 1591, and again, with "W. Sh." on the title-page, in 1611. For copyright purposes *King John* appears to have been regarded as a revision of *The Troublesome Reign,* and in fact the succession of incidents in the two plays is much the same. Shakespeare's dialogue, however, owes little or nothing to that of his predecessor.

14. *The Merchant of Venice,* certainly earlier than July 22, 1598, on which date it was entered in the Stationers' *Register,* and possibly inspired by the machinations of the Jew poisoner Roderigo Lopez, who was executed in June 1594, shows a considerable advance in comic and melodramatic power over any of the earlier plays, and is assigned by a majority of scholars to about 1596. The various stories of which its plot is compounded are based upon common themes of folk-tales and Italian *novelle.* It is possible that Shakespeare may have had before him a play called *The Jew,* of which there are traces as early as 1579, and in which motives illustrating "the greedinesse of worldly chusers" and the "bloody mindes of usurers" appear to have been already combined. Something may also be owing to Marlowe's play of *The Jew of Malta.*

15, 16. The first part of *Henry IV.* was published in 1598, the second not until 1600, but both parts must have been in existence before the entry of the first part in the Stationers' *Register* on Feb. 25, 1598, since Falstaff is named in this entry, and a slip in a speech-prefix of the second part, which was not entered in the *Register* until Aug. 23, 1600, betrays that it was written when the character still bore the name of Sir John Oldcastle. Richard James, in his dedication to *The Legend of Sir John Oldcastle* about 1625, and Rowe in 1709 both bear witness to the substitution of the one personage for the other, which Rowe ascribes to the intervention of Elizabeth, and James to that of some descendants of Oldcastle, one of whom was probably Lord Cobham. There is an allusion to the incident and an acknowledgment of the wrong done to the famous Lollard martyr in the epilogue to 2 *Henry IV.* itself. Probably Shakespeare found Oldcastle, with very little else that was of service to him, in an old play called *The Famous Victories of Henry the Fifth,* which had been acted by Tarlton and the queen's men at least as far back as 1588, and of which an edition was printed in 1598. Falstaff himself is a somewhat libellous presentment of the 15th century leader, Sir John Fastolf, who had already figured in *Henry VI.;* but presumably Fastolf had no titled descendants alive in 1598.

17. A note in the Stationers' *Register* during Aug. 1600 shows that *Much Ado About Nothing* was in existence, although its publication was then directed to be "stayed." It may plausibly be regarded as the earliest play not included in Meres's list. In 1613 it was revived before James I. under the alternative title of *Benedick and Beatrice.* Dogberry is said by Aubrey to have been taken from a constable at Grendon in Buckinghamshire. There is no very definite literary source for the play, although some of its incidents are to be found in Ariosto's *Orlando Furioso* and Bandello's *novelle,* and attempts have been made to establish relationships between it and two early German plays, Jacob Ayrer's *Die Schöne Phaenicia* and the *Vincentius Ladiszlaus* of Duke Henry Julius of Brunswick.

18. The completion of the Lancastrian series of histories by *Henry V.* can be safely placed in or about 1599, since there is an allusion in one of the choruses to the military operations in Ireland of the earl of Essex, who crossed on March 27 and returned on Sept. 28, 1599. The First Quarto, which, in spite of the fact that the play was "stayed" with *Much Ado About Nothing,* was published in 1600, is a surreptitious text, and does not include the choruses. A genuine version was first published in the First Folio.

19. That *Julius Caesar* also belongs to 1599 is shown, not only by its links with *Henry V.* but also by an allusion to it in John Weever's *Mirror of Martyrs,* a work written two years before its publication in 1601, and by a notice of a performance on Sept. 21, 1599, by Thomas Platter of Basle in an account of a visit to London. This was the first of Shakespeare's Roman plays, and, like those that followed, was based upon Plutarch's *Lives* as translated from the French of Jacques Amyot and published by Sir Thomas North in 1580.

20. It is reported by John Dennis, in the préface to *The Comical Gallant* (1702), that *The Merry Wives of Windsor* was written at the express desire of Elizabeth, who wished to see Falstaff in love, and was finished by Shakespeare in the space of a fortnight. A date at the end of 1599 or the beginning of 1600, shortly after the completion of the historical Falstaff plays, would be the most natural one for this enterprise, and with such a date the evidence of style agrees. The play was entered in the Stationers' *Register* on Jan. 18, 1602. The First Quarto of the same year gives a surreptitious text, which was replaced by that of the First Folio. The Windsor setting makes it possible that *The Merry Wives* was produced within the castle, and perhaps with the assistance of the children of Windsor chapel in the fairy parts. The plot has its analogies to various incidents in Italian *novelle* and in English adaptations of these.

21. *As You Like It* was one of the plays "stayed" fróm publication in 1600, and cannot therefore be later than that year. Some trifling bits of evidence suggest that it is not earlier than 1599. The plot is based upon Thomas Lodge's romance of *Rosalynde* (1590), and this in part upon the pseudo-Chaucerian *Tale of Gamelyn.*

22. *Twelfth Night* may be placed about 1600–01, since it quotes part of a song included in Robert Jones's *First Book of Songs and Airs* (1600), and is recorded by John Manningham to have been seen by him at a feast in the Middle Temple hall on Feb. 2, 1602. The principal source of the plot was Barnabe Riche's "History of Apolonius and Silla" in his *Farewell to Military Profession* (1581).

23. A play of *Hamlet* was performed, probably by the Chamberlain's men, for Henslowe at Newington Butts on June 9, 1594. There are other references to it as a revenge-play, and it seems to have been in existence in some shape as early as 1589. It was doubtless on the basis of this that Shakespeare constructed his tragedy. There is an allusion in *Hamlet* to the rivalry between the ordinary stages and the private plays given by boy actors, which points to a date not earlier than the revival of the plays at Paul's, which was probably in 1599, and another, to an inhibition of plays on account of a "late innovation," may also be explained by the revival rather than by the Essex rising of 1601, since the play is mentioned in a manuscript note by Gabriel

Harvey, probably written before the death of Essex. The play was entered in the Stationers' *Register* on July 26, 1602. The First Quarto was printed in 1603 and the Second Quarto in 1604. These editions contain texts whose differences from each other and from that of the First Folio constitute one of the most difficult of Shakespearian problems. The First Quarto is certainly surreptitious. Its title-page records performances in the Universities of Oxford and Cambridge and elsewhere, as well as in London. The ultimate source of the plot is to be found in Scandinavian legends preserved in the *Historia Danica* of Saxo Grammaticus, and transmitted to Shakespeare or his predecessor through the *Histoires Tragiques* (1570) of François de Belleforest (*see* HAMLET).

24. Few of the plays present so many difficulties as *Troilus and Cressida,* and it cannot be said that its literary history has as yet been thoroughly worked out. A play of the name, "as yt is acted by my Lord Chamberlens men" was entered in the Stationers' *Register* on Feb. 7, 1603, with a note that "sufficient authority" must be got by the publisher, James Roberts, before he printed it. This can hardly be any other than Shakespeare's play; but it must have been "stayed," for the First Quarto did not appear until 1609, and on Jan. 28 of that year a fresh entry had been made in the *Register* by another publisher. The text of the Quarto differs in certain respects from that of the Folio, but not to a greater extent than the use of different copies of the original manuscript might explain. Two alternative title-pages are found in copies of the Quarto. On one, probably the earliest, is a statement that the play was printed "as it was acted by the Kings Maiesties seruants at the Globe"; from the other these words are omitted, and a preface is appended which hints that the "grand possessors" of the play had made difficulties about its publication, and describes it as "never staled with the stage." Attempts have been made, mainly on grounds of style, to find another hand than Shakespeare's in the closing scenes and in the prologue, and even to assign widely different dates to various parts of what is ascribed to Shakespeare. But the evidence does not really bear out these theories, and the style of the whole must be regarded as quite consistent with a date in 1601. It has been thought that the description of Ajax and his humours in the second scene of the first act is Shakespeare's "purge" to Jonson in reply to the *Poetaster* (1601), alluded to, as already mentioned, in the *Return from Parnassus,* a Cambridge play acted probably at the Christmas of 1601–02. It is tempting to conjecture that *Troilus and Cressida* may have been played, like *Hamlet,* by the Chamberlain's men at Cambridge, but may never have been taken to London, and in this sense "never staled with the stage." The only difficulty of a date in 1601 is that a parody of a play on Troilus and Cressida is introduced into *Histriomastix* (*c.* 1599), and that in this Troilus "shakes his furious speare." But Henslowe had produced another play on the subject, by Dekker and Chettle, in 1599, and probably, therefore, no allusion to Shakespeare is really intended. The material for *Troilus and Cressida* was taken by Shakespeare from Chaucer's *Troilus and Criseyde,* Caxton's *Recuyell of the Historyes of Troye,* and Chapman's Homer.

25. It is almost wholly on grounds of style that *All's Well that Ends Well* is placed by most critics in or about 1602, and, as in the case of *Troilus and Cressida,* it has been argued, though with little justification, that parts of the play are of considerably earlier date, and perhaps represent the *Love's Labour's Won* referred to by Meres. The story is derived from Boccaccio's *Decameron* through the medium of William Paynter's *Palace of Pleasure* (1566).

26. *Measure for Measure* was played at court on Dec. 26, 1604. The evidence for this is a list of plays in one of the account-books of the Office of the Revels. This was formerly thought to have been forged, but is now satisfactorily rehabilitated. The play was probably produced when the theatres were reopened after the plague in 1604. The plot is taken from a story already used by George Whetstone, both in his play of *Promos and Cassandra* (1578) and in his prose *Heptameron of Civil Discourses* (1582), and borrowed by him from Giraldi Cinthio's *Hecatommithi* (1566).

27. A performance at court of *Othello* on Nov. 1, 1604, is noted in the same list as that recording *Measure for Measure,* and the play may be reasonably assigned to the same year. An alleged performance at Harefield in 1602 certainly rests upon a forgery. The play was revived in 1610 and seen by Prince Louis of Württemberg at the Globe on April 30 of that year. It was entered in the Stationers' *Register* on Oct. 6, 1621, and a First Quarto was published in 1622. The text of this is less satisfactory than that of the First Folio, and omits a good many lines found therein and almost certainly belonging to the play as written. It also contains some profane expressions which have been modified in the Folio, and thereby points to a date for the original production earlier than the Act to Restrain Abuses of Players passed in the spring of 1606. The plot, like that of *Measure for Measure,* comes from the *Hecatommithi* (1566) of Giraldi Cinthio.

28. *Macbeth* cannot, in view of its obvious allusions to James I., be of earlier date than 1603. The style and some trifling allusions point to about 1605 or 1606, and a hint for the theme may have been given by Matthew Gwynne's entertainment of the *Tres Sibyllae,* with which James was welcomed to Oxford on Aug. 27, 1605. The play was revived in 1610 and Simon Forman saw it at the Globe on April 20. The only extant text, that of the First Folio, bears traces of shortening, and has been interpolated with additional rhymed dialogues for the witches by a second hand, probably that of Thomas Middleton. But the extent of Middleton's contribution has been exaggerated; it is probably confined to act iii. sc. 5, and a few lines in act. iv. sc. 1. A ballad of *Macdobeth* is mentioned in the Stationers' records during 1596, but is not known. It is not likely that Shakespeare had consulted any Scottish history other than that included in Raphael Holinshed's *Chronicle;* he may have gathered witchlore from Reginald Scot's *Discoverie of Witchcraft* (1584) or King James's own *Demonologie* (1599).

29. The entry of *King Lear* in the Stationers' *Register* on Nov. 26, 1607, records the performance of the play at court on Dec. 26, 1606. This suggests 1605 or 1606 as the date of production, and this is confirmed by the publication in 1605 of the older play, *The True Chronicle History of King Leir,* which Shakespeare used as his source. Two Quartos of *King Lear* were published in 1608, and contain a text rather longer, but in other respects less accurate, than that of the First Folio. The material of the play consists of fragments of Celtic myth, which found their way into history through Geoffrey of Monmouth. It was accessible to Shakespeare in Holinshed and in Spenser's *Faerie Queene,* as well as in the old play.

30. It is not quite clear whether *Antony and Cleopatra* was the play of that name entered in the Stationers' *Register* on May 20, 1608, for no Quarto is extant, and a fresh entry was made in the *Register* before the issue of the First Folio. Apart from this entry, there is little external evidence to fix the date of the play, but it is in Shakespeare's later, although not his last, manner and may very well belong to 1606. It is possible that it motived some changes introduced by Samuel Daniel into a new edition of his *Cleopatra* issued in 1607.

31. In the case of *Coriolanus* the external evidence available is even scantier, and all that can be said is that its closest affinities are to *Antony and Cleopatra,* which in all probability it directly followed in order of composition. Both plays, like *Julius Caesar,* are based upon the *Lives* of Plutarch as translated by Sir Thomas North.

32. There is no external evidence as to the date of *Timon of Athens,* but it may safely be grouped on the strength of its internal characteristics with the plays just named, and there is a clear gulf between it and those that follow. It may be placed provisionally in 1607, although some critics put it next after *Lear.* The extraordinary incoherencies of its action and inequalities of its style have prevented modern scholars from accepting it as a finished production of Shakespeare, but there agreement ceases. It is sometimes and perhaps most reasonably regarded as an incomplete draft for an intended play; sometimes as a Shakespearian fragment worked over by a second hand either for the stage

or for printing in the First Folio; sometimes, but not very plausibly, as an old play by an inferior writer which Shakespeare had partly remodelled. It does not seem to have had any relations to an extant academic play of *Timon* which remained in manuscript until 1842. The sources are partly in Plutarch's *Life of Marcus Antonius,* partly in Lucian's dialogue of *Timon or Misanthropos,* and partly in William Paynter's *Palace of Pleasure* (1566).

33. Similar difficulties, equally unsolved, cling about *Pericles.* It was entered in the Stationers' *Register* on May 20, 1608, and published in 1609 as "the late and much admired play" acted by the king's men at the Globe. The title-page bears Shakespeare's name, but the play was not included in the First Folio, and was only added to Shakespeare's collected works in the Third Folio, in company with others which, although they also had been printed under his name or initials in quarto form, are certainly not his. In 1608 was published a prose story, *The Painful Adventures of Pericles Prince of Tyre.* This claims to be the history of the play as it was presented by the king's players, and is described in a dedication by George Wilkins as "a poore infant of my braine." The production of the play is therefore to be put in 1608 or a little earlier. It can hardly be doubted on internal evidence that Shakespeare is the author of the verse-scenes in the last three acts, with the exception of the doggerel choruses. It is probable, although it has been doubted, that he was also the author of the prose-scenes in those acts. To the first two acts he can at most only have contributed a touch or two. It seems reasonable to suppose that the non-Shakespearian part of the play is by Wilkins, by whom other dramatic work was produced about 1607. The prose story quotes a line or two from Shakespeare's contribution, and it follows that this must have been made by 1608. The close resemblances of the style to that of Shakespeare's latest plays make it impossible to place it much earlier. But whether Shakespeare and Wilkins collaborated in the play, or Shakespeare partially rewrote Wilkins, or Wilkins completed Shakespeare, must be regarded as yet undetermined. Unless there was an earlier Shakespearian version now lost, Dryden's statement that "Shakespeare's own Muse her Pericles first bore" must be held to be an error. The story is an ancient one which exists in many versions. In all of these except the play, the name of the hero is Apollonius of Tyre. The play is directly based upon a version in Gower's *Confessio Amantis,* and the use of Gower as a "presenter" is thereby explained. But another version in Laurence Twine's *Patterne of Painefull Adventures* (*c.* 1576), of which a new edition appeared in 1607, may also have been consulted.

34. *Cymbeline* shows a further development than *Pericles* in the direction of Shakespeare's final style, and can hardly have come earlier. A description of it is in a note-book of Simon Forman, who died in Sept. 1611, and describes in the same book other plays seen by him in 1610 and 1611. But these were not necessarily new plays, and *Cymbeline* may perhaps be assigned conjecturally to 1609. The masque-like dream in act v. sc. 4 must be an interpolation by another hand. This play also is based upon a widespread story, probably known to Shakespeare in Boccaccio's *Decameron* (day 2, novel 9), and possibly also in an English book of tales called *Westward for Smelts.* The historical part is, as usual, from Holinshed.

35. *The Winter's Tale* was seen by Forman on May 15, 1611, and as it clearly belongs to the latest group of plays it may well enough have been produced in that or the preceding year. A document amongst the Revels Accounts, also now cleared of the imputation of forgery, gives Nov. 5, 1611, as the date of a performance at court. The play is recorded to have been licensed by Sir George Buck, who began to license plays in 1607. The plot is from Robert Greene's *Pandosto, the Triumph of Time, or Dorastus and Fawnia* (1588).

36. The wedding-masque in act iv. of *The Tempest* has suggested the possibility that it may have been composed to celebrate the marriage of the princess Elizabeth and Frederick V., the elector palatine, on Feb. 14, 1613. But the document amongst the Revels Accounts gives the precise date of Nov. 1, 1611, for a performance at court. Sylvester Jourdan's *A Discovery of the Bermudas,* containing an account of the shipwreck of Sir George Somers in 1609, was published about Oct. 1610, and this or some other contemporary narrative of Virginian colonization probably furnished the hint of the plot.

37. It may now be accepted as a settled result of scholarship that *Henry VIII.* is the result of collaboration, and that one of the collaborators was Fletcher. There is no good reason to doubt that the other was Shakespeare, although attempts have been made to substitute Philip Massinger. The inclusion, however, of the play in the First Folio must be regarded as conclusive against this theory. There is some ground for suspicion that the collaborators may have had an earlier work of Shakespeare before them, and this would explain the reversion to the "history" type of play which Shakespeare had long abandoned. His share appears to consist of act i. scc. 1, 2; act ii. scc. 3, 4; act iii. sc. 2, ll. 1–203; act v. sc. 1. The play was probably produced in 1613, and originally bore the alternative title of *All is True.* It was being performed in the Globe on June 29, 1613, when the thatch caught fire and the theatre was burnt. The principal source was Holinshed, but Hall's *Union of Lancaster and York,* Foxe's *Acts and Monuments of the Church,* and perhaps Samuel Rowley's play of *When You See Me, You Know Me* (1605), appear also to have contributed.

38. The tale of the First Folio dramas is now complete, but an analysis of *The Two Noble Kinsmen* leaves no reason to doubt the accuracy of its ascription on the title-page of the First Quarto of 1634 to Shakespeare and John Fletcher. This appears to have been a case of ordinary collaboration. There is sufficient resemblance between the styles of the two writers to render the division of the play between them a matter of some difficulty; but the parts that may probably be assigned to Shakespeare are acts i. scc. 1–4; ii. 1; iii. 1, 2; v. 1, 3, 4. Fletcher's morris-dance in act iii. sc. 5 is borrowed from that in Beaumont's *Mask of the Inner Temple and Gray's Inn,* given on Feb. 20, 1613, and the play may perhaps be dated in 1613. It is based on Chaucer's *Knight's Tale.*

THE POET

Shakespeare's writings outside the field of drama are not numerous. The narrative poem of *Venus and Adonis* was entered in the Stationers' *Register* on April 18, 1593, and 17 editions, dating from 1593 to 1675, are known. The *Rape of Lucrece* was entered in the *Register* on May 9, 1594, and the nine extant editions range from 1594 to 1655. Each poem is prefaced by a dedicatory epistle from the author to Henry Wriothesley, earl of Southampton. The subjects, taken respectively from the *Metamorphoses* and the *Fasti* of Ovid, were frequent in Renaissance literature. It was once supposed that Shakespeare came from Stratford-on-Avon with *Venus and Adonis* in his pocket; but it is more likely that both poems owe their origin to the comparative leisure afforded to playwrights and actors by the plague-period of 1592–94. In 1599 the stationer William Jaggard published a volume of miscellaneous verse which he called *The Passionate Pilgrim,* and placed Shakespeare's name on the title-page. Only two of the pieces included herein are certainly Shakespeare's, and although others may quite possibly be his, the authority of the volume is destroyed by the fact that some of its contents are without doubt the work of Marlowe, Sir Walter Raleigh, Richard Barnfield and Bartholomew Griffin. In 1601 Shakespeare contributed *The Phoenix and the Turtle,* an elegy on an unknown pair of wedded lovers, to a volume called *Love's Martyr, or Rosalin's Complaint,* collected and mainly written by Robert Chester.

The Sonnets.—The interest of all these poems sinks into insignificance beside that of one remaining volume. The sonnets were entered in the *Register* on May 20, 1609, by the stationer Thomas Thorpe, and published by him under the title *Shakespeares Sonnets, never before Imprinted,* in the same year. In addition to 154 sonnets the volume contains the elegiac poem *A Lover's Complaint.* If this is Shakespeare's, which is very doubtful, it probably dates from the *Venus and Adonis* period. In 1640 the sonnets, together with other poems from *The Passionate Pilgrim* and elsewhere, many of them not Shakespeare's, were republished by John Benson in *Poems Written by Wil. Shake-*

speare, Gent. Here the sonnets are arranged in an altogether different order from that of 1609 and are declared by the publisher to "appeare of the same purity, the Authour himselfe then living avouched." No other Shakespearian controversy has received so much attention as that concerning itself with the date, character and literary history of the sonnets. This is intelligible enough, since upon the issues raised depends the question whether these poems do or do not give a glimpse into the intimate depths of a personality which otherwise is at the most only imperfectly revealed through the plays. On the whole, the balance of authority is in favour of regarding them as in a very considerable measure autobiographical. This view has undergone the fires of much destructive argument. The authenticity of the order in which the sonnets were printed in 1609 and even Shakespeare's authorship of some of them have been doubted; and their subject-matter has been variously explained as being of the nature of a philosophical allegory, of an effort of the dramatic imagination, or of a heartless exercise in the forms of the Petrarchan convention. This last theory rests upon the false psychological assumption, which is disproved by the whole history of poetry and in particular of Petrarchan poetry, that the use of conventions is inconsistent with the expression of unfeigned emotions; and it is hardly to be set against the direct conviction which the sonnets carry to the most finely critical minds of the strength and sincerity of the spiritual experience out of which they were wrought. This conviction makes due allowance for the inevitable heightening of emotion itself in the act of poetic composition; and it certainly does not carry with it a belief that all the external events which underlie the emotional development are capable at this distance of time of inferential reconstruction. But it does accept the sonnets as reflecting a part of Shakespeare's life during the years in which they were written, and as revealing at least the outlines of a drama which played itself out for once, not in his imagination but in his actual conduct in the world of men and women.

There is no advantage to be gained by rearranging the order of the 1609 volume, even if there were any basis other than that of individual whim on which to do so. Many of the sonnets are obviously linked to those which follow or precede them; and although a few may conceivably be misplaced, the order as a whole does not jar against the sense of emotional continuity, which is the only possible test that can be applied. The last two sonnets, however, are merely alternative versions of a Greek epigram, and it is a hazardous assumption that all of the rest have a common subject-matter. On this assumption, however, they have generally been interpreted somewhat as follows. There are two series, which are more probably parallel than successive. The shorter of these (cxxvii.–clii.) appears to be the record of the poet's relations with a mistress, a dark woman with raven brows and mourning eyes. In the earlier sonnets he undertakes the half-playful defence of black beauty against the blond Elizabethan ideal; but the greater number are in a more serious vein, and are filled with a deep consciousness of the bitterness of lustful passion and of the slavery of the soul to the body. The woman is a wanton. She has broken her bed-vow for Shakespeare, who on his side is forsworn in loving her; and she is doubly forsworn in proving faithless to him with other men. His reason condemns her, but his heart has not the power to throw off her tyranny. Her particular offence is that she, "a woman coloured ill," has cast her snares not only upon him, but upon his friend, "a man right fair," who is his "better angel," and that thus his loss is double, in love and friendship. The longer series (i.–cxxvi.) is written to a man, appears to extend over a considerable period of time, and covers a wide range of sentiment. The person addressed is younger than Shakespeare, and of higher rank. He is lovely, and the son of a lovely mother, and has hair like the auburn buds of marjoram. The series falls into a number of groups, which are rarely separated by any sharp lines of demarcation. Perhaps the first group (i.–xvii.) is the most distinct of all. These sonnets are a prolonged exhortation by Shakespeare to his friend to marry and beget children. The friend is now on the top of happy hours, and should make haste, before the rose of beauty dies, to secure himself in his descendants against devouring time. In the next group (xviii.–xxv.) a much more personal note is struck, and the writer assumes the attitudes, at once of the poet whose genius is to be devoted to eternizing the beauty and the honour of his patron, and of the friend whose absorbing affection is always on the point of assuming an emotional colour indistinguishable from that of love. The consciousness of advancing years and that of a fortune which bars the triumph of public honour alike find their consolation in this affection. A period of absence (xxvi.–xxxii.) follows, in which the thought of friendship comes to remedy the daily labour of travel and the sorrows of a life that is "in disgrace with fortune and men's eyes" and filled with melancholy broodings over the past. Then (xxxiii.–xlii.) comes an estrangement. The friend has committed a sensual fault, which is at the same time a sin against friendship. He has been wooed by a woman loved by the poet, who deeply resents the treachery, but in the end forgives it, and bids the friend take all his loves, since all are included in the love that has been freely given him. It is difficult to escape the suggestion that this episode of the conflict between love and friendship is the same as that which inspired some of the "dark woman" sonnets. Another journey (xliii.–lii.) is again filled with thoughts of the friend, and its record is followed by a group of sonnets (liii.–lv.) in which the friend's beauty and the immortality which this will find in the poet's verse are especially dwelt upon. Once more there is a parting (lvi.–lxi.) and the poet awaits as patiently as may be his friend's return to him. Again (lxii.–lxv.) he looks to his verse to give the friend immortality. He is tired of the world, but his friend redeems it (lxvi.–lxviii.). Then rumours of some scandal against his friend (lxix.–lxx.) reach him, and he falls (lxxi.–lxxiv.) into gloomy thoughts of coming death. The friend, however, is still (lxxv.–lxxvii.) his argument; and he is perturbed (lxxviii.–lxxxvi.) by the appearance of a rival poet, who claims to be taught by spirits to write "above a mortal pitch," and with "the proud full sail of his great verse" has already won the countenance of Shakespeare's patron. There is another estrangement (lxxxvii.–xc.), and the poet, already crossed with the spite of fortune, is ready not only to acquiesce in the loss of friendship, but to find the fault in himself. The friend returns to him, but the relation is still clouded by doubts of his fidelity (xci.–xciii.) and by public rumours of his wantonness (xciv.–xcvi.). For a third time the poet is absent (xcvii.–xcix.) in summer and spring. Then comes an apparent interval, after which a love already three years old is renewed (c.–civ.), with even richer praises (cv.–cviii.). It is now the poet's turn to offer apologies (cix.–cxii.) for offences against friendship and for some brand upon his name apparently due to the conditions of his profession. He is again absent (cxiii.) and again renews his protestations of the imperishability of love (cxiv.–cxvi.) and of his own unworthiness (cxvii.–cxxi.), for which his only excuse is in the fact that the friend was once unkind. If the friend has suffered as Shakespeare suffered, he has "passed a hell of time." The series closes with a group (cxxii.–cxxv.) in which love is pitted against time; and an *envoi,* not in sonnet form, warns the "lovely boy" that in the end nature must render up her treasure.

Mystery of "Mr. W. H."—Such an analysis can give no adequate idea of the qualities in these sonnets, whereby the appeal of universal poetry is built up on a basis of intimate self-revelation. The human document is so legible, and at the same time so incomplete, that it is easy to understand the strenuous efforts which have been made to throw further light upon it by tracing the identities of those other personalities, the man and the woman, through his relations to whom the poet was brought to so fiery an ordeal of soul, and even to the borders of self-abasement. It must be added that the search has, as a rule, been conducted with more ingenuity than judgment. It has generally started from the terms of a somewhat mysterious dedication prefixed by the publisher Thomas Thorpe to the volume of 1609. This runs as follows:—"To the onlie begetter of these insuing sonnets Mr. W. H. all happinesse and that eternitie promised by our ever-living poet wisheth the well-wishing adventurer in setting forth T. T." The natural interpretation of this is that the inspirer or "begetter" of

the sonnets bore the initials W. H.; and contemporary history has accordingly been ransacked to find a W. H. whose age and circumstances might conceivably fit the conditions of the problem which the sonnets present. It is perhaps a want of historical perspective which has led to the centring of controversy around two names belonging to the highest ranks of the Elizabethan nobility, those of Henry Wriothesley, earl of Southampton, and William Herbert, earl of Pembroke. There is some evidence to connect Shakespeare with both of these. To Southampton he dedicated *Venus and Adonis* in 1593 and *The Rape of Lucrece* in 1594, and the story that he received a gift of no less than £1,000 from the earl is recorded by Rowe. His acquaintance with Pembroke can only be inferred from the statement of Heminge and Condell in their preface to the First Folio of the plays, that Pembroke and his brother Montgomery had "prosequuted both them and their Authour living, with so much favour." The personal beauty of the rival claimants and of their mothers, their amours and the attempts of their families to persuade them to marry, their relations to poets and actors, and all other points in their biographies which do or do not fit in with the indications of the sonnets, have been canvassed with great spirit and some erudition, but with no very conclusive result. It is in Pembroke's favour that his initials were in fact W. H., whereas Southampton's can only be turned into W. H. by a process of metathesis; and his champions have certainly been more successful than Southampton's in producing a woman, a certain Mary Fitton, who was a mistress of Pembroke's, and was in consequence dismissed in disgrace from her post of maid of honour to Elizabeth. Unfortunately, the balance of evidence is in favour of her having been blond, and not "black." Moreover, a careful investigation of the sonnets, as regards their style and their relation to the plays, renders it almost impossible on chronological grounds that Pembroke can have been their subject. He was born on April 9, 1580, and was therefore much younger than Southampton, who was born on Oct. 6, 1573. The earliest sonnets postulate a marriageable youth, certainly not younger than 18, an age which Southampton reached in the autumn of 1591 and Pembroke in the spring of 1598. The writing of the sonnets may have extended over many years, but it is impossible to doubt that as a whole it is to the years 1593–98 rather than to the years 1598–1603 that they belong. There is not, indeed, much external evidence available. Francis Meres in his *Palladis Tamia* of 1598 mentions Shakespeare's "sugred sonnets among his private friends," but this allusion might come as well near the beginning as at the end of the series; and the fact that two, not of the latest, sonnets are in *The Passionate Pilgrim* of 1599 is equally inconclusive.

The only reference to an external event in the sonnets themselves, which might at first sight seem useful, is in the following lines (cvii.):—

> The mortal moon hath her eclipse endured,
> And the sad augurs mock their own presage;
> Incertainties now crown themselves assured,
> And peace proclaims olives of endless age.

This has been variously interpreted as referring to the death of Elizabeth and accession of James in 1603, to the relief caused by the death of Philip II. of Spain in 1598, and to the illness of Elizabeth and threatened Spanish invasion in 1596. Obviously the "mortal moon" is Elizabeth, but although "eclipse" may well mean "death," it is not quite so clear that "endure an eclipse" can mean "die."

Nor do the allusions to the rival poet help much. "The proud full sail of his great verse" would fit, on critical grounds, with Spenser, Marlowe, Chapman and possibly Peele, Daniel or Drayton; and the "affable familiar ghost," from whom the rival is said to obtain assistance by night, might conceivably be an echo of a passage in one of Chapman's dedications. Daniel inscribed a poem to Southampton in 1603, but with this exception none of the poets named is known to have written either for Southampton or for Pembroke, or for any other W. H. or H. W., during any year which can possibly be covered by the sonnets. Two very minor poets, Barnabe Barnes and Gervase Markham, addressed sonnets to Southampton in 1593 and 1595 respectively, and Thomas Nashe composed improper verses for his delectation.

But even if external guidance fails, the internal evidence for 1593–98 as approximately the sonnet period in Shakespeare's life is very strong indeed. It has been worked out in detail by two German scholars, Hermann Isaac (now Conrad) in the *Shakespeare-Jahrbuch* for 1884, and Gregor Sarrazin in *William Shakespeares Lehrjahre* (1897) and *Aus Shakespeares Meisterwerkstatt* (1906). Conrad's work, in particular, has hardly received enough attention even from recent English scholars, probably because he makes the mistakes of taking the sonnets in Bodenstedt's order instead of Shakespeare's, and of beginning his whole chronology several years too early in order to gratify a fantastic identification of W. H. with the earl of Essex. This, however, does not affect the main force of an argument by which the affinities of the great bulk of the sonnets are shown, on the ground of stylistic similarities, parallelisms of expression, and parallelisms of theme, to be far more close with the poems and with the range of plays from *Love's Labour's Lost* to *Henry IV.*, than with any earlier or later section of Shakespeare's work. This dating has the further advantage of putting Shakespeare's sonnets in the full tide of Elizabethan sonnet-production, which began with the publication of Sidney's *Astrophel and Stella* in 1591 and Daniel's *Delia* and Constable's *Diana* in 1592, rather than during years for which this particular kind of poetry had already ceased to be modish. It is to the three volumes named that the influence upon Shakespeare of his predecessors can most clearly be traced; while he seems in his turn to have served as a model for Drayton, whose sonnets to Idea were published in a series of volumes in 1594, 1599, 1602, 1605 and 1619. It does not of course follow that because the sonnets belong to 1593–98 W. H. is to be identified with Southampton. On general grounds he is likely, even if above Shakespeare's own rank, to have been somewhat nearer that rank than a great earl, some young gentleman, for example, of such a family as the Sidneys, or as the Walsinghams of Chislehurst.

It is possible that there is an allusion to Shakespeare's romance in a poem called "Willobie his Avisa," published in 1594 as from the pen of one Henry Willoughby, apparently of West Knoyle, in Wiltshire. In this Willoughby, enamoured of an innkeeper's wife, apparently at Sherborne, takes counsel with "his familiar friend W. S. who not long before had tryed the curtesy of the like passion, and was now newly recovered of the like infection." But there is nothing outside the poem to connect Shakespeare with a family of Willoughbys or with the neighbourhood of West Knoyle or Sherborne. Various other identifications of W. H. have been suggested, which rarely rest upon anything except a similarity of initials. There is little likelihood in a theory broached by Sir Sidney Lee, that W. H. was not the friend of the sonnets at all, but a certain William Hall, who was himself a printer, and might, it is conjectured, have obtained the "copy" of the sonnets for Thorpe. Rather more plausible is Sir William Harvey, the third husband of Southampton's mother. But, although it is just possible that "begetter" might mean, not "inspirer," but "procurer for the press," the interpretation is shipwrecked on the obvious identity of the person to whom Thorpe "wishes" eternity with the person to whom the poet "promised" that eternity. The external history of the sonnets must still be regarded as an unsolved problem; the most that can be said is that their subject may just possibly be Southampton, and cannot possibly be Pembroke.

The Evidence on Record.—In order to obtain a glimmering of the man that was Shakespeare, it is necessary to consult all the records and to read the evidence of his life-work in the plays, alike in the light of the simple facts of his external career and in that of the sudden vision of his passionate and dissatisfied soul preserved in the sonnets. By exclusive attention to any one of these sources of information it is easy to build up a consistent and wholly false conception of a Shakespeare; of a Shakespeare struggling between his senses and his conscience in the artistic Bohemianism of the London taverns; of a sleek, bourgeois Shakespeare to whom his art was no more than a ready way to a position of respected and influential competence in his native town;

of a great objective artist whose personal life was passed in detached contemplation of the puppets of his imagination. Any one of these pictures has the advantage of being more vivid, and the disadvantage of being less real, than the somewhat elusive and enigmatic Shakespeare who glances at us for a perplexing moment, now behind this, now behind that, of his diverse masks. It is necessary also to lay aside Shakespeareolatry, the spirit that could wish with Hallam that Shakespeare had never written the sonnets, or can refuse to accept *Titus Andronicus* on the ground that "the play declares as plainly as play can speak, 'I am not Shakespeare's; my repulsive subject, my blood and horrors, are not, and never were his.'" The literary historian has no greater enemy than the sentimentalist. In Shakespeare we have to do with one who is neither beyond criticism as a man nor impeccable as an artist. He was for all time, no doubt; but also very much of an age, the age of the later Renaissance, with its instinct for impetuous life, and its vigorous rather than discriminating appetite for literature. When Ben Jonson said that Shakespeare lacked "art," and when Milton wrote of his "native wood-notes wild," they judged truly. The Shakespearian drama is magnificent and incoherent; it belongs to the adolescence of literature, to a period before the instrument had been sharpened and polished, and made unerring in its touch upon the sources of laughter and of tears. Obviously nobody has such power over our laughter and our tears as Shakespeare. But it is the power of temperament rather than of art; or rather it is the power of a capricious and unsystematic artist, with a perfect dramatic instinct for the exposition of the ideas, the characters, the situations, which for the moment command his interest, and a perfect disregard for the laws of dramatic psychology which require the patient pruning and subordination of all material that does not make for the main exposition. This want of finish, this imperfect fusing of the literary ore, is essentially characteristic of the Renaissance, as compared with ages in which the creative impulse is weaker and leaves room for a finer concentration of the means upon the end. There is nearly always unity of purpose in a Shakespearian play, but it often requires an intellectual effort to grasp it and does not result in a unity of effect. The issues are obscured by a careless generosity which would extend to art the boundless freedom of life itself. Hence the intrusive and jarring elements which stand in such curious incongruity with the utmost reaches of which the dramatic spirit is capable; the conventional and melodramatic endings, the inconsistencies of action and even of character, the emotional confusions of tragicomedy, the complications of plot and subplot, the marring of the give-and-take of dialogue by superfluities of description and of argument, the jest and bombast lightly thrown in to suit the taste of the groundlings, all the flecks that to an instructed modern criticism are only too apparent upon the Shakespearian sun. It perhaps follows from this that the most fruitful way of approaching Shakespeare is by an analysis of his work rather as a process than as a completed whole. His outstanding positive quality is a vast comprehensiveness, a capacity for growth and assimilation, which leaves no aspect of life unexplored, and allows of no finality in the nature of his judgments upon life. It is the real and sufficient explanation and justification of the pains taken to determine the chronological order of his plays, that the secret of his genius lies in its power of development and that only by the study of its development can he be known. He was nearly 30 when, so far as we can tell, his career as a dramatist began; and already there lay behind him those six or seven unaccounted-for years since his marriage, passed no one knows where, and filled no one knows with what experience, but assuredly in that strenuous Elizabethan life with some experience kindling to his intellect and formative of his character. To the woodcraft and the familiarity with country sights and sounds which he brought with him from Stratford, and which mingle so oddly in his plays with a purely imaginary and euphuistic natural history, and to the book-learning of a provincial grammar-school boy, and perhaps, if Aubrey is right, also of a provincial schoolmaster, he had somehow added, as he continued to add throughout his life, that curious store of acquaintance with the details of the most diverse occupations which has so often perplexed and so often misled his commentators. It was the same faculty of acquisition that gave him the extensive range of his varied vocabulary.

His first group of plays is largely made up of essays in conventions of stage-writing which had already achieved popularity. In the Yorkist trilogy he takes up the burden of the chronicle play, in *The Comedy of Errors* that of the classical school drama and of the page-humour of Lyly, in *Titus Andronicus* that of the crude revenge tragedy of Kyd, and in *Richard III.* that of the Nemesis motive and the exaltation of the Machiavellian superman which properly belong to Marlowe. But in *Richard III.* he begins to come to his own with the subtle study of the actor's temperament which betrays the working of a profound interest in the technique of his chosen profession. The style of the earliest plays is essentially rhetorical; the blank verse is stiff and little varied in rhythm; and the periods are built up of parallel and antithetic sentences, and punctuated with devices of iterations, plays upon words, and other methods of securing emphasis, that derive from the bad tradition of a popular stage, upon which the players are bound to rant and force the note in order to hold the attention of a dull-witted audience. During the plague-vacations of 1592 to 1594, Shakespeare tried his hand at the ornate descriptive poetry of *Venus and Adonis* and *Lucrece;* and the influence of this exercise, and possibly also of Italian travel, is apparent in the next group of plays, with their lyric notes, their tendency to warm southern colouring, their wealth of decorative imagery, and their elaborate and not rarely frigid conceits. Rhymed couplets make their appearance, side by side with blank verse, as a medium of dramatic dialogue. It is a period of experiment, in farce with *The Taming of the Shrew,* in satirical comedy with *Love's Labour's Lost,* in lyrical comedy with *A Midsummer Night's Dream,* in lyrical tragedy with *Romeo and Juliet,* in lyrical history with *Richard II.,* and in romantic tragicomedy with *The Two Gentlemen of Verona* and with the masterpiece of this singular genre, *The Merchant of Venice.* It is also the period of the sonnets, which have their echoes both in the phrasing and in the themes of the plays; in the black-browed Rosaline of *Love's Labour's Lost,* and in the issue between friendship and love which is variously set in *The Two Gentlemen of Verona* and in *The Merchant of Venice.* But in the latter play the sentiment is already one of retrospection; the tempest of spirit has given way to the tender melancholy of renunciation. The sonnets seem to bear witness, not only to the personal upheaval of passion, but also to some despondency at the spite of fate and the disgrace of the actor's calling. This mood too may have cleared away in the sunshine of growing popularity, of financial success, and of the possibly long-delayed return to Stratford. Certainly the series of plays written during the next few years are light-hearted plays, less occupied with profound or vexatious searchings of spirit than with the delightful externalities of things. The histories from *King John* to *Henry V.* form a continuous study of the conditions of kingship, carrying on the political speculations begun in *Richard II.* and culminating in the brilliant picture of triumphant efficiency, the Henry of Agincourt. Meanwhile Shakespeare develops the astonishing faculty of humorous delineation of which he had given foretastes in Jack Cade, in Bottom the weaver, and in Juliet's nurse; sets the creation of Falstaff in front of his vivid pictures of contemporary England; and passes through the half-comedy, half melodrama of *Much Ado About Nothing* to the joyous farce of *The Merry Wives of Windsor,* and to his two perfectly sunny comedies, the sylvan comedy of *As You Like It* and the urban comedy of *Twelfth Night.*

There then comes a change of mood, already heralded by *Julius Caesar,* which stands beside *Henry V.* as a reminder that efficiency has its seamy as well as its brilliant side. The tragedy of political idealism in Brutus is followed by the tragedy of intellectual idealism in Hamlet; and this in its turn by the three bitter and cynical pseudo-comedies: *All's Well That Ends Well,* in which the creator of Portia, Beatrice, Rosalind and Viola drags the honour of womanhood in the dust—*Troilus and Cressida,* in which the ideals of heroism and of romance are confounded in the portraits of a wanton and a poltroon—and *Measure for Measure,*

in which the searchlight of irony is thrown upon the paths of Providence itself. Upon the causes of this new perturbation in the soul of Shakespeare it is perhaps idle to speculate. The evidence of his profound disillusion and discouragement of spirit is plain enough; and for some years the tide of his pessimistic thought advances, swelling through the pathetic tragedy of *Othello* to the cosmic tragedies of *Macbeth* and *King Lear*, with their Titan-like indictments not of man alone, but of the heavens by whom man was made. Meanwhile Shakespeare's style undergoes changes no less notable than those of his subject-matter. The ease and lucidity characteristic of the histories and comedies of his middle period give way to a more troubled beauty, and the phrasing and rhythm often tend to become elliptic and obscure, as if the thoughts were hurrying faster than speech can give them utterance. The period closes with *Antony and Cleopatra* and *Coriolanus*, in which the ideals of the love of woman and the honour of man are once more stripped bare to display the skeletons of lust and egoism, and in the latter of which signs of exhaustion are already perceptible; and with *Timon of Athens*, in which the dramatist whips himself to an almost incoherent expression of a general loathing and detestation of humanity. Then the stretched cord suddenly snaps. *Timon* is apparently unfinished, and the next play, *Pericles*, is in an entirely different vein, and is apparently finished but not begun. At this point only in the whole course of Shakespeare's development there is a complete breach of continuity. One can only conjecture the occurrence of some spiritual crisis, an illness perhaps, or some process akin to what in the language of religion is called conversion, which left him a new man, with the fever of pessimism behind him, and at peace once more with Heaven and the world.

The final group of plays, the Shakespearian part of *Pericles*, *Cymbeline*, *The Winter's Tale*, *The Tempest*, all belong to the class of what may be called idyllic romances. They are happy dreams, in which all troubles and sorrows are ultimately resolved into fortunate endings, and which stand therefore as so many symbols of an optimistic faith in the beneficent dispositions of an ordering Providence. In harmony with this change of temper the style has likewise undergone another change, and the tense structure and marmoreal phrasing of *Antony and Cleopatra* have given way to relaxed cadences and easy and unaccentuated rhythms. It is possible that *The Winter's Tale* and *The Tempest*, Shakespeare's last plays, with the unimportant exceptions of his contributions to Fletcher's *Henry VIII.* and *The Two Noble Kinsmen*, were written in retirement at Stratford. At any rate the call of the country is sounding through them; and it is with no regret that in the last pages of *The Tempest* the weary magician drowns his book, and buries his staff certain fathoms deep in the earth. (E. K. C.)

TEXTUAL CRITICISM

The early editors were concerned with two points—to produce an eclectic text and to cure verbal difficulties by conjecture. Pope (1723–25) made the text "correct" and regular. Theobald (1733) reduced the "science of criticism" to three points, "the emendation of corrupt passages, the explanation of obscure and difficult ones, and an inquiry into the beauties and defects of composition." He collated the early texts and made some famous emendations, e.g., "*a' babbled* of green fields" in *Henry V.*, II. iii. 17. Warburton's uncritical method was satirized by Thomas Edwards (1747). On the resort to conjecture Dr. Johnson finely said (1765): "It has been my settled principle that the reading of the ancient books is probably true, and therefore is not to be disturbed for the sake of elegance, perspicuity, or mere improvement of the sense." Capell (1768) was scholarly. The Johnson-Steevens text of 1773 was re-issued in 1786 by Isaac Reed. Edmund Malone (1790, 1821) exposed the corruption caused by misprints, ignorance of Shakespeare's phraseology, and ignorance of the texts Shakespeare used; and he discussed critical problems such as the genuineness of the *Henry VI.* plays. Of later editors Alexander Dyce was sound and careful. But the Cambridge Shakespeare (by W. G. Clark, John Glover and Aldis Wright, 1863–66; re-issued by Wright, 1891–93) gathered up in a complete critical apparatus the results of the older learning and almost became a *textus receptus*.

The new scholarship is bibliographical. In 1908 W. W. Greg proved from the technical evidence of water-marks, devices and type, that nine quartos—*The Merchant of Venice* and *A Midsummer Night's Dream* (Roberts, "1600"), *King Lear* (Butter. "1608"), *Henry V.* ("1608") *Pericles* and *The Merry Wives* ("1619"), and the spurious *Whole Contention*, *A Yorkshire Tragedy*, and *Sir John Oldcastle*—were printed by William Jaggard in 1619. In *Shakespeare Folios and Quartos* (1909) A. W. Pollard rounded off the evidence with a new classification of the Quartos into "Good" and "Bad," showing that Heminge and Condell in compiling the copy for the First Folio replaced the "Bad Quartos" by good playhouse texts, used independent mss. of four plays, but otherwise sent to press the texts of the "Good" First Quartos or of later editions of these then on the market. The authoritative text for each play was thus accurately determined.

The significance of the old rhetorical punctuation was shown by Percy Simpson in *Shakespearian Punctuation* (1911) and A. W. Pollard in *King Richard II.: A New Quarto* (1916).

In *Shakespeare's Fight with the Pirates* (1917) A. W. Pollard showed the possibility that the "Good Quartos," some of which were printed from prompt-copies, were set up from Shakespeare's autograph.

Palaeography came in with Sir Edward Maunde Thompson's *Shakespeare's Handwriting* (1916). He identified as Shakespeare's the handwriting of one scene in the *Book of Sir Thomas More* (Harley ms. 7368, folios 8, 9). The evidence was restated and amplified in *Shakespeare's Hand in the Play of Sir Thomas More*, edited by A. W. Pollard (1923). In this book J. Dover Wilson classified the peculiar spellings of the "Good Quartos," showed that misprints in them were misreadings of the English script which Shakespeare wrote, and produced parallels from the scene in the play. Sir Edward's claim has been criticized, but only one critic, Samuel A. Tannenbaum, in *Problems in Shakespeare's Penmanship* (1927), has attempted to tackle the handwriting. (P. Si.)

THE BACON-SHAKESPEARE THEORY

The thesis that the plays and poems ascribed to Shakespeare were the work of Francis Bacon appears to have been first thrown out in *The Life and Adventures of Common Sense* (1769) by Herbert Lawrence, without attracting critical attention. It emerged again in 1848, in J. C. Hart's *The Romance of Yachting* (N.Y.), taking stronger shape later in an article, "Who Wrote Shakespeare?" in *Chambers' Journal* (Aug. 5th, 1852). In all forms it appears to proceed upon *a priori* belief that the "Stratford actor" *could not* have possessed the scholarly and other qualifications supposed to be revealed in the works ascribed to him. This primary negative position is taken for granted alike in the merely negative "anti-Stratfordian" polemic of later years, and in the series of recent theories which undertake to supersede the claim for Bacon by similar claims made for the earls of Rutland, Derby and Oxford, successively.

The negative position would appear to have been originally suggested by the hyperbolical accounts given of the playwright by quite orthodox Shakespearians, as an accomplished classical scholar and a trained lawyer, abreast of all the philosophy and science of his time. The definite claim for Bacon's authorship was first fully set forth by William Henry Smith, who published in 1856, in the form of a letter to Lord Ellesmere, what appeared in 1857 in extended form, but still as a small book, under the title, *Bacon and Shakespeare: An Enquiry Touching Players, Playhouses and Play-Writers in the Days of Elizabeth.* Smith's procedure was to insist: (1) on the scantiness of our knowledge of Shakespeare's life, and at the same time to assume (2) that we know he cannot have possessed the culture required for the composition of the plays; noting further (3) that Bacon had the necessary culture; taking for granted (4) that he had all the requisite poetic and dramatic faculty; and assuming (5) that there need be no difficulty in believing that during 20 years he was secretly producing plays for Shakespeare's company at the risk of discrediting himself as a serious statesman. (6) For the rest, parallel passages (mostly

irrelevant) in Bacon's works and the Folio are cited to suggest that the plays really came from Bacon's pen, though Smith did not claim to have proved this.

The later evolution of the Baconian case involved the ascription to Bacon of the works of Marlowe and most of the other Elizabethan dramatists; the theorists, from Smith onwards, having, in general, no perception of the nature of versification; and to the list were further added Lyly's *Euphues,* Spenser's poems, the *Arte of English Poesy* ascribed to Puttenham, the whole works of Nashe, and Burton's *Anatomy of Melancholy.* As students may discover for themselves, the phraseology supposed at first to have been special to the works of Bacon and Shakespeare is normal in Elizabethan literature. Accordingly, when "Baconian" phrases were found in Florio's translation of Montaigne, Ignatius Donnelly ascribed that translation to Bacon; and Sir Edwin Durning Lawrence rounded the theory by the larger inference that Bacon was the real author of Montaigne's *Essais* in the original, having composed them as a youthful exercise in French.

Started in England, the Baconian campaign was, for a time, specially furthered in the United States by the work of Judge Nathaniel Holmes on *The Authorship of Shakespeare* (1866–86). Later, I. Donnelly contributed in his large work, *The Great Cryptogram* (1888), the theorem that Bacon had embedded in the plays a cipher narrative declaring his authorship. That claim, which was met by the demonstration that on Donnelly's methods any narrative could be extracted from any book of sufficient size, was rejected even by many Baconians. But Donnelly's simpler procedure of deducing identity of authorship from use of really common words and phrases was accepted and acclaimed by Lord Penzance (*On the Bacon-Shakespeare Controversy,* 1902) who dismissed the cipher. The summary of the movement is that, whereas it originated in a comprehensive ignorance of Elizabethan literature apart from Bacon and Shakespeare, the extension of knowledge forced upon its adherents has led to the ascription by them of practically the whole literature to Bacon.

Though the extravagances and the exposures of the procedure presumably checked acceptance of the theory, it was diligently developed until recent years, and is still represented by a Bacon Society and its periodical, *Baconiana.* Mrs. E. W. Gallup's cipher (*The Bi-Literal Cypher of Francis Bacon,* 1900) was an enterprising advance on Donnelly's; but when it was pointed out that the cipher had made Bacon employ Pope's future translation of Homer, faith was chilled; and the "anti-Stratfordian" temper found new outlets. In 1912 appeared the work of Prof. Celestin Demblon, of Brussels, *Lord Rutland est Shakespeare,* ascribing the authorship of the plays to Roger Manners, 15th earl of Rutland. This appears to have been suggested by the previous German work of Karl Bleibtreu, *Der wahre Shakespeare* (1907). In 1919 came the rival theory of Prof. Abel Lefranc of the Collège de France, *Sous le masque de "William Shakespeare"; William Stanley, VIe Comte de Derby,* introducing a third claimant; and in 1920 a fourth was presented by J. Thomas Looney, in his *Shakespeare Identified in Edward de Vere, the Seventeenth Earl of Oxford.* Since that date there has been a lull in the production of claimants. Each of the works cited negates the others, though all assume that the Stratford actor cannot possibly be the true author.

The theories, advanced by Baconians, proceed thus from a negative supposition. For instance, there is no proof that any of the four peers, above mentioned, ever wrote a line of blank verse. The "Shakespearean" reply to the Baconian theories may be stated. It is asserted by the orthodox authorities that Baconians merely evade the incontrovertible evidence for the authorship by "Shaxper" or Shakespeare of the poems published by him as his work, and the bulk of the contents of the folio volume of plays published as his, though criticism has long recognized that a number are adaptations or collaborations. Over and above other contemporary tributes to the actor-author, we have insuperable testimony in the poems by Ben Jonson prefixed to the Folio, wherein the "orthodox" claim for Shakespeare as a trained classical scholar is forestalled by the friendly avowal that he had "small Latin and less Greek." (This testimony W. H. Smith declared to be quite inapplicable to the playwright, but applicable to Bacon as an inferior Latinist.)

The further claim for the playwright as exceptionally skilled in legal technicalities was possible only through inattention to the contemporary drama. Students can see for themselves that in three or four plays of Jonson and Chapman, though neither was a lawyer, there is much more parade of technical legal knowledge than is to be found in the entire Folio. Such parade was, in fact, a common feature of the drama, poetry and prose literature of the age. All the "anti" theories, finally involve the assumption that the plays and poems could be more or less widely *known* to be the secret work of one or another aristocrat, while Jonson, the most widely associated literary man of the age, knew nothing about it. Thus a kind of thesis which finds its motive in the assumed improbability of the possession of abnormal literary genius by an actor who had left school at 14, has accumulated through all its variants a mass of improbabilities not to be matched in speculative research on any other field. It is, in fact, only as an extraordinary growth of critical extravagance that the Bacon-Shakespeare movement and its *sequelae* can hold literary attention.

Bibliography.—The literature of the Bacon-Shakespeare debate and kindred speculation runs to many hundreds of volumes in various languages, and a multitude of articles in periodicals. In addition to the pro-Baconian and other works above cited may be named:—Delia Bacon, *The Philosophy of the Plays of S. unfolded* (1857, anti-S. but not definitely Baconian); *The Promus of Formularies and Elegancies by Francis Bacon,* edited by Mrs. Henry Pott (1883, from previously unpublished mss.); W. H. Wyman, *Bibliography of the Bacon-S. Controversy* (Cincinnati, 1884, 255 entries); R. M. Theobald, *S. Studies in Baconian Light* (rep. 1901); G. C. Bompas, *The Problem of the S. Plays* (1902); Edwin Borman, *Francis Bacon's Cryptic Rhymes, and the Truth they Reveal* (1906); Sir E. Durning-Lawrence, Bt., *Bacon is S.* (1910); H. C. Batchelor, *Francis Bacon wrote S.* (1912); W. T. Smedley, *The Mystery of Francis Bacon* (1912); Parker Woodward, *Sir Francis Bacon, Poet-Philosopher-Statesman-Lawyer-Wit* (1920); E. W. Smithson, *Baconian Essays* with introd. and two essays by Sir G. G. Greenwood (1922). The last named writer has produced several "anti-Stratfordian" but non-Baconian works, of which the chief are *The S. Problem Restated* (1908) and *Is there a Shakespeare Problem?* (1916).

Among anti-Baconian works may be named:—*William S. not an Impostor, By an English Critic* (J. G. H. Townsend, 1857)—the first rejoinder in book form; T. D. King, *Bacon versus S., a Plea for the Defendant* (1875); Mrs. C. C. Stopes, The *Bacon-S. Question* (rev. ed., 1889); E. Marriott, *Bacon or S., An Historical Enquiry* (1879); L. Schipper, *S. und dessen Gegner* (Münster, 1895); W. C. Devecmon, of the Maryland bar, *In re S.'s "Legal Acquirements"* (1899); Judge Willis, *The S.-Bacon Controversy* (1902), and *The Baconian Mint* (1903); Charles Crawford, *The Bacon-S. Question,* in 2nd series of his *Collectanea* (1907); Dean Beeching, *William S., Player, Playmaker and Poet: A Reply to Mr. George Greenwood* (1908); Andrew Lang, *S., Bacon and the Great Unknown* (1912); J. M. Robertson, *The Baconian Heresy,* a confutation (1913).

(J. M. R.)

THE PORTRAITS OF SHAKESPEARE

The mystery that surrounds much in the life and work of Shakespeare extends also to his portraiture. The fact that the only two likenesses of the poet that can be regarded as carrying the authority of his co-workers, his friends, and relations—yet neither of them a direct life-portrait—differ in certain essential points, has opened the door to controversy and encouraged the advance and foolish acceptance of numerous wholly different types. The result has been a swarm of portraits which may be classed as follows: (1) the genuine portraits of persons not Shakespeare but not altogether unlike the various conceptions of him; (2) memorial portraits often based on one or other of accepted originals, whether those originals are worthy of acceptance or not; (3) portraits of persons known or unknown, which have been fraudulently "faked" into a resemblance of Shakespeare; and (4) spurious fabrications made for imposition upon the public.

The two portraits which can be accepted without question as authentic likenesses are—the Bust (really a half-length statue) with its structural wall-monument in the choir of Holy Trinity Church, Stratford-on-Avon, and the copper-plate engraved by Martin Droeshout as frontispiece to the First Folio of Shakespeare's plays (and used for three subsequent editions) published in 1623, although first printed in the previous year.

BY COURTESY OF (1, 4) THE NATIONAL PORTRAIT GALLERY, LONDON, (3) THE GOVERNORS OF THE SHAKESPEARE MEMORIAL THEATRE, STRATFORD-ON-AVON, (5) M. H. SPIELMANN, (6) GEO. M. CUSHING, (11) COPR. THE GARRICK CLUB; PHOTOGRAPHS, (2) DONALD MCLEISH, (8) HAROLD BAKER

BIRTHPLACE AND PORTRAITS OF WILLIAM SHAKESPEARE

1. The "Droeshout Print" of Shakespeare, prefixed to the first folio edition of his plays in 1623
2. The birthplace of Shakespeare, in Stratford-on-Avon
3. The "Flower Portrait" called the "Droeshout original," in the Shakespeare Memorial Museum, Stratford-on-Avon
4. The "Chandos" portrait attributed to Richard Burbage, from a painting in the National Portrait Gallery, London
5. The "Cosway Zuccaro" copied in miniature by Charlotte Jones in 1823. The miniature is in England but the portrait is in America
6. The "Boston Zuccaro," or "Joy Portrait," now in Boston, U.S.A. The picture has been attributed to an artist of the Flemish school
7. Marble statue of Shakespeare by Prof. O. Lessing erected in Weimar, Germany, in 1904
8. Bust and monument of Shakespeare erected in the north wall of the choir of Holy Trinity church, Stratford-on-Avon. Before 1623 it was executed in England by Garret and Nicholas Johnson, of Flemish race
9. Statue by Louis Hasselriis, a Danish sculptor; this was executed about the beginning of this century and is now in Kronborg Castle, Denmark. Early twentieth century
10. Statue by Frederick W. MacMonnies, in the Library of Congress, Washington, D.C., executed in 1898
11. Bust by Augusto Possaglio of Florence, presented to the Garrick Club, London, in 1876

The Stratford bust and monument must have been erected on the north wall of the chancel or choir within, at most, the six years that followed Shakespeare's death in 1616, as it is mentioned in the prefatory memorial lines by Leonard Digges in the First Folio: probably, three or four years earlier. The design in its general aspect was one often adopted by the "tombe-makers" of the period, though not originated by them, and according to Dugdale was executed by a Fleming resident in London since 1567, Garratt Johnson (Gerard Janssen), a denizen. The bust is believed to have been commissioned by the poet's son-in-law, Dr. John Hall, and, like the Droeshout print, must have been seen by and likely enough had the approval of Mrs. Shakespeare, who did not die until August 1623. It is thought to have been modelled from either a life or death mask, and inartistic as it is has the marks of facial portraiture and is not a generalization such as was common in funereal sculpture. According to the practice of the day, especially at the hands of Flemish sculptors of memorial figures, the bust was coloured; this is sufficient to account for the technical summariness of the modelling and of the forms. Thus the eyebrows are but slightly indicated by the chisel, and a solid surface represents the teeth of the open mouth: the brush was evoked to supply effect and detail. To the colour, as poorly reapplied after the removal of the white paint with which Malone had had the bust covered in 1793, must be attributed a good deal of the wooden appearance which is now a shock to many. The bust is of soft stone, but a careful examination of the work reveals no sign of the alleged breakage of the nose and repair to which some writers have attributed the apparently inordinate length of the upper lip. This appearance is to a great extent an optical illusion, the result partly of the smallness of the nose and, mainly, of the thinness of the moustache that shows the flesh above and below. Some repair was made to the monument in 1649, and again in 1748, but there is no mention in the church records of any meddling with the bust itself. Owing, however, to the characteristic inaccuracy of the print by one of Hollar's assistants in the illustration of Dugdale's *Antiquities of Warwickshire* (1656), certain writers have been misled into the belief that the whole monument and bust were not merely restored but replaced by others which we see to-day. As other prints in the volume are known to depart grossly from the objects represented, and as Dugdale, like Vertue, was at times equally loose in his descriptions and presentments, there is no reason to believe that the bust and the figures above it are other than those originally placed in position. Moreover, in style, they are strictly of their period. Other engravers, following the Dugdale print, have further stultified the original, but as they differ among themselves, little importance need be attached to the circumstance. A warning should be uttered against many of the so-called "casts" of the bust. George Bullock took a cast in 1814 and Signor A. Michele another about forty years after, but those attributed to W. R. Kite, W. Scoular, and others, are really misleading copies.

Mention should here be made of the "Kesselstadt Death Mask," now at Darmstadt, as that has been claimed as the true death-mask of Shakespeare, and by it the authenticity of other portraits has been gauged. In three places on the back of it is the inscription, +A°D$\bar{\text{m}}$ 1616, and this is the sole actual link with Shakespeare. The cast first came to light in 1849 when Dr. Becker bought it in a broker's rag shop in Mainz and coolly assumed it to be the unnamed "plaster of Paris cast" which had appeared in the death-sale at Mainz of Count Kesselstadt in 1847. Upon this an ill-judged theory has been elaborated, but nothing has been carried beyond the point of bare conjecture, while the arguments against the authenticity of the cast are strong and cogent. The handsome and refined aspect of the mask accounts for much of the favour in which it has been held.

The "Droeshout print" derives its importance from its having been executed at the order of Heminge and Condell to represent, as a frontispiece to the *Plays*, and put forth as his portrait, the man and friend to whose memory they paid the homage of their adventure. The volume was to be his real monument, and the work was regarded by them as a memorial erected in a spirit of love, pride, and veneration. Mrs. Shakespeare must have seen the print; Ben Jonson extolled it—his dedicatory verses, however should be regarded in the light of conventional approval. An authentic portrait, since lost, must necessarily have been the basis of the engraving. Sir George Sharf, judging from the contradictory lights and shadows in the head, astutely concluded that the original must have been a shadowless limning which the youthful engraver attempted to put into chiaroscuro with but partial success. That this is truly the case is shown by the so-called "unique proof" discovered by Halliwell-Phillipps, and now in Mr. H. C. Folger's collection in America. Another copy is in the Bodleian Library. In this plate the head is far more human, and the bony structure corresponds. In the "proof," moreover, there is a thin, wiry moustache, afterwards widened in the print as used; and in several other details there are divergencies. In this engraving by Droeshout the body is too small for the head, and the dress is out of perspective: an additional argument that the unpractised engraver had only a drawing of a head to work from, for while the head shows the individuality of portraiture the body is as clearly guesswork. The "first proof" is conclusive evidence against the contention that the "Flower Portrait" at the Shakespeare Memorial Museum, Stratford-on-Avon—too boldly entitled the "Droeshout original"—is the original painting from which the engraving was made and is, therefore, the actual life-portrait for which Shakespeare sat. We find that several details in the proof—the incorrect illumination, the small moustache (such as we see, at the same period, in Isaac Oliver's miniature of Shakespeare's contemporary, Richard Sackville, 3rd earl of Dorset, dated 1616), the shape of the eyebrow and of the deformed ear, etc.—have been corrected in the painting, in which further improvements are also imported. The conclusion is therefore irresistible. It is possible that the picture may be the earliest painted portrait of the poet—probably executed in the earlier half of the 17th century; but the inscription—*Willm̃ Shakespeare,* 1609—is suspect on account of being written in cursive script, the only known example at the date to which it professes to belong. The most interesting parallel to this portrait is perhaps that by William Blake, now in the Manchester Corporation Art Gallery; and one of the cleverest imitations of an old picture in the "Buttery" or "Ellis portrait," acquired by an American collector in 1902. It is curious that the "Thurston miniature" done from the Droeshout print gives the moustache of the "proof,"—the same moustache as appears in the late Sir James Fergusson's oil portrait of Shakespeare.

Two other portraits of the same character of head and arrangement are the "Ely Palace portrait" and the "Felton portrait." The "Ely Palace portrait" was discovered in 1845 in a broker's shop, and was bought by Thomas Turton, bishop of Ely, who died in 1864. It bears the inscription "A 39+1603," and it shows a moustache and a right eyebrow identical with those in the Droeshout "proof." Some hailed it as the original of the print; others dismissed it as a "make-up": at the same time it has not been proved a fraud. The "Felton portrait," which made its first appearance in 1792, had the championship of the cynical Steevens and other authorities, as the original of the Droeshout print, while a few of those who believed in the "Chandos portrait" denounced it as "a rank forgery." On the back of the panel was traced in a florid hand "Gul. Shakespear 1597 R.B." (by others read "R.N."). If R. B. were correct, it is contended the initials indicate Richard Burbage, Shakespeare's fellow-actor. (Boaden's copy, made in 1792, repeating the inscription on the back, has "Guil. Shakspeare 1587 R.N.") The spelling of Shakespeare's name—which in succeeding ages has been governed by the fashion of the day—has a distinct bearing on the authenticity of the panel. At the first appearance of the "Felton portrait" in a London sale-room it was bought by Samuel Felton of Drayton, Shropshire, for five pounds, along with a pedigree which carried its refutation along with it. Nevertheless, it bears evidence of being an honest painting of somebody done from life. Richardson, the printseller, issued fraudulent engravings of it by Trotter and others (by which it is best known) adding a body in the Droeshout costume and then maintaining that the work was the original of the Droeshout print and therefore a life-portrait of Shakespeare.

The "Janssen" or "Somerset portrait" is in many respects the most interesting painted likeness called "Shakespeare," as it is undoubtedly the finest of all the paintings in the series. It is certainly a genuine as well as a very beautiful picture, and bears the inscription—$\frac{\text{Æ}^{t}\,46}{1610}$—but doubt has rightly been expressed whether the 6 of 46 has not been tampered with, altered from 0 to fit Shakespeare's age. It was first truly revealed in the photograph of the original published in 1909 (in *The Connoisseur*) by permission of the owner, the late Lady Guendolen Ramsden, daughter of the duke of Somerset, the previous possessor. Charles Jennens, the eccentric amateur editor of *King Lear* issued in 1770, was the first known owner; he shrank from the challenge to produce the picture. It is more than likely that Janssen was the painter of it at his best; but it is idle to claim it as a likeness of Shakespeare. A number of good copies of it exist, all but one made in the 18th century: the "Croker Janssen" now lost, unless it be Lord Darnley's; the "Staunton," the "Buckston," the "Marsden Janssen," and the copy in the possession of the duke of Anhalt. These are all above the average merit of such work.

The portrait which has made the most popular appeal is that called the "Chandos," successively known as the "d'Avenant," the "Stowe," and the "Ellesmere;" it is now in the National Portrait Gallery. Tradition, tainted at the outset, attributes the authorship of it to Richard Burbage, who is alleged to have given it to his fellow-actor Joseph Taylor, who bequeathed it to Sir William d'Avenant, Shakespeare's godson. As a matter of fact, Taylor died intestate. Thenceforward, whether or not it once belonged to d'Avenant, its history is clear. At the great Stowe sale of the effects of the duke of Buckingham and Chandos (who had inherited it) the earl of Ellesmere bought it and then presented it to the nation. Many serious inquirers have refused to accept this romantic, Italian-looking head here depicted as a likeness of Shakespeare of the Midlands, if only because in every important physiognomical particular, and in face-measurement, it is contradicted by the Stratford bust and the Droeshout print. Oldys, indifferent to tradition, attributed it to Janssen, an unallowable ascription. That it has not been radically altered by the restorer is proved by the fine copy painted by Sir Godfrey Kneller, and by him presented to John Dryden. D'Avenant had died in 1668, and so could not, as tradition contends was the case, have been the donor. In Malone's time the picture was already in the possession of the earl Fitzwilliam. This at least proves the esteem in which the Chandos portrait was held by some so far back as the end of the 17th century, only 70 years after Shakespeare's death.

From among the innumerable copies and adaptations of the Chandos portrait a few emerge as having a certain importance of their own. That which Sir Joshua Reynolds is traditionally said to have made for the use of Roubiliac, then engaged on his statue of Shakespeare for David Garrick (now in the British Museum), and another alleged to have been done for Bishop Newton, are now lost. One by Ranelagh Barret was presented in 1779 to Trinity College Library, Cambridge. Dr. Matthew Maty, principal librarian of the British Museum, presented his copy, almost certainly by Roubiliac, to the museum in 1760. There are also the smooth but rather original copy (with drapery added) belonging to the earl of Bath at Longleat; the Warwick Castle version; the Lord St. Leonards; another copy in coloured crayons, formerly in the Jennens collection, afterwards belonging to Lord Howe, by van der Gucht; the Shakespeare Hirst picture, based on Houbraken's engraving, and the Baverstock portrait. The full-size chalk drawing by Ozias Humphry, R.A., at the Birthplace, Malone guaranteed to be a perfect transcript.

The "Lumley portrait" represents a heavy-jowled man with pursed-up lips, and with something of the expression but little of the vitality of the Chandos, the original of which George Rippon, when its owner, declared it to be (*c.* 1848). It was claimed to have belonged to John, Lord Lumley, of Lumley Castle, Durham, who died in 1609, but the evidence wholly fails. When in Rippon's possession the picture was so superbly chromo-lithographed by Vincent Brooks that copies of it, mounted on old panel or canvas, and varnished, have often changed hands as original paintings. It is thinly painted and scarcely looks the age that is claimed for it; but it is an interesting work which, in 1875, entered the collection of the late Baroness Burdett-Coutts and has since passed to America.

To Frederigo Zuccaro are attributed three of the more important portraits now to be mentioned; upon him also have been foisted several of the more impudent fabrications herein named. The "Bath" or "Archer portrait"—it having been in the possession of the Bath Librarian, Archer, when attention was first drawn to it in 1859—is worthy of Zuccaro's brush. It is Italian in feeling and in type, with an inscription ("W. Shakespeare") in an Italian but apparently more modern hand, and it is curious that in certain respects it bears some resemblance not only to the Chandos, and to the Droeshout and Janssen portraits, but also to the "death-mask"; yet it differs in essentials from all. If this refined and dandified and beautifully-painted portrait represents Shakespeare at about the age of 30, that is to say in 1594, the actor-dramatist had made astonishing progress in the world; but Zuccaro came to England in 1574, and as his biographers state "did not stay long." The conclusion appears to be definite. It is another of the Baroness Burdett-Coutts's portraits which have been acquired in America.

Stronger objection applies to the "Boston Zuccaro" or "Joy portrait," now in Boston, U.S.A.—a picture with a not wholly convincing pedigree, and tradition. It is in very fair condition and appears to be a good picture of the Flemish school; but the declaration that it was found in the Globe Tavern which was frequented by Shakespeare and his associates must be held subject to the circumstance that no such tavern is known with any certainty ever to have existed.

The "Cosway Zuccaro" portrait is also in America; but the reproduction of it exists in England in the miniature of it by Cosway's pupil, Charlotte Jones, painted in 1823, as well as in the rare mezzotint by Hanna Greene. Somewhat resembling Shelley in caricature, it suggests an unusual portrait (if authentic) of Shakespeare. The inscription on the back, "Guglielm: Shakespear," with its mixture of Italian and English, resembles in wording and spelling that adopted in the case of several pictures, the reliability of which is disputed. Wivell attributed it to Lucas Franchois.

Of the "Burdett-Coutts portrait" (the fourth interesting portrait of Shakespeare formerly the possession of the Baroness and then of Mr. Burdett-Coutts) there is no history whatever to record. The picture is admirably executed, but the face is weak and is the least satisfactory part of it. Shakespeare's shield, crest, with red mantling, and the figure "37" beneath it, appear on the background, in the manner adopted in 17th century portraits. From this picture the "Craven portrait" seems to have been derived.

Equally striking is the "Ashbourne portrait," well known through G. F. Storm's mezzotint of it. It is sometimes called the "Kingston portrait" as the first known owner of it was the Rev. Clement U. Kingston, who issued the engraving in 1847. It is an important three-quarter length, representing a refined, fair-haired Englishman, in black, standing beside a table at the corner of which is a skull whereon the figure rests his right forearm. It is an acceptable likeness of Shakespeare, in the manner of Paul von Somer. The inscription "AETATIS SVAE. 47. A° 1611," and the suspect decoration of *cross* spears on a book held by the right hand, are also raised from the ground, so that it would be injudicious to decide that these are not later additions. In 1928 it passed into American possession.

More famous, but less reputable, is the "Stratford" or "Hunt portrait," in the Birthplace at Stratford. It had been in the Hunt family for many years and represented a black-bearded man. Collins, the picture cleaner, removed the top figure from the dilapidated canvas with spirit and found beneath it the painted version of the Stratford bust. Then Collins (always a suspect in this matter) proceeded with the restoration, and by treatment of the hair made the portrait more than ever like the bust; and the picture thereupon was claimed to be the original from which the bust was made, although the style of the painting suggests a date not later than the latter half of the 18th century.

The "Duke of Leeds portrait," for many years at Hornby

castle, but without a history, slightly recalls the Janssen portrait. There is nothing but the "wired band" to connect it with Shakespeare. Much the same may be said of the "Welcombe portrait," which was bought by Mark Phillips of Welcombe and came into the possession of the late Sir George Trevelyan. It is a fairly good picture, having some resemblance to the "Boston Zuccaro" with something of the Chandos. Two other portraits at the Shakespeare Memorial should be named: the "Venice portrait," which was bought in Paris and is said to have come from Venice, bearing on the back an Italian undecipherable inscription—it seems to have no connection with Shakespeare; and the "Jacob Tonson portrait," 1735, which was probably executed for Tonson's 4th edition of Shakespeare, but not used.

The "Soest portrait" (often called Zoust or Zoest), formerly known as "the Douglas," the "Lister Kaye" or the "Clarges portrait," according to the owner of the moment, was for many years a public favourite, mainly through J. Simon's excellent mezzotint. Soest was not born until 1637, and according to Granger the picture was painted in Charles II.'s reign. A number of copies exist, two of which are at the Shakespeare Memorial.

Of the "Charlecote portrait," which was exhibited publicly at Stratford in 1896, the chief resemblance to Shakespeare lies in his baldness, and wired band. The fact that it was once in the possession of the Rev. John Lucy lent it a sort of reputation, although he bought it in 1853.

Similarly, the "Hampton Court portrait" derives such interest as it possesses from the fact that William IV. bought it as a portrait of Shakespeare, and lodged it in the Palace. Similarly unacceptable is the "H. Danby Seymour portrait" which was lent to the National Portrait Exhibition of 1866 (said to be still in the possession of that family). It is a fine three-quarter length in the Miervelt manner. The "Lytton portrait," a gift made to a former Lord Lytton after it had emerged from Windsor Castle, is mainly interesting as having been copied by Miller in his original profile engraving of Shakespeare. The "Rendelsham" and "Crooks" portraits also belong to the class of capital paintings representing some one other than Shakespeare; and the same may be said of the "Grafton" or "Winston" portrait, the "Sanders," the "Gilliland" (an old man's head absurdly advanced by Wivell), the striking "Thorne Court portrait," the "Aston Cantlow," the "Burn," the "Gwennet," and the "Wilson" portraits, and others.

Miniature-painting has assumed a certain importance in relation to the subject. The "Welbeck Abbey," or "Harleian miniature," is that which Walpole caused to be engraved by Vertue for Pope's edition of Shakespeare (1723–1725), but which Oldys declared, incorrectly, to be a juvenile portrait of James I. According to Scharf, it belonged to Robert Harley, 1st earl of Oxford, but whence it came is not known. It has been denounced as a piece of arrant sycophancy that Pope adopted this beautiful but unauthenticated portrait, simply in order to please the aristocratic patron of his literary circle. It measures 2 in. high; Vertue's exquisite engraving, executed in 1721, enlarged it to 5¼ in., and became the "authority" for numerous copies, British and foreign. The "Somerville" or "Hilliard miniature," long owned by Lord and Lady Northcote, is claimed to have descended from Shakespeare's friend, Somerville of Edstone, grandfather of the poet Somerville. It was first known in 1818 when in the possession of Sir James Bland Burges. It is certainly by Hilliard, but it hardly conforms to the appearance of the poet. The well-known "Auriol miniature," now in America, is one of the least sympathetic and the least acceptable of the so-called Shakespeare miniatures. Before it came into the hands of the collector, Charles Auriol, its history is unknown. The other principal miniatures of interest, but lacking authority, are the "Waring," the "Tomkinson," the doubtful "Isaac Oliver," the "Mackey" and "Glen" miniatures, and those presented to the Shakespeare Memorial by Lord Ronald Gower, T. Kite, and Henry Graves. These are all contemporary or early works. In this category are a number of enamels by accomplished artists, the chief of them Henry Bone, R.A., H. P. Bone, and W. Essex.

Several recorded painted portraits have disappeared, other than those already mentioned; these include the "Earl of Oxford portrait" and the "Challis portrait." The "Countess of Zetland's portrait," which had its adherents, was destroyed by fire.

There is a class of honestly produced memorial paintings in which earnest attempts have been made to reconstitute the face and form of the poet, combining within them the best and most characteristic features of the earliest portraits. The most successful of these is that by Ford Madox Brown, in Manchester. Those by J. F. Rigaud, R.A., and Henry Howard, R.A., take lower rank. The "Booker portrait," which gained wide publicity in Stratford, might be included here as well as the heads by P. Krämer and Rumpf, which are among those executed in Germany.

Unproved portraits have been at times as ardently accepted as those with some solid claim to consideration. The "Shakespeare Marriage picture" was discovered in 1872. It is a genuine Dutch picture of man and wife weighing out money in the foreground—a frequent subject—while through an open door Shakespeare and, presumably, Ann Hathaway are seen going through the ceremony of handfasting. The inscription and the Shakespeare head (probably the whole group and open door) are unproved. The "Rawson portrait," inscribed with the poet's name, is unproved; it is really a beautiful little study of the Lord Keeper Coventry by Janssen. The "Matthias Alexander portrait" shows a modern head on an old body. The "Belmount Hall portrait" with its pseudo-Garrick ms. inscription on the back, is in the present writer's opinion, doubtful. In the early part of the 19th century two clever "restorers," Holder and Zincke, made a fairly lucrative trade of producing imaginary portraits of Shakespeare and others. Many of these impostures won acceptance, sometimes by the help of the fine engravings which were made of them. Such are the "Stace" and the "Dunford" portraits—so named after the dealers who put them forward: of the latter a copy is in existence known as the "Dr. Clay portrait." The former is based upon the portrait of Robert Carr, earl of Somerset. There are the two "Winstanley portraits," the "Bishop Newton," the "Cygnus Avoniae," the "Norwich" or "Boardman," the "Bellows" or "Talma" portraits—most of them, as well as others, traceable to one or other or both of the enterprising restorers thus named. About a dozen are reinforced, as corroborative evidence, with verses supposed to have issued from the pen of Ben Jonson. These are all to be attributed to one ready pseudo-Elizabethan writer whose identity is known. With these pictures, apparently, should be ranged the composition, now in America, purporting to represent Shakespeare and Ben Jonson playing chess.

The "fancy-portraits" are also numerous. The 18th-century small full-length "Willett portrait" is at the Shakespeare Memorial—a charmingly touched-in little figure. There are many representations of the poet in his study in the act of composition—they include those by Benjamin Wilson (Stratford Town Hall), John Boaden, John Faed, R.A., Sir George Harvey, R.S.A., C. Bestland, B. J. N. Geiger, and the painter of the Warwick Castle picture, etc.; others have for subject Shakespeare reading, either to the Court or to his family, by John Wood, E. Ender, R. Westall, R.A., etc.; or the infancy and childhood of Shakespeare, by George Romney (three pictures), T. Stothard, R.A., John Wood, James Sant, R.A.; and Shakespeare before Sir Thomas Lucy, by Sir G. Harvey, R.S.A., Thomas Brooks, A. Chisholme, etc. These, and kindred subjects such as "Shakespeare's Courtship," have provided infinite material for Shakespeare-loving painters.

The engraved portraits on copper, steel, and wood number many hundreds. Vertue and Walpole speak of an engraved portrait by John Payne (*fl.* 1620, the pupil of Simon Pass and one of the first English engravers who achieved distinction); but no such print has been identified and its existence is doubted. Walpole perhaps confounded it with that by W. Marshall, a reversed and reduced version of the Droeshout, which was published as frontispiece to the spurious edition of Shakespeare's poems (1640). An engraving, to all but expert eyes unrecognizable as a copy, was made from it in 1815, and another later, by Swaine. William Faithorne (d. 1691) is credited with the frontispiece to Quarles's edition of "The Rape of Lucrece, by William Shakespeare, gent." (1655). It was copied for Rodd by R. Sawyer and republished in 1819. It represents the tragic scene between Tarquin and Lucrece, and

above is inset an oval medallion, being a rendering of the Droeshout portrait reversed. Of the earliest engravings from the Chandos portrait, the first is by L. du Guernier (Arlaud type) and that by M. (father of G.) van der Gucht; they are introduced into a pleasing composition. These, like Vertue's earlier prints, look to the left; subsequent versions are reversed. Perhaps the most popular and important up to that time is the line-engraving (to the right) by Houbraken, a Dutchman, done for Birch's "Heads of Illustrious Persons of Great Britain" (1747–1752). This free rendering of the Chandos portrait is the parent of the numerous engravings of "the Houbraken type." Since that date many plates of a high order, from many of the principal portraits, have been issued, in the majority of cases being extremely inaccurate.

Numerous portraits in stained glass have been inserted in the windows of public institutions. Typical of them are the German Chandos windows by Franz Mayer (Mayer & Co.) at Stationers' Hall, and in St. Helens, Bishopsgate (Professor Blaim); that of the Droeshout type in the great hall of the City of London school, and another by John R. Clayton in St. James's, Shoreditch. The Droeshout window by Savill, in the Empire theatre, London, has been removed to be placed, it is said, in the Drury Lane theatre. Ford Madox Brown's design is one of the best ever executed.

We now come to the sculptured memorials. After Gerrard Johnson's bust no statuary portrait seems to have been executed until 1740, when the statue in Poets' Corner, Westminster Abbey, was set up by public subscription, mainly through the activity of the earl of Burlington, Dr. R. Mead, and the poet Pope. It was "invented" by William Kent and carried out by Peter Scheemakers. It is technically good, and is interesting as being the first sculptured portrait of the poet based upon the Chandos picture. A free repetition, reversed and with many changes of detail, is erected in a niche on the exterior wall of the town-hall of Stratford-on-Avon. The marble copy, much simplified, in Leicester Square, is by Fontana, a gift to London by Baron Albert Grant. By L. F. Roubiliac is the statue which in 1758 David Garrick commissioned him to carve and which he bequeathed to the British Museum. Three terra-cotta models for the statue are in the Victoria and Albert Museum and in private hands; a marble reproduction of it also exists. To Roubiliac also must be credited the celebrated "Davenant Bust" of blackened terra-cotta in the possession of the Garrick Club. This fine work of art derives its name from having been found bricked up in the old Duke's theatre in Portugal Row, Lincoln's Inn Fields, which 180 years before was d'Avenant's. The fine alto-relievo representation of Shakespeare, by T. Banks, R.A., between the Geniuses of Painting and the Drama, is now in the garden of New Place, Stratford-on-Avon. It is remarkable that Banks's was the first British hand to model a portrait of the poet.

In more recent times numerous attempts have been made to reconstitute the figure of Shakespeare in sculpture. One of the most ambitious of these is Lord Ronald Gower's elaborate memorial group presented by himself to Stratford and set up outside the Memorial Theatre in 1888. In 1864 J. E. Thomas modelled the colossal group of Shakespeare with attendant figures of Comedy and Tragedy that was erected in the grounds of the Crystal Palace, and in the same year Charles Bacon produced his huge Centenary Bust. The chief statues, single or in a group, in London still to be mentioned are the following: that by H. H. Armstead, R.A., in marble, on the southern podium of the Albert Memorial; by Hamo Thornycroft, R.A. (1871), on the Poets' Fountain in Park Lane; by Messrs. Daymond on the upper storey of the City of London School, on the Victoria Embankment; and by F. E. Schenck, a seated figure, on the façade of the Hammersmith Public Library. The Droeshout portrait is the basis of the head in the bronze memorial by Professor Lantéri set into the wall on the conjectural site of the Globe Theatre (1909) and of the excellent bust by Mr. C. J. Allen in the churchyard of St. Mary the Virgin, Aldermanbury, in memory of Heminge and Condell (1896). A recumbent statue, with head of the Droeshout type, executed by H. McCarthy, was, through the efforts of Dr. R. W. Leftwich and the generosity of Mr. S. Saltus (an American lover of the poet) erected, in 1912, in the south aisle of Southwark Cathedral. Among statues erected in the provinces are those by H. Pegram in the building of Birmingham University (1908) and by M. Guillemin for the Nottingham University buildings. An imposing Shakespeare Monument by Sir Bertram Mackennal, has been erected in Melbourne.

Several statues of importance have been set up in other countries. The bronze by M. Paul Fournier in Paris (presented by an English resident) marks the junction of the Boulevard Haussmann and the Avenue de Messine (1888). The seated marble statue by Professor O. Lessing was erected in Weimar by the German Shakespeare Society; and a seated statue in stone roughly hewn with characteristic breadth by the Danish sculptor, Louis Hasselriis, has for some years been placed in the apartment of the Castle of Kronborg, in which, according to the Danish tradition, Shakespeare and his company acted for the king of Denmark; the present castle, however, was not built till a later period. America possesses some well-known statues. That by J. Q. A. Ward is in Central Park, New York (1872). In 1886 W. O. Partridge modelled and carved the seated marble figure for Lincoln Park, Chicago; and later, Frederick MacMonnies produced his very imaginative statue for the Library of Congress, Washington, D.C. This is in some measure based on the Droeshout engraving. William R. O'Donovan also sculptured a portrait of Shakespeare in 1874. Undue consideration was given by some to the bust made by William Page of New York in preparation for a picture of the poet he was about to paint. As he was no sculptor the bust is no more successful than the picture. The bust by R. S. Greenough, based in part on the "Boston Zuccaro" portrait, must be included here, as well as the romantic marble bust by Augusto Possaglio of Florence (presented to the Garrick Club by the tragedian Salvini in 1876); the imaginative work by Altini (Duke of Northumberland, Alnwick Castle) and the busts by F. M. Miller, E. G. Zimmermann, Albert Toft, J. E. Carew and P. J. Chardigny of Paris. The last named was a study made in 1850, for a proposed statue, 100 ft. high. Attention has been accorded for several years past to the large pottery bust in high relief attributed to John Dwight's Fulham Pottery (*c.* 1675); the present writer, however, has established that it is by Lipscombe, in the latter portion of the 19th century.

For the less significant sections of portraiture—the wood-carvings (including the medallion traditionally said to have been cut by Hogarth and inset in the back of the "Shakespeare Chair" presented to Garrick); the medals, coins, and token-money; porcelain and pottery—figures, busts, etc.; engraved gems; and numerous other items, space cannot here be found. The curious reader is referred to the article in the eleventh edition of this work for numerous details touching the whole subject.

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GENERAL CLASSIFIED BIBLIOGRAPHY

The following classified list is an attempt to indicate the more important books still valuable for study. For full lists *see* W. Jaggard's *Shakespeare Bibliography* (Stratford, 1911), supplemented by the *Jahrbuch* of the German Shakespeare-Gesellschaft, which records later books, with articles in periodicals; also the annual *Bibliography* of the Modern Humanities Research Association, and the *Year's Work in English Studies* of the English Association.

I. TEXTS

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SHALE OIL. The shale oil industry, although known in France in the early part of the 19th century, owes its existence in its present form to Dr. James Young, who, in 1850, obtained his well-known patent for producing paraffin oil and paraffin from bituminous coal by slow distillation. This process was even worked in America until the discovery of petroleum. The industry has been centred in the Mid-Lothian area of Scotland since 1862

and an average of about three million tons of raw shale has been raised for many years. The oil shale of Scotland is dark grey with a laminated or horny fracture. Its specific gravity is about 1·75. The oil consists chiefly of paraffins and olefins.

Shales are widely distributed throughout the world. The French industry is older than that of Scotland; the deposits in New South Wales are very much richer than those of Europe and yields of over 100gal. per ton have been quoted; in Germany there are vast quantities of lignites and brown coals that are being worked vigorously; while in Colorado and Utah there is an immense potential wealth of this material.

The world-wide exploitation of oil shale, however, is dependent entirely on the exhaustion of petroleum and there appears to be no immediate likelihood of any shortage in this direction. The world's annual production of mineral oil is approximately 150 million tons.

Shale Oil Refining.—Originally, horizontal retorts similar to those in coal-gas manufacture were employed. The first step in advance was made by Henderson in 1873 when vertical retorts with a capacity of 18cwt. were arranged in groups of four and charged in rotation. The outlet for the oil vapours was at the lower end of the retort, and steam was blown in copiously to assist in the uniform heating of the shale and to remove oil vapours. The later Henderson retorts worked continuously and were gas-heated. The upper part was of cast iron and heated to about 900° F whilst the lower part was fireclay maintained to about 1,300° F. The charge in the retort travelled downwards owing to the periodical removal of spent shale at the bottom and no shale passed into the fireclay section until it had yielded all its oil. In the lower section the high temperature and the presence of steam brought about the removal of the nitrogen in the shale in the form of ammonia. The vapours from the retorts passed through air condensers in which ammoniacal liquor and crude oil were separated. The uncondensed gas was stripped of its light gasolene and used as fuel.

Crude shale oil is dark in colour and has a specific gravity approaching 0·890 and a setting point of about 90° F. It contains about 80% of hydrocarbons together with pyridine bases and cresols. In the refining of shale oil, ample steam is used in the stills, which are continuous in operation. The various fractions are agitated with acid and soda and again redistilled into crude naphtha (up to 0·770 specific gravity) and to burning oil (up to 0·850 specific gravity) and into "heavy oil and paraffin" which is solid at ordinary temperature. The acid and soda treatment and redistillation is repeated on the lighter fractions, whilst the solid paraffin is separated by chilling and pressing from the lubricating oil base—so that finished naphtha, burning oil, solid paraffin and lubricating oils are ultimately obtained.

The following table gives an average yield:

Gasolene and naphtha	6·90%
Burning oils	31·84%
Intermediate and lubricating oils	23·97%
Crude paraffin wax	13·53%
Loss	24·57%

From the ammoniacal liquor ammonia is driven off by the application of heat and lime, the liberated gas is brought into contact with sulphuric acid and converted into ammonium sulphate, a by-product that has been of considerable importance in enabling the industry to hold its own against competition. (*See* Petroleum: *Gasolene.*) (A. E. D.)

SHALLOT (*Allium ascalonicum*) (family Liliaceae), a hardy bulbous perennial, which has not been certainly found wild and is regarded by A. de Candolle as probably a modification of *A. Cepa* (the onion), dating from about the beginning of the Christian era. It is extensively cultivated and is much used in cookery and is excellent when pickled.

SHALMANESER [Ass. *Ṣulmānu-aṣarid,* "the god Sulman (Solomon) is chief"], the name of three Assyrian princes.

Shalmaneser I., son of Hadad-nirari I., succeeded his father as king of Assyria about 1310 B.C. He carried on a series of campaigns against the Aramaeans in northern Mesopotamia, annexed a portion of Cilicia to the Assyrian empire, and established Assyrian colonies on the borders of Cappadocia. According to his annals, discovered at Assur, in his first year he conquered eight countries in the north-west and destroyed the fortress of Arinnu, the dust of which he brought to Assur. In his second year he defeated Sattuara, king of Malatia, and his Hittite allies, and conquered the whole country as far south as Carchemish. He built palaces at Assur and Nineveh, restored "the world-temple" at Assur, and founded the city of Calah.

Shalmaneser II. succeeded his father Assur-nazir-pal III. 858 B.C. His long reign was a constant series of campaigns against the eastern tribes, the Babylonians, the nations of Mesopotamia and Syria, as well as Cilicia and Ararat. His armies penetrated to Lake Van and Tarsus, the Hittites of Carchemish were compelled to pay tribute, and Hamath (Hamah) and Damascus were subdued. In 854 B.C. a league formed by Hamath, Arvad, Ammon, "Ahab of Israel" and other neighbouring princes, under the leadership of Damascus, fought an indecisive battle against him at Karkar (Qarqar), and other battles followed in 849 and 846. (*See* Jews § 10.) In 842 Hazael was compelled to take refuge within the walls of his capital. The territory of Damascus was devastated, and Jehu of Samaria (whose ambassadors are represented on the Black Obelisk now in the British Museum) sent tribute along with the Phoenician cities. Babylonia had already been conquered as far as the marshes of the Chaldaeans in the south, and the Babylonian king put to death. In 836 Shalmaneser made an expedition against the Tibareni (Tabal) which was followed by one against Cappadocia, and in 832 came the campaign in Cilicia. In the following year the old king found it needful to hand over the command of his armies to the Tartan (commander-in-chief), and six years later Nineveh and other cities revolted against him under his rebel son Assur-danin-pal. Civil war continued for two years; but the rebellion was at last crushed by Samas-Rimmon or Samsi-Hadad, another son of Shalmaneser. Shalmaneser died soon afterwards in 823 B.C. He had built a palace at Calah, and the annals of his reign are engraved on an obelisk of black marble which he erected there.

See V. Scheil in *Records of the Past,* new series, iv. 36–79.

Shalmaneser III. (or IV.) appears as governor of Zimirra in Phoenicia in the reign of Tiglath-pileser IV. (or III.) and is supposed by H. Winckler to have been the son of the latter king. At all events, on the death of Tiglath-pileser, he succeeded to the throne the 25th of Tebet 727 B.C., and changed his original name of Ululā to that of Shalmaneser. The revolt of Samaria took place during his reign (*see* Jews § 15), and while he was besieging the rebel city he died on the 12th of Tebet 722 B.C. and the crown was seized by Sargon.

For all these rulers *see* Babylonia and Assyria, Sections V. and VIII., and works quoted. (A. H. S.)

SHAMANISM, the name commonly given to the religion of the Ural-Altaic peoples. The shaman or priest (Tungus *saman,* Altain Turk *kama, cf.* Russian *kamlanie*) is (a) priest, (b) medicine man, (c) prophet. Family Shamanism is connected with the domestic ritual. Professional shamans are not definitely attached to a social unit. A supernatural gift is everywhere a necessary qualification, and in some cases the office is hereditary—if a descendant shows a disposition for the calling. Each family possesses one or more drums, and when these are beaten some member tries to communicate with the spirits. The possession is associated with hysteria. It is obtained in various ways, by dreams, visions, and fasting. Consecration rites are lengthy and expensive.

See M. A. Czaplicka, *Aboriginal Siberia* (1914).

SHAMASH or Šamas, the common Semitic word for "sun." In pre-Islamic times *Šamsu* was regarded throughout Arabia as a goddess and often called *ilā* "goddess," wife of the moon god Wadd, and mother of Athtar, the planet Venus. Her symbol in Arabia was a disk. Among the north Semitic races (Canaanitic and Aramaean) the name is *šemeš, šimšā,* and always masculine. Traces of Canaanitish worship are found in the Old Testament, for which *see* II Kings 23, 11, where the horses and the chariots of Canaanitish heathendom were removed by Josiah. The sun-god is symbolised by the horse in pre-Islamic Arabia also, and pillars called *ḥammanim,* bearing the sun disk, were set upon the altars of the Canaanitish Baʿals. In Arabia this deity has the

epithet "Mistress of heat," when she is the summer sun, and "Mistress of the distant region (south)," when she is the winter sun. When the Semites first appear in history in Babylonia they identified their sun god (*šamaš*) with the older Sumerian sun god, Utu, Babbar, and it is probable that this caused the change in gender throughout the north Semitic peoples. This contact of the Semite with the Sumerians occurred as early as 3200 B.C. He became here one of the great deities of ancient religion, and lost all earlier Semitic traces to be completely transformed into a Sumerian deity; as such his cult appears throughout Babylonian and Assyrian history and survived at various Syrian centres to a late period. The two chief centres of sun-worship in Babylonia were Sippara (Sippar), represented by the mounds at Abu Habba, and Larsa, represented by the modern Senkerah. At both places the chief sanctuary bore the name E-barra (or E-babbara) "the shining house"—a direct allusion to the brilliancy of the sun-god. Of the two temples, that at Sippara was the more famous, but temples to Shamash were erected in all large centres—as Babylon, Ur, Nippur and Nineveh.

The attribute most commonly associated with Shamash is justice. Khammurābi attributes to Shamash the inspiration that led him to gather the existing laws and legal procedures into a code, and in the design accompanying the code the king represents himself in an attitude of adoration before Shamash as the embodiment of the idea of justice. Several centuries before Khammurabi, Ur-Nammu of the Ur dynasty (*c.* 2600 B.C.) declared that he rendered decisions "according to the just laws of Shamash."

Together with Sin and Ishtar, Shamash forms a second triad by the side of Anu, Bel and Ea. The three deities, Sin, Shamash and Ishtār (*q.v.*), the sun, the moon and Venus form an astronomical triad corresponding to the same early Arabian triad. At times, instead of Ishtar, we find Adad (*q.v.*), the storm-god, associated with Sin and Shamash. In Sumero-Babylonian religion Shamash was regarded as the son of the moon god, Sin.

The consort of Shamash was known as Aya.

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SHAMMAI, a Jewish scribe of the time of King Herod, whom tradition almost invariably couples with Hillel (*q.v.*), with whom he stood in striking contrast, not merely in legal-religious decisions and discussions, but also in character and temperament. The opposition between Shammai and Hillel was perpetuated by their respective schools, till, under Gamaliel II., the strife was decided at Jabneh in favour of the school of Hillel.

SHAMOKIN, a borough of Northumberland county, Pennsylvania, U.S.A., on Federal highway 120 and Shamokin creek, 45 m. (in an air line) N. by E. of Harrisburg. It has an airport (Richardson field) on the transcontinental mail route, and is served by the Pennsylvania and the Reading railways. Pop. (1920) 21,204 (89% native white); 1930 Federal census 20,274, with 20,000 more in Coal township, immediately adjoining. It lies at an altitude of 700 ft., in the midst of beautiful mountain scenery. The mining, preparation and handling of anthracite constitute the principal industry. Shamokin was incorporated as a borough in 1864. It took its name from that of the creek, which is probably a corruption of an Indian word meaning "full of eels."

SHAMYL (*c.* 1797–1871), the leader of the tribes of the Caucasus in the war against Russia. He was born about 1797 and, educated by the Mullah Djemaleddin, soon took a leading part in preaching a holy war against the Russians. He was both the spiritual and military leader of the tribes, who maintained the struggle for twenty-five years (1834–1859). Shamyl's romantic fight for independence, making him a sort of ally of England and France at the time of the Crimean War (1853–55), earned him a European reputation. But the capacity of the tribes for resistance was already failing, and when at the close of the Crimean War Russia was able to employ large forces on the Caucasus, the defenders were gradually subdued, Shamyl himself being captured in 1859. The rest of his life was spent in an easy captivity at Kaluga, St. Petersburg and Kiev. He died at Mecca during a pilgrimage in 1871. One of his sons took service in the Russian, the other in the Turkish army.

SHAN, a southern Mongoloid race, one of the most numerous and important of Asia, constituting a large proportion of the population of Assam, Burma, Siam and probably southern China. Their own name for themselves is Tai (*Thai*), "Free." "Shan" is probably a Chinese term meaning mountaineer and the same word as Siam, where, however, the name for the race is *Lao*. In Assam they are called *Ahom; Paï* and *Ngiou* are other terms used in China and Burma. They seem to have come originally from the Kinlung mountains north of Szechwan, and to have fused with the Chinese, and with the leucoderm aborigines who survive all over the uplands between Tibet and the coast of Cochin-China. The expansion of the Shans towards the sea, at the expense of the Mon-Khmer nation, took place about the seventh century A.D. The Chinese invasion of Burma in the thirteenth century gave them the predominant position in ASIA: *Farther Asia*, which they held till the sixteenth century. Assam they invaded in the thirteenth century and held until the eighteenth.

They are widely diffused, and having amalgamated with other races are to be found in varying grades of culture, but although without political cohesion they display marked ethnical uniformity. Their written languages, based on the Devanagari script, may be also connected with the picture-writing system of the Lolo (*q.v.*). In the case of the Ahoms the language is virtually extinct, though many *"putis"*—books written on strips of palm leaf—are extant.

In religion the Shans are Buddhists, except in Assam where most of them have been Hinduized. The body is usually cremated, sometimes buried. They are notorious for gambling, but otherwise fairly industrious, growing cotton, tea and irrigated rice, breeding horses, catching elephants, mining for jade and amber. They are renowned for metal-work, swords in particular. The men tattoo their bodies as a rule and incise the skin for the insertion of precious stones as talismans. Their political organization is mostly in small states under princelings known as *Tsawbwa*. Polygamy is permitted, but monogamy is usual; and though the family is patrilineal, the bridegroom frequently resides with the bride's parents. They use a variation of the Chinese calendar system, reckoning by cycles of sixty years, each cycle containing five stems of twelve years each. Their language is highly tonal.

See Colquhoun, *Among the Shans* (1885); Scott and Hardiman—*Gazetteer of Upper Burma and the Shan States* (1900); Cochrane, *The Shans* (1915). (J. H. H.)

SHANGALLA, a name loosely applied by Abyssinians to the non-Arab and non-Abyssinian tribes living in the fertile belt which bounds Abyssinia on the west. The principal tribes are the Legas, Bertat, Gumus, Kadalos and Sienetjo. In some, Galla blood predominates: others are Negroids.

SHANGHAI, the commercial metropolis of China and one of the world's greatest seaports (31° 15′ N., 121° 27′ E.). The geographical position of Shanghai in respect both to the natural arteries of trade in China and to its wider space relations with the chief commercial regions of the world is extraordinarily favourable. To a degree unparalleled in any other great country is the foreign trade of China concentrated by geographical conditions into a single sea-gate. The magnificent natural waterways, which form the drainage basin of the Yangtze kiang, give to the great port at its outlet to the Pacific a vast hinterland, characterised by the unique range of its production and the magnitude of its population, estimated at 180 millions. The hinterland of Shanghai is not indeed limited to the Yangtze basin, vast though that is, for the port gathers up a large share of the coastwise commerce of the ports of Chekiang and Fukien, backed by the high ranges of south-east China which hinder their communications with the interior; while a part of the north China plain is also more closely connected with it than with any other outlet. It may be said that about one-half of China, and economically the more important half, is ultimately served by Shanghai; and its contribution to the revenue of the Maritime Customs is four times as great as that of

any other Chinese port. Its general world position is also extremely advantageous. It is the nearest port of China to Japan proper. It lies approximately midway along the rich monsoonal margin of Eastern Asia, from Malaya to Primorsk, while the fringing group of archipelagoes from the Philippines to Japan contribute greatly to the importance of the China seas. From a wider standpoint it is about equidistant, reckoned by shipping routes, from the two most developed industrial regions of the world, western Europe and eastern North America.

The Port of Shanghai.—The native city of Shanghai, on the left or west bank of the Whangpoo branch of the Yangtze, is the nucleus of the vast urban agglomeration which now bears its name. Although a city of some antiquity and an outlet of the rich deltaic region, it had little more than local importance prior to the Treaty Port period. Its commerce was considerably less than that of Ningpo, on a deep-water harbour on the southern shore of Hangchow Bay, with a position relative to the Yangtze delta comparable to that of Marseilles in relation to the Rhône. In the course of the naval operations during the first Anglo-Chinese or "Opium" war the British realized the possibilities of Shanghai and at the Treaty of Nanking (1842) it was included among the five "Treaty" ports opened to foreign trade. In the following year the English settlement was located to the north of the native city and was defined by the Soochow Creek on the north, the Yang-king canal on the south and the Whangpoo river on the east. Later the narrow strip between the Yang-king canal (now filled in) and the native city became the site of the French settlement, while the American settlement grew up on the northern side of the Soochow creek. The local advantages of the site were a position on the estuary as near to the sea as physical circumstances permitted a deep water port to be formed and the junction with the Whangpoo of the Soochow Creek, which linked it with one of the richest regions of the delta. To set against these advantages are certain drawbacks with which modern Shanghai is still contending. The first is the fact that the city is wholly built on the alluvial deposits of mud and silt with which the Yangtze has been gradually filling up the original basin that now constitutes its delta. The International Settlement stands on what was formerly a marshy swamp and, although by careful drainage it has been converted into a fairly healthy site, the soft character of the ground limits the height and weight of the buildings placed upon it. Thus, with the rapid growth of population, the city tends both to be congested with small buildings and to expand over a very large area. Hence a difficult problem of regional planning has emerged. The second difficulty concerns the character of the Whangpoo, on which Shanghai depends for its communications with the south channel of the Yangtze and the open ocean. As ships began to increase rapidly in draught the many shoals in the river and the shallowness of the water at its bar threatened to make Shanghai inaccessible to large vessels. The problem has now to some extent been solved by the work of the Whangpoo Conservancy Board which derives its authority directly from the Chinese Government and comprises the following officials: the Commissioner for Foreign Affairs for the Province of Kiangsu, the Shanghai Commissioner of Customs and the Shanghai Harbour Master. By means of a series of costly works, extending over a period of more than 20 years, the Whangpoo has been converted from an irregular creek, progressively silting up, into a good shipway with a minimum depth of 24 to 26 feet at the lowest tides and a high water depth of 30 to 42 feet available throughout the year. Continuous dredging is necessary to maintain these depths, which are not yet sufficient and the largest liners do not enter the river but discharge passengers and cargo into tenders and lighters outside Woosung, where the Whangpoo enters the Yangtze, and which has become the recognized outport of Shanghai. At the present time, however, it is not so much the navigation of the Whangpoo as the entrance to the Yangtze itself some 30 miles below Woosung, which presents the most serious engineering problem. The increase in the draught of ships has been so great in recent years as to make the navigation of the Yangtze bars difficult, and while this affects the Yangtze ports in general, it particularly concerns Shanghai as a world port. The present position is that whereas many ships having draughts of about 30 feet now arrive off the river and a further increase of draught is inevitable, the depth in the main channel of the Yangtze at the "Fairy Flats" is only about 16 to 17 feet at extraordinary low water, 26 to 28 feet at neap high water and 30 to 32 feet at ordinary spring high water. The deepening of one of the bars seems indispensable to the future welfare of the port of Shanghai but, owing to the great size of the bars, which are many miles in length, to the rapid changes produced by tidal forces and the absence of solid foundations for training works, the task involved is of immense magnitude. The problem has been engaging the attention of the Whangpoo Conservancy Board for many years and in 1921 it convened a committee of harbour and river experts whose detailed report, made after a thorough investigation, is now being considered. The gist of the recommendations is that by means of the largest dredgers procurable a channel should be cut through the Fairy Flats, deepening it "gradually foot by foot to as great a width as required and as possible and to provide as soon as feasible a channel of 600 feet bottom width for the passage of ships drawing 33 feet at ordinary neap high water." The committee further recommends the expansion of the existing Whangpoo Conservancy Board "into a new body, which might be known as the Shanghai Harbour Board, with more extended powers and more directly representing shipping and trade interests." It is pointed out that "the inauguration of a strong harbour policy at the earliest possible moment is a *sine qua non* for the prosperity of the port, will strengthen the position of Shanghai as the principal transhipment and distributing centre, and will confer immense benefits upon the shipping and commerce of China."

Apart from its maritime and river communications Shanghai is an important railway centre.

(1). It is connected by the Shanghai-Nanking (Hu-Ning) railway with Nanking (194 miles) at the apex of the delta, whence by ferry across the river it is linked by the Tientsin-Pukow railway with Peking, north China, the South Manchurian and Trans-Siberian railways. By the overland route Shanghai can be reached from Western Europe in about a fortnight. There is a local branch of the Shanghai-Nanking railway to the outport, Woosung.

(2). The Shanghai-Hangchow-Ningpo railway (Hu-Hang-Jung), with a mileage of 178, connects the metropolis with the southern margins of the delta, the important districts round Hangchow Bay and the ancient emporium of Ningpo, with which it has very intimate commercial relations.

Trade.—The chief function of Shanghai is to serve as the principal entrepôt for the trade of central and much of north China and particularly to transact trans-oceanic business. The total tonnage using the port in 1926 was returned at 33,937,466, making it—on the criterion of tonnage—the premier port of the Far East and the fifth port of the world. Of this tonnage the share of the British Empire was 32·67%, of Japan 27·96%, of China 15·05% and of the United States of America 12·05%. Approximately half the total shipping is engaged on coastal and river trade, shared as follows: British Empire 37·98%, China 30·56%, Japan 21·19%, U.S.A. 1·75%.

Of the total *ocean* shipping of Shanghai, Japan in 1926 claimed (in tonnage) 34·48%, the British Empire 27·56%, and the United States 21·94%. About one-half of the shipping engaged on the trans-Pacific (northern) trade, which forms approximately 10% of the total, is owned by the United States and most of the remainder is shared between the British Empire and Japan.

The general character of Shanghai's trade is indicated by the following analysis:

	1924 Millions of Haikwan Taels. (H.T.=3s.7$\frac{15}{16}$d. in 1924)
Imports	
Foreign goods from foreign ports and Hongkong	483·5
Foreign goods from Chinese ports	4·6
Chinese goods from Chinese ports	311·0
Total Imports	799·1

Exports

Foreign goods re-exported to foreign ports	12.7
Foreign goods re-exported to Chinese ports	174.2
Imported Chinese goods re-exported to foreign ports	155.9
Imported Chinese goods re-exported to Chinese ports	63.9
Local Chinese produce exported to foreign ports	120.5
Local Chinese produce exported to Chinese ports	263.9
Total Exports	791.1

The table indicates the importance of the re-export business which forms about 40% of Shanghai's gross trade.

In 1926 Shanghai yielded no less than 41·81% of the total revenue of the Maritime Customs, a fair indication of her share of China's foreign trade. Swelling the total volume of trade there is, moreover, a large importation of Chinese products in junks which passes through the "native" customs. The possibilities of the future are indicated by the fact that, so far as purchasing power is concerned, China is still in its infancy and the Yangtze valley with its 180 millions imports less than Australia with six millions. The list of foreign goods imported into Shanghai is increasingly varied but considerably the most valuable items are cotton piece goods (grey, white or dyed, printed, etc.) and raw cotton (including thread and yarn) which in 1926 represented respectively about 87 and 89 million Haikwan Taels out of total imports valued at 596 millions. In 1926 Shanghai took over 80% of the total Chinese import of foreign cotton. Among other outstanding imports are tobacco, sugar, oils and soap, cereals and coal. Out of a total export trade in 1926 valued at about 362 million H.T. silk, silk materials and products accounted for nearly 154 millions, vegetable products (particularly bean and wood oil) 78 millions and textiles and textile products other than silk nearly 37 millions. An important and growing item is the export to Europe of frozen eggs, albumen and yolk. The chief participants in the import trade of Shanghai are the British Empire, supplying cotton piece goods, woollens, raw cotton (Indian) and machinery, the United States (machinery, tobacco, wheat and kerosene), Japan (cotton piece-goods and coal) and China itself (raw cotton, coal, metals, hides and skins). The United States is the chief foreign market for Shanghai, which is responsible for 33% of the total Chinese exports to America. No less than 65% of Shanghai's exports to U.S.A. consists of raw silk and silk products.

Industrial Life.—Shanghai is not only China's premier seaport and commercial metropolis, it is also incomparably the chief manufacturing centre of the country and the city where the new industrial activities and tendencies are most conspicuously displayed. This is the result of many causes, chiefly connected with its geographical position as the gateway of commercial China and the base of Western influences. Raw material reaches it from all parts of China and from many foreign sources. It lies in one of the most densely peopled regions of the country, with traditional skill in handicrafts. Fuel for power, although comparatively lacking in the immediate vicinity, is cheaply imported The main reliance is on coal imported chiefly from Japan, the Kaiping field of Hopeh (Chihli) via Chinwangtao, Fushun near Mukden in Manchuria and from the Shantung fields via Tsingtao, while further supplies from the interior coal basins of Shansi, Honan and Hunan reach it by the Yangtze from Hankow. Finally the immense opportunities for industrial development, the immunities hitherto enjoyed by the International Settlement and the relative security which it has offered, in contrast to the troubled conditions of the interior, have attracted not only foreign but Chinese capital. The rapid expansion of native industries in the Shanghai area is one of the most noteworthy features of recent years, especially during and since the World War (1914–18). This is strikingly shown by the increased importance of "Total Exports of local origin" in the returns of the Maritime Customs. In the decade preceding the War they ranged in value from about 70 to 95 millions of Haikwan Taels per annum. Since 1918 they have never been less than 200 and in 1924 reached 384 millions. Their value is now about half that of the net trade of the port. The major industries of Shanghai are concerned either with her primary activity as a sea-port, *e.g.*, shipbuilding, for which there are now five yards, or with the large-scale manufacture of raw materials on modern factory lines. Of the latter the most outstanding is the cotton industry whose development has been remarkably rapid. There are at present 58 cotton mills in Shanghai out of a total of 119 in China. They employ over half the total number of cotton operatives in the whole country and account for 60 per cent of the looms and 52 per cent of the spindles used in China. At first it was mainly a Western and Japanese industry but since the War there has been a steady advance in the Chinese ownership of mills. The present position is as follows:—

	Labourers
30 Japanese cotton mills employing	58,113
24 Chinese cotton mills employing	49,908
4 British cotton mills employing	16,500
Total, 58	124,521

The four British mills are the only cotton factories of this nationality in China but 70% of the spindles used in Shanghai are of British origin.

Other large industries of the same type include steam (silk) filatures—economically a very promising development for China—over 40 modern rice-hulling factories, leather factories and paper mills. Shanghai is one of the greatest centres of the engineering industry in the Far East. Among the largest enterprises of this kind are the Kiangnan Dock and Engineering works (Chinese Government) (dock), the Shanghai Dock and Engineering Co., Ltd. (British) (5 docks), New Engineering and Shipbuilding Co., Ltd. (British), the Marine Motor Works (British), China Engineering Works (Chinese), Eastern Engineering and Shipbuilding Works (Sino-Japanese). There is also a great variety of miscellaneous industries, including cigarette factories, egg product plants, meat and fruit-canning establishments. Apart from factories fully equipped in western fashion there is a large number of small workshop handicraft industries of traditional type and intermediate establishments combining the old and the new features.

Social Problems.—The rapid development of industrialism in Shanghai has created a city proletariat of a type new to China and much larger than in any other Chinese centre. A recent estimate places the number of industrial workers, disregarding wharf, ricksha and other transport coolies, at nearly 300,000. These include 66,000 cotton mill operatives, 15,300 iron workers and 14,000 workers in tobacco factories. They are drawn from a wide area and many of them are men who have left their families in distant villages and speak a dialect different from that of Shanghai, which belongs to the Wu group. There is also a large element of female labour which is particularly employed in the steam filatures and hosiery mills. Although the conditions under which factory labour is carried on differ greatly from the traditional methods of native production, the Chinese artisans in Shanghai have earned the reputation of being good industrial workers, and, relative to the wages received, the standard of efficiency is high. Labour is abundant and the struggle for existence is tense. Until recently there were no regulations governing employment in factories. Under such circumstances the evils associated with the early days of the Industrial Revolution in England were certain to appear in an aggravated form. In the years succeeding the War the social conditions of the Shanghai millworkers attracted widespread attention. In response to considerable agitation and following the example of Hongkong, a commission of enquiry into child labour was appointed by the Shanghai Municipal Council. The report of the commission in July 1924 disclosed deplorable conditions, and the Municipal Council initiated regulations relating to child labour, designed within a period of four years to eliminate the employment in factories of all children under twelve years of age. At the same time improvements with regard to the safeguarding of machinery and the general protection of workers began to be introduced. The problems, however, still remain acute. It has been quite definitely shown (*see* the impartial discussion in Dame Adelaide Anderson's "Humanity and Labour in China") that as a whole the Western millowners have a good record and that the conditions in the British cotton mills are above the average. The problems, indeed, are inherent in the introduction of the Western industrial system into a country with an abundant labour supply, a low standard of comfort and an entirely different tradition of craftsmanship. In Shanghai the situation is much

aggravated by the special housing difficulty arising out of the conditions already mentioned. The International Settlement and its immediate suburbs are already densely occupied with houses; land is dear and rents are high. Many of the unskilled workers, especially the men without families from distant parts, are therefore living under unhealthy conditions in wattle huts on the outskirts of the city beyond the boundaries of the Settlement, and are completely cut off from the traditional sanctions of Chinese family life. Meanwhile labour under external influence has begun to organize itself and all the phenomena of industrial unrest have been conspicuously displayed. In 1913 the National Labour Party was formed in Shanghai and the Federation of Labourers and Farmers in 1916. The first important strike of a modern type was that of the seamen in January 1922, which particularly affected Hongkong, and this was followed by many others and a great extension of the union movement. The strongest unions are those of the seamen, mechanics and textile workers but their funds are at present small and the membership uncertain. While the majority of the strikes seem to have been chiefly inspired by economic grievances, *e.g.*, low wages or alleged ill-treatment, the industrial issues during recent years have been increasingly complicated by political questions affecting the status of foreign powers in China, particularly since the "Shanghai incident" of May 30, 1925. On this occasion a demonstration organized by labour unions and students to protest against the killing of a workman by a Japanese foreman culminated in the firing by the police of the International Settlement on a crowd advancing on one of the police stations. Many subsequent strikes were of a purely political character. In the most recent phase the organisation of the workers and the Union Movement have been largely directed by the Kuomintang or Nationalist Party. Many conflicting tendencies are visible but there is a strong movement to prevent the development of class warfare and it is the hope of some that the ancient Chinese guild system can be adapted to meet the requirements of the new industrial situation. Much may depend on the degree of co-operation between the authorities of the International and French Settlements and those of the large areas outside under Chinese jurisdiction which are now known as Greater Shanghai.

Population and Administration.—The Shanghai urban agglomeration now consists of six main areas: (a) The Old City, dating from the eleventh century A.D. (b) The International Settlement. (c) The French Concession. (d) A northern outer suburb: Chapei. (e) An eastern suburb: Pootung. (f) A southern suburb: Nantou.

The city in the wider sense covers an immense area. The International Settlement, made up of the original British and American concessions and with boundaries extended in 1893, comprises 5,584 acres and has a population of 30,565 foreigners and 802,700 Chinese. The adjacent French concession, about 2,525 acres in extent, contains 7,811 foreigners and 289,261 Chinese. The settlements, and particularly the original British concession, form the central districts, comprising the principal commercial quarter and the famous river front or Bund. Their hinterlands and especially that of the French concession, are mainly residential in character, laid out in long avenues. But the "eastern" district of the International Settlement, following the southward bend of the Whangpoo below the Bund, and also both shores of the Soochow Creek for a distance of about seven miles, both within and beyond the Settlement's limits, are completely industrialised and thickly studded with factories and warehouses. Of the same character are Pootung on the southern side of the Whangpoo and the suburb of Nantou, which is a westward outgrowth along the river banks of the old native city of Shánghai. The built-up portions of Greater Shanghai outside the International Settlement and the French Concession are estimated to cover about 2,800 acres. The total population of the Shanghai urban aggregation is well over one and a half millions and is rapidly increasing. The resident foreign population (on basis of five years' residence) has been recently estimated as follows: Japanese, 14,230; British, 7,047 (including 1,177 British Indian subjects); Russians, 2,972; Americans, 1,800; Portuguese, 1,402; other nationalities, 3,034. The Chinese population is drawn from many areas, but a very important element is represented by the large influx of men from Hangchow and Ningpo, who maintain close relations with their own home towns and are said to number 400,000. There are also some 160,000 labourers from Canton and Swatow.

Apart from native industrial establishments, Shanghai is the headquarters of many important Chinese organisations, such as the Y.M.C.A., and the centre of many modern movements of a cultural, religious and educational character. It contains a large number of colleges and higher-grade institutions, some maintained by missionary organisations (many of which have their headquarters in Shanghai) and some by the provincial (Kiangsu) or national government, as well as many private enterprises. There is in this great city, where perhaps more than in any other oriental centre East meets West, abundant opportunity for cultural interchange, and in the sphere of religious and similar movements this has already been productive of good results. In the main, however, the Western commercial communities in Shanghai have so far come little into contact with the Chinese apart from business relations, chiefly transacted through compradores.

The administration of Shanghai reflects the special circumstances of its origin and growth and has no exact parallel elsewhere. Although it forms a single urban unit, there are three distinct administrative areas: the International Settlement, the French Concession, and the Chinese Greater Shanghai. The International Settlement, as such, dates from 1854 when the British, French and American consuls drew up a code of regulations applicable to the two concession areas which then existed, those of Great Britain and France. The concession subsequently obtained by the United States was included within the same jurisdiction in 1863, but meanwhile (1862) France had withdrawn from the joint arrangement, and ever since the French Concession has constituted a distinct municipality. Other Treaty Powers, particularly Japan, have since entered the field and have adhered to the regulations governing the International Settlement. It exercises complete powers of self-government, including police control, and the efficiency of its administrative arrangements soon earned it the title of "The Model Settlement." The executive power is a Municipal Council, elected until recently entirely by the foreign ratepayers. The Settlements were originally intended only for foreign merchants, but at a very early period Chinese refugees and others were allowed to reside within their boundaries; and especially since the period of the Taiping Rebellion, which created great insecurity in the lower Yangtze region, they have constituted the immense majority of the population. As participants in the benefits of the Settlement administration they were required to pay municipal taxes, but until 1926 they had no voice in the conduct of its affairs. In that year, in deference to the rising demands of Chinese nationalism, the Municipal Council sanctioned the appointment of three Chinese members to the Council, which now consists of five British members, two American, two Japanese and three Chinese. Another important recent development is the Chinese scheme to unify the administration of the urban district outside the Settlements, including Chapei, Nantou, Pootung and Woosung, and a large area at present agricultural in character, into a new municipality or "Directorate of the Port of Shanghai and Woosung." The conception of a Greater Shanghai involves the co-operation of the Settlement and Chinese authorities in a regional planning scheme and the adjustment of many difficult issues, such as the status and control of extra-concessional roads. The problems involved in the promised relinquishment of extraterritorial rights in China by the western Powers must also be particularly acute in the case of Shanghai.

SHANGHAI, to drug and ship aboard a vessel needing hands.

SHANHAIKWAN ("The Gate between mountain and sea"), an important Chinese garrison town (population about 30,000) in the extreme north-east corner of the province of Chihli (Hopeh) in 40° N. and 119° 47′ E. It occupies a notably strategic position, commanding the narrow coastal sill between the sea (Gulf of Liao-tung) and the outlying mountain ranges of Jehol, followed by the Great Wall, which was formerly continued to the actual coast. Its historic function has thus been that of a military post, guarding the crucial corridor communicating

between the plain of north China and that of south Manchuria, and so it has come into prominence at different periods,—as at the time of the establishment of the Manchu dynasty in China, during the Boxer Rebellion, and the Sino-Japanese War.

SHANKARSETT, JAGANNATH (1800–1865), the recognized leader of the Hindu community of Bombay for more than forty years, was born in 1800 into a family of goldsmiths of the Daivadnya caste. He was one of the greatest benefactors of Bombay, a pioneer in the provision of schools both for boys and girls, and of higher education for men, and a generous donor to educational institutions. To Jagannath Shankarsett and his public-spirited friends, Sir George Birdwood and Dr. Bhau Daji, Bombay is also indebted for the reconstruction which, beginning in 1857, gradually changed a close network of lanes and streets into a spacious and airy city, adorned with fine avenues and splendid buildings. He was the first Indian to be nominated to the legislative council of Bombay under the Act of 1861. He died at Bombay on July 31, 1865.

SHANKLIN, a watering-place in the Isle of Wight, England, $8\frac{1}{2}$ m. S. of Ryde by rail. Pop. of urban district (1931) 5,071. It is beautifully situated on the cliffs bordering the south-east coast, and is sheltered west by high-lying downs. The old church of St. Blasius is Perpendicular. There are several modern churches and chapels, a pier and a lift connecting the town with the esplanade beneath the cliff. The picturesque winding chasm of Shanklin Chine breaches the cliffs south of the town.

SHANNON, CHARLES HAZELWOOD (1865–), English artist, was born at Sleaford in Lincolnshire in 1865, the son of the Rev. Frederic Shannon. He attended the Lambeth school of art, and was subsequently considerably influenced by his friend Charles Ricketts and by the example of the great Venetians. In his early work he was addicted to a heavy low tone, which he abandoned subsequently for clearer and more transparent colour. He achieved great success with his portraits and his Giorgionesque figure compositions, which are marked by a classic sense of style, and with his etchings and lithographic designs. The Dublin Municipal gallery owns his circular composition "The Bunch of Grapes" and "The Lady with the Green Fan" (portrait of Mrs. Hacon). His "Study in Grey" is at the Munich gallery, a "Portrait of Mr. Staats Forbes" at Bremen, and a "Souvenir of Van Dyck" at Melbourne. His most remarkable pictures include "The Bath of Venus," in the collection of the late Lord Northcliffe. Other portraits are those of his friend Charles Ricketts and of Lillah McCarthy in "The Dumb Wife." Complete sets of his lithographs and etchings have been acquired by the British Museum and the Berlin and Dresden print rooms. He was awarded a first-class gold medal at Munich in 1895 and a first-class silver medal in Paris in 1900. He was elected A.R.A. in 1911 and R.A. in 1921, and is a member of the Society of Twelve, and Associate of the Société nationale des Beaux Arts.

SHANNON, JAMES JEBUSA (1862–1923), Anglo-American artist, was born at Auburn, N.Y., in 1862, and at the age of eight was taken by his parents to Canada. When he was sixteen, he went to England, where he studied at South Kensington, and after three years won the gold medal for figure painting. He soon became one of the leading portrait painters in London. He was one of the first members of the New English Art Club, and in 1897 was elected an associate of the Royal Academy, and R.A. in 1909. He died in London on March 6, 1923.

SHANNON, the principal river of Ireland. It flows with a bow-shaped course from north to south and south-west, from the north-west part of the island to its mouth in the Atlantic on the south-west coast, with a length of about 240 m. and a drainage area of 4,544 sq.m. Rising in co. Cavan in some small pools at the foot of Cuilcagh Mountain, the Shannon crosses co. Leitrim, traversing Lough Allen (9 m. in length), the first of a series of large lakes. It then separates co. Roscommon on the right (W.) bank from counties Leitrim, Longford, Westmeath and Offaly County on the left. In this part of its course it forms Loughs Boderg (7 m. long), Forbes (3 m.) and Ree (18 m.), and receives from the west the river Boyle and from the east the Inny, while in co. Longford it is joined by the Royal Canal. It now separates co. Galway on the right from Offaly County and co. Tipperary; receiving the Suck from the west and the Brosna from the east, and forming Lough Derg (23 m.). Dividing co. Clare from counties Tipperary and Limerick, the Shannon reaches the city of Limerick and debouches upon an estuary 60 m. in length with a direction nearly east and west. This divides co. Clare on the right from counties Limerick and Kerry on the left. A wide branch estuary, that of the Fergus, joins from the north, and the rivers Mulkear, Maigne and Deel enter from the south. From Lough Allen to Limerick, where the Shannon becomes tidal, its fall is 144 ft. With the assistance of short canals the river is navigable for light vessels to Lough Allen, and for small steamers to Athlone; while Limerick is accessible for large vessels. The salmon-fishing is famous; trout are also taken in the loughs and tributary streams. Carrick-on-Shannon, Athlone, Killaloe and Castleconnel are favourite stations for sportsmen. The islands of the loughs are in several cases sites of early religious settlements, while of those on the river-banks the most noteworthy is that of the seven churches of Clonmacnoise.

One of the first matters to engage the attention of the Government of the Irish Free State was the provision of cheap electrical power, and it was decided that power could be most economically produced by the construction of a central generating station capable of utilising the immense resources of the Shannon.

Outline of the Scheme.—The scheme provided for the development of hydro-electric power from the Shannon in three stages —called the partial development, the further development and the full development respectively. In the partial development Lough Derg alone was to be used for storage, but the winter level would not be raised. In the further development the storage in Lough Ree and Lough Allen would be added; and in the full development the storage in Lough Derg would be increased by raising the level of the lake above winter high water level. The head race constructed for the partial development was to be the size necessary for the full development; but the tail race, which is mostly in rock, would be enlarged for the further development.

In the Shannon the period of maximum flow coincides with that of maximum demand, thereby reducing storage requirements. On the other hand, as the fall from Lough Derg to the sea is gradual, it was necessary to construct a long head race in order to obtain an adequate fall. The Siemens-Schückert project (constructional work began in 1925) utilises the total fall of 100 ft. between Lough Derg and Limerick in a single large step, by leading the water out of the river bed into an inlet canal, or head race, to leave the Shannon at Parteen, above O'Brien's Bridge, and to extend a distance of about $6\frac{1}{2}$ m. to Ardnacrusha. Here, as an initial installation, are three vertical Francis turbines each of 38,500 h.p. The water is conducted to the turbines by large steel pipes 20 ft. in diameter and 140 ft. long and carried back to the Shannon in a tail race $1\frac{1}{8}$ m. in length. The electric energy produced in the power station is to be transmitted by means of a high tension network to most of the towns and villages of the Free State with a population of over 500. By means of a network radiating in a closed ring formation from the power-station, Dublin, Cork and Maryborough, all stations will be fed from two directions. A semi-public Board, known as the Electricity Supply Board, has been formed to control the distribution of current. The Board has extensive powers of acquiring existing undertakings and has already acquired the majority of such undertakings.

Cost of the Scheme.—The revised estimate of the cost of the partial development is £5,835,000. The estimated costs of the further and full development are £7,700,000 and £8,000,000 respectively. Provision is made for the advance of £2,500,000 to the Electricity Supply Board for the purpose of constructing the low tension network, wiring houses, and acquiring existing undertakings. The price at which electricity can be supplied to the consumer will depend upon the density of population in the locality and upon the volume of demand. It is estimated that the wholesale price of electric power supplied in bulk at Dublin and Cork should be about 0·6d. and at the end of the 10 kv. lines about 2·5d. Ultimately the current might be supplied at a flat rate, in which case the wholesale price everywhere should be less than

1d. per unit. These figures are considerably less than the costs at the commencement, and the price might be expected continuously to decrease with the growth in the demand for current. It was calculated that the scheme should return from 5½ to 7% upon the invested capital, provided out of public money.

Benefits of the Scheme.—The success of the scheme will depend largely upon the growth of effective demand for current. At first the Free State was very backward in its use of electricity both for industrial and domestic purposes. Both Siemens-Schückert and the experts who advised on the scheme were of opinion that the supply would create a very rapid growth in demand and this hope has been largely realized. Cheap light, heat and power for domestic consumption would be provided; and also power for large and small scale industry, particularly mills and creameries. It was hoped that farmers would use the power to light their premises and to drive farmyard machinery, and that the growth of manufacturing industries of an electro-chemical nature would be stimulated. The electrification of the railway system, apart from those suburban lines with heavy traffic, was not contemplated.

It remains to consider the effects which the Siemens-Schückert Scheme will have on (a) the drainage, (b) the navigation and (c) the fisheries of the Shannon. As regards drainage, it is claimed that the partial development, in which the winter level at Lough Derg will be maintained for about five months of the year, will by reason of the embankments to be erected, save from 3,000 to 4,000 acres of land from annual flooding; and that the later stages of development, in which the storage capacity will be increased and the consequent embankment extended, will save a further large area. The drainage of the Shannon basin will therefore be improved by the scheme. As regards navigation, there have been constructed two locks each 50 feet high to provide a passage from the tail race to the head race. The complete protection of the fisheries from damage is admitted to be impossible, but everything possible has been done or is being done to minimize the injury that will be inflicted; also provision has been made in the scheme for compensation to fishery interests.

BIBLIOGRAPHY.—Full particulars of the Shannon Scheme are to be found in *The Electrification of the Irish Free State; The Shannon Scheme Developed by Siemens-Schückert* and The Report of the Experts appointed by the Government Stationery Office, Dublin; Dail Eireann, Debates, *Official Report*, vol. 10 and 11. *See* also *Electrical Industries* (Aug. 29, 1928); Annual accounts of the Shannon Power Development Fund, and annual reports and accounts of the Electricity Supply Board. (G. O'B.)

SHANSI, an upland province in the interior of north China. It is a link in the girdle of loess-lands which wrap around the edges of the Mongolian plateau and which in effect constitute a belt intermediate between arid pastoral Mongolia and the great plain of north China, one of the foci of Chinese agricultural population. The Shansi plateau rises abruptly from the alluvial plain (relative to which it constitutes the "western mountains" as opposed to Shantung, the "eastern mountains") in the broken limestone edge of the Tai-hang-shan, but passes by much easier gradations into the Mongolian tableland beyond. The plateau surface is not, however, uniform. A series of ridges, arranged in the form of an arc, convex to the north-west, obtrudes from beneath the loess-mantle and, while almost buried in south Shansi, becomes increasingly conspicuous northwards so that in north Shansi the loess-cover is restricted to basins between high mountain ranges. Let down below the general level of the plateau in south Shansi is a chain of alluvial-floored basins strung along the valley of the Fên-ho and continuous with the Wei-ho valley in central Shansi. The largest of the Shansi basins lies at the head of the Fên-ho valley in the very heart of the province and contains Taiyüan-fu, the capital. These basins, being the foci of drainage, are better watered than the porous loess of the plateau above. As the rainfall of Shansi as a whole is marginal (being under 20 inches) and liable to fail, this distinction between basin and plateau is of great importance and the population is mainly concentrated either in the central belt of basins or on the terraces of the Tai-hang-shan which sink into the plains of Chihli (Hopeh) and Honan. The total population was estimated in 1922 at 11,654,879, and that of Taiyüan-fu at 51,363. The bulk of the population is therefore essentially rural.

The loess-basins along the Fên and Wei valleys were the homeland of Chinese agricultural civilization. They offered not only the intrinsic advantages of open unwooded country and a fertile soil but also easy communication with the old oasis cultures of the Tarim basin. It is suggested, indeed, that by way of Central Asia indirect links may have existed with the oldest agricultural centres of all, at Anau and in Babylonia, and the fact that the cereals (wheat, barley and millet) which formed the basis of the agricultural system both in western Asia and in north-west China have been found in a wild state only in the former points to early cultural links between them. It seems probable that the early Chinese acquired first the art of pottery, always closely associated with early agriculture, and later the knowledge of metal from the west, by way of Central Asia. Whether the Wei or the Fên valley was the first to be involved in this early development is a debatable point, but the first dynasty, the Hsia (2205–1766 B.C.) is traditionally associated with the lower Fên-ho valley, and many of the oldest legends belong to it. The Fên-ho valley has thus been under continuous cultivation for fully forty centuries. The conservation of water-supply has always been one of the essentials of agricultural practice in Shansi due to the marginal rainfall and porous loess soil. An elaborate system of agreements between individual farmers in the same village and between villages in the same valley has grown up in order to ensure an equitable distribution of the water-supply. This necessity hastened organization and contributed to the early development of civilization in the loess-lands. The chief crops grown are those cereals—wheat, barley and millet—able to subsist on comparatively small supplies of moisture. It was these which formed the basis of the agricultural system in the very beginning, in the 3rd millennium B.C. Rice, which was not adopted by the Chinese until they had spread out from their original home in the loess-lands into the Yangtze Valley, is cultivated only where the supply of water is sufficiently plentiful to permit the flooding of the fields.

Shansi was not only the home of Chinese agriculture but the centre of the most intense coal-mining activity and the site of the most famous iron industry of the Old China. The greater part of south Shansi consists of a vast coalfield which, though buried underneath loess and sandstone in the centre, crops out in the terraces of the Tai-hang-shan edge, which Richthofen named the "Anthracit-Terrasse." The main seam is here on the average 18 ft. thick and at the base of the coal measures iron ores are interbedded.

From the "Anthracit-Terrasse" there developed an extensive trade not only in lump anthracite with the adjacent parts of the north China plain but also in pig iron and manufactured iron goods, which supplied the whole of the north China market. The two most famous iron-working centres were Pingting and Tsechow.

In modern China the arterial routes of communication with but one exception skirt the edges of but do not penetrate into the province of Shansi, and its old industrial importance has been lessened by coal-mining nearer the coast and by the importation of foreign iron. But in the future Shansi is likely to be penetrated by more railways than the single line at present in existence (the branch to Taiyüan-fu from the Peking–Hankow railway) and, although its iron industry may never revive, its coalfields are the most valuable in all China and will once again be the focus of coal-mining activity. This relative removal, however, at the present day from the turmoil along the main routes has facilitated the gradual transformation of the province which has been effected by Yen Hsi-shan who alone among the provincial governors has remained in office since the 1911 Revolution and has thus been able to carry out a continuous policy. He is known as the "model governor" and Shansi as the "model province." The chief agency in the transformation of the people is the school and Shansi comes nearer than any other province to attaining compulsory school attendance. Over six hundred miles of roads have been built, hill-tops have been planted with saplings, partly for the sake of their timber and partly in order to regularize

the flow of river-water, and the cultivation of several remunerative commercial crops has been encouraged with considerable success. The most important of the latter are cotton, cultivated chiefly in the Fên-ho valley, and the mulberry, which has been planted especially in the south-east overlooking the Hwang Ho plain.

SHAN STATES, a collection of semi-independent states on the eastern frontier of Burma inhabited by the Shan or Tai race. The Shan States had an area of 56,311 sq.m. and a pop. (1921) of 1,433,542. On Oct. 1, 1922 a scheme came into effect for the Federation of the Shan States, along lines proposed by Sir Reginald Craddock. Under this the control of the Federated Shan States is vested solely in the governor and its financial arrangements are separated from those of the province generally. The administration is in the hands of a council of chiefs or *Sawbwas,* with a British commissioner. The Federation is financed partly by a fixed contribution from Government, partly by contributions from the chiefs. The Federation includes the former three divisions of the Northern Shan States (N.S.S), Southern Shan States (S.S.S.) and Karenni. There are besides several Shan States in other parts of Burma and a number beyond the border of Burma, which are tributary to China, though China exercises only a nominal authority. The British Shan States were tributary to Burma and came under British control on the annexation of Upper Burma. They rank as British territory, not as native states. The civil, criminal and revenue administration of each state is vested in the chief, subject to the restriction specified in the *sanad* or order of appointment granted to him.

Physical Features.—The shape of the Shan States is roughly that of a triangle, with its base near the plains of Burma and its apex on the Mekong river. The Shan plateau is properly only the country between the Salween and Irrawaddy rivers. On the west it is marked by the line of hills running from Bhamo to the plains of Lower Burma. On the east it is defined by the rift of the Salween. The average height of the plateau is between 2,000 and 3,000 ft., but it is seamed and ribbed by mountain ranges, which split up and run into one another. On the north the Shan States are barred across by ranges following the line of the Namtu. The huge mass of Loi Ling, 9,000 ft., projects south from this and from each side of it and to the south is the wide plain extending to Möng Nai. The highest peaks are in the north and the south. Loi Ling is the highest point west of the Salween, and in Kokāng and other parts of north Hsenwi there are many peaks above 7,000 ft. The majority of the intermediate parallel ranges have an average of between 4,000 and 5,000 ft. with peaks rising to over 6,000. The country beyond the Salween is a mass of broken hills, ranging in the south towards the Menam from 2,000 to 3,000 ft., while in the north towards the Wa states they average from 5,000 to 7,000. Several peaks rise to 8,000 ft., such as Loi Maw (8,102). From December to March it is cool everywhere, and 10° of frost are experienced on the open downs. The hot season temperature is 80° to 90°, rising to 100° in the Salween valley. The annual rainfall varies from 60 in. in the broader valleys to 100 on the higher mountains.

Race and Language.—In 1921 there were 1,017,987 Shans in Burma. The Thai or Tai, as they call themselves, were first known to the Burmese as Tarôks or Tarets. The original home of the Thai race was S.W. China. It is probable that their first settlement in Burma proper was in the Shweli valley, and that from this centre they radiated at a comparatively recent date north, west and south-east, through Upper Burma into Assam. It is supposed that the Thai race boasts of representatives across the breadth of Indo-China; that it numbers among its members not only the Shans proper, the Laos and the Siamese, but also the Muongs of French Indo-China, the Hakas of S. China, and the Li, the inhabitants of the interior of the far Eastern island of Hainan in the China seas.

The Thai language may be divided into two sub-groups, the North and the South. The South includes Siamese, Lao, Lü and Hkün; the North, the three forms of Shan, namely North-Burmese Shan, South-Burmese Shan and Chinese Shan with Hkamti and Ahom. The vernacular of the people who are directly known in Burma as Shan is South-Burmese Shan. This language is isolating and polytonic. It possesses five tones, a mastery of which is a *sine quâ non* if the language is to be properly learnt. It is exhaustively described in the works of Dr. Cushing.

The Shans are a peaceful race, fond of trading. During the past 25 years the trade with Burma has increased very largely, especially after the construction of the Lashio and Heho railways. The huge silver-lead-zinc mines of the Burma Corporation at Bawdwin lie in the Northern Shan States. The cultivation of wheat and potatoes in the South States promise them wealth also when a railway furnishes them means of getting the produce out of the country. Since 1893 the peace of the Shan States has been practically undisturbed.

See Ney Elias, *Introductory Sketch of the History of the Shans in Upper Burmah and West Yun-nan* (Calcutta, 1876); Cushing, *Shan Dictionary* (Introduction); Bock, *Temples and Elephants;* Sir A. Phayre, *History of Burmah;* A. R. Colquhoun, *Across Chrysê* (London, 1883), and *Amongst the Shans* (1885); Diguet, *Étude de la langue Thai* (Paris, 1896).

The Southern Shan States number 36 with a total area of 36,154 square miles and a population in 1921 of 836,220. The largest is Tũng Kēng (12,400 sq.m., pop. 208,755); the smallest has an area of only 14 sq.m. The Northern Shan States are six in number:—Hsipaw (4,400 sq.m., pop. 131,410); Tawngpeng (778 sq.m., pop. 41,255); North Hsenwi (6,335 sq.m., pop. 222,191); South Hsenwi (2,281 sq.m., pop. 84,141); Manglün (2,800 sq.m., pop. 57,318); Möng Mit (3,561 sq.m., pop. 56,498). For the Karen States, *see* KARENNI.

Among the Southern group of States the following are the more important:

TŨNG KĒNG is the most extensive of the Shan States in the province of Burma. The state is known to the Chinese as Mêng Kêng, and was frequently called by the Burmese "the 32 cities of the Gôn" (Hkön), Tũng Kēng has expanded considerably since the establishment of British control, by the inclusion of the districts of Hsen Yawt, Hsen Mawng, Möng Hsat, Möng Pu, and the cis-Mekong portions of Kēng Cheng, which in Burmese times were separate charges. The "classical" name of the State is Khemarata or Khemarata Tungkapuri. About 63% of the area lies in the basin of the Mekong river and 37% in the Salween drainage area. Some peaks rise to over 7,000 ft.; the elevation is nowhere much below 5,000 feet. There are successive parallel hill ranges running north and south. Mountainous country predominates. The chief rivers, tributaries of the Salween, are the Nam Hka, the Hwe Lông, Nam Pu and the Nam Hsīm. The first and last are considerable rivers. Rocks and rapids make both unnavigable, but much timber goes down the Nam Hsīm.

Teak forests exist in Möng Pu and Möng Hsat, and also in the Mekong drainage area in the south of the State, but there is only a local market for the timber. Rice, as elsewhere in the Shan States, is the chief crop. Next to it is sugar-cane. Earth-nuts and tobacco are the only other field crops in the valleys. On the hills, besides rice, cotton, poppy and tea are the chief crops. The tea is carelessly grown, badly prepared, and only consumed locally. Much garden produce is raised in the valleys. The State is rich in cattle, and exports them to the country west of the Salween. As in all parts of the Shan States, there are huge areas awaiting development.

Tũng Kēng, the capital, is surrounded by a brick wall and moat about 5 m. round. Only the central and northern portions are much built over.

MÖNG NAI is second in size among the Southern States (3,100 sq. m., pop. [1921] 55,647), and lies with Möng Pan and Mawkmai in the south-west.

MÖNG PAN ranks next to Tũng Kēng and Möng Nai in size among the Southern Shan States, with an area of 2,988 sq.m., and a pop. (1921) of 21,728. The main State lies, except for a few insignificant circles, entirely west of the Salween. The only considerable area of flat land is round the capital, which lies in a large and fertile plain, marking roughly the centre of the State. From this plain rise low hills covered with scrub jungle, sloping up to ranges of about 5,000 ft. on nearly every side. Rice is the only crop, irrigated where possible; elsewhere dry cultivation prevails. The State has valuable teak forests, which cover a considerable

but undetermined area. The general altitude of the valleys is about 2,000 feet. The capital is small, and has only about 200 houses.

LAWKSAWK has an area of 2,362 sq.m. and a pop. of 28,010 and ranks fourth in size among the States of the southern division. The crops are rice, sesame, cotton, ground-nuts and oranges. The State is mountainous. To the north the country falls away to the Nam Tu (Myit-ngè), where there are teak forests, as well as along the Nam Lang and Nam Et, which with the Zawgyi form the chief rivers. Most of them disappear underground which makes the extraction of timber impossible except for local use. Lawksawk is the capital. The old brick walls and the moat are falling into decay.

MŌNG PAI (called Mobyē by the Burmese), is the most south-westerly of the Shan States. It has an area of 73 sq.m., and a pop. (1921) of 20,996. The country is hilly, rising westwards from the chief stream, the Nam Hpilu or Balu. This is navigable for native boats throughout the year to the point where it sinks underground in Karen-ni. The chief cultivation is rice, with about two acres of dry or hill rice to one of wet bottom. The hill fields are left fallow for ten years after two years' cultivation.

Other States in the southern group with an area of more than 1,000 sq.m. include: Mawkmai (2,200 sq.m.), Mōng Nawng (1,646), Mōng Kūng (1,593), Lai Hka (1,560), Yawnghwe (1,302) and Loilong (1,084).

TAUNG-GYI is the chief town of the Shan States and the meeting place of the Council of Chiefs. It is situated in 96° 58′ E. and 20° 47′ N., at an altitude of about 5,000 ft., in a depressed plateau on the crest of the Sintaung hills. It is in the State of Yawnghwe, a few miles by motor road from the present terminus of the Southern Shan States railway which joins the main Rangoon-Mandalay line at Thazi. The five-day bazaar is the trading place of the natives. A special quarter contains the temporary residences of the chiefs when they visit headquarters, and there is a school for their sons.

Among the northern group of States, of which North and South Hsenwi, Hsipaw and Mang Lön are the chief.

HSENWI or THEINNI is better known by the Burmanized name of Theinni. The northern part of North Theinni is a mass of hills, in the valleys between which are numerous tracts under rice cultivation. The southern portion has much more flat land, along the line of the Nam Tu, its tributaries the Nam Yao and the Nam Nim, and the Nam Yek flowing into the Salween. This was formerly thickly populated, and still remains the most valuable portion of the State. Both north and south of the Nam Tu there are many peaks which rise to 6,000 ft., and several over 7,000 feet. The northern portion (about 4,000 ft.) might be called a plateau. It has large, grassy, upland downs. This part of the State has fallen almost entirely into the hands of the Kachins. The Shans are found in the Nam Mao (Shweli or Lung Kiang) valley, and in the Nam Tu and other valleys in the southern part of the State. South Theinni is bisected by the huge mass of Loi' Ling, nearly 9,000 ft. above sea-level. Apart from this it consists of broken hill-country or downs, the latter chiefly in the eastern half of the State. It is watered by numerous streams, of which the chief is the Nam Pang, an affluent of the Salween. Considerable deposits of coal, or rather of lignite, exist in both North and South Theinni, but have as yet been little worked. Gold is washed in many of the streams in a fitful way. No valuable timber exists to any considerable extent. Pine forests cover some of the ranges, but, as elsewhere in the Shan States, varieties of the oak and chestnut are the commonest forest trees. The climate as a whole is temperate. The average rainfall is about 60 in. yearly. It has regained much population since the British occupation in 1888, and especially since the opening of the Mandalay Lashio Railway and the Burma Corporation's mine and smelting works.

Hsenwi, the capital of North Hsenwi, stands near the north bank of the Nam Tu. The ruins of the old capital lie at a short distance, and show it to have been a large and well-built town. Mōng Yai is the capital of South Hsenwi, with a population of about 2,000. The races found in Hsenwi comprise Shans, Kachins, Chinese, Burmese, Lihsaws, Wa, Palaungs and Yanglam. The Shans and Kachins predominate, and are nearly equal in numbers.

LASHIO, the chief town of the northern Shan States, lies in the state of North Hsenwi, situated in 22° 56′ N. and 97° 45′ E. at an altitude of 3,100 ft., on a low spur overlooking the valley of the Nam Yao. It is the terminus of the Mandalay-Kun Lông railway and of the government cart road from Mandalay, from which it is 178 m. distant.

HSIPAW or THIBAW is called by the Shans, and officially, Hsipaw, and also frequently Ōng Pawng (the name of an old capital). The chief plain land is in the valley of the Nam Tu (Myit-ngè), near Thibaw town, and the valley or strath of the Pyawng Kawng, Nawng Ping neighbourhood. Elsewhere the valleys are insignificant. The hills on the Möng Tung border reach their highest elevations in the peaks Loi Pan (6,848 ft.) and Loi Htan (6,270 ft.). To the north-west of Thibaw town, on the Tawng Peng border, Loi Lam rises to 6,486 ft. The valley of the Nam Tu marks the lowest point in the State at Thibaw town, about 1,400 ft., and rises on the east in Möng Tung to a plain level of about 2,500 ft., and on the west in Möng Lông to a mass of hills with an average height of 4,500 ft., broken up by the Nam Yawn and Nam Kaw valleys, which are about 3,000 ft. above sea-level.

The chief river is the Nam Tu or Myit-ngè. Between Thonzè and Lawksawk (Yatsauk) it flows through a gorge between cliffs 3,000 to 4,000 ft. high. At the gorge of Gôkteik the Nam Htang and the Nam Pasè unite to form the Nam Küt, which passes into the ground at the natural bridge where the Mandalay-Lashio railway crosses the gorge, and reappears to join the Nam Tu. The bed of the Nam Küt is about 1,500 ft. below the general level of the country. Coal of poor quality is found at various places. The average maximum temperature at the beginning of April is about 96°, and the minimum about the same period 65°. The rainfall averages about 70 in. The chief crops are rice, cotton, sesame, tea in the hills, and *thanat,* the leaf of a tree used for the wrapper of the Burma, or "green" cheroot. Cotton cloth was formerly much more generally manufactured than it now is, and a coarse country paper is also made. The government cart road to Lashio passes through the centre of the State, and the Mandalay-Lashio railway also passes through the capital. Teak forests exist along the banks of the Nam Tu and in the Mang Lön States, but both have been practically exhausted, and will have to be closed for many years.

MANG LÖN, is the chief state of the Wa or Vü tribes, some of whom are or were till very recently head-hunters, and Mang Lön is the only one which as yet has direct relations with the British government. The State extends from about 21° 30′ to 23° N., or for 100 m. along the river Salween. Its width varies from a mile or even less on either side of the river to perhaps 40 m. at its broadest part near Taküt, the capital. It is divided into East and West Mang Lön, the boundary being the Salween. There are no Wa in West Mang Lön. Shans form the chief population, but there are Palaungs, Chinese and Yanglam, besides Lahu. The bulk of the population is Wa, but there are many Shans and Lahu. The only flat land is along the banks of streams in the valleys. Here the Shans are settled. There are prosperous settlements and bazaars at Nawng Hkam and Möng Kao in West Mang Lön. The Wa of Mang Lön have given up head-hunting, and many profess Buddhism. The capital, Taküt, is on a hill-top 6,000 ft. above sea-level. The sawbwa is a Wa, and has control over two sub-states, Mōt Hai to the north and Maw Hpa to the south.

See under BURMA, also the Report on the Administration of the Shan and Karenni States (annual).

SHANTUNG, a northern maritime province of China, consisting of a mountainous peninsula of much indented coastline projecting eastward into the Yellow sea, but separated from the other highlands of China by the wet alluvial plain of the Hoang-ho. That river has changed its course many times. Prior to 1851 it reached the sea south of the highland of Shantung; since about 1853 it has flowed north of the highland, but not always in the same bed. The province includes a considerable belt of the alluvial plain west and north of the highland, but less of it on the south. The main direction of the mountain lines is

west-south-west to east-north-east, as in Liaotung, and siliceous schists form a great part of the masses concerned, while in the granite and gneiss, the direction N. 30° W.–S. 30° E. is more evident. The Tai-shan, on the north side of Shantung, west of Chefoo, gives a steep coast facing the Gulf of Pe-chih-li. These hills are marked off from those of the south-east coast by a relatively low line from Chefoo to Tsingtao. At the base of the peninsula, hill lines, in which both directions are exemplified, gather around the Tai-shan, the culmination of which is 5,060 ft. above sea-level. This mountain is one of the chief centres of pilgrimage in China, and has been famed in this way from immemorial antiquity. It was von Richthofen's opinion that Shantung was very early occupied by cultivators spreading from the Wei valley, and that here, once the barbarians were subdued, they had opportunities of defence as well as of economic development; in this way he thinks Shantung came to play a special rôle in Chinese life, a rôle greatly enhanced by the fact that Confucius (551–479 B.C.) and Mencius were natives of the province. The Tai-shan has sanctuaries of many kinds, and pilgrims visit them, especially in spring. The Tai-shan is divided from the mountains of the peninsula by the low line of the Kiau-ho; the other rivers of the highland region are mostly short, but across the plain to the north there run several streams which interlace to some extent; the largest is called Wei-ho. South-west of the mountain system runs the Grand canal, which receives the I-ho from the Tai-shan. The rainfall at Chefoo is about 29 in. per annum, the autumn being driest; the mean monthly temperature here varies from 25·3° in January to 80° in August. The climate on the slopes facing south-east is considerably warmer. The heights still shelter wild boars and wolves, and the trees in the colder regions include pines, oak, poplar, willow, with some cypress. The valleys in the mountain region are often fertile, but the hills themselves are barren. Millet, wheat, barley, sorghum, maize, peas, cotton, hemp and poppies are, or have been, cultivated, with castor-oil and rice in the south. Fruit trees are numerous and specially rich in parts of the south. The wax tree grows in the east, and the wax insects are placed on it for the summer, being taken indoors in the autumn to void the substance whence wax is prepared. They are protected indoors during the winter. Shantung produces both ordinary silk and the silk made by a caterpillar which lives on oak leaves. There are many mules and horses, as well as sheep, cattle, goats, etc. The province is famed for its minerals. Coal occurs at I-chow-fu (south), I-hien (south-west), Lao-fu (centre), and Wei-hien (north). About two million tons of bituminous coal were produced in 1922 in the province, and there are considerable reserves of the material. Production of iron ore has been small, but there are large reserves, estimated to yield some 14 million tons of iron when worked. Gold is produced here and there, and there is some copper, lead, etc.

The area of the province is estimated at 56,000 sq.m., and its population at anything between 25 and 38 million. Britain obtained a lease of Wei-hai-wei, near the eastern end of the peninsula, and Germany a lease of Kiao-chow (port Tsingtao) in 1898. The Japanese captured the latter in 1914 and it was returned to China in 1922. Negotiations for the return of Wei-hai-wei were begun in 1921. The towns of Shantung include Chinan (Tsi-nan) at the northern foot of the Tai-shan, the capital and largest city; Tsaochow, in the south-west; Tsining, on the Grand canal; I-chow, in the south; Wei-hien, in the north; and Chefoo, the treaty port, on the north coast, all probably above the 100,000 line in population. The lowland portions of the province are among the most densely-peopled regions in China. The railways of the province include a long section of the Tientsin-Pukow main line, while a railway, originally German, leaves this line at Chinan and goes to Tsingtao; there are also branch lines and others are planned. The province under the empire was divided into ten prefectures.

See F. von Richthofen, *China*, vol. ii. (1882); L. Richard, *Géographie de l'Empire de Chine* (Shanghai, 1905); Anon., *The Christian Occupation of China* (Shanghai, 1922); ed. H. G. W. Woodhead, *The China Year Book*, Tientsin and London, annual; ed. S. Cooling, *Encyclopaedia Sinica* (1918).

Political History.—The province of Shantung obtained an international reputation during the years immediately following the World War, owing to the difficulties attending the rendition of the Kiao-Chow territory seized by Germany in 1897. The territory remained in the hands of the Germans, who spent large sums of money improving and developing the colony, until Nov. 1914, when it was captured by the Japanese. The Treaty of Versailles confirmed Japan in the possession of the territory, but the Chinese were thoroughly dissatisfied with the decision. At the time of the Washington Conference Japan agreed to hand back her holdings to China, under conditions, however, which still gave the Japanese an acknowledged interest in the province. During the recent civil war banditry has been rife. In 1928 Japanese troops clashed with the Chinese Nationalist forces in Tsinanfu and a tense situation developed which up to 1929 had been only partially relieved.

See Forsyth, *Shantung* (1902) and Willoughby, *China at the Conference* (1922).

SHANTUNG. A plain silk fabric of light texture originally produced in the Chinese province of that name from a variety of native silk known as "pongee" silk obtained from the cocoons of wild silkworms that feed on oak leaves. Hence, "pongee" is of a strong and rough type of silk with a light tan natural colour and a coarser filament structure than that produced by cultivated silkworms that are fed on mulberry leaves.

Japanese "pongee" is also a type of wild silk of a similar character to Shantung silk, but of a smoother and more even filament structure than that of Chinese "pongee." The word "pongee" is said to correspond with "homespun," "hand-spun," and "hand-woven," as it is chiefly conducted on a very large scale as a home or domestic industry both in China and Japan, although "pongee" silk or Shantung is now woven on power looms.

"Tusser" silk is the name applied to a type of low grade fabric produced from silk spun by a species of wild native silkworms of India, and possessing characteristics similar to those of Chinese "pongee" silk. Fabrics produced from "pongee" or other types of wild silk partake of the physical characteristics of such silk and feel somewhat harsh and rough, although the better qualities of these wild silks are said to be of a more durable character and to wear better than silk fabrics produced from the products of cultivated silkworms.

Shantung silk fabrics are also sometimes sold under the trade-name of "Ninghai." (H. N.)

SHANTY or **CHANTY,** a song of the class of labour songs which sailors on merchant ships sing as they pull ropes to hoist yards and sails, raise anchors or work pumps. The word "shanty," however it is spelt, is usually thought to be the British sailor's corruption of the French word "chanter" and to come from the French Canadian lumbermen, who sing as they haul their logs; Sir Richard Terry derives it from the West Indian negroes, who move their huts or "shanties" with ropes and sing as they work, with a shantyman as soloist and leader.

On board ship there are two kinds of shanties, one for pulling ropes, and one for winding the capstan. The former kind provides in the tune points for collective pulls (or a simple final pull on the last note, as in "bunting" a sail), the latter for continuous rhythmical movement. Among the best known tunes are those of "Shanadar" (or Shenandoah), "Rio Grand," "Clear the track, let the bullgine run," "Knock (or 'blow') the man down," "A-roving," "Heave away my Johnnie," "O Johnny come to Hilo," and "Whoop (or 'whip') Jamboree," to name but a few.

See Cecil Sharp, *English Folk-Chanteys;* R. R. Terry, *Shanty Book* (2 vols.), and Grove's *Dictionary of Music.*

SHAPING MACHINES: *see* PLANING MACHINES.

SHAPUR (Pahlavi, *Shāhpuhre,* "son of the king"; Greek *Sapores,* commonly *Sapor*), the name of three Sassanian kings.

1. SHAPUR I. (A.D. 241–272), son of Ardashir I. The Persian legend which makes him the son of an Arsacid princess is not historical. Ardashir I. had towards the end of his reign renewed the war against Rome; Shapur conquered the Mesopotamian fortresses Nisibis and Carrhae and advanced into Syria; but he was driven back by C. Furius Timesitheus, father-in-law of the

young emperor, Gordianus III., and beaten at Resaena (243). Shortly afterwards Timesitheus died, and Gordianus (*q.v.*) was murdered by Philip the Arabian, who concluded an ignominious peace with the Persians (244).

When the invasion of the Goths and the continuous elevation of new emperors after the death of Decius (251) brought the Roman empire to utter dissolution, Shapur resumed his attacks. He conquered Armenia, invaded Syria and plundered Antioch. At last the emperor Valerianus marched against him, but suffered near Edessa the fate of Crassus (260). Shapur advanced into Asia Minor, but was beaten by Ballista; and now Odaenathus (Odainath), prince of Palmyra, rose, in his rear, defeated the Persian army, reconquered Carrhae and Nisibis, captured the royal harem, and twice invested Ctesiphon (263–265). Shapur was unable to resume the offensive; he even lost Armenia again. But according to Persian and Arabic traditions, which appear to be trustworthy, he conquered the great fortress of Hatra in the Mesopotamian desert; and the great glory of his reign was that a Roman emperor was by him kept prisoner to the day of his death.

In the valley of Istakhr (near Persepolis), under the tombs of the Achaemenids at Nakshi Rustam, Shapur is represented on horseback, in the royal armour, with the crown on his head; before him kneels Valerian, in Roman dress, asking for grace. The same scene is represented on the rocks near the ruins of the towns Darabjird and Shapur in Persis. Shapur left other reliefs and rock inscriptions: one, at Nakshi-Rajab near Persepolis, is accompanied by a Greek translation; here he calls himself "the Mazdayasnian (worshipper of Ahuramazda), the god Sapores, king of kings of the Aryans (Iranians) and non-Aryans, of divine descent, son of the Mazdayasnian, the god Artaxares, king of kings of the Aryans, grandson of the god-king Papak." Another long inscription at Hajjiabad (Istakhr) mentions the king's exploits in archery in the presence of his nobles.

From his titles we learn that Shapur I. claimed the sovereignty over the whole earth, although in reality his domain extended little farther than that of Ardashir I. Shapur built the great town Gundev-Shapur near the old Achaemenian capital Susa, and increased the fertility of this rich district by a barrage through the Karun river near Shushter, which was built by the Roman prisoners and is still called Band-i-Kaisar, "the mole of the Caesar." Under his reign the prophet Mani, the founder of Manichaeism (*q.v.*) began his preaching in Persia, and the king himself seems to have favoured his ideas.

For the monuments and inscriptions *cf.* Sir R. Ker Porter, *Travels;* Flandin and Coste, *Voyage en Perse;* Stolze, *Persépolis;* Thomas, *Journal R. Asiat. Soc.*, new series, iii., 1868: West in *Grundriss der iranischen Philologie*, ii. 76 f.; Dittenberger, *Orientis Graeci inscr.* i., No. 434. A gem with the portrait of the king is in the museum of Gotha, *cf.* Pertsch, *Zeitsch. d. deutschen morgenl. Ges.* xxii. 280.

2. Shapur II. (310–379). When King Hormizd II. (302–310) died, the Persian magnates killed his eldest son, blinded the second, and imprisoned the third (Hormizd, who afterwards escaped to the Romans); the throne was reserved for the unborn child of one of the wives of Hormizd. This child, named Shapur, was therefore born king; the government was conducted by his mother and the magnates. But when Shapur came of age, he turned out to be one of the greatest monarchs of the dynasty. Under his reign the collection of the *Avesta* was completed, heresy and apostasy punished, and the Christians persecuted. This was the natural oriental reaction against the transformation of the Roman empire into a Christian empire by Constantine. In 337, just before the death of Constantine, Shapur broke the peace concluded in 297 between Narses and Diocletian, which had been observed for forty years, and a war of twenty-six years (337–363) began. Shapur attempted with varying success to conquer the great fortresses of Roman Mesopotamia, Singara, Nisibis (which he invested three times in vain), Amida (Diarbekr). The emperor Constantius II. was always beaten in the field. Nevertheless Shapur made scarcely any progress; the military power of his kingdom was not sufficient for a lasting occupation of the conquered districts. At the same time he was attacked in the E. by nomad tribes, among whom the Chionites are named. After a prolonged struggle they were forced to conclude a peace, and their king, Grumbates, accompanied Shapur in the war against the Romans. Shapur now conquered Amida after a siege of seventy-three days (359), and took Singara and some other fortresses in the next year.

In 363 the emperor Julian, at the head of a strong army, advanced to Ctesiphon, but was killed. His successor Jovian was defeated and made an ignominious peace, by which the districts on the Tigris and Nisibis were ceded to the Persians, and the Romans promised to interfere no more in Armenia. In the rock-sculptures near the town Shapur in Persis (Stolze, *Persépolis*, pl. 141) the great success is represented; under the hoofs of the king's horse lies the body of an enemy, probably Julian, and a suppliant Roman, the emperor Jovian, asks for peace.

Shapur now invaded Armenia, took king Arsaces III. (of the Arsacid race), the faithful ally of the Romans, prisoner by treachery and forced him to commit suicide. He then attempted to introduce Zoroastrian orthodoxy into Armenia. But the Armenian nobles resisted him successfully, secretly supported by the Romans, who sent King Pap, the son of Arsaces III. into Armenia. The war with Rome threatened to break out again; but Valens sacrificed Pap and caused his assassination in Tarsus, where he had taken refuge (374). Shapur had conducted great hosts of captives from the Roman territory into his dominions, most of whom were settled in Susiana. Here he rebuilt Susa, after having killed her rebellious inhabitants, and founded some other towns. He was successful in the east, and the great town Nishapur in Khorasan (E. Parthia) was founded by him.

3. Shapur III. (383–388), son of Shapur II., elevated to the throne by the magnates against his uncle, Ardashir II., and killed by them after a reign of five years. He concluded a treaty with Theodosius the Great. (Ed. M.)

SHARES. A share is tangible evidence of the fact that the holder has invested money in a given company, and is also the means of defining the extent of his holding as against those of his fellow-shareholders. In England, a share always has a definite nominal or face value, such as "one pound," "ten shillings," or even "one shilling." The size of a man's holding is measured in "so many shares," and shares are issued, bought and sold by number. This is the vital distinction from stock (*q.v.*) which is always measured by its nominal or face value. Thus a holding of stock is described, for example, as "£100 stock"; a holding of shares as "100 £1 shares." Furthermore, stock is dealt in in odd amounts, *e.g.*, "100.3s.4d. stock"; shares must always be dealt in in multiples of a share—thus a sale of "$\frac{3}{4}$ share" or "$101\frac{1}{2}$ shares" is not permitted.

Interest or dividend payable on shares is expressed in one of two ways—"a dividend of sixpence (or other sum) per share," or "a dividend of 5 (or so much) %," the latter meaning a dividend equivalent to the percentage named on the face value of each share. If the shares are £1 shares, 5% is equivalent to 1s. per share, but if they are 10s. shares, 5% is equivalent to 6d. per share.

The market value of shares has no connection with their nominal value. It is governed by price, which is always expressed in so many pounds, shillings or pence per share. Thus:—

$3\frac{1}{4}$	means	£3.5s.	cash per share.
11/6	"	11s.6d.	" " "
/6	"	6d.	" " "

This is the usual stock exchange way of publishing prices. The presence of fractions and the absence of the stroke implies pounds; otherwise it is shillings and pence.

A company increases its capital by issuing additional shares. They may be issued either free as a complete bonus to shareholders (*e.g.*, two bonus shares for every three held), or at a price below their current market price as a partial bonus to shareholders (*e.g.*, if the market price of outstanding £1 shares is 4, they may be issued at $2\frac{1}{4}$, each holder of two shares being entitled to buy one new, or to sell his right in the market to anyone who will buy it), or at the full market price direct to the public. Con-

versely, if the capital of a company has to be written down—*i.e.*, reduced, this is done by reducing the nominal value of each share, *e.g.*, a company with shares of £1 each might write them down to ten shillings each. Occasionally shares are "split"—*i.e.*, a company whose shares were originally of £10 each might split each share into ten of £1 each, thus increasing the saleability of the shares.

Shares usually represent capital as opposed to loans and debentures. (*See* STOCKS.) They take three main forms: preference, ordinary, and deferred.

Kinds of Shares.—Preference shares usually receive only a fixed rate of dividend, although occasionally they share with the ordinary shares in any further profits. They are then called "participating preference shares." Usually in this case, the ordinary shares get a definite dividend for themselves, and the participating preference shares only receive a share of what is left. In all cases, preference shares rank ahead of ordinary and deferred shares, both as to dividend and as to repayment in the event of liquidation. Thus, if a company earns £100,000 and the preference dividend (say 5% on 2,000,000 £1 preference shares) requires the full £100,000, the holders of the ordinary shares get nothing. If preference shares are "cumulative" any arrears of dividend on them are carried forward and accumulated until a profit is earned. Then all the arrears must be paid off, before anything is paid on the ordinary shares; otherwise, once a preference dividend is not paid, the shareholders have no claim in respect of that dividend upon any future profits.

Ordinary shares rank after preference shares, but whereas the preference shareholder (unless "participating") is only entitled to a fixed dividend and to the return of the nominal value of his shares in the case of liquidation, in both cases the ordinary shareholder receives "what is left." If, however, the company has also issued deferred shares, the ordinary shareholder only gets a fixed rate of dividend, perhaps with participating rights, and the deferred shareholder receives "what is left."

It is not usual for a company to issue all three kinds of shares. Usually it only issues two of the three kinds. When the first and third are issued, they are often called "preferred ordinary" and "deferred ordinary." In no case are directors bound to declare any dividend, even if profits have been earned. (*See* also INVESTMENTS; STOCKS; TRANSFERS.) (N. E. C.)

United States.—In the United States the term "stock" is used to denote the ownership or owned capital in a business, just as the word "shares" is used in England, and the term "share" is reserved to denote one of the units or divisions of this ownership. For a full discussion of American usage *see* STOCK.

SHARI, a river of North-Central Africa, carrying the drainage of a large area into Lake Chad. Its headstreams rise on the watersheds between the Chad basin and those of the Nile and Congo. The principal headstream, known generally as the Wam, rises, in about 6° 30′ N., 15° E., in mountainous country forming the divide between the Chad system and the basin of the Sanga affluent of the Congo. From the source of the Wam to the mouth is a distance, following the windings of the stream, of fully 1,400 m.

The Wam flows east and then north and in about 7° 20′ N., 18° 20′ E. is joined by the Fafa, a considerable stream rising east of the Wam. The upper course of the Wam is much obstructed by rapids, but from a little above the Fafa confluence it becomes navigable. Below the confluence the river, now known as the Bahr Sara, receives three tributaries from the west. In about 9° 20′ N., 18° E., it is joined by the Bamingi, which is formed by the junction of the eastern headstreams of the Shari. One of its branches, the Kukuru, rises in about 7° N., 21° 15′ E. Some 90 m. from its source the Bamingi becomes navigable, being 12 ft. deep and flowing with a gentle current. In 8° 42′ N. it receives on the west bank the Gribingi, a river rising in about 6° 20′ N. It is narrow and tortuous with rocky banks and often broken by rapids. It flows in great part through a forest-clad country. A few miles above its confluence with the Bahr Sara the Bamingi receives on the right hand another large river, the Bangoran, which rises in about 7° 45′ N. and 22° E., in a range of hills which separates the countries of Dar Runga and Dar Banda, and, like the Bamingi, flows through open or bush-covered plains with isolated granite ridges.

Below the junction of the Bahr Sara and the Bamingi the Shari, as it is now called, becomes a large river, reaching, in places, a width of over 4 m. in the rains; while its valley, bordered by elevated tree-clad banks, contains many temporary lakes and back-waters. In 9° 46′ N. it receives the Bakare or Awauk (Aouk) from the east, known in its upper course as the Aukadebbe. This, like the Bahr es Salamat, which enters the Shari in 10° 2′ N., traverses a wide extent of arid country in southern Wadai, and brings no large amount of water to the Shari. In 10° 12′ a divergent branch, the Ergig, leaves the main stream, only to rejoin it in 11° 30′.

In 12° 15′ N. and 15° E. the Shari receives on the west bank its largest tributary, the Logone, the upper branches of which rise far to the south between 6° and 7° N. The principal headstreams are the Pende and the Mambere. Its system is connected with that of the Benue (*see* NIGER) by the Tuburi Swamp, which sends northward a channel joining the Logone in about 10° 30′ N. Below the Logone confluence the Shari, here a noble stream, soon splits up into various arms, forming an alluvial delta, flooded at high water, before entering Lake Chad.

The existence of the Shari was made known by Oudney, Denham and Clapperton, the first Europeans to reach Lake Chad (1823). In 1852 Heinrich Barth spent some time in the region of the lower Shari and Logone, and in 1872–1873 Gustav Nachtigal studied their hydrographical system and explored the Gribingi, which he called the Bahr el Ardhe. But the most prominent explorers have been Frenchmen. In 1896 Émile Gentil reached the Bamingi and in a small steamer passed down the river to its mouth. In 1907 an expedition under Captain E. Lenfant followed the Wam-Bahr Sara from its source to the confluence with the Bamingi and showed it to be the true upper course of the Shari. The same expedition also discovered the Pende tributary of the Logone. From the mouth of the Shari in Lake Chad there is a current towards the Bahr-el-Ghazal channel at the south-eastern end of that lake (*see* CHAD). This channel has been supposed to be a dried-up affluent of the lake. Investigations by the French scientists E. F. Gautier and R. Chudeau led Chudeau to the conclusion that the Shari did not end in Lake Chad, but, by way of the Bahr-el-Ghazal, passed between Tibesti and Ennedi and ended in some *shat* in the Libyan desert. The major part of the Shari basin is in French Equatorial Africa; some of the western affluents are in the Cameroons.

See the works of Barth, Nachtigal and other travellers, especially Lenfant's *La Découverte des grandes sources du centre de l'Afrique* (1909).

SHARK, the name generally given to the larger kinds of Selachians (*q.v.*) of the order Pleurotremi, the smaller kinds being known as dog-fishes. Typical sharks are active and piscivorous, swimming near the surface in warm seas, and are generally bluish or greyish in colour; the body is of the normal fish shape, the snout pointed, the crescentic mouth placed on the under side of the head, and there is a series of separate gill-openings on each side; the teeth are often sharp-edged and triangular; the fins are pointed and the end of the tail is strongly upturned. Owing to the position of the mouth a shark may have to turn over to seize a man swimming at the surface, but this is not its normal method of feeding. Some large pelagic sharks have minute teeth and feed on plankton, and among those that live at the bottom there are many divergences from the type described above; they are generally less active, and have rounded fins and the end of the tail less upturned; some are stout and blunt-headed, others flattened, others eel-like; many are spotted, banded or marbled. The mouth of these bottom-living forms is often transverse, and their teeth are often small and cuspidate, but cutting, piercing and crushing teeth occur. The spiracles, vestigial gill-openings placed behind the eyes, are small in pelagic sharks, but larger in the bottom-living forms, in some (*Squatina, Orectolobus*) as large as in the rays.

To the family Lamnidae belong several large pelagic sharks, widely distributed in warm seas. One of the largest, swiftest, and most voracious is the great white shark or man-eater (*Carcharo-*

don), which reaches a length of 40 ft.; this is somewhat similar in form to a tunny, the body being stout and rounded, the snout pointed, and the tail slender and keeled on each side; the mouth is crescentic, and the teeth are large, triangular, with sharp serrated edges; on each side five separate gill-openings appear in front of the large, falcate pectoral fins; the first dorsal fin is moderate, the second small and opposite the anal; the powerful caudal fin is lunate, the lower lobe being nearly as large as the upper, which is supported by the upturned end of the tail. This shark feeds on fishes and other marine animals; a young sea-lion, weighing 100 lb., was found in the stomach of one 30 ft. long. Teeth found fossil in tertiary strata, and others dredged in the Pacific ocean indicate the former existence of a *Carcharodon* about 90 ft. long. The porbeagles (*Lamna*) are similar in form to the great white shark, but have narrower piercing teeth. The thresher (*Alopias*) is more slender, and is remarkable for the great length of the upper lobe of the tail-fin; it swims near the surface and feeds on fishes, and has been observed to strike them with blows from the tail. The family Lamnidae also includes the basking shark (*Cetorhinus maximus*), which takes its name from its habit of basking at the surface. It is distinguished by the large mouth, minute conical teeth and very wide gill-clefts, the inner openings of which are guarded by series of long, slender gill-rakers. It reaches a length of 40 ft., but is quite harmless, feeding on minute organisms. Formerly it was hunted by harpooning off Ireland, for the sake of the oil from the liver.

The numerous species of the Carchariidae are mainly tropical, pelagic and piscivorous sharks, with sharp triangular teeth, distinguished from the Lamnidae by having the last one or two gill-openings above the pectoral fin. The tiger shark (*Galeocerdo tigrinus*) is one of the largest and most dangerous. The hammer-heads (*Sphyrna*) are peculiar in having the front part of the head produced outwards on each side, with the eyes at the ends of these extensions. The topes (*Galeus*) and hounds (*Mustelus*) are small bottom-living Carchariids with small teeth, which are serrated in the topes, blunt and forming a pavement in the hounds; both genera are represented in British seas.

The Scyliorhinidae include the dog-fishes, most of which are small bottom-living fishes, spotted, marbled or banded, with rounded fins and with small cuspidate teeth; they are distinguished from the Lamnidae and Carchariidae in that they are not viviparous, but lay large heavily-yolked eggs enclosed in oblong horny cases, with threads at each corner that serve for attachment. The Orectolobidae are distinguished by a pair of grooves running through the upper lip and connecting the nasal sacs with the mouth. *Orectolobus* of Australia and Japan includes species with a broad, flat head, margined with skinny flaps, much as in the angler (*Lophius*); most of the other species are bottom-living and have the appearance of dog-fishes, but one is pelagic and is the largest of all sharks, for it is said to reach a length of 70 feet. This shark (*Rhinodon*) known as the whale-shark, or at the Seychelles as the "chagrin," has the same numerous small teeth and long gill-rakers as the basking shark, which it resembles in habits.

A small group of sharks is distinguished by having six or seven gill-openings on each side, and a single dorsal fin, opposed to the anal. The six-gilled shark (*Hexanchus griseus*) is said to attain a length of over 25 ft.; there are a few records from British seas. The frilled shark (*Chlamydoselachus anguineus*) is an eel-shaped shark known from deep water off Japan and in the North Atlantic.

The third group of sharks has five gill-openings (six in *Pliotrema*), and two dorsal fins, each of which is typically preceded by a spine; most of these are bottom-living forms. The genus *Heterodontus* includes about seven species from the Indian and Pacific oceans, distinguished by having small teeth in the front of the jaws and large blunt teeth, suitable for crushing shell-fish, at the sides; the egg-case is conical, with spiral ridges. *H. philippi* is the Port Jackson shark. The piked dog-fishes (*Squalus*) inhabit the north and south temperate zones; they have no anal fin; the points of the small teeth are deflected laterally, so that the inner margin forms a cutting edge. *Squalus acanthias* is very abundant in British waters, and off the Atlantic coast of North America; it reaches a length of 4 ft.; it is a great nuisance to fishermen, eating fish caught in lines or in nets. All the Squalidae are viviparous; two noteworthy species of this family, both without fin-spines, are the spiny shark (*Echinorhinus*), a large bulky shark with spiny tubercles on the skin, and the Greenland shark (*Somniosus*) of the Arctic seas, which reaches a length of 25 ft., has conical teeth in the upper jaw and cutting teeth in the lower, and is active and voracious, often attacking whales. Many Squalidae (*Centrina, Centrophorus*, etc.) are inhabitants of deep water, and off Portugal are caught by long lines at depths of 400 or 500 fathoms. Closely related to the Squalidae are the saw-sharks, *Pristiophorus* of the Indo-Pacific and *Pliotrema* of South Africa, with the snout produced into a flat blade bearing a series of teeth on each side. Also related to the Squalidae are the angel-fishes or monks (*Squatina*) with flattened body, large wing-like pectoral fins, and terminal mouth with conical teeth; about ten species of this genus are known, mainly from temperate seas.

Few sharks are valued as food, but the dried fins are used by the Chinese for the preparation of gelatine, and for culinary purposes. Shagreen, used for polishing wood, is the skin of those kinds that are covered with numerous close-set pointed denticles. In recent years extensive fisheries for sharks have developed, starting in Carolina, and spreading to Africa, Australia, etc. The skins are made into leather of high quality; the oil obtained from the liver is said to be excellent, and the rest of the shark is used in the preparation of products such as glue, meal, etc. (*See* SELACHIANS; RAY.) (C. T. R.)

SHARON, a city of Mercer county, Pennsylvania, U.S.A., on the Shenango river, 60 m. N.N.W. of Pittsburgh and 15 m. N.E. of Youngstown, O. It is served by the Erie and the Pennsylvania railways, and for freight also by the New York Central and the Pittsburgh and Lake Erie. Pop. (1920), 21,747 (19% foreign-born white); 1930 Federal census 25,908. Sharon, together with the borough of Farrell (*q.v.*) adjoining it on the south, the borough of Sharpsville, 2 m. N.E. (pop. 4,674 in 1920), and other neighbouring communities, constitute an important unit of the Youngstown industrial district. The manufactures include iron, steel castings, automobile frames and accessories, steel hoops and barrels, tin plate, gas engines, oil tanks, tank cars, car wheels, steel rails, fire-brick, electrical transformers and many other articles. The aggregate product of the factories within the city limits in 1927 was valued at $27,564,501. Sharon was settled in 1795, but it remained small until coal-mining was begun in 1836. It was incorporated as a borough in 1841 and as a city in 1918.

SHARP, CECIL JAMES (1859–1924), British musician and writer, was born in London Nov. 22, 1859. He was educated at Uppingham and at Clare College, Cambridge, and, in 1883 went to South Australia where he founded a school of music at Adelaide. He was principal at the Hampstead Conservatoire, London, from 1896–1905, and director of the English Folk-Dance Society which he founded in 1911. His valuable work in collecting and arranging English folk-songs and dances, in lecturing on the subject revived interest in English national music. During a visit to America he discovered in the Appalachian Mountains interesting survivals of old national melodies. He died in London June 23, 1924.

Sharp's works include: *A Book of British Song* (1902); with C. L. Marson, *Folk Songs from Somerset*, series 1–5 (1904–19); *Folk Songs for use in Schools* sets 1–10; *English Folk Songs from the Southern Appalachians* (1917); *American English Folk Songs*, etc.; *English Folk Songs*, 2 vol. (1921); Posthum. with A. P. Oppé, *The Dance, an Historical Survey of Dancing in Europe* (1924). *See* Winifred A. S. Shaw, *Cecil Sharp, an Appreciation* (1925).

SHARP, GRANVILLE (1735–1813), English philanthropist, was born at Durham, the son of Thomas Sharp (1693–1758), a theological writer and the biographer of John Sharp, archbishop of York. Granville was apprenticed to a London draper, but in 1758 he entered the Government ordnance department. A diligent student of Greek and Hebrew, he published several treatises on biblical criticism, one of which, *Remarks on the Uses of the definitive article in the Greek Text of the New Testament*, gave rise to a controversy on account of the proposition, known as "Granville Sharp's canon," which it contained. His fame rests,

however, on his untiring efforts for the abolition of slavery. In 1767 he became involved in a law suit with a slave owner in which it was finally laid down that a slave becomes free the moment he sets foot on English territory. Sharp advocated the cause of the American colonies, supported parliamentary reform at home and the legislative independence of Ireland, and agitated against press gangs. In 1797 he founded a society for the abolition of slavery, and he was a joint founder of the British and Foreign Bible Society, and of the Society for the Conversion of Jews. Sharp died on July 6, 1813, and a memorial to him was erected in Westminster abbey.

See Prince Hoare, *Memoirs of Granville Sharp* (London, 1820), which contains observations by Bishop Burgess on Sharp's biblical criticisms; Sir James Stephen, *Essays in Ecclesiastical Biography* (London, 1860); Thomas Clarkson, *History of the Rise, Progress* and *Accomplishment of the Abolition of the African Slave Trade by the British Parliament* (London, 1839).

SHARP, JAMES (1618–1679), Scottish divine, the son of William Sharp, sheriff-clerk of Banffshire, was born in Banff Castle on May 4, 1618. In 1633 he went to King's College, Aberdeen, where he graduated in 1637. On the outbreak of the Covenanting War he visited Oxford, and perhaps Cambridge, becoming acquainted with the principal English divines. On his return he was chosen (1643) one of the "regents" of philosophy in St. Leonard's College, St. Andrews, and in 1648 was appointed minister of Crail in Fifeshire. In the great schism of Resolutioners and Protestors he took active part with the Resolutioners, and in March 1651 was taken prisoner by Cromwell, but subsequently liberated on parole. In 1657 he went to London to counteract the influence with the Protector of Archibald Johnston, Lord Warriston. He was again sent to London in Feb. 1660, to watch over the interests of the Resolutioners at the time of Monk's march to London. He was favourably received by Monk, who sent him to the king at Breda. He certainly regarded himself equally as the emissary of the Scottish kirk; he was also the bearer of a secret letter from Lauderdale to the king. There can be little doubt that he was finally corrupted by Charles and Clarendon, and decided that the interests of the Kirk should not imperil his own chances. He returned to Scotland in May 1660, and, while successfully stopping all petitions from Scottish ministers to the king, parliament or council, was at pains to allay the suspicions of his loyalty to the Kirk which had been aroused by his attitude in London. A letter of his (preserved in the Museum of the Society of Antiquaries, Edinburgh) dated May 21, 1661, from London, to Middleton the high commissioner, whose chaplain he now was, shows that he was in confidential communication with Clarendon and the English bishops; that he was cooperating in the restoration of Episcopacy in Scotland: that he was aware that Middleton, with whom he had held conferences, had all along intended it; and that he drew up the quibbling proclamation of June 10, whose sole purpose was "the disposing of minds to acquiesce in the king's pleasure." The mask at length dropped in August when Episcopacy was restored and Sharp was rewarded with the archbishopric of St. Andrews, Leighton, Fairfoul and Hamilton being consecrated bishops at the same time. On April 8 the new prelates entered Scotland, and on April 20 Sharp preached his first sermon at St. Andrews.

Sharp had kept on good terms with Lauderdale, and avoided acting against him on the occasion of the Billeting Plot concocted in Sept. 1662 by Middleton. When Lauderdale's supremacy was established he cooperated in passing the National Synod Act in 1663, the first step in the intended subjection of the church to the crown. In 1664 he obtained the grant of a new church commission. Gilbert Burnet made a written protest against the oppressive conduct of Sharp and other bishops, but Sharp failed to obtain a sentence of deprivation and excommunication against him. Sharp now placed himself in opposition to the influence of Lauderdale, in alliance with Rothes, Hamilton, Dalyell, and others but in 1665 he suffered, in London, a complete humiliation at the hands of Lauderdale, well described by Burnet. The result of their system of violence and extortion was the rising of the Covenanters, during which Sharp showed, according to Bellenden, the utmost fear, only equalled by his cruelty to the prisoners after the rout of Pentland. When the convention of estates met in January 1667 Hamilton was substituted for him as president, and he now wrote grovelling letters to Lauderdale, who extended him a careless reconciliation.

For a time he helped to restrain his brethren from complaining to London of Lauderdale's conciliation policy. On July 10, 1668, an abortive attempt to shoot him was made by James Mitchell in Edinburgh. After a visit to London Sharp assisted in December to carry out Tweeddale's tolerant proposals for filling the vacant parishes with some of the "ousted" ministers. In the debates on the Supremacy Act, by which Lauderdale destroyed the autonomy of the church, Sharp's reluctance gave way upon the first pressure, but he actively opposed Leighton's endeavour, as archbishop of Glasgow, to carry out a comprehensive scheme. From this time he was completely subservient to Lauderdale, who had now finally determined upon a career of oppression, and in 1674 he was again in London to support this policy. In this year Mitchell, who had shot at him six years before, was arrested, and Sharp obtained from him privately a full confession by a promise of pardon which he afterwards repudiated. It was, however, confirmed by the entry of the act in the records of the court. Mitchell was finally condemned, and Sharp refused to support the appeal for a reprieve. On May 3, 1679, while driving with his daughter Isabel to St. Andrews, he was set upon by nine men, and murdered in revenge. The place of the murder, on Magus Muir, now covered with fir trees, is marked by a monument erected by Dean Stanley, with a Latin inscription recording the deed.

Unless otherwise mentioned the proofs of the statements in this article will be found in vols. i. and ii. of the Lauderdale Papers (Camden Society) and in two articles in the Scottish Review (July 1884 and Jan. 1885).

SHARP, WILLIAM (1749–1824), English line-engraver, was born at London on Jan. 29, 1749. He was originally apprenticed to what is called a bright engraver, and practised as a writing engraver, but gradually became inspired by the higher branches of the engraver's art. He died at Chiswick on July 25, 1824. In his youth, owing to his hotly expressed adherence to the politics of Paine and Horne Tooke, he was examined by the privy council on a charge of treason. Mesmer and Brothers found in Sharp a staunch believer; and for long he maintained Joanna Southcott at his own expense. As an engraver he achieved a European reputation, and enjoyed many foreign honours. Among his earlier plates are some illustrations, after Stothard, for the *Novelists' Magazine*. He also engraved the "Doctors Disputing on the Immaculateness of the Virgin" and the "Ecce Homo" of Guido Reni, the "St. Cecilia" of Domenichino, the "Virgin and Child" of Dolci and the portrait of John Hunter of Sir Joshua Reynolds.

SHARP, WILLIAM (1856–1905), Scottish poet and man of letters, was born at Paisley on Sept. 12, 1856. His was a double personality, for during his lifetime he was known solely by a series of poetical and critical works of great, but not of outstanding merit, while from 1894 onwards he published, with elaborate precautions of secrecy, under the name of "Fiona Macleod," a series of stories and sketches in poetical prose which made him perhaps the most conspicuous Scottish writer of the modern Gaelic renaissance. His early life was spent chiefly in the W. highlands of Scotland, and after leaving Glasgow University he went to Australia in 1877 in search of health. After a cruise in the Pacific he settled for some time in London as clerk to a bank, became an intimate of the Rossettis, and began to contribute to the *Pall Mall Gazette* and other journals. In 1885 he became art critic to the *Glasgow Herald*. He spent much time abroad, in France and Italy, and travelled extensively in America and Africa. In 1885 he married his cousin, Elizabeth Amelia Sharp, who helped him in much of his literary work and collaborated with him in compiling the *Lyra Celtica* (1896). His volumes of verse were *The Human Inheritance* (1882), *Earth's Voices* (1884), *Romantic Ballads and Poems of Fantasy* (1886), *Sospiri di Roma* (1891), *Flower o' the Vine* (1894), *Sospiri d' Italia* (1906). William Sharp was the general editor of the "Canterbury Poets" series. He was a discriminating anthologist, and his *Sonnets of the Cen-*

tury (1886), to which he prefixed a useful treatise on the sonnet, ran through many editions. This was followed by *American Sonnets* (1889).

Sharp wrote biographies of Dante Gabriel Rossetti (1882), of Shelley (1887), of Heinrich Heine (1888), of Robert Browning (1890), and edited the memoirs of Joseph Severn (1892). The most notable of his novels was *Silence Farm* (1899). During the later years of his life he was obliged for reasons of health to spend all his winters abroad. The secret of his authorship of the "Fiona Macleod" books was faithfully kept until his death, which took place at the Castello di Manlace, Sicily, on Dec. 12, 1905. As late as the 13th of May 1899 Fiona Macleod had written to the *Athenaeum* stating that she wrote only under that name and it was her own. She began to publish her tales and sketches of the primitive Celtic world in 1894 with *Pharais: A Romance of the Isles*. They found only a limited public, though an enthusiastic one. The earlier volumes include *The Mountain Lovers* (1895), *The Sin-Eater* (1895), *The Washer of the Ford and other Legendary Moralities* (1896), etc. In 1897 a collected edition of the shorter stories, with some new ones, was issued as *Spiritual Tales, Barbaric Tales and Tragic Romances*. Later volumes are *The Dominion of Dreams* (1899); *The Divine Adventure: Iona: and other Studies in Spiritual History* (1900), and *Winged Destiny* (1904).

See a memoir by his wife (1910).

SHARP, in music, the sign ♯, signifying the raising of the note to which it is attached by a semitone, the direction holding good to the end of the bar. Or, if placed at the beginning of the stave, as part of what is called the key signature, it governs the note in question throughout the composition unless contradicted. A double sharp (𝄪) raises a note two semitones. (*See* ACCIDENTALS; CLEF: MUSICAL NOTATION.)

SHARPSBURG, a borough of Allegheny county, Pennsylvania, U.S.A., on the Allegheny river, opposite the north-eastern part of Pittsburgh; served by the Pennsylvania railroad. Pop. (1920) 8,921; and it was 8,642 in 1930. It is a manufacturing suburb, with iron and steel works, and factories making varnish, lubricating oil, oil-cans, glass and various other articles. There are coal mines and oil wells in the environs. Sharpsburg was settled in 1826 and incorporated as a borough in 1841. It was named after the original proprietor of the land, James Sharp.

SHARQAT, BATTLE OF, 1918. This is the name given to the final battle, Oct. 1918, in which the British in Mesopotamia, under General Marshall, overthrew the Turkish force which was covering Mosul, the last important centre then remaining in the hands of the Turks. (*See* MESOPOTAMIA, OPERATIONS IN.)

SHASI, a city in the province of Hupeh, central China, in latitude 30° 26′ N. and longitude 112° 5′ E., with an estimated Chinese population of 190,500. It is situated on the left bank of the Yangtze about 120 miles directly west of Hankow, though much farther distant by the river-route. It is admirably placed as an entrepôt centre in the low-lying cotton region of Hupeh amid a network of canals, one of which gives it direct connection with Hankow. These canal facilities have done much to restrict the development of Shasi as a river-port. Before the opening of Ichang (higher up the river) as a treaty port in 1895, Shasi was the usual transhipment centre for the Szechwan trade, but it subsequently lost much of its trade to Ichang. Shasi was opened to foreign trade by the treaty of Shimonoseki (1896) but only within the last 10 years has its total trade made really appreciable advances, due to a steadily growing export trade, chiefly in raw cotton. The annual increase was maintained in 1926, despite civil war in Hupeh and Hunan.

		s d Haikwan Taels 3/8
1926	Net Foreign imports	3,044,700
	Net Chinese imports	5,614,281
	Exports	24,133,311
	Total	32,792,292

The value of the total trade was in 1904, Hk. Taels 1,956,371; 1911, 2,948,656; 1924, 23,594,654. Shasi is a distributing centre for salt, fibres and nutgalls, from Szechwan; the import of salt averaging about 400,000 bags, and nutgalls about 100,000 chests annually. The foreign import trade is chiefly in cotton piece goods, kerosene oil, and refined sugar. The basis of an active export trade is raw cotton, which was shipped to the amount of 650,000 piculs in 1926. Seeds, especially rape and cotton seeds, are also exported. In 1913 a contract was signed for the construction of a railway from Shasi, via the Yuan-kiang valley, south-westward to Kwei-yang, capital of Kweichow province. Work on this scheme was, however, held up by the World War. The construction of a railway westward from Hankow into Szechwan (via Shasi) is one of the railway projects most likely to materialize in the near future.

SHASTA. This Indian group, of Hokan speech stock, lived on and south of Klamath river, east of Mt. Shasta. Culturally they stood intermediate between the north-western tribes, such as the Yurok and Hupa (*q.v.*) and the Maidu (*q.v.*) and other central Californians. Originally numbering 2,000, they have dwindled to a few dozen scattered households.

See R. B. Dixon, *Bull. Am. Mus. Nat. History,* vol. xvii. (1907).

SHASTA, MOUNT, a peak at the northern extremity of the Sierra Nevada range in Siskiyou county, California, U.S.A. It is the cone of an extinct volcano rising to a height of 14,161 ft. above sea-level. Its deep-fluted sides show that it has been considerably lowered and wasted by ice action. The remaining glaciers, which extend down to within 9,500 ft. of sea-level, are but a remnant of their former greatness. A sulphurous fumarole just below the extreme summit and another on its north slope still show vestiges of volcanic activity.

See John Muir, *The Mountains of California* (9th ed., 1911) and *Spirit Leveling in California 1896–1923* (1925), which is Bulletin No. 766 of the United States Geological Survey.

SHATT-AL-ARAB, a river in Mesopotamia formed by the junction of the Tigris and the Euphrates (*qq.v.*). There is reason to believe that the stream is not of great antiquity. (*See* MESOPOTAMIA: *Ancient Geography.*) The Shatt-al-Arab may be said to extend from Qurna to the bar at Fao, and the effect of the tide reaches up to the former point, where formerly the Euphrates discharged. It is 123 miles long. The importance of the Shatt-al-Arab is restricted to its lower reach from Basra to Fao, the railway from Baghdad having its terminus at Basra. Between Basra and Mohammera, the Persian port at the junction of the Karun with the Shatt-al-Arab, the river has an average breadth of 600 yards. At the actual point of junction the river widens out to half a mile and at Fao, 49 m. down stream, it is a mile broad. Below Fao the river rapidly widens and flows through interminable sandbanks and mudflats to the Persian Gulf.

The utility of the river for navigation is restricted by the bar at Fao, which allows only vessels of under 11 ft. draught to pass at low water. Sir Arnold Wilson has computed that the silt coming down the river annually is about half a million tons; the amount deposited in the main channel would be insignificant if, after dredging, a channel of 24 ft. at low water were maintained. Beyond the bar there is a depth of 30–40 ft. except in two places, the bar at Mohammera at the confluence of the Karun being the only other serious restriction to navigation.

Rawlinson suggests that there are three main facts to be considered in the history of the Shatt-al-Arab. First the coast line at the mouth of the Shatt-al-Arab advanced very slowly until, at the end of the 18th century, the Karun forced its way into the Shatt-al-Arab. When this happened the Shatt-al-Arab began to enlarge its bed and began to cut the great bend between Mohammera and Abadan. After this islands began to form at the mouth of the Shatt-al-Arab. (*See* also MESOPOTAMIA, and BASRA.)

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SHAUGHNESSY, THOMAS GEORGE SHAUGHNESSY, 1ST BARON, cr. 1916 (1853–1923), Canadian railway magnate, was born at Milwaukee Oct. 6, 1853. He began railway service at the age of 16, and in 1882 joined the staff of the

Canadian Pacific Railway as general purchasing agent. In 1891 he was appointed a vice-president and from 1899 to 1918 he was president and chairman of the board of directors, and director of all the allied lines. He died in Montreal on Dec. 10, 1923.

SHAW, ANNA HOWARD (1847–1919), American reformer, was born at Newcastle-upon-Tyne on Feb. 14, 1847. When she was a small child, her parents moved to the United States. From 1872 to 1875 she studied at Albion college (Mich.), and in 1878 graduated from the theological school of Boston university. The district conference of the Methodist Episcopal Church granted her a local preacher's licence, but the New England Conference of the M.E. Church refused to ordain her because of her sex, and the refusal was upheld by the General Conference at Cincinnati in 1880. The same year she was ordained in the Methodist Protestant Church. While preaching she had studied medicine and received the degree of M.D. from Boston university in 1885.

She was associated after 1886 with the National American Woman Suffrage Association in various capacities, from 1904–15 as president. In 1917 she was chairman of the woman's committee of the Council of National Defence. She died at Moylan (Pa.), on July 2, 1919

SHAW, GEORGE BERNARD (1856–), Irish dramatist, was born in Dublin on July 26, 1856. His father, George Carr Shaw, a younger son of Bernard Shaw, high sheriff of Kilkenny, was an impoverished and humorously helpless member of what, in England, would have been called the middle class, but in Ireland is still called the gentry. He was first employed by the Government in the Four Courts, then the Dublin Law Courts, and when his office was abolished in 1850 compounded his pension for a lump sum, with which he became a member of the Dublin Corn Exchange, engaging in a business of which he was totally ignorant, that of a corn merchant. He married Lucinda Elizabeth Gurly, who was the daughter of Walter Bagenal Gurly, a landed proprietor in County Carlow. Three children were born of the marriage, Lucinda Frances, Elinor Agnes and George Bernard.

The financial affairs of the Shaw family did not prosper, but the young wife, who had a *mezzo soprano* voice of remarkable purity, became known as an amateur singer. There was then in Dublin a gifted conductor and teacher of singing, named George John Vandaleur Lee, with whose work Mrs. Shaw became associated. In this way the Shaw children, despite their father's financial straits, acquired a considerable musical culture which was extended to the theatre by her amateur operatic performances. Her son, after a private grounding in Latin grammar from his uncle, the Rev. William George Carroll, vicar of St. Bride's, Dublin, who was reputed to be the first minister of the Church of Ireland to proclaim himself a Home Ruler, was like many other Church of Ireland children, sent to the Wesleyan Connexional School, later known as Wesley college, in Dublin, and was "generally near or at the bottom of his classes." At home, however, he acquired an extensive acquaintance with the works of composers of music, so that before he was 15, "he knew at least one important work by Handel, Mozart, Beethoven, Mendelssohn, Rossini, Bellini, Donizetti, Verdi and Gounod from cover to cover." He studied pictures in the National Gallery of Ireland, and at 15 "knew enough of a considerable number of painters to recognize their work at sight."

In 1871, when he was 15 and had no hope of going to a university, he received, through the influence of his uncle, Frederick Shaw, an appointment in the office of a Dublin land agent, Charles Uniacke Townshend, at a commencing salary of £18 per annum. At the end of a year, when he was 16, the important post of cashier unexpectedly became vacant, and he was temporarily appointed to it. He filled it so ably that he was confirmed in it, and his salary, then £24 per annum, was doubled. In 1876, no longer able to endure employment which had always irked him, he withdrew from it and joined his mother, who, some years earlier, had settled in London and become a professional teacher of music. But before he did this he made his first communication to the Press. The American evangelists Moody and Sankey had arrived in Dublin to conduct a revival, and he went to hear them deliver their gospel. After he had heard it he wrote a letter, signed "S," and dated April 3, 1875, to *Public Opinion,* in which he asserted, to the horror of his pietistic relatives, that if this sort of thing was religion then he, on the whole, was an atheist.

The first nine years of his life in London were passed in poverty and oppressed to some extent by a sense of failure. His literary earnings in that time amounted to six pounds. "When people reproach me," he wrote in 1896, "with the unfashionableness of my attire, they forget that to me it seems like the raiment of Solomon in all his glory by contrast with the indescribable seediness of those days when I trimmed my cuffs to the quick with scissors, and wore a tall hat and *soi-disant* black coat green with decay." In those nine years, 1876–85, he "devilled" for a musical critic; began a passion play in blank verse which he did not finish; wrote an article for *One and All,* of which George R. Sims was editor, the payment for which was 15s., wrote an article on patent medicines for £5, and a verse for a school prizebook for 5s., and composed five novels. He was supported during these nine years by his mother, and by his father, who was still struggling with his dwindling business on the Dublin Corn Exchange. On a few occasions he endeavoured "to earn an honest living," the last occasion being in 1879, when, for a few months, he was in the service of a company formed in London "to exploit an ingenious invention by Mr. Thomas Alva Edison." Thereafter he insisted on following the bent of his mind. "I did not throw myself into the struggle for life: I threw my mother into it. I was not a staff to my father's old age: I hung on to my father's coat tails. . . . Callous as Comus to moral babble, I steadily wrote my five pages a day and made a man of myself (at my mother's expense) instead of a slave." Such glimpses of London society as he obtained he owed to the possession of a suit of evening clothes and to his being a sufficiently sympathetic accompanist to be tolerated as an amateur in musical circles.

Between 1879 and 1883 the five novels were written—one each year. The first was, "with merciless fitness," called *Immaturity.* It was declined by all the publishers, including Chapman and Hall, whose reader, George Meredith, wrote "No" on it. The manuscript was thrown aside and nibbled by mice, but "even the mice failed to finish it." *The Irrational Knot, Love Among the Artists, Cashel Byron's Profession* and *An Unsocial Socialist* proved equally unacceptable, and it was not until after he had made many friends in advanced political and humanitarian circles that they were printed as padding in propagandist magazines.

In 1882, when Bernard Shaw was 26 and the author of four unpublished books, he attended a public meeting at the Memorial Hall, Farringdon street, London, which was addressed by Henry George on the subject of land nationalization. George believed that the social ills of mankind would be cured by the nationalization of land, or single tax; all other forms of capital could safely be left in private possession. Shaw resolved to join in George's campaign, but he did not long remain in it, for, on proceeding from a study of George's *Progress and Poverty* to Marx's *Capital* he became a Socialist and demanded the nationalization of *all* forms of capital, a demand which was repugnant to George. In this campaign Shaw made a number of firm friendships—with James Leigh Joynes, Sydney Olivier (later Lord Olivier), Henry Hyde Champion, the Rev. Stewart D. Headlam, Henry S. Salt and his wife, William Morris, Annie Besant, Edward Carpenter and Sidney and Beatrice Webb.

Propaganda magazines inevitably followed in the trail of these friends, and in one of them, printed by Champion and called *To-day, An Unsocial Socialist* and *Cashel Byron's Profession* were serialised. *To-day* died, and was succeeded by *Our Corner,* published by Mrs. Besant, with whom Shaw had become acquainted about the time that he joined the Fabian Society, a society of Socialists founded in 1884. *The Irrational Knot* and *Love Among the Artists* were serialised in this magazine. It, too, died. *Cashel Byron's Profession* had an artistic, but not a popular success. Stevenson was enraptured by it, and Henley wanted to make a play out of it. Shaw himself, some years afterwards, burlesqued it for the stage under the name of *The Admirable Bashville,* in excellent blank verse.

It was abundantly clear in these novels, written after the style of the 18th century authors, that narrative was *not* the form in which Shaw could best express himself. He ran to dialogue rather than to description or to narrative, and his characters on any or no provocation uttered long speeches that read like platform deliveries rather than conversation. The *story* was always a poor one when there was any story at all; the author was not fastidious about the peg on which he hung his opinions. He shared with Shakespeare a willingness to use any plot that would serve his purpose. But he could not continue to use a form which was intractable in his hands, and so, after many diversions and adventures in search of a suitable instrument, he turned to the stage. It may here be said, however, that the novels were a preparation for the plays. Much of what is in the former, was re-used in the latter. The hatred of hypocrisy and pretentious respectability and irrational social cleavages and stupefying poverty and every kind of organised priestcraft, whether of the law or the church or of medicine or of politics, which he acquired in Dublin as a boy and a youth, was poured into his novels and distilled from them into his plays. Ann Whitefield, who takes the initiative in the sex duel with John Tanner in *Man and Superman,* is descended from Madge Brailsford who hunts down Owen Jack in *Love Among the Artists.* The conclusion of *Love Among the Artists,* as Julius Bab has pointed out, is almost identical in situation and words with the conclusion of *Candida.*

His fortunes now began to mend. He criticised books for the *Pall Mall Gazette* and pictures for *The World.* He was appointed musical critic of the *Star,* under the pseudonym of "Corno di Bassetto," but he presently transferred himself in the same capacity to *The World,* in which he made his initials G.B.S. familiar to the public. Later on he acted as dramatic critic of *The Saturday Review.* During this period of critical activity, however, he was arduously engaged in his political propaganda. Henry George's *Progress and Poverty* diverted his attention from the so-called controversies between science and religion to political economy, to which he devoted several years of study; Karl Marx's *Das Kapital,* which he read in French, completed his disillusion with capitalistic civilisation. He took up public speaking and incessantly addressed "audiences of every description, from university dons to London washerwomen. From 1883 to 1895, with virtually no exception, he delivered a harangue with debate, questions, and so on every Sunday—sometimes twice or even thrice—and on a good many weekdays. This teeming and tumultuous life was passed on many platforms, from the British Association to the triangle at the corner of Salmon's lane in Limehouse." He was now a most active member of the Fabian Society, which he joined in 1884, and was the author of its second and third tracts.

In 1898 Shaw's health yielded under the weight of his work. He recovered after his marriage in that year to Charlotte Payne-Townshead, but did not resume his former incessant activity on the platform. He became, instead, a co-opted member of the Vestry of St. Pancras, now the St. Pancras Borough Council. To his six years' work on that body we owe his *Common Sense of Municipal Trading.* He contested the County Council seat; but the result confirmed his conviction that the Conservatives would vote against him and none of the Liberals for him. This was his only open candidature for popular election. His chief political work was done in the committees of the Fabian Society. By this time he was well known as a brilliant and witty critic and debater, but was hardly known at all as an author, although, in addition to his novels, he had written *The Sanity of Art* (1908), a reply to Dr. Max Nordau's *Degeneration; The Perfect Wagnerite* (1898); *The Quintessence of Ibsenism* (1891); and four plays.

But from 1894 his rise to world fame was steady and swift. He now definitely was a dramatist, publishing his plays for general reading (then an innovation in London) with elaborate prefaces on political, social and finally on religious and biological questions, which were quite independent of the plays to which they were attached. Thus he became known as an unacted dramatist before he was conclusively accepted on the London stage after 1904. His vogue as an acted dramatist began in New York and Germany about six years earlier.

The first of these plays was finished in 1892, seven years after it had been begun in collaboration with William Archer. Shaw, it seemed, could write "incomparable" dialogue, but "construction was not his strong point"; Archer "could not write dialogue a bit, but . . . considered himself a born constructor." They agreed to pool their abilities and make a play. Archer constructed "a twaddling cup-and-saucer comedy . . . to be called *Rhinegold.*" But Shaw held that plot was the curse of fiction, literary or dramatic; and Archer was the apostle of plot and construction. Consequently the plot, in Shaw's hands, underwent such a change that Archer retired from the collaboration, nor did he ever expect to see the play completed. Seven years later, to help the Independent theatre out of an emergency, Shaw finished the play —a treatise on slum-property—and it was performed for the first time under the management of Mr. J. T. Grein at the Royalty theatre in London in Dec. 1892. Shaw was then in his thirty-seventh year. Archer, writing in *The World,* earnestly endeavoured to dissuade Shaw from following a career as a dramatist, "for which he has no special ability, and some constitutional disabilities." In 1893 he wrote *The Philanderer,* a topical comedy on Ibsenism and the "new woman," for the same theatre, but the piece proved technically unsuitable for Mr. Grein's company. To replace it Mr. Shaw wrote *Mrs. Warren's Profession,* which was refused a license by the Lord Chamberlain and was not presented until Jan. 5, 1902, when it was privately given by the Stage Society at the New Lyric theatre. When it was played in New York by the late Arnold Daly's company in 1905 the actors were prosecuted. These three plays were classed by the author as "unpleasant plays" in the printed version. *Arms and the Man* was produced at the Avenue theatre (April 21, 1894) by Miss Florence Farr, who was experimenting on the lines of the Independent theatre, and by Mr. Richard Mansfield at the Herald Square theatre, New York (Sept. 17, 1894). The scene was laid in Bulgaria, the piece being a satire on romanticism, a destructive criticism on military "glory." *Candida* was written in 1894 and won a decisive success in Germany with Agnes Sorma as Candida; but the London managers would have none of it. It won Shaw many friends as a vindication of the woman in the home.

He had found no regular English audience when he published *Plays Pleasant and Unpleasant* (2 vols.), in 1898, and his pieces first became well known to the ordinary playgoer by the performances given at the Royal Court theatre under the management of T. E. Vedrenne and Harley Granville-Barker. *Man and Superman* (published in 1903) was produced there on May 23, 1905, in a necessarily abridged form, with Granville-Barker in the part of John Tanner, the author of the "Revolutionist's Handbook and Pocket Companion," printed as an appendix to the play. A great success was *John Bull's Other Island,* dealing satirically with Ireland, as she was before receiving autonomy. *Major Barbara* (Court theatre, Nov. 1905), announced as a "discussion in three acts," placed the Salvation Army on the stage. The last of the plays, *Saint Joan,* was written in 1923. It will be seen, then, that the bulk of Shaw's dramatic work was done after he had passed his 40th birthday, and that half of it was done after he had reached the age at which Shakespeare died. It will also be seen that the three plays which are now considered to be his greatest, *Heartbreak House, Back to Methuselah* and *Saint Joan,* were written when he was well over 60 years of age. Three of the plays, *Mrs. Warren's Profession, The Shewing-up of Blanco Posnet,* and *Press Cuttings* were banned by the censor, but the ban was subsequently lifted from them. *Passion, Poison and Petrifaction* is a burlesque melodrama written for the benefit of the Actors' Orphanage. *The Interlude at the Playhouse* is a topical prologue quoted at length in the *Daily Mail,* Jan. 29, 1907, and not otherwise published. His political writings, in addition to a number of Fabian tracts and pamphlets, include *Common Sense about the War, Peace Conference Proposals,* and *The Intelligent Woman's Guide to Socialism and Capitalism.*

The plays vary from exposure of social wrongs, as for example slum ownership in *Widowers' Houses* and prostitution in *Mrs. Warren's Profession,* to philosophical and religious disquisitions, as in *Misalliance* and *Androcles and the Lion, Heartbreak House,*

metabiological prophecies, as in *Back to Methuselah,* and dramatised historical chronicle, as in *Caesar and Cleopatra* and *Saint Joan.* Shaw has ranged through a great variety of scenes in his plays—America, Bulgaria, Egypt, England, France, Germany and Ireland, and he is always careful to make the settings as picturesque and romantic as possible. He goes to extraordinary lengths to introduce oddity into his work, as when he makes Captain Shotover, in *Heartbreak House,* live in a house shaped like a ship, and causes one of the characters in the play to wear the clothes of an Arab chief in the evening. At first, his work seemed to express an absolute determinism—not man, but his environment, was at fault—but in his later plays he insists, in Macbeth's phrase, that man "still has judgment here," and expresses what may be called a neo-Protestant belief. Mankind, in *Back to Methuselah,* reaches through creative evolution a state of longevity which resembles eternal life. Joan of Arc protests that no one shall stand between God and her.

The general religious belief expressed in the plays may be briefly summarised as follows: God, or the Life Force, is an imperfect power striving to become perfect. If He were omniscient and omnipotent, He would not allow certain horrors to exist in the lives of His creatures, any more than an ordinary father would tolerate disease in his children if he could prevent it. The whole of time has been occupied by God in experiments with instruments invented to help Him in His attempt to perfect Himself. When He found that these instruments were either useless or no longer serviceable He scrapped them. In this way the disappearance from the world of mammoth beasts, among other creatures, is explained. God eventually found that all His instruments suffered from a common defect, that they were incapable of apprehending His purpose and unable to help overcome their circumstances and bodily limitation. He thereupon created a new instrument, Man, who is still on probation. Shaw warns the world that if we, too, fail to achieve God's purpose He will become impatient and scrap mankind as He scrapped the mammoth beasts. "You should live so that when you die God is in your debt." He was awarded the Nobel Prize for literature in 1926, but immediately handed over the money, amounting to more than £7,000, to the Anglo-Swedish Foundation for spreading a knowledge of Swedish literature in English-speaking countries.

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SHAW, HENRY WHEELER (1818–1885), American humorist, known by the pen-name of "Josh Billings," was born of Puritan stock at Lanesborough (Mass.), April 21, 1818. He left Hamilton college to go West, where he worked on steamboats, farmed, and was an auctioneer. In 1858 he settled in Poughkeepsie (N.Y.), as a land agent and auctioneer, and began writing, especially for the *Poughkeepsie Daily Press.*

His "Essa on the Muel bi Josh Billings" (1860) in a New York paper won him an audience he could not secure by more conventionally spelled articles and was followed by many similar contributions, chiefly in the *New York Weekly* and the *New York Saturday Press,* and by several popular volumes, among which are *Josh Billings: His Sayings* (1866); *Josh Billings on Ice and Other Things* (1868); *Josh Billings: His Works, Complete* (1876); *Trump Kards* (1877); *Old Probabilities* (1879); *Josh Billings' Spice-Box* (1881), and his burlesques of the familiar almanacs, issued annually for the decade beginning 1870, and collected into a volume in 1902 under the title *Josh Billings' Old Farmers' Allminax.* He died in Monterey (Calif.), Oct. 14, 1885. He was his best in the humorous aphorism and displayed a shrewd philosophy, especially in his contributions to the *Century Magazine* under the name of Uncle Esek.

See *Life and Adventures of Josh Billings* (1883), by F. S. Smith.

SHAW, JOHN BYAM (1872–1919), English painter, was born at Madras on Nov. 13, 1872. He came to England in 1878 and after studying at the St. John's Wood school of art, entered the Royal Academy schools in 1889. His picture, "Rose Mary," was hung in 1893. One of his best known works was "Love the Conqueror" (1899). He illustrated many books, including Browning's *Poems* (1898); *Tales from Boccaccio* (1899); *Pilgrim's Progress* (1904); Edgar Allan Poe's *Tales* (1909), etc. In 1911 he established with Rex Vicat Cole (b. 1870), a school of art at Kensington. He died in London on Jan. 26, 1919.

SHAW, LEMUEL (1781–1861), American jurist, was born at Barnstable, Mass., Jan. 9, 1781. He graduated at Harvard college in 1800, and was admitted to the bar in 1804. In 1805 he began to practise law in Boston. He was a prominent Federalist and was a member of the Massachusetts house of representatives in 1811–14, in 1820 and in 1829, and of the State senate in 1821–22, a delegate to the State constitutional convention of 1820–21, and chief justice of the supreme court of the State from 1830 to 1860. He presided over the trial in 1850 of Prof. John White Webster (1793–1850) for the murder of Dr. George Parkman. His opinion in *Cary* v. *Daniels* (8 Metcalf) is the basis of the present law in Massachusetts as to the regulation of water power rights of riparian proprietors. He died in Boston, March 30, 1861.

See the address by B. F. Thomas in *Proceedings of the Massachusetts Historical Society,* x. 50–79 (Boston, 1869).

SHAW, RICHARD NORMAN (1831–1912), British architect, was born in Edinburgh on May 7, 1831. At the age of sixteen he was apprenticed in London to William Burn. He also attended the architectural schools of the Royal Academy, where, in 1854, he gained the gold medal and two years' travelling studentship. On his return in 1856 he published the drawings made during his two years abroad, *Architectural Sketches from the Continent.* He then entered the office of G. E. Street, and presently became his chief assistant. In 1863, after sixteen years of severe training, he began to practise. He went into partnership with W. E. Nesfield, who had worked with him in Burn's office, and even when the partnership was dissolved the two men occupied the same office for some time. In 1872 Shaw was elected an Associate of the Royal Academy, and a full member in 1877; he joined the "retired" list towards the end of 1901. He died at Hampstead on Nov. 7, 1912.

Characteristic examples of Shaw's work are Preen Manor, Shropshire; New Zealand Chambers, Leadenhall Street; Pierrepont, Wispers, and Merrist Wood, in Surrey; Lowther Lodge, Kensington; Adcote, in Shropshire; his houses at Kensington, Chelsea and at Hampstead; Flete House, Devonshire; Greenham Lodge, Berkshire; Dawpool, in Cheshire; Bryanstone, in Dorsetshire; Chesters, Northumberland; New Scotland Yard, on the Thames Embankment; besides several fine works in Liverpool and the neighbourhood. Shaw broke away from the academic tradition in which he was held, to adopt the characteristic style which entirely changed English domestic architecture. Shaw's style has been vulgarized by the imitations of the speculative builder, but the houses he himself designed were admirable in proportion and in their adaptation to their purpose. They were the outcome of much enthusiastic and intelligent study of old examples, and were based directly on old methods and traditions. As his powers developed, his buildings gained in dignity, and had an air of serenity and a quiet homely charm which were less conspicuous in his earlier works; the "half timber" was more sparingly used, and finally disappeared entirely. His planning is invariably fine and full of ingenuity. Adcote (a beautiful drawing of which hangs in the Diploma Gallery at Burlington House) is perhaps the best example of the series of his country houses built between 1870 and 1880. The elements are few but perfectly proportioned and combined, and the scale throughout is consistent. The Great Hall is the keynote of the plan, and is properly but not unduly emphasized. New Scotland Yard is undoubtedly Mr. Shaw's finest and most complete work. Unfortunately no great public rebuilding scheme in London was ever entrusted to him, but his spirit and his enthusiasm for his art inspired many of the younger men.

SHAWINIGAN FALLS, a pulp, paper and power centre in St. Maurice county, Quebec, Canada, on the St. Maurice river, 21 m. N. of Three Rivers, and on the Canadian National and Canadian Pacific railways. It is the site of the Shawinigan

Water and Power Company, which carries the highest voltage line in operation in Canada. It is also a centre for the pulp and paper industry in Canada, an industry which has grown since 1900 from a gross value of production of less than $10,000,000 to more than $250,000,000. Shawinigan Falls itself contains manufactures with the gross value of $16,381,429. Pop. (1931), 15,345.

SHAWL. A square or oblong article of dress worn in various ways dependent from the shoulders. The term is of Persian origin (*shâl*), and the article itself is most characteristic of the natives of north-west India and central Asia; but in various forms, and under different names, the same piece of clothing is found in most parts of the world. The shawls made in Kashmir occupy a pre-eminent place among textile products; and it is to them and to their imitations from western looms that specific importance attaches. The Kashmir shawl is characterized by the elaboration of its design, in which the "cone" or "mango" pattern is a prominent feature, and by the glowing harmony, brilliance, depth and enduring qualities of its colours. The basis of these excellences is found in the very fine, soft, short, flossy under-wool, called pashm or pashmina, found on the shawl-goat, a variety of *Capra hircus* inhabiting the elevated regions of Tibet. There are several varieties of pashm, but the finest is a strict monopoly of the maharaja of Kashmir. Inferior pashm and Kirman wool—a fine soft Persian sheep's wool—are used for shawl weaving at Amritsar and other places in the Punjab, where colonies of Kashmiri weavers are established. Of shawls, apart from shape and pattern, there are only two principal classes: (1) loom-woven shawls called tiliwalla, tilikár or káni kár—sometimes woven in one piece, but more often in small segments which are sewn together with such precision that the sewing is quite imperceptible; and (2) embroidered shawls—amlikár—in which over a ground of plain pashmina is worked by needle a minute and elaborate pattern.

SHAWM or **SHALM,** the mediaeval forerunner of the wooden double-reed wind-instrument now called the oboe (*q.v.*).

SHAWNEE. This Algonkin tribe lived, when discovered in the 17th century, in two wholly separated portions, one on Cumberland river in Tennessee and Kentucky, the other on Savannah river in South Carolina. Like their relatives the Sauk, Fox and Kickapoo, they were restless and inclined to wander. Toward the end of the 17th century the eastern division moved north into Pennsylvania, and early in the 18th the other began to drift north-westward across the Ohio. The two divisions united, for the first time in the historic period, about 1750 in eastern Ohio. They fought the British or Americans until 1795, then variously joined the Cherokee or Creek or withdrew to Indiana and even Missouri. Those in Indiana were again defeated at Tippecanoe in 1811. Portions of the tribe lived for a time in Texas and Kansas, and they are now gathered in Oklahoma, though in several districts. They number 1,400.

SHAWNEE, a city of Pottawatomie county, Oklahoma, U.S.A., on the North Canadian river, 38 m. E.S.E. of Oklahoma City, at an altitude of 1,006 ft.; served by the Oklahoma City-Ada-Atoka, the Rock Island and the Santa Fe railways. Pop. (1920) 15,348; in 1930, 23,283. It is the trading centre and shipping point for a farming and stock-raising country; has cotton gins and compresses, cottonseed-oil mills, a large meat-packing plant, railway shops and other manufacturing industries, with an output in 1927 valued at $5,716,284; and is the seat of the Oklahoma Baptist University (1910). The site of Shawnee was in the territory of the Pottawatomie Nation. The city was founded in 1895 and incorporated in 1896.

SHAYS, DANIEL (1747–1825), American soldier, the leader of Shays's Rebellion, 1786–87 (*see* MASSACHUSETTS: *History*), was born in Hopkinton, Mass., in 1747. In the Revolutionary War he served as second lieutenant in a Massachusetts regiment from May to Dec. 1775, and became captain in the 5th Massachusetts Regiment in Jan. 1777. He took part in the battle of Bunker Hill, and in the expedition against Ticonderoga, participated in the storming of Stony Point and fought at Saratoga. In 1780 he resigned from the army. After the collapse of Shays's Rebellion he escaped to Vermont. He was pardoned in June 1788, and died at Sparta, N.Y., on Sept. 29, 1825.

See J. T. Adams, *New England in the Republic 1776–1850,* pp. 146–166 (Boston, 1926).

SHEARER, THOMAS, English 18th-century furniture designer and cabinet-maker. The solitary biographical fact known is that this distinguished craftsman was the author of most of the plates in *The Cabinet Maker's London Book of Prices and Designs of Cabinet Work,* issued in 1788 "For the London Society of Cabinet Makers." The majority of these plates, republished separately as *Designs for Household Furniture,* exhibit simplicity of design, delicacy of proportion and originality. There can be little doubt that Shearer exercised considerable influence over Hepplewhite. Shearer, in his turn, owes something to the brothers Adam. It is probable that he worked at his craft with his own hands and that he was literally a cabinet-maker—so far as we know, he never made chairs. Much of the elegance of Shearer's work is due to his graceful and reticent employment of inlays of satinwood and other foreign woods.

SHEARING MACHINES: *see* PUNCHING AND SHEARING MACHINES.

SHEARWATER, *Puffinus puffinus,* family *Procellariidae,* a sea bird with a wide distribution in the North Atlantic, though rarely resorting to land, except in the breeding season. The Manx shearwater is the only one that breeds in Britain. It is a plain-looking bird, black above and white beneath, and about the size of a pigeon. Its flight is graceful as it skims close over the waves. Shearwaters are widely distributed pelagic birds, spending the greater part of their lives on the ocean. The shearwater lays its single white egg in a hole underground. The young are thickly clothed with long down and are extremely fat. In this condition they are thought good eating, and enormous numbers are caught in some localities, especially of *P. brevicaudus,* which frequents islands off Australia, where it is known as the "Mutton bird."

SHEATHBILL (*Chionis alba*), a bird so-called from the horny case which ensheaths the basal part of its bill.

The Sheathbill is about the size of a pigeon; its plumage is pure white, its bill somewhat yellow at the base, passing into pale pink towards the tip. Round the eyes the skin is bare and beset with cream-coloured papillae, while the legs are bluish-grey. The second eastern species, *C. minor,* is smaller, with a dark bill and legs and a differently shaped "sheath." The western species gathers its food, consisting of sea-weeds and shell-fish, on rocks at low water; but it is also known to eat birds' eggs. Though most abundant as a shore-bird, it is frequently met with far out at sea. It is not uncommon on the Falkland Isles, where it breeds. *C. minor* inhabits Kerguelen Land, Prince Edward Island, Marion Island, and the Crozets. The eggs of both species are not unlike those of oyster-catchers. The sheathbills constitute the family *Chionidae* of the plovers (*Charadriiformes*).

SHEBOYGAN, a city of eastern Wisconsin, U.S.A., on Lake Michigan at the mouth of the Sheboygan river, 52 m. N. of Milwaukee; a port of entry and the county seat of Sheboygan county. It is on Federal highway 141, and is served by the Chicago and North-western and the Milwaukee Electric railways and lake steamers. Pop. 30,955 in 1920 (27% foreign-born white) and was 39,251 Federal census 1930. There is a good harbour, open throughout the year, which in 1928 had traffic amounting to 448,226 tons, valued at $7,532,100. The city ships 80,000,000 lb. of cheese in a year, and millions of gallons of its mineral waters. It has a large fishing industry, and its manufactures are varied and extensive. Chairs, enamel-ware, desks and bookcases are among the leading products. The aggregate factory output in 1927 was valued at $31,034,062. The city's assessed valuation of property for 1927 was $51,977,171. About 1820 a trading post was established at the mouth of the Sheboygan river, and in 1834 a saw-mill was built at the first rapids, 2 m. above. Settlers came in rapidly; a great city was laid out on paper; and the village was incorporated in 1846. It was chartered as a city in 1853, and in 1860 had a population of 4,262. The decade 1880–90 was a period of rapid growth. From 1845 to 1848 a Fourierist community of ten families (the Spring Valley Association) successfully farmed 30 ac. of land several miles S.W. of Sheboygan, dissolving by

mutual agreement because they lost interest in the experiment.

SHECHEM, an ancient town of Palestine, 6 m. S. of Samaria, mod. Nāblus. The modern town lies in the valley between Ebal and Gerizim in a beautiful situation: pop. in 1922, 15,947 (145 Samaritans and 700 Christians). The Samaritan quarter is in the south-west of the city and contains their synagogue. Nāblus is connected by rail with the Haifa-Damascus line at Afuleh, and with the Lydda-Haifa line at Tulkarem.

History.—The site was occupied in patriarchal times by Hivites (Gen. xxxiv., 2). There Jacob and his family settled for a time (Gen. xxxiii., 18). It was set apart as a city of refuge (Josh. xx., 7). Abimelech, son of Gideon, was for a space ruler in Shechem (Judges viii., 31). Rehoboam's foolish speech there set the northern kingdom on fire; and Jeroboam made it his headquarters (I Ki. xii.). The rise of Samaria (*q.v.*) threw Shechem into the shadow and it disappears from history during the latter part of the Hebrew monarchy. The rise of the Samaritan community from the colonists settled by Sargon and Ashurbanipal, and the downfall of Samaria contributed to its resurrection. To Josephus it was Neapolis (whence modern Nāblus) or Flavia, so called to commemorate its restoration by Titus Flavius Vespasian.

A bishopric was set up at Neapolis and a Samaritan attack on him (A.D. 474) was punished by Zeno, who gave Gerizim (*q.v.*) to the Christians. Captured by crusaders (1099), it was lost to Saladin (1184), the church the crusaders had built being converted into a mosque. The soldiery of Ibrahim Pasha pillaged the town in 1834. On Sept. 21, 1918, it was occupied by British troops.

Archaeology.—Shechem is the traditional site of the tomb of Joseph. One and a half miles on the way to Jerusalem is the well of Jacob, an identification most probably authentic. The "sacred oak" (Gen. xxv., 4) has been sought at El 'Amūd, and at Balāta less than a mile from the town to the east. Excavations now in progress (1928) at Balāta have revealed a blunt topped pyramid, 131 ft. square and 16 ft. high, part evidently of a tower in the fortifications. Near to it were found cubical cellars resembling corn granaries such as were found at Pithom in Egypt. Below the fortifications are traces of an older city dating from 1700 B.C. It was seemingly destroyed in 1300 B.C. The Balāta site is now identified with Migdal-Schechem ("tower of Shechem," Judges ix., 49). Other discoveries there include the remains of a palace (18th century B.C.), a temple (to Baal-Berith?) and two cuneiform tablets, one containing a list of witnesses and the other a letter. (E. Ro.)

SHEE, SIR MARTIN ARCHER (1770–1850), Irish portrait painter, was born in Dublin on Dec. 23, 1770. He studied in the Academy schools, became A.R.A. in 1798, and R.A. in 1800. Besides his many excellent portraits, he painted various subject and historical works. He succeeded Lawrence as president of the Academy in 1830. He died on Aug. 13, 1850.

SHEEP. Little is known with certainty about the origin of domesticated sheep. The earlier writers assumed a hypothetical wild ancestor having a long tail and certain other characteristics that distinguish the majority of domesticated breeds from the existing wild species; but none of these characters is of real significance, and the more probable view is that the ancestors of our modern sheep belonged to species that still survive.

Dr. J. U. Duerst, from evidence collected on the site of the City of Anau in Turkistan, believes that the urial (*Ovis vignei*) was domesticated there, and he considers that the earliest domesticated European type (*Ovis aries palustris*) was directly derived from this stock. The latter animal, known as the turbary sheep, appeared in Europe in neolithic times and it survives, but little changed, in the Bündnerschaf or Nalperschaf of the Grisons. It is a small, slender limbed sheep, black faced, and with long, sharp-edged and rather goat-like horns. In the Copper age a new breed (*Ovis aries studeri*) with massive spiral horns, appeared in Europe, and Duerst has shown that this was almost certainly derived in part at least from the wild mouflon (*Ovis musimon*). In Sardinia, as has been known since the time of Pliny, the mouflon interbreeds freely with domesticated sheep. The bulk of our modern breeds are obviously much more closely related to the sheep of the Copper age than to the earlier turbary type; while it thus seems likely that the mouflon played the major part and the urial a minor part in producing our farm flocks, it is by no means certain that other species, such as the argali (*Ovis ammon*) were not concerned. Dr. Keller's theory, however, which derived the turbary sheep from the arui or udad (*Ammotragus*) of northern Africa has been shown to be quite untenable. (*See* also ARGALI, MOUFLON, UDAD.) (J. A. S. W.)

Characteristics of Sheep.—Sheep belong to the family of hollow-horned ruminants or Bovidae (*q.v.*). Practically they form a group impossible of definition, as they pass imperceptibly into the goats. Both sexes usually possess horns, but those of the females are small. In the males the horns are generally angulated, and marked by fine transverse wrinkles; their colour being greenish or brownish. They are directed outwards, and curve in an open spiral, with the tips directed outwards. Although there may be a fringe of hair on the throat, the males have no beard on the chin; and they also lack the strong odour characteristic of goats. Usually the tail is short; and in all the wild species the outer coat takes the form of hair, though beneath lies a short undercoat of fine wool, which has been developed into the fleece of domesticated races. Like goats, sheep have narrow upper molar teeth, very different from those of the oxen, and narrow hairy muzzles. Between the two middle toes, in most species, is lodged a deep glandular bag having the form of a retort with a small external orifice, which secretes an unctuous and odorous substance. This, tainting the herbage or stones over which the animal walks, affords the means by which, through the powerfully developed sense of smell, the neighbourhood of other individuals of the species is recognized. The crumen or suborbital face-gland, which is so largely developed and probably performs the same office in some antelopes and deer, is present, although in a comparatively rudimentary form, in most species, but is absent in others. Wild sheep attain their maximum development, both in respect of number and size, in Central Asia. They associate either in large flocks, or in family-parties; the old males generally keeping apart from the rest. Although essentially mountain animals, sheep generally frequent open, undulating districts, rather than the precipitous heights to which goats are partial. It may be added that the long tails of most tame breeds are, like wool, in all probability the results of domestication.

Varieties and Distribution.—The Pamir plateau, on the confines of Turkistan, at an elevation of 16,000 ft. above the sea-level, is the home of the magnificent *Ovis poli*, named after the celebrated Venetian traveller Marco Polo, who met with it in the 13th century. It is remarkable for the great size of the horns of the old rams and the wide open sweep of their curve, so that the points stand boldly out on each side, far away from the animal's head, instead of curling round nearly in the same plane, as in most of the allied species. A variety inhabiting the Thian Shian is known as *O. poli karelini*, and other racial forms occur in the mountains and lower ground of Turkistan, and in Central Asia. An even larger animal is the argali, *O. ammon*, typically from the Altai, but represented by one race in Ladak and Tibet (*O. ammon hodgsoni*), by a second in eastern Mongolia and by a third in the Desert of Gobi. Although its horns are less extended laterally than those of *O. poli*, they are grander and more massive. In their short summer coats the old rams of both species are nearly white. *Ovis sairensis* from the Sair mountains and *O. littledalei* from Kulja are closely allied forms. In the Stanovoi mountains and neighbouring districts of E. Siberia and in Kamchatka occur two sheep which have been respectively named *O. borealis* and *O. nivicola*. They are, however, so closely allied to the so-called bighorn sheep of N. America, that they can scarcely be regarded as more than local races of *O. canadensis*, or *O. cervina*, as some naturalists prefer to call the species. These bighorns are characterized by the absence of face-glands, and

BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

THE OVIS POLI OF TURKISTAN, REMARKABLE FOR THE GREAT SIZE OF THE HORNS

the comparatively smooth front surface of the horns of the old rams, which are thus very unlike the strongly wrinkled horns of the argali group. The typical bighorn is the khaki-coloured and white-rumped Rocky Mountain animal; but on the Stickin river there is a nearly black race, with the usual white areas (*O. canadensis stonei*), while this is replaced in Alaska by the nearly pure white *O. c. dalli*; the grey sheep of the Yukon (*O. c. fannini*) being perhaps not a distinct form. Other geographical races of the bighorn, distinguished chiefly by the colour of the coat, include the mountain sheep of Mexico, of Lower California, of Upper Missouri, and of the Kenai Peninsula. Returning to Asia, we find in Ladak, Astor, Afghanistan and the Punjab ranges, a sheep whose local races are variously known as urin, urial and shapo, and whose technical name is *O. vignei.* It is a smaller animal than the members of the argali group, and approximates to the Armenian and the Sardinian wild sheep or mouflon (*Ovis orientalis* and *O. musimon*). (*See* MOUFLON.) We have in Tibet the bharal or blue sheep, *Ovis* (*Pseudois*) *bharal,* and in N. Africa the udad or aoudad, *O.* (*Ammotragus*) *lervia,* both of which have no face-glands and in this and their smooth horns approximate to goats. (*See* BHARAL and UDAD.)

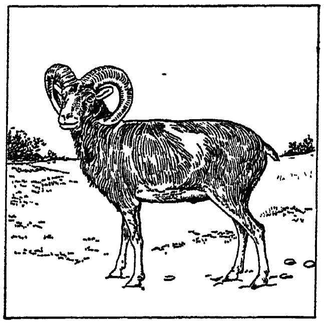
The sheep was domesticated in Asia and Europe before the dawn of history, though unknown in this state in the New World until after the Spanish conquest. It has now been introduced by man into almost all parts of the world where agricultural operations are carried on, but flourishes especially in the temperate regions of both hemispheres. The variations of external characters seen in the different breeds are very great. They are chiefly manifested in the form and number of the horns, which may be increased from the normal two to four or even eight, or may be altogether absent in the female alone or in both sexes; in the shape and length of the ears, which often hang pendent by the side of the head; in the peculiar elevation or arching of the nasal bones in some eastern races; in the length of the tail, and the development of great masses of fat at each side of its root or in the tail itself; and in the colour and quality of the fleece.

On the west coast of Africa two distinct breeds of hairy sheep are indigenous, the one characterized by its large size, long limbs and smooth coat, and the other by its inferior stature, lower build and heavily maned neck and throat. Both breeds, which have short tails and small horns (present only in the rams), were regarded by the German naturalist Fitzinger as specifically distinct from the domesticated *Ovis aries* of Europe; and for the first type he proposed the name *O. longipes* and for the second *O. jubata.* Although such distinctions may be doubtful (the two African breeds are almost certainly descended from one ancestral form), the retention of such names may be convenient as a provisional measure.


BY COURTESY OF THE CANADIAN NATIONAL RAILWAYS
THE ROCKY MOUNTAIN BIGHORN (OVIS CANADENSIS), A WILD SHEEP THAT HAS NEVER BEEN DOMESTICATED

The long-legged hairy sheep, which stands a good deal taller than a Southdown, ranges, with a certain amount of local variation, from lower Guinea to the Cape. In addition to its long limbs, it is characterized by its Roman nose, large (but not drooping) ears, and the presence of a dewlap on the throat and chest. The ewes are hornless, but in Africa the rams have very short, thick and somewhat goatlike horns. On the other hand, in the west Indian breed, which has probably been introduced from Africa, both sexes are devoid of horns. The colour is variable. In the majority of cases it appears to be pied, showing large blotches of black or brown on a white ground; the head being generally white with large black patches on the sides, most of the neck and the fore-part of the body black, and the hind-quarters white with large coloured blotches. On the other hand, these sheep may be uniformly yellowish white, reddish brown, greyish brown or even black. The uniformly reddish or chestnut-brown specimens approach most nearly to the wild mouflon or urial in colour, but the chestnut extends over the whole of the underparts and flanks; domestication having probably led to the elimination of the white belly and dark flank band, which are doubtless protective characters. The feeble development of the horns is probably also a feature due to domestication.

In Angola occurs a breed of this sheep which has probably been crossed with the fat-tailed Malagasy breed; while in Guinea there is a breed with lappets, or wattles, on the throat, which is probably the result of a cross with the lop-eared sheep of the same district. The Guinea lop-eared breed, it may be mentioned, is believed to inherit its drooping ears and throat wattles from an infusion of the blood of the Roman-nosed hornless Theban goat. (*See* GOAT.) Hairy long-legged sheep are also met with in Persia, but are not pure-bred, being apparently the result of a cross between the long-legged Guinea breed and the fat-tailed Persian sheep.


A SARDINIAN MOUFLON SHEEP

The maned hairy sheep (*Ovis jubata*), which appears to be confined to the west coast of Africa, takes its name from a mane of longish hair on the throat and neck; the hair on the body being also longer than in the ordinary long-legged sheep. This breed is frequently black or brown and white; but in a small sub-breed from the Cameroons the general colour is chestnut or foxy red, with the face, ears, buttocks, lower surface of tail and under-parts black. The most remarkable thing about this Cameroon sheep is, however, its extremely diminutive size, a full-grown ram standing only 19 in. at the withers.

In point of size this pigmy Cameroon breed comes very close to an exceedingly small sheep of which the limb-bones have been found in certain ancient deposits in the south of England; and the question arises whether the two breeds may not have been nearly related. Although there are no means of ascertaining whether the extinct pigmy British sheep was clothed with hair or with wool, it is practically certain that some of the early European sheep retained hair like that of their wild ancestor; and there is accordingly no prima facie reason why the breed in question should not have been hairy. On the other hand, since the so-called peat-sheep of the prehistoric Swiss lake-dwellers appears to be represented by the existing Graubünden (Grisons) breed, which is woolly and coloured something like a Southdown, it may be argued that the former was probably also woolly, and hence that the survival of a hairy breed in a neighbouring part of Europe would be unlikely. The latter part of the argument is not very convincing, and it is legitimate to surmise that in the small extinct sheep of the south of England we may have a possible relative of the pigmy hairy sheep of west Africa.

Fat-rumped sheep, *Ovis steatopyga,* are common to Africa and Asia, and are piebald with rudimentary horns, and a short hairy coat, being bred entirely for their milk and flesh. In fat-tailed sheep, on the other hand, which have much the same distribution, the coat is woolly and generally piebald. Four-horned sheep are common in Iceland and the Hebrides, and in early historic times they occurred frequently in the sheep flocks then present in lowland Scotland. There is another four-horned breed, distinguished by its black (in place of brown) horns, whose home is probably S. Africa. In the unicorn sheep of Nepal or Tibet the two horns of the rams are completely welded together. In the Himalayan and Indian hunia sheep, the rams of which are specially trained for fighting, and have highly convex foreheads, the tail is short at birth. Most remarkable of all is the so-called Wallachian sheep, or Zackelschaf (*Ovis strepsiceros*), represented by several more or less distinct breeds in eastern Europe, in which the long upright horns are spirally twisted in a manner similar to those of the markhor wild goat.

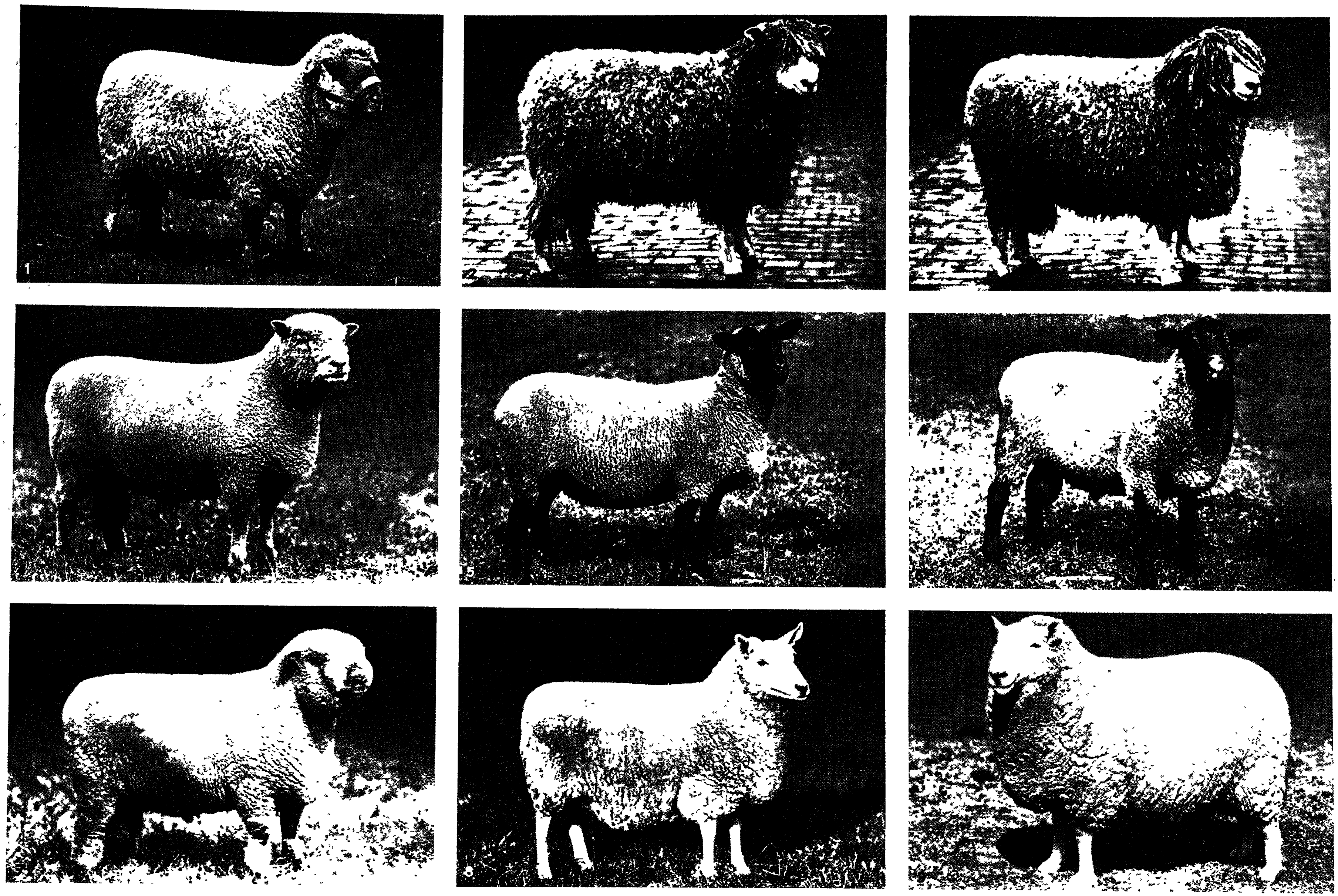
For the various breeds of wild sheep *see* R. Lydekker, *Wild Oxen,*

PHOTOGRAPHS, (1, 2, 4, 5, 7, 8) HILDEBRAND, (3, 6, 9) H A STROHMEYER, JR.

AMERICAN BREEDS OF SHEEP

1. Leicester ewe, champion at International Fair, 1920
2. Leicester ram, champion at International Fair, 1920
3. Merino ewe, "George Deeds 177," champion A type at Ohio State Fair. Owner S. Blamer & Son
4. Rambouillet ewe, champion at International Livestock Exposition, 1927
5. Rambouillet ram, champion at International Livestock Exposition, 1922
6. Merino ram, "G. A. Shank 280," champion A type at Ohio State Fair, Owner, George W. Deeds
7. Lincoln ewe, champion at International Fair, 1924
8. Lincoln ram, champion at International Fair, 1924
9. Oxford Down ram, "Fleming 479," champion at Canadian National Exhibition at Toronto, 1927. Owner R. R. Fleming

SHEEP



PHOTOGRAPHS, (1, 4, 7, 8, 9) H A. STROHMEYER, JR, (2, 3, 5, 6) HILDEBRAND

AMERICAN BREEDS OF SHEEP

1. Hampshire ram, "Ismay," champion. Owner, J. Watson Webb
2. Cotswold ewe, champion at International Fair, 1924
3. Cotswold ram, champion at International Fair, 1924
4. Southdown ram, champion Owner, Robert McEwen
5. Suffolk ewe, champion at International Fair, 1924
6. Suffolk ram, champion at International Fair, 1924
7. Shropshire ram, "Greatwood 518," champion. Owner, W. S. Martin
8. Cheviot ewe, "M. L. Thomas 522," champion. Owner, High Pastures, Vermont
9. Cheviot ram, "Erdenheim Royal Winner," champion, 1922. Owner, Erdenheim Farm, Pennsylvania

Sheep and Goats (1898), later papers in the *Proceedings of the Zoological Society of London* and *The Sheep and its Cousins* (London, 1912). Also Rowland Ward, *Records of Big Game* (5th ed., 1906).
(R. Ly.; J. Ri.)

MODERN BRITISH BREEDS OF SHEEP

The sheep native to the British Isles are commonly grouped into longwool, shortwool and mountain breeds.

Longwools receive their name because of their long lustre wool; they are white-faced (except the Wensleydale) and hornless; their mutton tends to become rather fat, but this quality makes them useful for crossing with lean fleshed breeds, *e.g.*, the Merino. The longwool breeds are the Leicester, Border Leicester, Wensleydale, Cotswold, Lincoln, Devon Longwool, South Devon, Roscommon and Kent or Romney Marsh.

The *Shortwools* include the Down breeds all of which are hornless and have dark faces and legs, short dense wool of fine quality, and very good mutton. They are the Southdown, Shropshire, Suffolk, Hampshire Down, Dorset Down and Oxford Down. The other Shortwool breeds are the Dorset Horn, Western or Wiltshire Horn, Ryeland, Devon Closewool, Kerry Hill and Clun Forest.

The *Mountain* breeds are relatively small hardy sheep which produce mutton of fine quality. They are the Scotch Blackface, Swaledale, Lonk, Rough Fell, Derbyshire Gritstone, Cheviot, Welsh Mountain, Herdwick, Exmoor Horn, Dartmoor and Shetland.

The *Leicester* is of high interest. It was the breed which Robert Bakewell, the pioneer stock improver, took in hand in the 18th century, and developed by the exercise of his skill and judgment. In past times Leicester blood was extensively employed in the improvement or establishment of other longwool breeds of sheep. The Leicester, as seen now, has a white wedge-shaped face with a few dark spots, the forehead covered with wool; thin mobile ears; neck full towards the trunk, short and level with the back; width over the shoulders and through the heart; a full broad breast; fine clean legs standing well apart; deep round barrel and great depth of carcass; firm flesh, springy pelt, and pink skin, covered with long, fine, curly, lustrous wool. The breed is now chiefly centred in east and north Yorkshire and Durham, but its chief value is for crossing, when it is found to promote maturity and to improve the fattening propensity.

The *Border Leicester* originated after the death in 1795 of Bakewell, when the Leicester breed, as it then existed, diverged into two branches. The one is represented by the breed still known in England as the Leicester. The other, bred on the Scottish Borders, with possibly an early admixture of Cheviot blood, acquired the name of Border Leicester.

The *Wensleydales* take their name from the Yorkshire dale of which Thirsk is the centre. They are longwool sheep, derived from the old Teeswater breed by crossing with Leicester rams. They have a tuft of wool on the forehead. The skin of the body is sometimes blue, whilst the wool has a very bright lustre, is curled in small distinct pirls, and is of uniform staple. The rams are in much favour in the N. of England for crossing with ewes of the various black-faced horned mountain breeds to produce mutton of superior quality and to use the cross-ewes to breed to a pure longwool or sometimes a Down ram.

The *Cotswold* is an old-established breed of the Gloucestershire hills, extending thence into Oxfordshire. It was but slightly crossed for improvement by the Dishley Leicesters and has retained its characteristic type for generations. They are useful for crossing purposes to impart size, and because they are exceptionally hardy.

The *Lincolns* are descended from the old native breed of Lincolnshire, improved by the use of Leicester blood. They are the largest and most massive British breed and they are quite hardy. Breeders of Lincoln rams like best a darkish face, with a few black spots on the ears; and white legs. The wool has a broad staple, and is denser and longer, and the fleece heavier, than in any other British breed. For this reason it has been the breed most in favour with breeders in all parts of the world for mating with Merino ewes and their crosses. The progeny is a good general-purpose sheep, giving a large fleece of wool but only a medium quality of mutton. With a greater proportion of Lincoln blood in the mixed flocks of the world there is a growing tendency to produce finer mutton by using Down rams, but at the sacrifice of part of the yield of wool.

The *Devon Longwool* is a breed locally developed in the valleys of W. Somerset, N. and E. Devon, and parts of Cornwall. It originated in a strong infusion of Leicester blood amongst the old Bampton stock of Devonshire.

The *South Devon* was developed from an old local breed by crossing with the Leicester. The animals are large and hardy and their mutton is said to be superior to the average longwool quality; they produce a heavy, valuable fleece.

The *Roscommon*—the one breed of modern sheep native to Ireland—is indebted for its good qualities largely to the use of Leicester blood.

The *Kent* or *Romney Marsh* is native to the rich tract of grazing land on the S. coast of Kent. They are hardy, short-legged, thickly-made, white-faced sheep, with a close-coated longwool fleece. They were gradually, like the Cotswolds, improved from the original type of slow-maturity sheep by selection in preference to the use of rams of the Improved Leicester breed. With the exception of the Lincoln, no breed has received greater distinction in New Zealand, where it is in high repute for its hardiness and general usefulness. When difficulties relating to the quantity and quality of food arise the Romney is a better sheep to meet them than the Lincolns or other longwools.

The *Oxford Down* is a modern breed which owes its origin to crossing between Cotswolds and Hampshire Downs and Southdowns. Although it has inherited the forelock from its longwool ancestors, it approximates more nearly to the shortwool type, and is accordingly classified as such; it is the largest and heaviest of the Down breeds. The rams are largely used for crossing in Scotland, particularly with Border Leicester-Cheviot ewes.

The *Southdown,* from the short close pastures upon the chalky soils of the South Downs in Sussex, was formerly known as the Sussex Down. In past times it did for the improvement of the shortwool breeds of sheep very much the same kind of work that the Leicester performed in the case of the longwool breeds. A pure-bred Southdown sheep has a small head, with a light brown or brownish grey (often mouse-coloured) face, fine bone, and a symmetrical, well-fleshed body. The legs are short and neat, the animal being of small size compared with the other Down sheep. The fleece is of fine, close, short wool, and the mutton is excellent. "Underhill" flocks that have been kept for generations in East Anglia, on the Weald, and on flat meadow land in other parts of the country, have assumed a heavier type than the original "upperdown" sheep. It was at one time thought not to be a rent-paying breed, but modern market requirements have brought it well within that category.

The *Shropshire* is descended from the old native sheep of the Salopian hills, improved by the use of Southdown blood. Though heavier in fleece and a bulkier animal, the Shropshire resembles an enlarged Southdown. As distinguished from the latter, however, the Shropshire has a darker face, blackish brown as a rule, with very neat ears, whilst its head is more massive, and is better covered with wool on the top and at the sides. The Shropshire is the most popular mutton sheep in the corn belt and Great Lakes regions of the United States.

The *Hampshire Down.*—Early in the 19th century the old Wiltshire white-faced horned sheep, with a scanty coat of hairy wool, and the Berkshire Knot, roamed over the downs of their native counties, and the Hampshire was evolved by blending these types with the blood of the Southdown. The Wiltshire horned sheep still survives as a pure breed. Early maturity and great size have been the objects aimed at and attained, this breed, more, perhaps than any other, being identified with early maturity. One reason for this is the early date at which the ewes take the ram. Whilst heavier than the Shropshire, the Hampshire Down sheep is less symmetrical. It has a black face and legs, a big head with Roman nose, darkish ears set well back, and a broad level back (especially over the shoulders) nicely filled in with lean meat.

The *Dorset Down* or *West Country Down,* "a middle type of

Down sheep pre-eminently suited to Dorsetshire," is a local variety of the Hampshire Down breed, separated by the formation of a Dorset Down sheep society in 1904.

The *Suffolk* is another Down, which took its origin about 1790 in the crossing of improved Southdown rams with ewes of the old black-face Horned Norfolk. The characteristics of the latter are retained in the black face and legs of the Suffolk, but the horns have been bred out. The fleece is moderately short, the wool being of typical Down quality. Owing to its fine quality of mutton the Suffolk competes very strongly with the best mutton breeds—*e.g.*, the Southdown—in carcass competitions; it has secured notable successes at Smithfield and at the Scottish National Fat Stock Show.

The *Dorset Horn* is an old west-country breed of sheep. This is a hardy breed, in size somewhat exceeding the Southdown. The special characteristic of the breed is that the ewes take the ram at an unusually early period of the year, and cast ewes are in demand for breeding house lamb for Christmas. The *Ryeland* breed is so named from the Ryelands, a poor upland district in Herefordshire. It is a hardy grassland breed which is neither very quick maturing nor particularly prolific.

The *Clun Forest* is a local breed in west Shropshire and the adjacent part of Wales. It is descended from the old Tan-faced sheep. It is now three parts Shropshire, having been much crossed with that breed.

The *Western* or *Wiltshire Horned* sheep is an old breed that has recently been revived. It is not unlike the Dorset Horn but it has even stronger horns in both sexes and is peculiar in that it carries practically no wool. The skin shows a considerable number of small black spots. The sheep are very hardy and they are useful for grassland farms where it is undesirable to apply the intensive system of management customary with Down flocks.

The *Devon Closewool* was originated in North Devon by blending the blood of Devon Longwools with Exmoor Horns. The size is intermediate between the parent breeds and the animals are short in the leg and thickly made. The sheep are very well suited to commercial purposes on land of intermediate quality.

The *Kerry Hill* is a brown and white speckled faced breed found along the Welsh border. Kerry hills are hardy grass sheep; the ewes are often crossed with Shropshires to produce fat lambs, while on the other hand the rams are often used for crossing with Welsh Mountain ewes.

The *Cheviot* is a hardy sheep with straight wool, of moderate length and very close-set. Put to the Border Leicester ram the Cheviot ewe produces the *Half-bred*, which as a breeding ewe is unsurpassed as a rent-paying, arable-land sheep.

The *Scotch Blackface* breed is chiefly reared in Scotland, but it is of N. of England origin. Their greater hardiness, as compared with the Cheviots, has brought them into favour upon the higher grounds of the N. of England and of Scotland, where they thrive upon heather hills and coarse and exposed grazing lands. The colour of face and legs is well-defined black and white, the black predominating. The spiral horns are low at the crown, with a clear space between the roots, and sweep in a wide curve, sloping slightly backwards, and clear of the cheek. The fashionable fleece is down to the ground, hairy and strong, and of uniform quality throughout.

The *Lonk* has its home amongst the moorlands of N. Lancashire and the W. Riding of Yorkshire, and it is the largest of the mountain breeds of the N. of England and Scotland.

The *Herdwick* is the hardiest of all the breeds; it thrives upon the poor mountain land in Cumberland and Westmorland. The rams generally have small, curved, wide horns; the ewes are hornless.

The *Welsh Mountain* is a small, active, soft-woolled, white-faced breed of hardy character. The legs are often yellowish, and this colour may extend to the face. Horns occur only in the males. The mutton is of excellent quality. The ewes, although difficult to confine by ordinary fences, are in high favour in lowland districts for breeding fattening lambs to Down and other early maturity rams.

The *Dartmoor*, a hardy local Devonshire breed, is a large hornless, longwool, white-fleeced sheep, with a long mottled face. It has been attracting attention in recent years. It is intermediate in type between a mountain and a Longwool breed.

The *Exmoor* is a horned breed of Devonshire moorland, one of the few remaining remnants of direct descent from the old forest breeds of England. They have white legs and faces and black nostrils. The coiled horns lie more closely to the head than in the Dorset and Somerset Horn breed. The Exmoors have a close, fine fleece of short wool. They are very hardy, and yield mutton of choice flavour.

The *Swaledale* is one of the larger sized breeds of the Blackface or heath type; it is native to Yorkshire. It is horned; its face is dark with a light or "mealy" nose.

The *Rough Fell* is a Westmorland breed belonging to the Blackface heath group. The ewes are frequently crossed with the Wensleydale and the cross-breeds form valuable feeding sheep for poor and exposed conditions.

The *Derbyshire Gritstone* is a hornless breed with black and white mottled face and legs; it is native to the hills and dales of the millstone grit formation. The animals are hardy and their wool is the finest and closest of any heath breed. The mutton is typical of hill sheep being lean and of fine flavour.

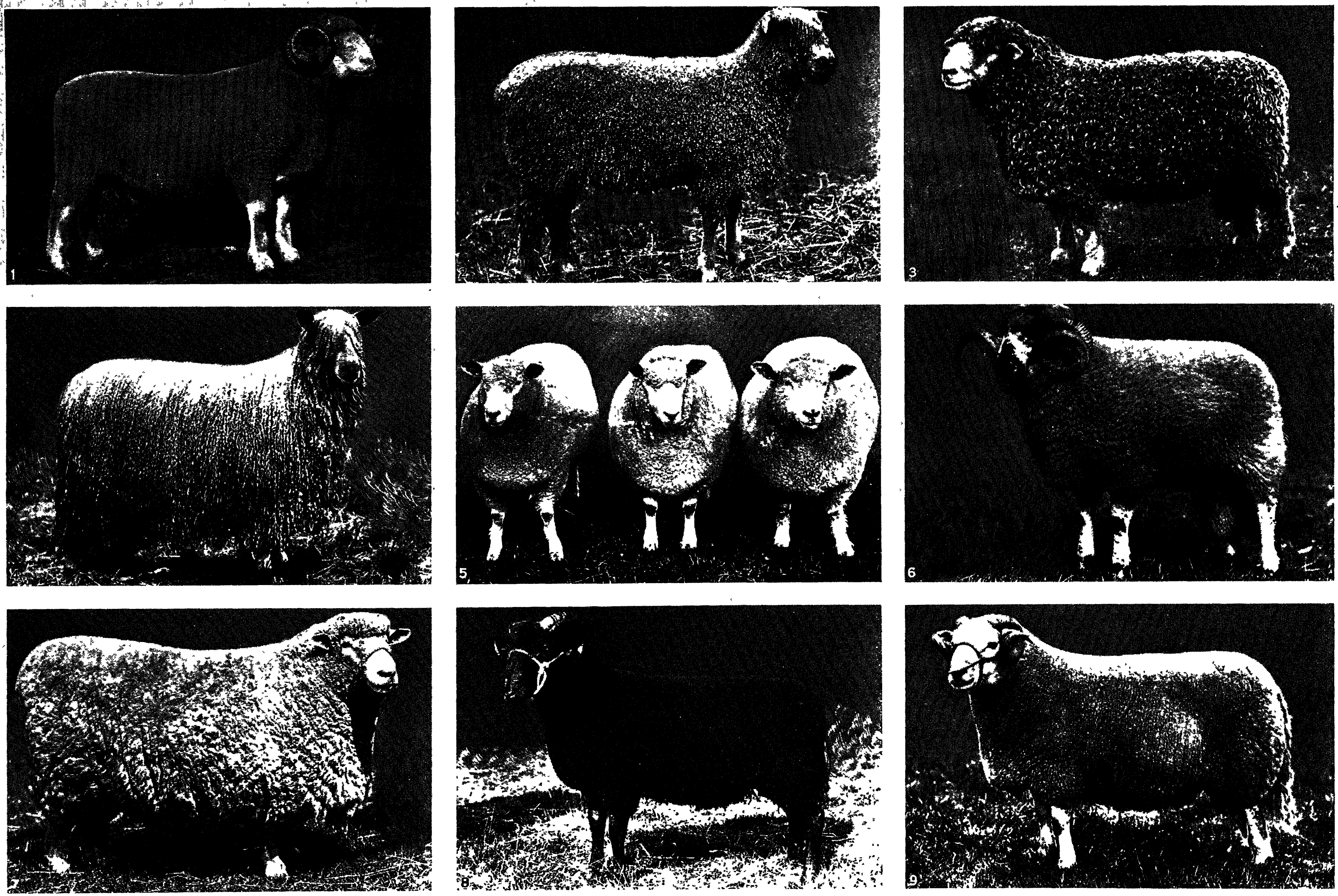
The *Shetland* is a small sized sheep which is found in the islands whose name it bears. The colours are variable, white, black and rich brown all being common. The animals are very hardy and can subsist on poor fare. The outstanding quality of the breed is its extraordinary fine soft wool which has a very high value. The breed is slow to mature and very thin fleshed.

Other Breeds of Sheep.—The *Merino* is the most widely distributed sheep in the world. The breed is indigenous to Spain but the modern Merino has been largely developed and improved in Australia and the United States. The breed suits countries with a relatively small rainfall, although it is adapted to a wide variety of climatic conditions. The outstanding product of the Merino is its very fine close wool. The mutton is palatable and nutritious but the carcasses average less plump and fat than those of mutton type sheep such as the Downs and Longwools. While pure Merinos are kept in the poorest and driest districts abroad, on better land the flocks are frequently crossed with Longwools, thereby greatly improving the quality of the carcass without seriously injuring the value of the wool. On still better land Down breeds are bred to the Merino-Longwool crosses and give a very good mutton carcass fit for exportation.

The Merino is white-faced and has a flesh-coloured nose; its wool has no coloured fibres. The illustration shows a modern type of Australian Merino. There are in fact a number of well recognized types varying from small, thin-fleshed animals with very wrinkled skins and extra fine wool to relatively large, smooth sheep producing barely such fine wool but possessing better mutton qualities.

The *Corriedale* is a Lincoln-Merino cross which in New Zealand has been fixed as a pure breed. It combines a splendid fleece with a good constitution and a good commercial mutton carcass.

Lowland Sheep-breeding and Feeding.—A Shropshire flock of about 200 breeding ewes is here taken as a typical example of the numerous systems of managing sheep on a mixed farm of grazing and arable land. The ewes lamb from early in January till the end of February. The lambs have the shelter of a lambing shed for a few days. When drafted to an adjoining field they run in front of their mothers and get a little crushed oats and linseed cake meal, the ewes receiving kail (kale) or roots and hay to develop milk. Swedes gradually give place to mangolds, rye and clover before the end of April, when shearing of the ewe flock begins, to be finished early in May. At this time unshorn lambs are dipped and may be dosed with medicine to destroy internal parasites. The operation is repeated in September. The lambs are weaned towards the end of June and the ewes run on the poorest pasture till August to dry off their milk. In August the ewes are culled and the flock made up to its full numbers by selected shearling ewes. All are assorted and mated to suitable rams. Most of the older ewes take the ram in September, but maiden or yearling ewes are kept back till October. During the



BY COURTESY OF (2, 3, 4, 6, 7, 9) THE FARMER AND STOCKBREEDER, (5, 8) THE FARMER AND STOCKBREEDER AND THE AGRICULTURAL GAZETTE; PHOTOGRAPH, (1) H A STROHMEYER, JR.

BRITISH AND AMERICAN BREEDS OF SHEEP

1. Dorset ram, champion. Owner, Fillmore Farm
2. Wensleydale ram, royal champion. Owner, J. A. Willis
3. Devon Longwool ram, Devon Show, 1927. Owner, F. White
4. Wensleydale yearling ewe. Owner, J. A. Willis
5. Three Ryeland ewes, champions. Owners, E. W. Langford
6. Lonk ram, first (champion) at Preston. Owner, Thomas Lord
7. Kent—two-shear ram, first (champion), Royal Counties, 1927. Owner, J. E. Quested
8. Black Welsh mountain shearling ram, first (champion), Welsh Show, 1926. Owned by Mrs. Jervoise
9. Welsh mountain two-shear ram, Royal Show champion, 1927

SHEEP

BY COURTESY OF THE NEW ZEALAND HIGH COMMISSIONER

WOOL AND FROZEN MEAT PRODUCTION IN NEW ZEALAND

1. Dipping sheep in a small vat on the prairie of New Zealand
2. Great sheep dipping yards on North Island, New Zealand, where immense flocks of sheep are immersed in large vats
3. Crew of expert shearers in shearing shed
4. Fellmongery (separating wool from pelts) in New Zealand
5. Thousands of bales of wool in a wool store in Canterbury
6. Cooling room of a freezing works in New Zealand filled with sheep carcasses that will be frozen thoroughly for export

rest of the year the ewes run on grass and receive hay when necessary, with a limited amount of dry artificial food daily, ¼ lb. each, gradually rising as they grow heavy in lamb to 1 lb. per day. Turnips before lambing, if given in liberal quantities, are an unsafe food. To increase the number of doubles, ewes are sometimes put on good fresh grass, rape or mustard a week or two before the tups (breeding rams) go out—a ram to 60 ewes is a usual proportion, though with care it is possible to get a stud ram to settle twice that number. With good management 20 ewes of any of the lowland breeds should produce and rear thirty lambs, and the proportion can be increased by breeding from ewes with a prolific tendency. The period of gestation of a ewe is between 21 and 22 weeks, and the period of oestrum 24 hours. If not settled the ewe comes back to the ram in from 13 to 18 (usually 16) days. To indicate the time or times of tupping (breeding) three colours of paint are used. The breast of the ram is rubbed daily for the first fortnight with blue, for a similar period with red, and finally with black.

Fattening tegs (sheep approximately one year old that have never been sheared) usually go on to soft turnips in the end of September or beginning of October, and later on to yellows, green-rounds and swedes and, in spring and early summer, mangolds. The roots are cut into fingers and supplemented by an allowance of concentrated food made up of a mixture of ground cakes and meal, ¼ lb. rising to about ½ lb.; and ½ lb. to 1 lb. of hay per day. The dry substance consumed per 100 lb. live weight in a ration of ½ lb. cake and corn, 12 lb. roots and 1 lb. hay daily, would be 16½ lb. per week, and this gives an increase of nearly 2% live weight or 1 lb. of live weight increase for 8¼ lb. of dry food eaten. Sheep finishing at 135 lb. live weight yield about 53% of carcass or over 70 lb. each.

Management of Mountain Breeds.—Ewes on natural pastures receive no hand feeding except a little hay when snow deeply covers the ground. The rams come in from the hills on Jan. 1 and are sent to winter on low ground. Weak ewes, not safe to survive the hardships of spring, are brought in to better pasture during February and March. Ewe hogs (ewe lambs or yearlings that have never been sheared) wintered on grass in the low country from Nov. 1 are brought home in April, and about the middle of April on the average mountain ewes begin to lamb. One lamb at weaning time for every ewe is rather over the normal amount of produce. Cheviot and cross-bred lambs are marked, and the males are castrated, towards the end of May. Nearly a month later Blackface lambs are marked and the eild (mature) sheep are shorn—the shearing of milch ewes (ewes nursing lambs) being delayed till the second week of July. Towards the end of July sheep are all dipped to protect them from maggot flies (which are generally worst during August) with materials containing arsenic and sulphur. Fat wethers for the butcher are drafted from the hills in August and the two succeeding months. Lamb sales are most numerous in August, when lowland farmers secure their tegs to feed in winter. In this month breeding ewes recover condition and strength to withstand the winter storms. Ram auctions are on in September and draft ewe (a less desirable ewe sold from a stud flock) sales begin and continue through October. Early this month winter dipping is done at midday in dry weather. Early in November stock sheep having lost the distinguishing "buist" put on at clipping time with a large iron letter dipped in hot branding fluid, have the distinctive paint or kiel mark claimed by the farm to which they belong rubbed on the wool. The rams are turned out to the hills between Nov. 15 and 25. Lowland rams put to breed half-bred and cross lambs receive about 1 lb. of grain daily to prevent their falling off too rapidly in condition, as they would do if exclusively supported on mountain fare. (R. WA.; J. A. MO.)

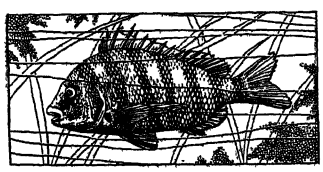
American Sheep.—The established breeds of sheep in North America are of British, Spanish and French origin. The British breeds predominate in Canada and constitute considerably more than half of the pure-bred sheep in the United States. Mexico has shown more interest in Merinos and Rambouillets, which are of Spanish and French origin respectively. According to the 1920 census of pure-bred sheep in the United States, Shropshires made up 31% of those enumerated by breeds; Rambouillets, 27; Merinos, 15; Hampshires, 13; Oxfords and Lincolns, each 4; Dorsets and Southdowns, each 2. The remaining 2% included Cheviots, Leicesters and Suffolks. Romneys, Cotswolds, Corriedales and Karakuls are bred in the United States but are comparatively few and were not enumerated by breeds.

Shropshires are most numerous in the corn belt and Great Lakes regions; Rambouillets in the western range States, although they are also bred in some farm States, especially Ohio and Michigan. Merinos are most numerous in Ohio, West Virginia, Pennsylvania and Michigan, but they are also bred in other parts of the country, especially Oregon, California, New Mexico and Texas. Hampshires are most numerous in the western range country but are also important in farm States, notably New York, Pennsylvania, Michigan, Missouri, Kentucky and Virginia. Oxfords are found in the North-Central States; Lincolns in the Mountain and Pacific States; Dorsets in the Middle Atlantic and East North-Central States; Southdowns in Tennessee, Kentucky, West Virginia, Ohio, Pennsylvania and New York; Cheviots in New York; Leicesters principally in the North-East and North-Central States. Romneys, Cotswolds, Corriedales, Suffolks and Karakuls are sparsely distributed in both farm and range areas.

Through selection these breeds have been modified to suit American conditions. Cross-breeding is also practised, especially in the western range country where forage is sufficiently abundant for finishing lambs by weaning time without grain. Under such conditions Rambouillet ewes are often bred to Lincoln or Hampshire rams and Lincoln-Rambouillet cross-bred ewes to Hampshire rams for the production of market lambs. Lincoln-Rambouillet cross-bred sheep are proving well adapted to this kind of range sheep production and the U.S. Department of Agriculture has been endeavouring since 1912 to establish this type by mating the cross-bred ewes to the cross-bred rams. The progress made is encouraging and this type is now known as the Columbia. Corriedales are the result of interbreeding Lincoln-Merino cross-breds in New Zealand and they have been bred in the United States since 1914. While they are smaller than the Columbia they are similar in type and produce lambs and wool of excellent quality. Karakuls are bred for their famous lamb skins of tight, lustrous curls. (D. A. S.)

See D. Low, *Breeds of the Domestic Animals of the British Isles* (1842, illustrated, and 1845); R. Wallace, *Farm Live Stock of Great Britain* (1923); and the *Flock Books* of the various breed societies; C. S. Plumb, *Types and Breeds of Farm Animals;* Watson and More, *Agriculture: The Science and Practice of British Farming* (1928); W. C. Coffey, *Productive Sheep Husbandry;* D. A. Spencer and others, *The Sheep Industry,* in *U.S. Department of Agriculture Yearbook 1923,* pp. 229–310.

SHEEPSHEAD, one of the large species of the genus *Archosargus.* These fishes possess two kinds of teeth: one, broad and flat, like incisors, in a single series in the front of the jaws; the other, semiglobular and molar-like, in several series on the sides of the jaws. The genus belongs to the acanthopterygian family *Sparidae* which includes the sea-breams. The common sheepshead occurs in abundance on the Atlantic coasts of the United States, from *Cape Cod to Florida,* and is one of the most valued food-fishes of North America. It may attain a length of 30in. and a weight of 15lb. Its food consists of shellfish, which it detaches with its incisors, then crushing them with its powerful molars. It may be distinguished from allied species by its seven or eight dark cross-bands. The term "sheepshead" is also given in some parts of North America to a freshwater sciaenoid, *Corvina oscula.*



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY

SHEEPSHEAD (ARCHOSARGUS PROBATOCEPHALUS), A FOOD FISH FOUND ALONG THE EASTERN COAST OF NORTH AMERICA

SHEEP SHEARING MACHINES. In countries where individual flocks of sheep are large or where wages are high, mechanical aids to hand clipping are employed in order to lower the cost or to speed up the work. In the pastoral districts of Australia, New Zealand and South America mechanical shearing

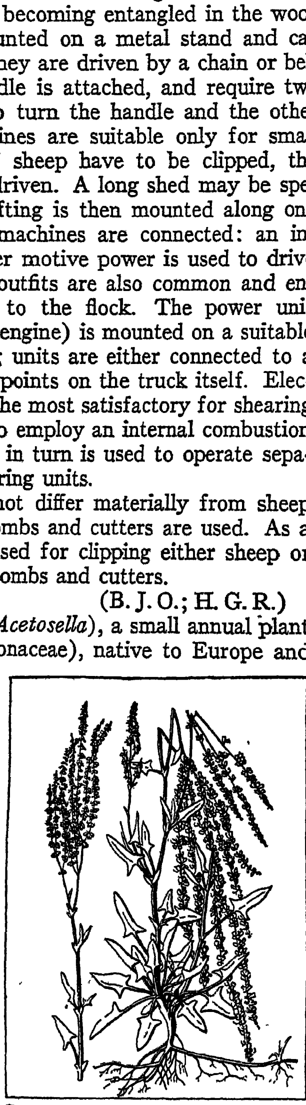
is almost universal. In Great Britain, although hand clipping is still widely practised, the use of shearing machines is gradually extending. Hand-shearing leaves the clipped surface in ridges whose evenness and symmetry are an indication of the skill of the operator while the machine leaves the surface level. It is claimed that the machine clips a heavier fleece than hand shears; but the result depends largely on the comparative skill of the operators.

The essential components of a shearing machine are a comb which is guided by hand over the body of the animal, a cutter with sharp edges which shears the wool by passing backwards and forwards across corresponding edges on the comb, a reciprocating device for actuating the cutter, a flexible or universally jointed coupling for driving the cutter, and the hand wheel or power unit. The moving parts of the actuating mechanism are protected so as to prevent them becoming entangled in the wool. Hand machines are usually mounted on a metal stand and can be easily carried by one man. They are driven by a chain or belt from a wheel to which the handle is attached, and require two persons to operate them, one to turn the handle and the other to clip the sheep. These machines are suitable only for small flocks. When large numbers of sheep have to be clipped, the machines are invariably power driven. A long shed may be specially adapted for shearing: shafting is then mounted along one side to which several shearing machines are connected: an internal combustion engine or other motive power is used to drive the shafting. Portable shearing outfits are also common and enable the machine to be taken to the flock. The power unit (usually an internal combustion engine) is mounted on a suitable transport truck and the shearing units are either connected to a portable shafting or to separate points on the truck itself. Electric drive has been found to be the most satisfactory for shearing machines and it is not unusual to employ an internal combustion engine to drive a dynamo which in turn is used to operate separate motors for driving the shearing units.

Horse clipping machines do not differ materially from sheep shearing machines but special combs and cutters are used. As a rule shearing machines can be used for clipping either sheep or horses by merely changing the combs and cutters.

(B. J. O.; H. G. R.)

SHEEP SORREL (*Rumex Acetosella*), a small annual plant of the buckwheat family (Polygonaceae), native to Europe and Asia, and found in gravelly soil in the British Isles. It is widely naturalized in North America, often becoming a pestiferous weed in pastures, meadows and fields. It grows usually less than 1 ft. high, with smooth acid herbage, the leaves narrowly, lance-shaped or halberd-form. The small dioecious flowers, which appear in spring, are borne in a narrow terminal cluster (panicle).



SHEEP SORREL, A HARDY SUMMER WEED OF THE TEMPERATE ZONE

SHEERNESS, a garrison town and naval seaport in the Faversham parliamentary division of Kent, England, in the Isle of Sheppey, on the right bank of the Medway estuary at its junction with the Thames, with a goods station on the S.R. Pop. (1931), 16,721. Blue Town, the older part, with the dockyard, is defended by strong modern-built fortifications, especially the forts of Garrison Point and Barton's Point, commanding the entrance of both the Thames and the Medway. The dockyard, chiefly used for naval repairs, covers about 60 ac., and consists of three basins and large docks, the depth of water in the basins ranging down to 26 feet. Within the yard there are extensive naval stores and barracks. Outside the dockyard are the residences of the admiral of the home fleet and other officers, and barracks. The harbour is spacious, sheltered and deep even at low water. Sheerness has some trade in corn and seed, and in supplying shipping. There is steamboat connection with Port Victoria, on the opposite side of the Medway; with Southend, on the opposite side of the Thames; and with Chatham and London, and the town is in some favour as a seaside resort. A small fort was built at Sheerness by Charles II., which, on July 10, 1667, was taken by the Dutch fleet under De Ruyter.

SHEETS, IRON AND STEEL. The production of rolled sheet iron dates back before 1620 in Bohemia and was introduced in Wales in 1720. (*See* TIN-PLATE AND TERNE PLATE.) Most of the rolling was done by hand, and great skill was required. The sheets were usually made of puddled or wrought iron. Upon the development of the Bessemer (*q.v.*) process and the open hearth (*q.v.*) process, steel was produced more rapidly and cheaply and practically replaced iron. However, steel sheets showed shorter service life under corrosive conditions, and interest in sheet iron reawakened. Metallurgists found methods of manufacturing it in larger quantities and less laboriously. To-day iron sheets are generally available and marketed at prices not greatly different from those of steel sheets.

Production.—In the production of sheets, the first part of the process is much the same as that employed for plates, sections and other products. The metal is refined, teemed into ingot moulds, heated again in soaking pits, and the ingots reduced in the blooming (or cogging) mill. The "bloom" is reduced in size and increased in length by its passage through rolls in the bar mill. The slabs that come from the blooming mill are cut up into bars of the proper length, which length becomes the width of the sheet to be later rolled from these bars. The bars are usually produced in two widths: 12 in. and 8 inches. The thickness in the bar governs the gauge of the sheet it will make.

"Roughing down" the bars is the next step. They are put through roughing mills to reduce them to the proper gauge to go into the finishing mills. This laborious work has been eliminated in some plants by the "continuous process." This process, introduced in 1923, makes it possible to roll the slabs as they come from the blooming operation. As they go from one mill to another, each succeeding mill turns slightly faster and rolls the metal thinner. Along the route are heating furnaces designed to keep the slabs at proper temperatures for rolling. The development of the continuous process makes possible a reduction of the ingots to sheets approximately ·06 in. thick without the metal being manipulated by hand. The iron is converted into a long, thin strip which is coiled while still hot as it comes from the mill. The coiled material is cut into lengths that correspond exactly to the roughed down sheet. The sheets are then matched and placed in another furnace for reheating in advance of finishing. Some of the new type furnaces contain slowly moving conveyors that bring the sheets through for withdrawal at one end. They are then passed between the finishing rolls, the top one driven by friction against the bottom roll, which is coupled into the "roll train" drive.

Heavy sheets and light plates are rolled in what is usually known as a "jobbing mill." There are no essential differences between it and a sheet mill except that the former handles sheets and plates from 16 gauge to ½ inch.

Annealing and Pickling.—After the sheets come from the finishing rolls, it is necessary to anneal them because the grain structures have been very much disarranged. Box annealing, or open or blue annealing, is used. In the first, the sheets are stacked on cast steel plates and covered with an iron cover to exclude the air, then placed in large ovens under known temperatures and for definite periods of time, depending upon the kind of treatment desired. In the open annealing process, the sheets are passed under a brick hood open at both ends. As they are conveyed through this furnace, they are subjected to the open flame that comes in at the sides of the furnace. The controlling factors in this process are the varying temperatures in different parts of the furnace, and the speed of the different sections of the conveyor drive. The purpose of the pickling in diluted acid is to remove all dirt and scale. In some of the newer mills, the sheets are stitched or spot welded together and sent through the annealing furnaces very slowly so that they receive the necessary heat treat-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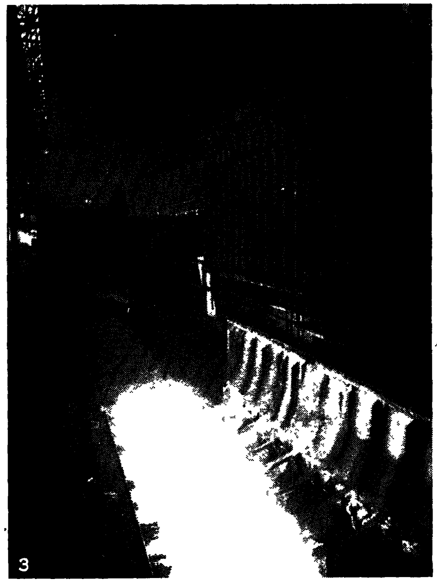
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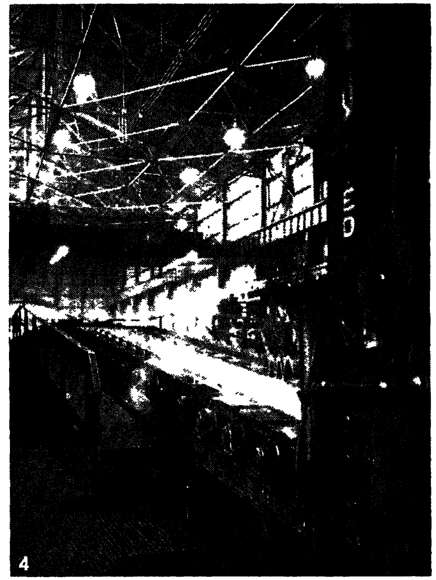
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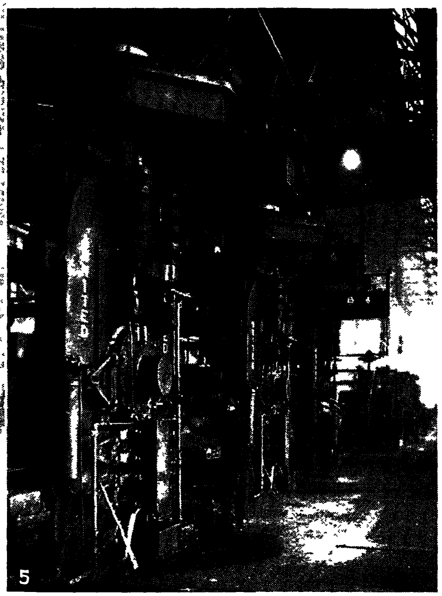
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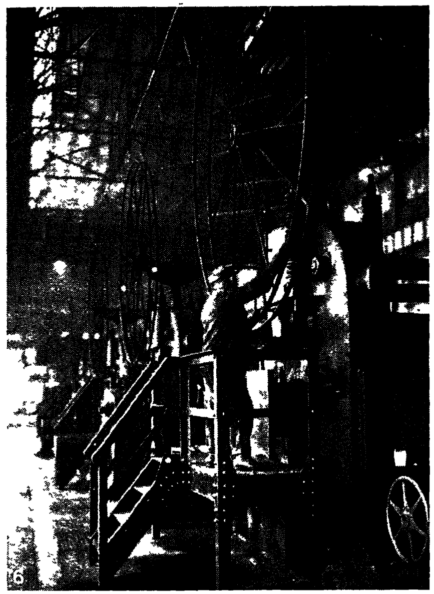
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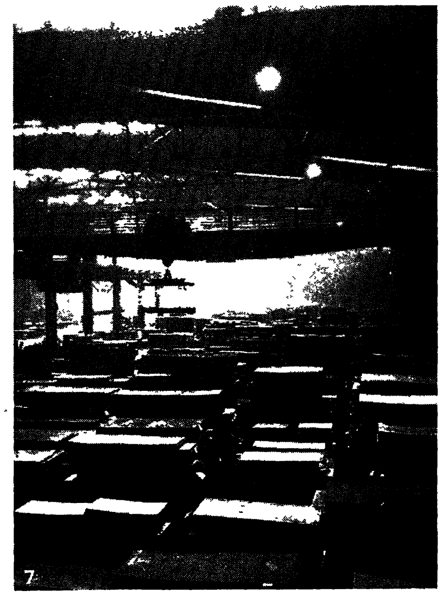
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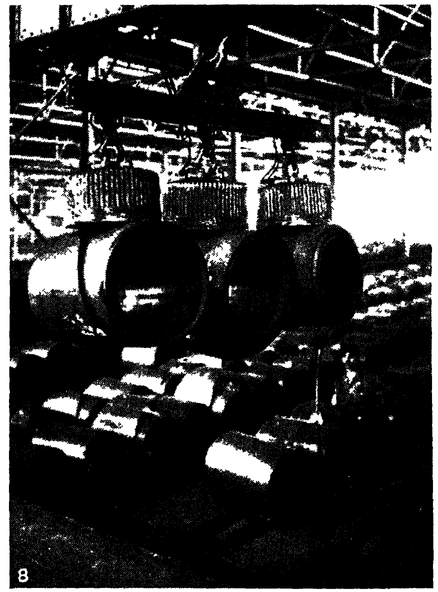
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BY COURTESY OF THE AMERICAN ROLLING MILL COMPANY

PROCESSING SHEET METAL

1. Liquid steel being poured out of an open-hearth furnace into the ladle
2. An 11,000 lb. slab being conveyed from slabbing mill to furnace in the foreground
3. Slab being conveyed through the continuous mills to be compressed to a ribbon of sheet metal
4. Slab compressor in foreground, which reduces a slab to 200 ft. of sheet metal in about 20 seconds
5. Four high mills set in tandem, used to reduce metal to sheet form
6. Adjusting the rolls to proper thickness or gauge
7. Sheets cut to specified sizes ready for shipment
8. Huge magnets convey the metal, automatically coiled, to the warehouse, thence to the decoiler and shears

ment as they go. The endless chain of metal then comes out and goes through a continuous pickling process in the same manner.

Galvanizing.—If the sheets are to be galvanized they are coated with zinc in galvanizing pots. (*See* GALVANIZED IRON AND STEEL.) The speed of the exit rolls and the temperature of the zinc control the weight of coating. Zinc makes a very good coating for iron and steel because it forms an alloy bond with the iron.

Coating.—Paint is often used to cover galvanized iron. Best results are secured when the zinc is allowed to weather several months. A quicker way to prepare the zinc is to brush it with a special priming coat for painting, a dilute solution of acetic acid or vinegar, rinsing with water and allowing to dry. Bitumastic or asphalt coatings are also employed. They are especially valuable where erosion is encountered.

Special Finish Sheets.—Many sheets are not galvanized, but are given special finishes. They are cold rolled between highly polished or ground rolls to secure a high or smooth finish. They are often cold rolled to as much as one-third their previous thickness. In case the sheets are required to be absolutely flat, they are stretcher-levelled, being placed in large grips under hydraulic pressure and pulled from both ends to a point just beyond the "yield point."

Uses.—To name the industries that use iron and steel sheets would be to list practically every industry of importance. In general, galvanized sheets are used in exposed situations where corrosion is a factor. One of the largest uses is roofing and sheet metal work. Ungalvanized sheets are sold as black sheets and blue annealed. These are used in many fabricated products such as tanks, pipe, locomotive jackets and car siding. (*See* TIN-PLATE AND TERNE PLATE; GALVANIZED IRON AND STEEL.) (B. CHA.)

SHEFFIELD, a city, county and parliamentary borough in the West Riding of Yorkshire, England, 158½ m. N.N.W. of London, 42½ m. S.E. of Manchester and 53 m. S.W. of York. It is served by the L.M.S. and L.N.E. railways and has connection with all the principal towns in the North of England. Pop. (1931) 511,742. It is situated in the extreme south of the county at the foot of the Pennines and at the junction of the Don with its tributaries the Sheaf, the Porter, the Rivelin and the Loxley. These valleys provide easy routes N.W., W. and S.W. into the Pennines.

At the time of the Domesday Survey, Sheffield (Escafeld) was unimportant, forming with the manors of Grimesthorpe, Hallam and Attercliffe what is now the borough of Sheffield. Of these four manors Hallam was the most important, and gave its name to the shire. In 1296, a grant was made, to Hallamshire, of a market every Tuesday and an annual fair lasting three days, and in the following year the inhabitants were given a charter granting them the privileges as burgesses, of holding a court baron every three weeks, and of freedom from toll. By the end of the 14th century Sheffield had become more important than Hallam, partly no doubt on account of the castle built there in the 13th century. In the reign of Edward VI. certain property in the town which had been left to the burgesses in trust for charities was forfeited to the crown under the act for the suppression of colleges and chantries, but on their petition it was restored in 1554 by Queen Mary, who, at the same time, incorporated the town under the government of twelve capital burgesses. The town trust for the administration of property belonging to the town dates from the 14th century, and in 1681 the number and manner of election of the "town trustees" was definitely settled by a decree of the Court of Chancery. Additional powers were conferred on the trustees by an act passed in 1874. The town first returned members to parliament in 1832. In 1885 the representation was increased from two to five members, and since 1918, seven members have been returned. The county borough was created in 1888, in 1893 the town became a county borough and the title of Lord Mayor was conferred on the chief magistrate in 1897.

Manufactures.—Sheffield owes its prosperity to the manufacture of steel. In the valleys of the Don and its tributaries iron smelting from local ore by means of wood was carried on, probably by the Romans at Templeborough, and certainly at the time of the Norman Conquest. Later, water power was used to drive bellows for the provision of artificial draught and for this the upland streams which converge on Sheffield were important. The town had become famed for its cutlery by the 14th century and was a strong rival of London; local iron contained too much phosphorus and the cutlery trade throve chiefly on imported iron from Sweden and Spain. The Cutlers Company was formed in 1624. Local hard stone provided grinding wheels and even to-day much grinding is done by individual workers. In the 18th century, iron smelting was on the verge of ruin, owing to the exhaustion of local timber supplies, and outcrop coal from the South Yorkshire coalfield gave the industry a new lease of life. Coke replaced charcoal, clay and gannister were found locally, and gradually, as steam power superseded water power, the steel industry concentrated in the lower parts of the valley and the town of Sheffield grew rapidly. In early times, cutlery was made of blister or bar steel, later shear steel was used, but in 1740, Benjamin Huntsman introduced the manufacture of cast steel and upon this achievement many subsequent steel making discoveries have been based. It was with the aid of Sheffield capital that Henry Bessemer founded his pioneer works to develop the manufacture of his invention, and so revolutionised the industry by cheapening its production. Large quantities of Bessemer steel are still made in Sheffield. Further improvements in steel were made in 1858 and in 1882 manganese steel was introduced. Progress lagged until 1900 when it seemed America would capture the market. A still better type of high speed steel was then produced and the position of Sheffield was maintained.

The trade in heavy steel has kept place with that in other branches and armour plates, large castings for engines and ocean liners, hydraulic presses, rails, tyres, axles, stoves and grates, steel shot and steel for rifles are produced. Modern works dealing with heavy steel goods are located in the Don valley between its elbow and the town of Rotherham, near the easiest route to and from Sheffield, while cutlery and lighter metal goods are made on the higher sites to S. and W. The cutlery trade embraces almost every variety of instrument and tool—spring and table knives, razors, scissors, surgical and mathematical instruments, edge tools, saws, engineering and agricultural tools, etc. The art of silver-plating was introduced in 1742 and specimens of early Sheffield plate are highly prized. Among other industries of the town are tanning, confectionery, cabinet making, bicycle manufacture, iron and brass founding, manufacture of paper (due to the purity of the streams), printing and bookbinding, and making of optical instruments, brushes, horsehair cloth, railway fittings, chemicals and paint and varnish. The most recent developments are the manufacture of gramophones and needles, and nickel-silver cooking utensils which were introduced to England by a Sheffield firm in 1919. By acts of 1883–88, the Cutlers' Company exercises jurisdiction in all matters relating to the registration of trade marks, over all goods composed in whole or in part of any metal, wrought or unwrought, and also over all persons carrying on business in Hallamshire and within 6 m. thereof.

Communications.—Sheffield lies on no great lowland route or natural highway. To N.W. and S. the valleys lead only to Pennine dales and lofty moorlands. In 1732, improvements were made in the Don navigation to help the trade of Sheffield and in 1793 the Don was joined to the Trent by the Stainforth and Keadby canal. The original Midland railway main line passed direct from Chesterfield to Rotherham and for more than 40 years Sheffield was reached only by a branch line. The main line through Sheffield was not built until 1870 after the tunnelling of the Sheaf-Rother watershed. Long tunnels connect Sheffield by rail with the west and even now relatively little of the trunk traffic of England passes through the town.

The University of Sheffield began as the Firth college founded by Mark Firth, an eminent steel manufacturer, in 1879. It was enlarged in 1892. Although it provides ample opportunities for a broad cultural education, the university has especially developed branches of study and research related with local

industries, as, *e.g.*, fuel and glass technology, geology and non-ferrous metallurgy. It has also given prominence to dental surgery and pharmacology; and in conjunction with the university of Leeds maintains a laboratory for marine zoology at Robin Hood's Bay. With two new research laboratories for engineering and metallurgy and in its mining department, it is increasingly occupied with research connected with local industries. Like the other universities in manufacturing districts it organises much extramural education amongst persons unable to be regular students of the university. The social interests of the students, both men and women, are well provided for, especially in their respective unions. Within recent years benefactions to an amount over £180,000 have been received. (*See* UNIVERSITIES.) Other educational institutions include the boys' charity school (1706), the free writing school (1715), the girls' charity school (1786), the Wesley college, associated with London university, and Ranmoor college of the Methodist New Connexion.

Sheffield has four voluntary hospitals and it was proposed in 1924 to amalgamate and extend them, utilising the old buildings as receiving wards and casualty stations and carrying on the main work in Norton Hall which was given for the purpose. A new wing of the Royal Infirmary was opened in 1925. In Meersbrook Hall is a fine Ruskin museum, containing Ruskin's art, mineralogical, natural history and botanical collections and some original drawings and valuable books. These are in the custody of the corporation. Part of the manor house of Hallam, dating from the 16th century still remains, and in the south of the city is Broom Hall, a fine old half-timbered building. To the N.W. towards Penistone, is Wharncliffe, retaining many of the characteristics of an ancient forest, and overlooking the valley of the Don from bold rocky terraces and ridges.

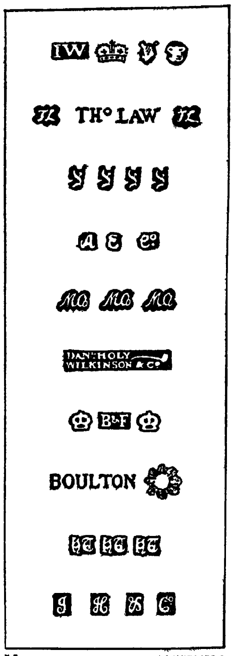
Until 1914, Sheffield was the seat of a suffragan bishop in the diocese of York; at that date it was created a diocese consisting of the archdeaconries of Sheffield and Doncaster with that part of the rural deanery of Dronfield which was within the city boundaries. The old parish church of St. Peter and St. Paul became the cathedral. It is a cruciform building, mainly Perpendicular, built on the site of a Norman edifice which is believed to have been burnt during the wars of Edward III. with the barons. The 14th century tower is the oldest part existing.

The great period of prosperity in the 19th century led to great crowding of population in the valleys and a later spread over the ridges between. The older parts of the town are still irregular and overcrowded, but under the act of 1875 a great number of improvements were effected and have been steadily continued. The latest suburb development is to the west, extending over the moors. The borough was enlarged by the inclusion of part of Tinsley in 1911, and part of Bradfield in 1914, and in 1920 powers were sought to include a large area for purposes of a bold scheme for regional devolution. The area of land incorporated in 1921 included Handsworth and parts of Ecclesfield and Brinsworth, and a new ward of Handsworth was created. The old boards of guardians of Sheffield and Ecclesfield were dissolved in 1925 and a united board established. An exhaustive civic survey has been carried out and a zonal town plan prepared; authority for applying the plan to an area of 5,909 ac. was obtained in 1925. A village with a painted fabrics industry for ex-service men has been established at Coal Aston on the outskirts of the city. In connection with the Derwent valley water scheme, for utilising the water of the Derwent and Ashop rivers, of which 25% will be used by Sheffield, the Howden reservoir was opened in 1912 and the Derwent reservoir and the service reservoir at Ambergate were completed in 1926.

SHEFFIELD, a city of Colbert county, Alabama, U.S.A., on the south bank of the Tennessee river, opposite Florence, in the Muscle Shoals district of the north-western part of the State. It is on Federal highway 72, and is served by the Louisville and Nashville and the Southern railway systems and river steamers. Pop. (1920), 6,682 (29% negroes); 6,221 in 1930 by the Federal census. Sheffield is beautifully situated between the Government nitrate plants No. 1 and No. 2.

SHEFFIELD PLATE is the term applied to articles produced from copper and coated with silver by the process of fusion.

History.—About the year 1742 Thomas Boulsover, a Sheffield cutler, while undertaking repairs to the haft of a knife observed that by the application of heat a piece of silver and the copper to which it accidentally adhered had become fused and could be dealt with as one metal and that the two metals behaved as one when subjected to hammering. This caused him to experiment, with the result that he eventually produced buttons and boxes with a copper foundation coated with silver which had the appearance of being made entirely of the more precious metal. Joseph Hancock, who served his apprenticeship with a relative of the inventor, realized the wider possibilities of the discovery and was the first to apply the process to making saucepans, coffee-pots, candlesticks and other large articles for domestic service, closely resembling in their detail hall-marked silver specimens.



MARKS FROM SPECIMENS OF SHEFFIELD PLATE

These pioneers were soon followed by other cutlers who added the production of Sheffield Plate to their other undertakings. Two factors were necessary for the complete success of the new invention, viz., capital and skilled labour. The money required was readily obtained locally, but the highly trained assistance of London silversmiths was also essential and ultimately when their services were enlisted the success of the undertaking was assured.

The excellent appearance and relative cheapness of these plated productions caused a widespread demand. Henry Tudor (*see* Plate, fig. 3), a local gentleman, having realized the great possibilities of the invention, appears to have been the first to seek the assistance of a London silversmith, and about the year 1760 entered into partnership with Thomas Leader, and as Tudor and Leader they founded the first Sheffield plate and silver manufactory on an extensive scale. Boulsover apparently did not embark on this new phase of the industry, but turned to the rolling of metals, still however, carrying on his lucrative plated button manufactory.

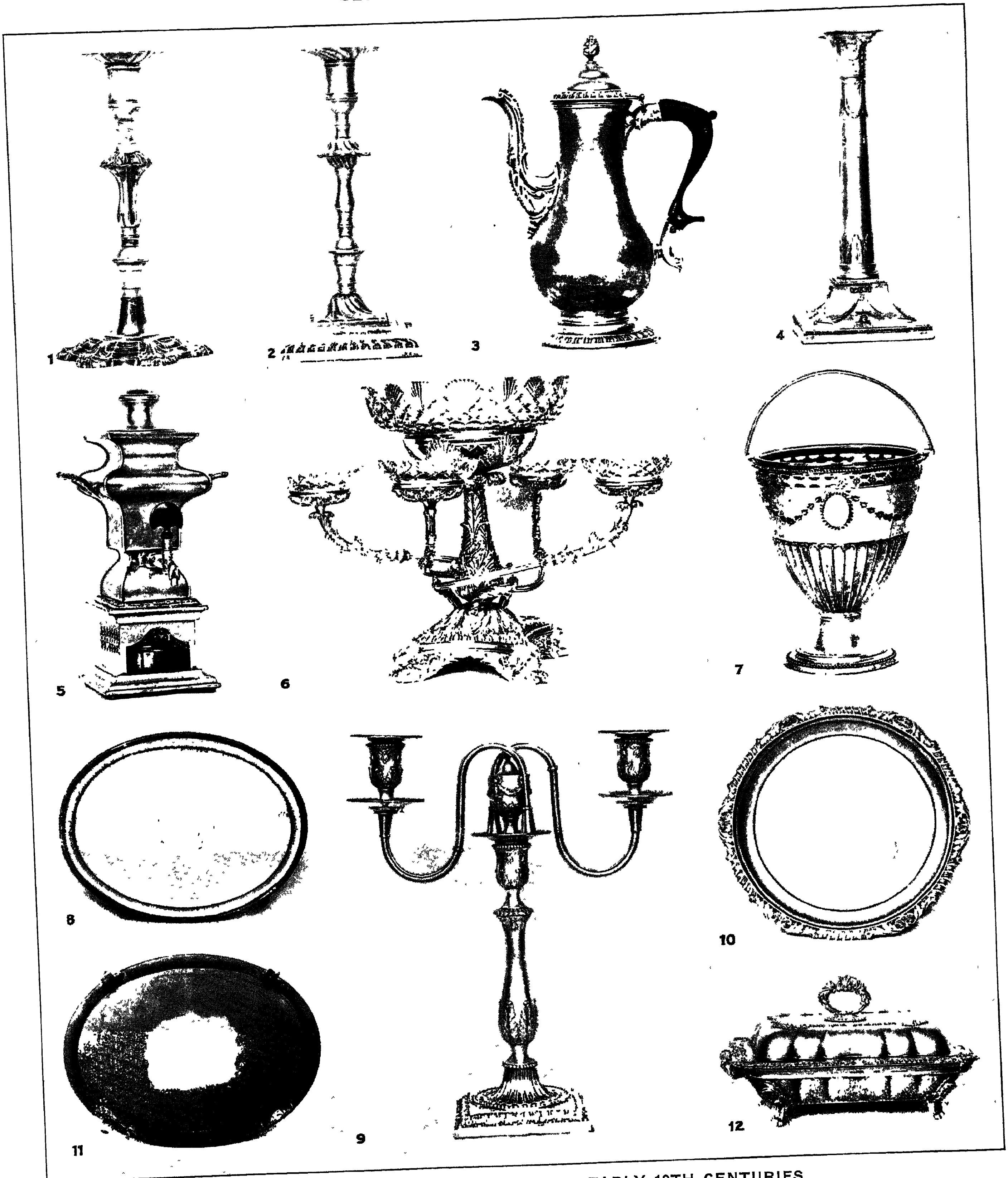
Hancock appears to have carried on the making of Sheffield Plate from about the year 1750 until 1765. He then interested himself chiefly in the production of plated materials required by manufacturers of the finished articles. Originally beaten out into sheets by hand the fused metal was subsequently manipulated by rollers turned by hand; the application of horse and water power followed, and eventually steam was employed to drive the mills.

The establishment of Leader in Sheffield raised the artistic standard of the craft, and from being content at first to copy contemporary London-made silver the Sheffield Plate workers soon evolved a style of their own and found much inspiration in the work of the brothers Adam and John Flaxman, particularly in the construction of candlesticks. So cunningly devised were some of their productions and so peculiarly marked (Plate I., figs. 3–10) that in the year 1773, the London silversmiths were successful in obtaining an injunction restraining the Sheffield plate makers from using marks on their wares.

Prominent amongst men of local origin who assisted in the advancement of design and workmanship in this new craft, and who themselves built up lucrative businesses, were John Winter (Plate I., fig. 9), Thomas Law (Plate I., fig. 2), Richard Morton and Joseph Ashforth, whose marks are still to be found on Old Sheffield Plate made previous to 1773.

By the year 1784, after much agitation the Sheffield platers were authorized to use marks once again, but it was enacted that such marks should bear the name of the maker together with a distinctive device not used for silver. About the year 1790 the most prominent manufacturers and designers were Samuel

SHEFFIELD PLATE



SHEFFIELD PLATE OF THE 18TH AND EARLY 19TH CENTURIES

1. Shell pattern candlestick by Joseph Hancock, 1755
2. Gadroon pattern candlestick by Thomas Law, 1765
3. Coffee pot by Tudor and Leader, 1760
4. Adam candlestick by M. Fenton & Co., late 18th century
5. Russian samovar made in 1820
6. Épergne with five crystal glasses by T. & J. Creswick, 1818
7. Pierced sugar basket with blue glass lining by J. Hoyland & Co., late 18th century
8. & 11. Obverse and reverse of soldered-in, heavily plated shield for engraving, by Nathaniel Smith & Co., 1788
9. Candelabrum by John Winter, 1772
10. Salver by Roberts, Cadman & Co., 1810, with rubbed-in silver shield
12. Entrée dish and warmer with oak leaf shell and gadroon mount by Watson & Bradbury, 1812

Roberts, Nathaniel Smith, Daniel Holy, the Watsons, Bradburys and Creswicks. Birmingham played but a small part in the earlier history of the trade, being represented practically by one man, Matthew Boulton. Though his workmanship, in association with his partner John Fothergill, is excellent and dates from the period 1760, he had many other interests, and articles made by him from fused plate of the first period are somewhat scarce. In the early part of the 19th century he and his successors carried on an increasing business, and their device, the sun, is still to be found on many old Sheffield specimens.

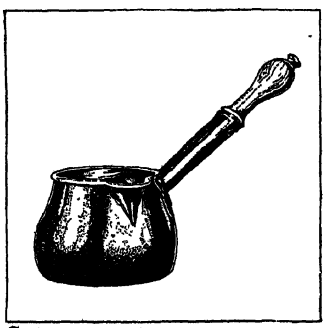
WORKSHOP IN AN 18TH CENTURY SHEFFIELD PLATE FACTORY SHOWING PROCESS OF PLATING BY FUSION

The manufacture of fused plate, though confined in England to Sheffield and Birmingham for many years, spread in the early part of the 19th century to the continent of Europe, but the articles made in France, Russia and Central Europe never bore comparison in quality or craftsmanship with those of the Sheffield makers.

Processes.—To produce the plated metal sheets, ingots of copper containing a slight alloy, $1\frac{1}{2}''$ to $1\frac{1}{4}''$ thick by $2\frac{1}{2}''$ wide by $8''$ long, were cast, and the surfaces planed, then smoothed. A sheet of silver was cut to the size of the face of the ingot, about $\frac{1}{8}''$ thick, also smoothed on the surfaces. The two prepared surfaces were cleaned of all impurities, placed together and firmly pressed. A copper plate dressed with solution of chalk was placed upon the silver and all three firmly secured together, and bound with iron wire.

The ingot was now placed in a furnace especially prepared, and most carefully watched until the silver melted slightly when it firmly adhered to the copper surface. After being withdrawn from the oven and allowed to cool, the copper plate and iron wires were removed from the ingot which after being well cleaned and trimmed was ready for the rolling mills.

At first plated on one side only, a new process was discovered about the year 1765 which enabled the makers to produce sheets with a coating of silver on both sides of the metal. The ingenious craftsmen were now not far off realizing their ambition, viz., to produce articles that were indistinguishable from those made in London of standard silver.



SAUCEPAN OF ABOUT 1755, MARKED JOSEPH HANCOCK, SHEFFIELD

Plated Wire.—About the year 1768, plated wire was introduced. A strip of fine silver $\frac{1}{32}''$ thick was bent to fit a round copper rod $5''$ long by $1''$ diameter. The two metals were then united by fusion and afterwards drawn continuously through a "whortle" until they assumed the form of a wire. The repeated drawings brought the two silver edges together almost as one piece. This early method was improved upon and superseded some years later, though the original principle was adhered to in its general details.

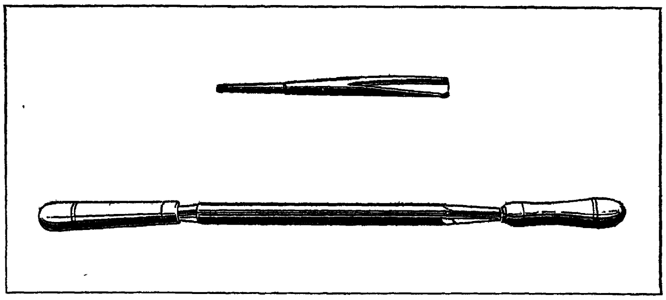
Silver Edges.—The next feature that marked a great advance in manufacture was the addition of silver edges, invented by George Cadman in 1788. Previous to this the raw copper edges had been hidden with solder. The method consisted of drawing a hollow silver wire through a hole which corresponded in size exactly with the edges of the article it was intended to cover: at the same time this process shaped up the silver thread to a groove, thereby enabling the operation of soldering on these silver edges to be carried out more easily.

Silver Shields for Engraving.—The method of rubbing in silver shields by applied heat was evolved about the year 1810. Previous to this in order to carry out the engraving of crests, etc., it had been necessary to solder in extra heavily plated sections of metal.

This invention has been attributed to a man of the name of Wilks, who also improved the method of production of plated wire. Having hammered the surface on to which the shield was to be fixed, a piece of pure silver was cut suitable to the size of article to which it was to be made to adhere and heated lightly in a flame, it was flattened all over and chamfered on the edges, as thinly as possible. After being cleaned of impurities the shield was secured to the centre of the plate and heated till it adhered to the metal, then quickly rubbed with a burnish until it was definitely sealed to the under surface. The blank was subsequently hammered until both silver shield and fused plated sheet were brought to one level.

With all these discoveries and inventions allied to their skill in technique and design, it is not surprising that early in the 19th century the Sheffield platers then at the height of their prosperity led the fashion in production of domestic silver as well as Sheffield Plate. By the aid of steel dies in which the delicate tracery of their conceptions could be stamped, they continued to produce on an elaborate scale new designs with which the London silversmiths found it difficult to compete.

End of the Industry.—Having for close on a century held the field for pre-eminence in design and workmanship, Sheffield Plate was gradually superseded by articles plated by the process of electro disposition; though even as late as the 1851 Exhibition the reports of the jurors were unfavourable to this new invention. "They desired to guard against being considered as expressing an opinion on the merit of the application of the electro process of silverplating to objects of domestic use."



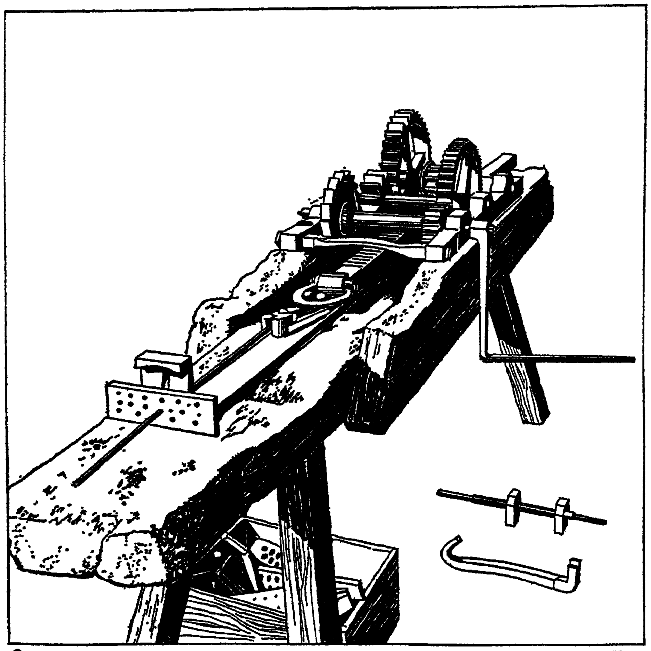
ABOVE: SECTION OF METAL BEFORE BEING DRAWN INTO WIRE; AND, BELOW: OLD BURNISHER USED IN FINISHING PLATED WIRE

By the year 1860 the firms in Sheffield which had declined to adapt themselves to this innovation were gradually dying out. Though the two processes had merged into each other gradually by the year 1865, the older method of plating by fusion for articles of domestic use had ceased to exist. The production of fused plated silver is still carried on for the making of buttons, it having been found that the rolling and hammering of the sheets is conducive of greater lasting properties for articles so continuously subjected to hard wear.

Old Sheffield Plate.—About 30 years after its disappearance as a commercial commodity, the acquisition of what was by then termed "Old Sheffield Plate" became a cult amongst collectors of antiques. It was evident that the process of manufacture might be classed as a lost art. The superb workmanship could not be disputed and was well nigh impossible of reproduction. Most of the older skilled craftsmen had by then passed away, and the younger ones had adopted other callings. The demand soon began greatly to exceed the supply. This state of affairs was

followed by the appearance on the market of many imitations electro-plated on copper, which were dishonestly described as "Sheffield Plate." To so great an extent were these spurious articles sold as Sheffield plate that in the year 1911 prosecutions were undertaken by the Sheffield Cutlers company, when it was established in court that the term "Sheffield Plate" could only legally be applied to articles made by the older method of plating by fusion.

The tendency to-day has not been towards a general increase in values of all specimens of Old Sheffield Plate, but those of



OLD DRAW BENCH APPLIANCES FOR MAKING AND DRAWING WIRE. THE TWO INSTRUMENTS ON THE RIGHT COMPRISE THE "MAUNDRILL"

utility such as candlesticks, candelabra, waiters, trays, entrée dishes, tea services, salt cellars and mustard pots, coffee pots, and many original designs in pierced work have advanced greatly in value. For such articles in perfect condition almost as high a figure is occasionally paid as for contemporary hall-marked silver specimens.

With regard to the large articles that, early in the 19th century, were so prominently displayed on sideboards and dining tables, these, under modern conditions of home life, are not now greatly in request, consequently they may frequently be purchased at a price which is under their original cost.

With regard to the future of the industry, the modern demands for a cheaper class of goods has led to a deterioration of design generally associated with mass production. Possibly silver plated articles may eventually be superseded for domestic use by solid silver, which since the removal of duty in 1891 and decline in value of the raw metal has greatly grown in demand. Again, too, there has been a resuscitation of pewter for table use, which is treated more scientifically than formerly and bears a marked resemblance to a standard silver. Pewter also has the advantage of practical immunity from tarnish, whilst the material is easily worked and very durable.

The manufacturers of best quality plated goods are to-day more concerned with the production of wares suitable for hotels, restaurants, clubs and the shipping services, than for domestic utility. *See* SILVERSMITHS' AND GOLDSMITHS' WORK.

(F. BRA.)

SHEIKH or **SHAYKH,** an Arabic title of respect. Strictly it means a venerable man, of more than 50 years of age. It is specially borne by heads of religious orders, chiefs of tribes and headmen of villages. Every village, however small, every separate quarter of a town, has a sheikh in whom is lodged the executive power of government—a power loosely defined, and of more or less extent according to the personal character and means of the individual who wields it. (For the Sheikh ul-Islam *see* MUFTI.)

SHEKEL, originally a Jewish unit of weight ($\frac{1}{50}$ of a mina, and $\frac{1}{3000}$ of a talent) and afterwards a coin of the same weight (Heb. *shakal,* to weigh). The Biblical references to shekels must refer to uncoined ingots. In the time of Josephus it seems that the *light* shekel weighed from 210 to 210·55 grains; the *heavy* shekel was twice that amount, corresponding to 1s. 4½d. and 2s. 9d. respectively in English silver. Jewish shekels were first coined by Simon the Hasmonean, probably in 139–138 B.C. These bear inscriptions in the archaic Hebrew and various emblems, such as the cup or chalice, the lily branch with three flowers, the candlestick, the citron and palm branch and so forth. They never bear the portraits of rulers or figures of animals. A later series of shekels, belonging to the Roman period, are tetradrachms, "which came from the mints of Caesarea and Antioch and were used as blanks on which to impress Jewish types." Hence in Matt. xvi. 24 the temple tax of half a shekel is called a didrachm (2 drams). In 2 Samuel xiv. 26 we read of "shekels after the King's weight." The Hebrews divided the shekel into 20 parts, each of which was called a *gerah.* (*See* also NUMISMATICS.)

See articles in *Ency. Bibl.* col. 4,442, and Hastings' *Dict. of the Bible,* ii. 417 *seq.;* F. W. Madden, *Coins of the Jews* (1881); T. Reinach, *Jewish Coins* (1903).

SHEKINAH, a Hebrew word meaning "that which dwells," or "the dwelling." An expression used in the Targums in place of "God." The word "Shekinah" is of constant occurrence in the Targums (*q.v.*). Great care was taken by the scribes to mitigate the anthropomorphic expressions applied to God in the Scriptures, and, by paraphrase, to prevent such expressions from giving rise to erroneous views in the popular mind as to God's personal manifestation. Thus, whenever any indication of local limitation or action of God was implied or expressed, in the Hebrew text, the Targumists were careful to substitute some expression involving the use of "Shekinah." Thus Ex. xxix. 45 is rendered in the Targum (Onkelos): "And I will cause my Shekinah to dwell," etc. All expressions implying God's *local* presence are similarly rendered: *e.g.,* Habak. ii. 20 "Jehovah was pleased to cause His Shekinah to dwell." "To see" God is similarly paraphrased. Thus Is. xxxiii. 17 is rendered "Thine eyes shall see the Shekinah of the king of the worlds." So "hiding the face," when used of God is regularly paraphrased "remove His Shekinah" (Is. lvii. 17, viii. 17, lix. 2). Closely connected with the idea of the Shekinah is that of "the glory of the Lord." "Glory," indeed, in this connection was conceived of as a property of the Shekinah (as, in fact, it is of God). For the divine "glory" as a property of the Shekinah, *cf., e.g.,* Is. vi. 5 which is rendered "mine eyes have seen the glory of the Shekinah of the King," etc.

This Shekinah-glory is several times denoted in the New Testament by δόξα. The most notable passage is Rom. ix. 4, where St. Paul, enumerating the list of Israel's privileges, says: "whose is the adoption, *and the glory*" (*i.e.,* the Shekinah-glory); *cf.,* Luke ii. 9. There is also an obvious allusion to the Shekinah in the description of the theophanic cloud of the transfiguration-narrative (St. Matt. xvii. 5 and parallels) the same verb being used as in the lxx. of Exod. xl. 34, *seq.* There can be no doubt too, that the word rendered "tabernacle" (σκηνή) with the corresponding verb "to tabernacle" (σκηνοῦν) is used in St. John i. 14, and Rev. xii. 3, because of its likeness to the term "Shekinah." In St. John i. 14, there is an allusion to the Word (the *mēmrā* of the Targums) the Shekinah, and the Shekinah-glory, all of which the writer declares became incarnate in Jesus. *Cf.* also Heb. i. 3.

It is remarkable that the *mēmrā* (Logos or "Word") of the Targums almost entirely disappears in the Midrashic literature and the Talmud, its place being taken by Shekinah. The Rabbis apparently dreaded the possibility of such terms becoming hypostasized into personal entities distinct from God. Against this they emphasized the Shekinah-idea. It is safe to say that wherever Shekinah is mentioned in Rabbinic literature it is God's direct action or activity that is thought of. Independent personality is never imputed to it. (Maimonides, however, regarded the Shekinah, like the *mēmrā* and "the glory" as a distinct entity.) It is probable that the use of the term was often in Rabbinic

writings polemical (against Jewish Christians or gnostic sects).

BIBLIOGRAPHY.—*See* "Shekinah" in J. Hastings, *Dictionary of the Bible,* 5 vols. (1900–04); *Dictionary of Christ and the Gospels,* 2 vols. (1906) and in I. Singer, *Jewish Encyclopedia,* 12 vols. (1901, 1925); also I. W. Weber, *Judische Theologie* (1897, pp. 185–190). For the Targums in English *see* W. J. Etheridge, *The Targums on the Pentateuch,* 2 vols. (1862); C. W. Pauli, *The Chaldee Paraphrase of the Prophet Isaiah* (1871). (G. H. B.)

SHELBY, a city of North Carolina, U.S.A., the county seat of Cleveland county; in the foothills of the Blue Ridge. Pop. 10,789 in 1930 (Federal census). Mineral springs and the natural beauty of the region have made the city a health and pleasure resort, and since 1900 it has been developing rapidly as an industrial centre. Its textile mills had 76,000 spindles in 1928. The city was founded and incorporated in 1844.

SHELBYVILLE, a city of Indiana, U.S.A., 27 m. S.E. of Indianapolis, on the Blue river; county seat of Shelby county. It is served by the Big Four and the Pennsylvania railways. Pop. 10,618 in 1930. It was named after General Isaac Shelby of Kentucky, was platted in 1822, incorporated as a town in 1850, and chartered as a city in 1860.

SHELDON, GILBERT (1598–1677), archbishop of Canterbury, was born at Stanton in the parish of Ellastone, Staffordshire, and educated at Oxford. He was ordained in 1622 and was appointed chaplain to Thomas Lord Coventry (1578–1640). Four years later he was elected warden of All Souls college, Oxford. In 1648 he was ejected from All Souls by order of parliament for his royalist activities, and imprisoned for some months, but he regained the wardenship in 1659. In 1660 he became bishop of London and master of the Savoy, and the Savoy Conference was held at his lodgings. He was consecrated archbishop of Canterbury in 1663. He was greatly interested in the welfare of Oxford University, of which he became chancellor in 1667, succeeding Clarendon (1609–74). The Sheldonian theatre at Oxford was built (1669) and endowed at his expense.

SHELDRAKE or **SHELD-DRAKE** (*Tadorna tadorna*), a bird of the duck tribe, *Anatidae,* distinguished by its size and upright stature, and by its striking black, white, and bay plumage. The head and neck are a very dark glossy green and the speculum, or wing-spot, bronze-green. The bill, which bears a fleshy knob at its base, is pale red. The female is smaller but very similar in coloration. The sheldrake inhabits sandy coasts in Europe, Asia and North Africa, penetrating inland in favourable localities. The nest is made under cover, usually in rabbit-burrows; in the Frisian Islands the people supply artificial burrows to obtain the eggs and down for their own profit. The male assists in incubation and care of the brood.

The allied *T. radjah* of Australia, Papua, and the Moluccas is less brightly coloured, and the head is white. *Casarca rutila,* the ruddy sheldrake, inhabits Barbary, south-eastern Europe and central Asia; it is an almost uniform bay, but with some black and white markings and a green and purple speculum. Other species occur in various parts of Africa and Australia and also in New Zealand.

In 1859, in the London Zoological Gardens, a male *T. cornuta* mated with a female *C. cana* from Africa, the resultant offspring resembling the two Australasian species of *Casarca.*

Related to the sheldrakes are the genera *Chenalopex,* including the Egyptian goose (*C. aegyptiaca*) and *Plectropterus,* the spur-winged goose of Africa.

SHELL, originally a thin flake; the hard outside natural covering of some fruits, seeds and animals (*see* articles on MOLLUSCA; GASTROPODA; MALACOSTRACA, etc.). The word is also used of a hollow projectile filled with explosives (*see* AMMUNITION: *Shell;* ORDNANCE; SHELL-MONEY).

In architecture shell is used for a single dome, considered as a structural entity rather than an architectural form.

SHELLAC: *see* RESINS: *Natural Resins.*

SHELLEY, MARY WOLLSTONECRAFT (1797–1851), English writer, only daughter of William Godwin and his wife Mary Wollstonecraft, and second wife of the poet Percy Bysshe Shelley, was born in London on Aug. 30, 1797. For the history of her girlhood and of her married life *see* GODWIN, WILLIAM, and SHELLEY, PERCY BYSSHE. When she was in Switzerland with Shelley and Byron in 1816 a proposal was made that various members of the party should write a romance or tale dealing with the supernatural. The result of this project was that Mrs. Shelley wrote *Frankenstein,* Byron the beginning of a narrative about a vampyre, and Dr. Polidori, Byron's physician, a tale named *The Vampyre,* the authorship of which used frequently in past years to be attributed to Byron himself.

Frankenstein, published in 1818, when Mary Shelley was at the utmost twenty-one years old, is a very remarkable performance for so young and inexperienced a writer; its main idea is that of the formation and vitalization, by a deep student of the secrets of nature, of an adult man, who, entering the world thus under unnatural conditions, becomes the terror of his species, a half-involuntary criminal, and finally an outcast whose sole resource is self-immolation. This romance was followed by others: *Valperga, or the Life and Adventures of Castruccio, Prince of Lucca* (1823), an historical tale written with a good deal of spirit, and readable enough even now; *The Last Man* (1826), a fiction of the final agonies of human society owing to the universal spread of a pestilence—this is written in a very stilted style, but possesses a particular interest because Adrian is a portrait of Shelley; *The Fortunes of Perkin Warbeck* (1830); *Lodore* (1835), also bearing partly upon Shelley's biography, and *Falkner* (1837). Besides these novels there was the *Journal of a Six Weeks' Tour,* which is published in conjunction with Shelley's prose-writings; and *Rambles in Germany and Italy* in 1840–1842–1843 (which shows an observant spirit, capable of making some true forecasts of the future), and various miscellaneous writings.

After the death of Shelley, Mary in the autumn of 1823 returned to London. At first she had to live by her writings; but after a while Sir Timothy Shelley made her an allowance, which would have been withdrawn if she had persisted in a project of writing a full biography of her husband. In 1838 she edited Shelley's works, supplying the valuable notes. She succeeded, by strenuous exertions, in maintaining her son Percy at Harrow and Cambridge; in 1840 his grandfather acknowledged his responsibilities and in 1844 he succeeded to the baronetcy. She died on Feb. 21, 1851.

See Richard Church, *Mary Shelley* (1928); and bibliography under PERCY BYSSHE SHELLEY.

SHELLEY, PERCY BYSSHE (1792–1822), English poet, was born on Aug. 4, 1792, at Field Place, near Horsham, Sussex. He was the eldest child of Timothy Shelley (1753–1844), M.P. for Shoreham, by his wife Elizabeth, daughter of Charles Pilfold, of Effingham, Surrey. His father was the son and heir of Sir Bysshe Shelley, Bart. (baptized Percy Bysshe; 1731–1815), whose baronetcy (1806) was a reward from the Whig party for political services. Sir Bysshe's father Timothy had emigrated to America, and he himself had been born in Newark, New Jersey; but he came back to England, and did well for himself by marrying successively two heiresses, the first, the mother of Timothy, being his cousin, Mary Catherine, daughter of the Rev. Theobald Michell of Horsham. He was a handsome man of enterprising and ambitious character, accumulated a large fortune, built Castle Goring, and lived in sullen and penurious retirement in his closing years. None of his talent seems to have descended to his son Timothy, who, except for being of a rather oddly self-assertive character, was undistinguishable from the ordinary run of commonplace country squires. The mother of the poet, who was his father's second cousin, is described as beautiful, and a woman of good abilities, but not with any literary turn; she was an agreeable letter-writer. The branch of the Shelley family to which the poet Percy Bysshe belonged traces its pedigree to Henry Shelley, of Worminghurst, Sussex, who died in 1623. These Worminghurst or Castle Goring Shelleys are of the same stock as the Michelgrove Shelleys, who trace up to Sir William Shelley, judge of the common pleas under Henry VII., thence to a member of parliament in 1415, and to the reign of Edward I., or even to the epoch of the Norman Conquest. The Worminghurst branch was a family of credit, but not of special distinction, until its fortunes culminated under the above-named Sir Bysshe.

In the character of Percy Bysshe Shelley three qualities became early manifest, and may be regarded as innate: impressionableness or extreme susceptibility to external and internal impulses of feeling; a lively imagination or erratic fancy, blurring a sound estimate of solid facts; and a resolute repudiation of outer authority or the despotism of custom. These qualities were highly developed in his earliest manhood, were active in his boyhood, and no doubt made some show even on the borderland between childhood and infancy. At the age of six he was sent to a day school at Warnham, kept by the Rev. Mr. Edwards; at ten to Sion House School, Brentford, of which the principal was Dr. Greenlaw, while the pupils were mostly sons of local tradesmen; at twelve (or immediately before that age, on the 29th of July 1804) to Eton. The headmaster of Eton, up to nearly the close of Shelley's sojourn in the school, was Dr. Goodall, a mild disciplinarian; it is therefore a mistake to suppose that Percy (unless during his very brief stay in the lower school) was frequently flagellated by the formidable Dr. Keate, who only became headmaster after Goodall. Shelley was a shy, sensitive, mopish sort of boy from one point of view—from another a very unruly one, having his own notions of justice, independence and mental freedom; by nature gentle, kindly and retiring—under provocation dangerously violent. He resisted the odious fagging system, exerted himself little in the routine of school-learning, and was known both as "Mad Shelley" and as "Shelley the Atheist." Shelley's first published work, a romance entitled "Zastrozzi" (1810), appeared shortly before he left Eton. This volume was followed quickly by "Original Poetry by Victor and Cazire" (1810) written in collaboration with his sister Elizabeth; and another romance "St. Irvyne or the Rosicrucian" (1811). In these early efforts Shelley played the sedulous ape to "Monk" Lewis, Ann Radcliffe, Rosa Matilda and other exponents of the "School of Terror," but worthless though they may be intrinsically, they are not without interest as having been written by the same hand that gave us "Prometheus Unbound," and "Hellas."

Oxford Life.—Shelley entered University College, Oxford, in April 1810, returned thence to Eton, and finally quitted the school at mid-summer, and commenced residence in Oxford in October. Here he met a young Durham man, Thomas Jefferson Hogg, who had preceded him in the university by a couple of months; the two youths at once struck up a warm and intimate friendship. Shelley had at this time a love for chemical experiment, as well as for poetry, philosophy and classical study, and was in all his tastes and bearing an enthusiast. He continued to write verse and published at Oxford a small collection entitled "Posthumous Fragments of Margaret Nicholson" (1810). The title was suggested by Hogg and is the only touch of the burlesque in what otherwise is a feeble attempt at serious poetry. Hogg was not an enthusiast, but he was a steady and well-read classical student. In religious matters both were sceptics; whether Hogg, as the senior and more informed disputant, pioneered Shelley into strict atheism, or whether Shelley, as the more impassioned and unflinching speculator, outran the easy-going jeering Hogg, is a moot point; we incline to the latter opinion. Certain it is that each egged on the other by perpetual disquisition on abstruse subjects, conducted partly for the sake of truth and partly for that of mental exercitation, without on either side any disposition to bow to authority or stop short of extreme conclusions. The upshot of this habit was that Shelley and Hogg, at the close of some five months of happy and uneventful academic life, got expelled from the university. Shelley—for he alone figures as the writer of the "little syllabus," although there can be no doubt that Hogg was his confidant and coadjutor throughout—published anonymously a pamphlet entitled *The Necessity of Atheism* (1811), which he sent round to bishops and all sorts of people as an invitation or challenge to discussion. It amounted to saying that neither reason nor testimony is adequate to establish the existence of a deity, and that nothing short of a personal individual self-revelation of the deity would be sufficient.

The college authorities heard of the pamphlet, identified Shelley as its author, and summoned him before them—"our master, and two or three of the fellows." The pamphlet was produced, and Shelley was required to say whether he had written it or not. The youth declined to answer the question, and was expelled by a written sentence, ready drawn up. Hogg was next summoned, with a result practically the same. The precise details of this transaction have been much controverted; the best evidence is that which appears on the college records, showing that both Hogg and Shelley (Hogg is there named first) were expelled for "contumaciously refusing to answer questions," and for "repeatedly declining to disavow" the authorship. Thus they were dismissed as being mutineers against academic authority, in a case pregnant with the suspicion—not the proof—of atheism; but how the authorities could know beforehand that the two undergraduates would be contumacious and stiff against disavowal, so as to give warrant for written sentences ready drawn up, is nowhere explained. Possibly the sentences were worded without ground assigned, and would only have been produced *in terrorem* had the young men proved more malleable.

Harriet Westbrook.—Shelley and Hogg came up to London, where Shelley was soon left alone, as his friend went to York to study conveyancing. Percy and his incensed father did not at once come to terms, and for a while he had no resource beyond pocket-money saved up by his sisters (four in number altogether) and sent round to him, sometimes by the hand of a singularly pretty school-fellow, Harriet Westbrook, daughter of a retired and moderately rich hotel-keeper. Shelley, in early youth, had a somewhat "priggish" turn for moralizing and argumentation, and a mania for proselytizing; his school-girl sisters, and their little Methodist friend Miss Westbrook, aged between fifteen and sixteen, must all be enlightened and converted to anti-Christianity. He cultivated the society of Harriet, being encouraged in his assiduity by her much older sister Eliza. Harriet fell in love with him; and he, though not it would seem at any time ardently in love with her, dallied along the pathway which leads to sentiment and a definite courtship. This was not his first love-affair; for he had but a very few months before been courting his cousin Harriet Grove, who, alarmed at his heterodoxies, finally broke off with him—to his no small grief and perturbation at the time. It seems that Shelley never indulged in any sensual or dissipated amour; and, as he advances in life, it becomes apparent that, though capable of the passion of love, and unusually prone to regard with much effusion of sentiment women who interested his mind and heart, the mere attraction of a pretty face or an alluring figure left him unenthralled.

After a while Shelley was reconciled to his father, revisited his family in Sussex and made the acquaintance of Miss Elizabeth Hitchener, a school-teacher at Hurstpierpoint with whom, for the space of one year he pursued an intimate and voluminous correspondence. He then stayed with a cousin in Wales, from whence he was recalled to London by Harriet, who wrote complaining of her father's resolve to send her back to her school, in which she was now regarded with repulsion as too apt a pupil of the atheist Shelley. He replied counselling resistance. "She wrote to say" (these are the words of Shelley in a letter to Hogg, dating towards the end of July 1811) "that resistance was useless, but that she would fly with me, and threw herself upon my protection." Shelley returned to London, where he found Harriet agitated and wavering; finally they agreed to elope, travelled in haste to Edinburgh, and there, on Aug. 28, were married with the rites of the Scottish Church. Shelley had by this time openly broken, not only with the dogmas and conventions of Christian religion, but with many of the institutions of Christian polity, and in especial with such as enforce and regulate marriage; he held—with William Godwin—that marriage ought to be simply a voluntary relation between a man and a woman, to be assumed at joint option and terminated at the after-option of either party. If, therefore, he had acted upon his personal conviction of the right, he would never have wedded Harriet, whether by Scotch, English or any other law; but as they were married without delay on their arrival in Edinburgh, it is probable that Harriet may have consented to the elopment on the understanding that Shelley would marry her.

Harriet Shelley was not only beautiful; she was amiable, accommodating, adequately well educated and well bred. She liked

reading, and her reading was not strictly frivolous. But she could not (as Shelley said at a later date) "feel poetry and understand philosophy." She appears to have been a simple-minded affectionate girl who did her best to respond to her husband's somewhat nebulous ideas on sociology and politics. For nearly three years Shelley and she led a shifting sort of life upon an income of £400 a year, one-half of which was allowed (after his first severe indignation at the *mésalliance* was past) by Mr. Timothy Shelley, and the other half by Mr. Westbrook. The couple left Edinburgh for York and the society of Hogg; broke with him upon a charge made by Harriet, and evidently fully believed by Shelley at the time, that, during a temporary absence of his upon business in Sussex, Hogg had tried to seduce her (this quarrel was entirely made up at the end of about a year); moved off to Keswick in Cumberland, where they received kind attentions from Southey, and some hospitality from the duke of Norfolk, who, as chief magnate in the Shoreham region of Sussex, was at pains to reconcile the father and his heir; sailed thence to Dublin, where Shelley was eager in the good cause of Catholic emancipation, conjoined with repeal of the union; crossed to Wales, and lived at Nant-Gwillt, near Rhayader, then at Lynmouth in Devonshire, then at Tanyrallt in Carnarvonshire. All this was between September 1811 and February 1813.

Residence in Wales.—At Lynmouth an Irish servant of Shelley's was sentenced to six months' imprisonment, but released on his master's recognizances, for distributing and posting up printed papers, bearing no printer's name, of an inflammatory or seditious tendency—being a *Declaration of Rights* composed by the youthful reformer, and some verses of his named *The Devil's Walk.* At Tanyrallt Shelley was (according to his own and Harriet's account, confirmed by the evidence of Miss Westbrook, the elder sister, who continued an inmate in most of their homes) attacked on the night of Feb. 26 by an assassin who fired three pistol-shots. It was either a human assassin or (as Shelley once said) "the devil." The motive of the attack was undefined; the fact of its occurrence was generally disbelieved, both at the time and by subsequent inquirers. A disclosure, some years later, proved that a shepherd close to Tanyrallt, named Robin Pant Evan, being irritated by some well-meant acts of Shelley in terminating the lives of dying or diseased sheep, did really combine with two other shepherds to scare the poet, and Evan was the person who played the part of "assassin." This was the break-up of the residence of the Shelleys at Tanyrallt; they revisited Ireland, and then settled for a while in London. Here, in June 1813, Harriet gave birth to her daughter Ianthe Eliza (she married a Mr. Esdaile, and died in 1876). Here also Shelley brought out his first poem of any importance, *Queen Mab;* it was privately printed, as its aggressive tone in matters of religion and morals would not allow of publication. In July the Shelleys took a house at Bracknell near Windsor Forest, where they had congenial neighbours, Mrs. Boinville and her family. Early in the summer of 1814 Shelley paid his last visit to Field Place (during the absence of his father), to see his mother. Several attempts to arrive at a reconciliation with his father had failed, probably owing, among other circumstances, to the officious intervention of the family solicitor.

The Godwin Circle.—The speculative sage whom Shelley especially reverenced was William Godwin (*q.v.*); in 1796 he had married Mary Wollstonecraft, authoress of *The Rights of Woman,* who died shortly after giving birth, on Aug. 30, 1797, to a daughter Mary. With Godwin Shelley had opened a volunteered correspondence at the beginning of 1812, and he had known him personally since the winter which closed 1812. Godwin was then a bookseller, living with his second wife, who had been a Mrs. Clairmont; there were four other members of the household, two of whom call for some mention here—Fanny Wollstonecraft, the daughter of the authoress and Mr. Imlay, and Claire (Clara Mary Jane), the daughter of Mrs. Clairmont. Fanny committed suicide in October 1816, being, according to some accounts which remain unverified, hopelessly in love with Shelley; Claire was closely associated with all his subsequent career. It was towards May 1814 that Shelley first saw Mary Wollstonecraft Godwin as a grown-up girl (she was well on towards seventeen); he instantly fell in love with her, and she with him. Just before this, on March 24, Shelley had remarried Harriet in London, apparently with a view to strengthening his position in his relations with his father as to the family property; but, on becoming enamoured of Mary, he seems to have rapidly made up his mind that Harriet should not stand in the way. She was at Bath while he was in London. They had, however, met again in London and come to some sort of understanding before the final crisis arrived—Harriet remonstrating and indignant, but incapable of effective resistance—Shelley sick of her companionship, and bent upon gratifying his own wishes, which as we have already seen were not at odds with his avowed principles of conduct. For some months past there had been bickerings and misunderstandings between him and Harriet, aggravated by the now detested presence of Miss Westbrook in the house; more than this cannot be said, and it seems dubious whether more will be hereafter known. Shelley, and not he alone, alleged grave misdoing on Harriet's part—perhaps mistakenly. The upshot came on July 28, when Shelley aided Mary to elope from her father's house, Claire Clairmont deciding to accompany them. They crossed to Calais, and proceeded across France into Switzerland. Godwin and his wife were greatly incensed. Though he and Mary Wollstonecraft had entertained and avowed bold opinions regarding the marriage-bond, similar to Shelley's own, and had in their time acted upon these opinions, it is not clearly made out that Mary Godwin had ever been encouraged by paternal influence to think or do the like. Shelley and she chose to act upon their own responsibility—he disregarding any claim which Harriet had upon him, and Mary setting at nought her father's authority. Both were prepared to ignore the law of the land and the rules of society.

The three young people returned to London in September. In the following January 1815 Sir Bysshe Shelley died, and Percy, who had lately been in great money-straits, became the immediate heir to the entailed property inherited by his father Sir Timothy. This entailed property seems to have been worth £6,000 per annum, or little less. He came to an understanding with his father and, giving up certain future advantages, he received henceforth a regular income of £1,000 a year. Out of this he assigned £200 a year to Harriet, who had given birth in November to a son, Charles Bysshe (he died in 1826). Shelley, and Mary as well, were on moderately good terms with Harriet, seeing her from time to time. His peculiar views as to the relations of the sexes appear markedly again in his having (so it is alleged) invited Harriet to return to his and Mary's house as a domicile; an arrangement which did not take effect. He had, undoubtedly, while previously abroad with Mary, invited Harriet to stay in their immediate neighbourhood. Shelley and Mary (who was naturally always called Mrs. Shelley) now settled at Bishopgate, near Windsor Forest; here he produced his first excellent poem, *Alastor, or the Spirit of Solitude,* which was published soon afterwards (1816) with a few others. Thomas Love Peacock was one of his principal associates at Bishopgate.

With Byron in Switzerland.—In May 1816 the Shelleys left England for Switzerland, together with Claire Clairmont, and their own infant son William. They went straight to Sécheron, near Geneva; Byron, whose separation from his wife had just then taken place, arrived there immediately afterwards. A great deal of controversy has arisen as to the motives and incidents of this foreign sojourn. The clear fact is that Claire Clairmont, who had a fine voice and some inclination for the stage, had seen Byron, as connected with the management of Drury Lane theatre, early in the year, and an intrigue had begun between them in London. Prima facie it seems quite reasonable to suppose that she had explained the facts to Shelley or to Mary, or to both, and had induced them to convoy her to the society of Byron abroad; were this finally established as the fact, it would show no inconsistency of conduct, or breach of his own code, on Shelley's part. But documentary evidence shows that Mary was totally ignorant of the amour shortly before they went abroad. Whether or not they knew of it while they and Claire were in daily intercourse with Byron, and housed close by him on the shore of the Lake of Geneva, may be left unargued. The three returned to London in September 1816, Byron remaining abroad; and in January 1817

Claire gave birth to his daughter named Allegra.

The return of the Shelleys was closely followed by two suicides —first that of Fanny Wollstonecraft (already referred to), and second that of Harriet Shelley, who on Nov. 9 drowned herself in the Serpentine. The body was not found until Dec. 10. The latest stages of the lovely and ill-starred Harriet's career have never been very explicitly recorded. It seems that she formed a connexion with some man from whom circumstances or desertion separated her, and that she was treated with harshness by her sister during an illness of their father. She had always had a propensity to the idea of suicide, and she now carried it out in act. Shelley, then at Bath, hurried up to London when he heard of Harriet's death, giving manifest signs of the shock which so terrible a catastrophe had produced on him. So far from Shelley dismissing the subject from his mind it is more than probable that the memory of this tragedy was ever present to him, and especially so during his last days.

This was the time when Shelley began to see a great deal of Leigh Hunt, the poet and essayist, editor of the *Examiner;* they were close friends, and Hunt did something to uphold the reputation of Shelley as a poet—which, we may here say once for all, scarcely obtained any public acceptance or solidity during his brief lifetime. The death of Harriet having removed the only obstacle to a marriage with Mary Godwin, the wedding ensued on Dec. 30, 1816, and the married couple settled down at Great Marlow in Buckinghamshire. Their tranquillity was shortly disturbed by a Chancery suit set in motion by Mr. Westbrook, who asked for the custody of his two grandchildren, on the ground that Shelley had deserted his wife and intended to bring up his offspring in his own atheistic and anti-social opinions. Lord Chancellor Eldon delivered judgment on March 27, 1817. He held that Shelley, having avowed condemnable principles of conduct, and having fashioned his own conduct to correspond, and being likely to inculcate the same principles upon his children, was unfit to have the charge of them. He appointed as their curator Dr. Hume, an orthodox army-physician, who was Shelley's own nominee. The poet had to pay for the maintenance of the children a sum which stood eventually at £120 per annum; if it was at first (as generally stated) £200, that was no more than what he had previously allowed to Harriet. This is the last incident of marked importance in the perturbed career of Shelley; the rest relates to the history of his mind, the poems which he produced and published, and his changes of locality in travelling. The first ensuing poem was *The Revolt of Islam,* referred to near the close of this article.

Removal to Italy.—In March 1818, after an illness which he regarded (rightly or wrongly) as a dangerous pulmonary attack, Shelley, with his wife, their two infants William and Clara, and Claire Clairmont and her baby Allegra, went off to Italy, where the short remainder of his life was passed. Allegra was soon sent on to Venice, to her father, who, ever since parting from Claire in Switzerland, showed a callous and unfeeling determination to see and know no more about her. In 1818 the Shelleys—always nearly with Claire in their company—were in Milan, Leghorn, the Bagni di Lucca, Venice and its neighbourhood, Rome and Naples; in 1819 in Rome, the vicinity of Leghorn and Florence (both their infants were now dead, but a third was born late in 1819, Percy Florence Shelley, who in 1844 inherited the baronetcy and died in 1889); in 1820 in Pisa the Bagni di Pisa (or di San Giuliano), and Leghorn; in 1821 in Pisa and with Byron in Ravenna; in 1822 in Pisa and on the Bay of Spezia, between Lerici and San Terenzio.

The incidents of this period are but few, and of no great importance apart from their bearing upon the poet's writings. In Leghorn he knew Mr. and Mrs. Gisborne, the latter a once intimate friend of Godwin; she taught Shelley Spanish, and he was eager to promote a project for a steamer to be built by her son by a former marriage, the engineer Henry Reveley; it would have been the first steamer to navigate the Gulf of Lyons. In Pisa he formed an intimacy with the Contessina Emilia Viviani, a girl who was pining in a convent pending her father's choice of a husband for her; this impassioned but vague and fanciful attachment —which soon came to an end, as Emilia's character developed less favourably in the eyes of her Platonic adorer—produced the transcendental love-poem of *Epipsychidion* in 1821. In Ravenna the scheme of the quarterly magazine the *Liberal* was concerted by Byron and Shelley, the latter being principally interested in it with a view to benefiting Leigh Hunt by such an association with Byron.

In Pisa Byron and Shelley were constantly together, having in their company at one time or another Shelley's cousin and schoolfellow Captain Thomas Medwin (1788–1869), Lieutenant Edward Elliker Williams (1793–1822) and his wife, to both of whom the poet was very warmly attached, and Captain Edward John Trelawny, the adventurous and romantic seaman, who has left important and interesting reminiscences of this period. Byron admired very highly the generous, unworldly and enthusiastic character of Shelley, and set some value on his writings; Shelley half-worshipped Byron as a poet, and was anxious, but in some conjunctures by no means able, to respect him as a man. In Pisa he knew also Prince Alexander Mavrocordato, one of the pioneers of Grecian insurrection and freedom; the glorious cause fired Shelley, and he wrote the drama of *Hellas* (1821) with its magnificent choruses breathing of hope for the future of mankind.

Last Days.—The last residence of Shelley was the Casa Magni, a bare and exposed dwelling on the Gulf of Spezia. He and his wife, with the Williamses, went there at the end of April 1822 to spend the summer, which proved an arid and scorching one. Peacock describes Shelley as being disillusioned during his last days; there is certainly a trace of melancholy in his later lyrics and correspondence; a foreboding of some approaching fatality which, however, he appears to have attempted to divert. Shelley and Williams, both of them insatiably fond of boating, had a small schooner named the "Don Juan" (or more properly the "Ariel"), built at Genoa after a design which Williams had procured from a naval friend, but the reverse of safe. They received her on May 12, found her rapid and alert, and on July 1 started in her to Leghorn, to meet Leigh Hunt, of whose arrival in Italy he had just been notified. After doing his best to set things going comfortably between Byron and Hunt, Shelley returned on board with Williams on July 8. It was a day of dark, louring, stifling heat. Trelawny took leave of his two friends, and about half-past six in the evening found himself startled from a doze by a frightful turmoil of storm. The "Ariel" had by this time made Via Reggio; she was not to be seen, though other vessels which had sailed about the same time were still discernible. Shelley, Williams and their only companion, a sailor-boy, perished in the squall. The exact nature of the catastrophe was from the first regarded as somewhat disputable. The condition of the "Ariel" when recovered did not favour any assumption that she had capsized in a heavy sea—rather that she had been run down by some other vessel, a felucca or fishing-smack. In the absence of any counter-evidence this would be supposed to have occurred by accident; but a rumour, not strictly verified and certainly not refuted, exists that an aged Italian seaman on his deathbed confessed that he had been one of the crew of the fatal felucca, and that the collision was intentional, as the men had plotted to steal a sum of money supposed to be on the "Don Juan," in charge of Lord Byron. In fact there was a moderate sum there, but Byron had neither embarked nor intended to embark. This may perhaps be the true account of the tragedy; at any rate Trelawny, the best possible authority on the subject, accepted it as true. He it was who laboriously tracked out the shore-washed corpses of Williams and Shelley, and who undertook the burning of them, after the ancient Greek fashion, on the shore near Via Reggio, on Aug. 15 and 16. The great poet's ashes were then collected, and buried in the new Protestant cemetery in Rome. He was, at the date of his untimely death, within a month of completing the thirtieth year of his age.

Character.—The character of Shelley can be considered according to two different standards of estimation. We can estimate the original motive forces in his character; or we can form an opinion of his actions, and thence put a certain construction upon his personal qualities. We will first try the latter method. It cannot be denied that his actions were in some considerable degree abnormal, dangerous to the settled basis of society, and marked

by headstrong and undutiful presumption. But it is remarkable that, even among the censors of his conduct, many persons are none the less impressed by the beauty of his character; and this leads us back to our first point—the original motive forces in that. Here we find enthusiasm, fervour, courage (moral and physical), an unbounded readiness to act upon what he considered right principle, however inconvenient or disastrous the consequences to himself, sweetness and indulgence towards others, extreme generosity (he appears to have given Godwin, though sometimes bitterly opposed to him, between £4,000 and £5,000), and the principle of love for humankind in abundance and superabundance. He respected the truth, as he conceived it, in spiritual or speculative matters, and respected no construction of the truth which came to him recommended by human authority. No man had more hatred or contempt of custom and prescription; no one had a more authentic or vivid sense of universal charity. The same radiant enthusiasm which appeared in his poetry as idealism stamped his speculation with the conception of perfectibility and his character with loving emotion.

In person Shelley was attractive, winning and almost beautiful, but not to be called handsome. His height was nearly 5 ft. 11; he was slim, agile and strong, with something of a stoop; his complexion brilliant, his hair abundant and wavy, dark brown but early beginning to grizzle; the eyes, deep blue in tint, have been termed "stag-eyes"—large, fixed and beaming. His voice was high-pitched and wanting in richness and suavity; his general aspect, though extremely variable according as his mood of mind and his expression shifted, was on the whole youthful. The only portrait of Shelley, from which some idea of his looks used to be formed, is that painted by an amateur, Miss Curran, in 1819; Mrs. Shelley, later, pronounced it to be "in many things very like." This is now in the National Portrait Gallery, together with a quasi-duplicate of it painted by Clint, chiefly from Miss Curran's likeness, and partly from a water colour (now lost) by Lieutenant Williams. In 1905 (*Century Magazine*) another portrait was brought forward: a pencil sketch taken in the last month of the poet's life by an American artist, William E. West, followed by an oil-painting founded on that sketch. The two works differ very considerably, and neither of them resembles Miss Curran's portrait; yet we incline to believe that the sketch was really taken from Shelley.

Place in European Literature.—If we except Goethe (and leave out of count living writers, whose ultimate value cannot at present be assessed), we must consider Shelley to be a supreme poet of the new era which, beginning with the French Revolution, remains continuous into our own day. Victor Hugo shares his lofty poetic stature, and might for certain reasons be even preferred to him; Byron and Wordsworth also belong to the same great period, and later, Tennyson and Browning. The grounds, however, on which Shelley's eminence is based are mainly three. He is unexcelled in his ideality, unexcelled in his music and unexcelled in his importance. By importance we here mean the direct import of the work performed, its controlling power over the reader's thought and feeling, the contagious fire of its white-hot intellectual passion, and the long reverberation of its appeal. Shelley is emphatically the poet of the future. In his own day an alien in the world of mind and invention, and in our day but partially a denizen of it, he appears destined to become, in the long vista of years, an informing presence in the innermost shrine of human thought. Shelley appeared at the time when the sublime frenzies of the French revolutionary movement had exhausted the elasticity of men's thought—at least in England—and had left them flaccid and stolid; but that movement prepared another in which revolution was to assume the milder guise of reform, conquering and to conquer. Shelley was its prophet. As an iconoclast and an idealist he took the only position in which a poet could advantageously work as a reformer. To outrage his contemporaries was the condition of leading his successors to triumph and of personally triumphing in their victories. Shelley had the temper of an innovator and a martyr; he united speculative keenness and humanitarian zeal in a degree for which we might vainly seek his precursor. We have already named ideality as one of his leading excellences. This Shelleian quality combines, as its constituents, sublimity, beauty and the abstract passion for good. Perhaps no outstanding English poet, and he was essentially an English poet, has used a greater variety of forms and measures than Shelley. In the pure lyrics the rapture, the music and the emotion are in exquisite balance, and the work has often as much of delicate simplicity as of fragile and flower-like perfection. Great as Shelley's fame is now, it should be remembered that it was entirely posthumous. He practically received no encouragement during his lifetime, and died believing that the world had rejected his poetry.

Works.—Some of Shelley's principal writings have already been mentioned above; we must now give a brief account of others. *Alastor* (1816) was succeeded (1817) by *The Revolt of Islam*, a poem of no common length in the Spenserian stanza, preaching bloodless revolution; it was written in a sort of friendly competition with Keats (who produced *Endymion*) and is amazingly fine, but as a whole somewhat long-drawn and exhausting. This transcendental epic (for such it may be termed) was at first named *Laon and Cythna, or the Revolution of the Golden City*, and the lovers of the story were then brother and sister as well as lovers—an experiment upon British endurance which the publishers would not connive at. The year 1818 produced *Rosalind and Helen*, a comparatively weak poem, begun in England and finished in Italy, and *Julian and Maddalo*, a very strong one, written in the neighbourhood of Venice—demonstrating in Shelley a singular power of seeing ordinary things with directness, and at once figuring them as reality and transfiguring them into poetry. In each of these two poems Shelley gives a quasi-portraiture of himself; and in the latter one may perhaps trace a veiled description of Harriet's tragic end. The next year, 1819, was his culmination, producing as it did the grand tragedy of *The Cenci* and the sublime ideal drama *Prometheus Unbound*, composed partly on the ruins of the Baths of Caracalla in Rome. This last we have no hesitation in calling his masterpiece. It embodies, in forms of surpassing imagination and beauty, Shelley's deepest and most daring conceptions. Prometheus, the human mind and will, has invested with the powers proper to himself Jupiter, the god of heaven, who thereupon chains and torments Prometheus and oppresses mankind; in other words, the anthropomorphic god of religion is a creation of the human mind, and both the mind of man and man himself are enslaved as long as this god exercises his delegated but now absolute power. Prometheus, who is from of old wedded to Asia, or Nature, protests against and anathematizes the usurper enthroned by himself. At last the anathema (although Prometheus has revoked it by an act of self-conquest) takes effect: Eternity, Demogorgon, dismisses Jupiter to unending nothingness. Prometheus is at once unbound, the human mind is free; he is reunited to his spouse Nature, and the world of man passes from thraldom and its degradation into limitless progression, or (as the phrase goes) perfectibility, moral and material. This we regard as in brief the argument of *Prometheus Unbound*. It is closely analogous to the argument of the juvenile poem *Queen Mab*, but so raised in form and creative touch that, whereas to write *Queen Mab* was only to be an ambitious and ebullient tiro, to invent *Prometheus Unbound* was to be the poet of the future. *The Witch of Atlas* (1820) is the most perfect work among all Shelley's longer poems, though it is neither the deepest nor the most interesting. It may be rated as a pure exercise of roving imagination—guided, however, by an intense sense of beauty, and by its author's exceeding fineness of nature.

The elegy on Keats, *Adonais*, followed in 1821. The translations—chiefly from Homer, Euripides, Calderon and Goethe—date from 1819 to 1822, and testify to the poetic endowment of Shelley not less absolutely than his own original compositions; there are also prose translations from Plato.

Shelley, it will be seen, was not only a prolific but also a versatile poet. Works so various in faculty and in form as *The Revolt of Islam, Julian and Maddalo, The Cenci, Prometheus Unbound, Epipsychidion*, and the grotesque effusions of which *Peter Bell the Third* is the prime example, added to the consummate array of lyrics, have seldom to be credited to a single writer—one, moreover, who died before he was thirty years of age. In prose Shelley

could be as admirable as in poetry. His letters to Thomas Love Peacock and others, and his uncompleted *Defence of Poetry,* are the chief monuments of his mastery in prose; and certainly no more beautiful prose—having much of the spirit and the aroma of poetry, yet without being distorted out of its proper essence—is to be found in the English language.

The chief original authorities for the life of Shelley (apart from his own writings, which contain a good deal of autobiography, if heedfully sifted and collated) are—(1) the notices by Mrs. Shelley interspersed in her edition of the *Poems;* (2) Hogg's amusing, discerning and authentic, although in some respects exaggerated, book; (3) Trelawny's *Records;* (4) the *Life* by Medwin; and (5) the articles written by Peacock. Some other writers, especially Leigh Hunt, might be mentioned, but they come less close to the facts. Among biographical books produced since Shelley's death, by authors who did not know him personally, the leading work is the *Life* by Professor Dowden (2 vols., 1886), which embodies important materials imparted by the Shelley family. *The Real Shelley,* by J. C. Jeaffreson (1885), is controversial in method and decidedly hostile in tendency, and tries a man of genius by tests far from well adapted (in our opinion) to bring out a right result; it contains, however, an ample share of solid information and sharp disquisition. The memoir by W. M. Rossetti, prefixed to an edition of Shelley's *Poems* in two forms of publication (1870 and 1878), was an endeavour to formulate in brief space, out of the then confused and conflicting records, an accurate account of Shelley—admiring, but not uncandidly one-sided. There is valuable material in Lady Shelley's *Shelley Memorials,* and in Dr. Garnett's *Relics of Shelley;* and the memoir by J. Addington Symonds, in the *English Men of Letters* series, is characteristic of the writer. *Shelley in England* by Roger Ingpen contains new facts respecting Shelley's relations with his family, his expulsion from Oxford and some unpublished facts about Harriet's death. One of the handiest editions of Shelley's poems was edited by Thomas Hutchinson (Clarendon Press, 1905), which includes the emendations, &c., published by Mr. C. D. Locock (1903) from examination of the MSS. in the Bodleian Library. Mr. Locock edited in 1911 an excellent and fully annotated edition of the Poems, with some new material. A full edition of Shelley's letters was edited by Roger Ingpen in 1909, reprinted with additions in 1911 and 1916. The most complete collection of Shelley's Poems, Prose works and Correspondence is the *Julian Edition* edited by Roger Ingpen and W. E. Peck (1927–1929). France has by no means neglected Shelley. A. Koszul's *"La Jeunesse de Shelley"* (1910), is a valuable study of the subject, while André Maurois has written a popular romance in his *"Ariel ou la vie de Shelley"* (1923). Mr. Buxton Forman's earlier and excellent edition includes the writings in prose as well as in verse. (W. M. R.; R. I.)

SHELLEY'S CASE, RULE IN, an important decision in the law of real property. The litigation was brought about by the settlement made by Sir William Shelley (*c.* 1480–1549), a judge of the common pleas, of an estate which he had purchased on the dissolution of Sion Monastery. After prolonged argument the celebrated rule was laid down by Lord Chancellor Sir Thomas Bromley, who presided over an assembly of all the judges to hear the case in Easter term 1580–81 (i. Coke's Rep. 93 *b.*). The rule may be stated as follows: When an ancestor by any gift or conveyance takes an estate of freehold and in the same gift or conveyance an estate is limited, either mediately or immediately, to his heirs or the heirs of his body, in such a case the word "heirs" is a word of limitation and the estate of the ancestor is an estate in fee or an estate tail according to circumstances. (*See* also *Van Grutten* v. *Foxwell,* 1897. A.C. 658.) This rule was abolished in England by the Law of Property Act 1925, by which date it had already been abolished in several colonies. It is said to have had its origin in the wish of the law to preserve to the lords their right of wardship. (*See* Burge's *Foreign and Colonial Laws,* vol. iv. pt. II.) In the United States the rule in Shelley's case is in operation as a part of the common law, but it has been repealed by statute in many States.

SHELL-MONEY, a medium of exchange common to many primitive races, consisting of sea shells or pieces of them worked into beads or artificially shaped. Shell-money appears to have been almost universal, being found in America, Asia, Africa and Australia. The shell used by the Indians of Alaska and California was the *Dentalium pretiosum,* a species of tusk-shell. The *ligua,* the highest denomination of their coinage, consisted of twenty-five shells strung together, which from end to end made a total measurement of a fathom (6ft.) or thereabouts, equalling in English coinage about £50.

But the shell most used by primitive peoples has always been the *Cypraea moneta,* or money-cowry (*see* COWRY). It is most abundant in the Indian Ocean, and is collected more particularly in the Maldive Islands, in Ceylon, along the Malabar coast, in Borneo and other East Indian islands, and in various parts of the African coast from Ras Hafun to Mozambique. It was formerly in familiar use in Bengal, where, though it required 3,840 to make a rupee, the annual importation was valued at about £30,000. In western Africa it was, until past the middle of the 19th century, the usual tender. The use of the cowry currency gradually spread inland in Africa, and about 1850 Heinrich Barth found it fairly recognized in Kano, Kuka, Gando and even Timbuktu. In the countries on the coast the shells were fastened together in strings of 40 or 100 each, so that 50 or 20 strings represented a dollar; but in the interior they were laboriously counted one by one. The districts mentioned above received their supply of *kurdi,* as they were called, from the west coast; but the regions to the north of Unyamwezi, where they were in use under the name of *simbi,* were dependent on Muslim traders from Zanzibar. The shell of the land-snail, *Achatina monetaria,* cut into circles with an open centre, has been long used as coin in Benguella, Portuguese West Africa. In parts of Asia *Cypraea annulus,* the ring cowry, was commonly used. In north Australia different shells were used, one tribe's shell being absolutely valueless in the eyes of another tribe. In the islands north of New Guinea the shells are broken into flakes. Two shells are used by these Pacific islanders, one a cowry found on the New Guinea coast, and the other the common pease shell. As late as 1882 local trade in the Solomon Islands was carried on by means of a coinage of shell beads, small shells laboriously ground down to the required size by women.

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SHELL-MOUNDS or **KITCHEN-MIDDENS** (Dan. Kjökken-mödding), prehistoric refuse heaps or mounds, found in all quarters of the globe, which consist chiefly of the shells of edible molluscs mixed with fragments of animal bones, and implements of stone, bone and horn. They may sometimes, as in the Straits of Magellan, be seen in process of formation.

Many, of prehistoric origin, have been examined, notably on the eastern coast of Denmark. These were at first thought to be raised beaches, but a cursory examination at once proved their artificial construction. Further investigation proved these shell-mounds to belong to the early part of the Neolithic age (*q.v.*). They contained the remains of quadrupeds, birds and fish, the food of the prehistoric inhabitants. Among the bones were those of the wild bull or aurochs, beaver, seal and great auk, all now extinct or rare in this region. Moreover, shell-mounds contain full sized shells of the common oyster, which cannot live at present in the brackish waters of the Baltic except near its entrance, the inference being that the shores where the oyster at that time flourished were open to the salt sea. Thus also the eatable cockle, mussel and periwinkle abounding in the kitchen-middens are of full ocean size, whereas those now living in the adjoining waters are a third of full size, owing to the want of saltness. This extention of the North sea is called the "Littorina sea"; and it existed round about 4000–3000 B.C., the end of Brooks's Maritime period. The débris is in some places 10ft. to 20ft. thick.

The men of the kitchen-middens had seemingly no knowledge of agriculture, no traces of grain of any sort being found. The only vegetable remains were burnt pieces of wood and some charred substance, possibly a sea-plant used in the production of salt. Flat stones blackened with fire, forming hearths, were also found. That periods of scarcity must have been frequent is indicated by the discovery of bones of the fox, wolf and other carnivora, which would hardly have been eaten from choice. The kitchen-middens of Denmark were not mere summer-quarters; the ancient fishermen appear to have stayed in the neighbourhood

for two-thirds, if not the whole of the year, since by examination of the bones of the wild animals it is often possible to tell the time of year when they were killed. Thus the remains of the wild swan (*Cygnus musicus*), a winter visitor, leaving the Danish coast in March and returning in November, are found in abundance. Additional proof is afforded among the mammalian remains by two periodical phenomena, the shedding of the stag's antlers and the birth and growth of the young. The flint implements found include flakes, axes, awls, sling-stones or net-weights, and rude lance-heads. A fragment of one polished axe was found, at Havelse, which had been worked up into a scraper. Small pieces of coarse pottery are also met with, the typical vessel having a pointed base. The Danish kitchen-midden men were not cannibals. They seem to have resembled the Lapps, small men with heavy over-hanging brows and round heads.

At Omori (Japan), in the Aleutian islands, in British Columbia, Oregon and California shell-mounds were explored, and always proved that the present populations had been preceded by ruder tribes of great antiquity. On the Atlantic coast of Brazil shell-mounds, which must have taken thousands of years to accumulate, are now overgrown with dense forests. Shell-mounds also occur round the coasts of Britain, at Chark near Gosport, inland at Blashenwell farm, Dorset, at Harlyn bay in Cornwall and in Cork harbour, but there is no reason to suppose all these deposits to be contemporary. The shell-mounds on the west coast of Scotland are often associated with raised beaches.

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SHELL SHOCK. A term which first arose during the early period of the World War to describe the condition of certain soldiers who had been exposed to unusually heavy bombardment. These persons, in whom a more or less strong hereditary nervous history was obtainable, suffered from various mental and physical disabilities, often of a very severe kind. As time passed the application of the term was extended to cover neurasthenia in its various forms arising under war conditions, and often was so loosely applied that it came to carry a suggestion of deception or malingering and often of lack of courage in the highest degree unjust to the real sufferers. The treatment was psychotherapeutic (*see* Psychotherapy) and usually was highly successful, but in some instances the mental condition of the patient underwent progressive deterioration and ended in insanity. (*See* Neurasthenia; Medicine, General.)

"SHELL" TRANSPORT & TRADING CO., LTD, an oil company founded by the late Viscount Bearsted and his brother Samuel Samuel, M.P. The origin of the title "Shell" is to be found in the fact that these two men, as Eastern merchants, gave special attention to the collection of marine shells, their cleaning, polishing, distribution, and sale for decorative and other purposes. In addition to their normal businesses they carried on a substantial trade in the shipment of Russian and American kerosene, then packed in tins and cases, to the Far East.

Prior to the actual registration of the Shell company M. Samuel & Co. had already established an organisation with various private firms in the East, which proved so successful that a much closer combination was made in 1897 by the formation of the Shell Transport & Trading Co., Limited. From these comparatively small beginnings the business expanded until, in 1928, it covered the production, transport, and distribution of crude petroleum and its products all over the world.

Samuel & Co. acquired in 1895 a considerable territory in Dutch East Borneo and proceeded to exploit it for the production of mineral oil, its refining, shipment, and marketing. This investment was acquired, with other oil investments, by the new company. In the year 1902 negotiations were started with the Royal Dutch company for a reduction of the competition, which was then acute in the Far East, an amicable working arrangement which led to the closest possible amalgamation of interests in 1907. The Royal Dutch company, which had oil concessions in the Dutch East Indies from the Dutch Government, together with the Shell company formed a strong combination that afterwards extended into other areas.

The Shell company in 1928 owned, in conjunction with their associates the Royal Dutch company, oil lands in the Dutch East Indies, Sarawak, Egypt, Rumania, Mexico, Venezuela, Trinidad, the United States, Argentine, etc. Starting with three tank steamers of about 4,500 tons capacity each (which were constructed for transporting general cargo on the return voyages from the Far East), the tonnage owned by the company in 1928 exceeded 1,000,000 tons. From an initial capital of £1,800,000, the authorised Shell capital in 1928 had risen to £43,000,000, the issued capital being over £26,500,000 valued in the open market at close on £100,000,000. (L. C. M.)

SHELTON, THOMAS (*fl.* 1612–1620), English translator of *Don Quixote.* In the dedication of *The delightful history of the wittie knight, Don Quishote* (1612–20) he explains to his patron, Lord Howard de Walden, afterwards 2nd Earl of Suffolk, that he had translated *Don Quixote* from Spanish into English some five or six years previously in the period of forty days for a "very dear friend" who was unable to understand the original. Shelton did not use the original edition of Cervantes, but one published in Brussels in 1607. On the appearance of the Brussels imprint of the second part of *Don Quixote* in 1616, he translated that also into English, completing his task in 1620, and printing at the same time a revised edition of the first part. His performance has become a classic among English translations for its racy, spirited rendering of the original. It seems safe to identify the translator with the Thomas Shelton who wrote a sonnet prefixed to the *Restitution of Decayed Intelligence* (1605) of Richard Verstegan.

The 1612 edition is available in Fitzmaurice Kelly's reprint for the *Tudor Translations* (1892); that of 1620 is reproduced in Macmillan's "Library of English Classics" with an introduction by A. W. Pollard, who incorporates the suggestions made by A. T. Wright in his *Thomas Shelton, Translator.*

SHELTON, a city of Fairfield county, Connecticut, U.S.A., on the west bank of the Housatonic river, opposite Derby and Ansonia; served by the New York, New Haven and Hartford railroad. Pop. (1920), 9,475 (30% foreign-born white); it was 10,113 in 1930. Shelton (formerly Huntington) was incorporated in 1789, and the city was chartered in 1917.

SHEM was the eldest of Noah's three sons. In the Old Testament genealogical tables tracing the origins and connections of the various peoples we find among the descendants of Shem, in addition to the Hebrews, Elam, Assyria, Aram, Lud. From the name is derived the adjective Semitic (*see* Semitic Languages). The interesting statement in Genesis ix. 26 that Yahweh was "the God of Shem" suggests, what is indeed on other grounds probable, that Yahweh was worshipped by peoples akin to the Hebrews. Roughly speaking, the nations supposed to have descended from Shem lie geographically between the descendants of Japheth on the North, and those of Ham on the South. *See* also Ham, Japheth.

SHEMAKHA, a town of Russia in the Azerbaijan S.S.R., in 40° 38′ N., 48° 37′ E. The population has declined from 20,000 to 3,631 (1926) owing to the terrible times following the 1917 revolution. Shemakha was the capital of the khanate of Shirvan, and was known to the Roman geographer Ptolemy as Kamachia. About the middle of the 16th century it was the seat of an English commercial factory, under the traveller Jenkinson, afterwards envoy-extraordinary of the khan of Shirvan to Ivan the Terrible of Russia. In 1742 Shemakha was taken and destroyed by Nadir Shah of Persia, who, to punish the inhabitants for their creed (Sunnite Mohammedanism), built a new town under the same name about 16 m. to the west at the foot of the main chain of the Caucasus. The new Shemakha was at different times a residence of the khan of Shirvan, but was finally abandoned, and

the old town rebuilt. The Russians first entered Shirvan in 1723, but soon retired. In 1795 they captured Shemakha as well as Baku; but the conquest was once more abandoned, and Shirvan was not finally annexed to Russia until 1805.

SHENANDOAH (shĕn′-ạn-dō′ạ), an anthracite-mining borough of Schuylkill county, Pennsylvania, U.S.A., 35 m. S.W. of Wilkes-Barre; served by the Lehigh Valley, the Pennsylvania and the Reading railways. Pop. (1920), 24,726 (31% foreign-born white); 21,782 in 1930 by Federal census. It is an important mining and shipping centre in the Schuylkill region of the great anthracite fields. A log house was built here in 1835, but no further development took place until 1862, when the first colliery was opened. The borough was incorporated in 1866.

SHENANDOAH VALLEY, in Virginia, U.S.A., begins at the Potomac river and extends south-westward between the Blue Ridge mountains on the east and the Alleghenies on the west, to the eminence of land between Staunton and Lexington. The valley is more than 100 m. long and varies in width from 20 to 30 m.; included within its area are Berkeley and Jefferson counties, W. Va., and Frederick, Clarke, Warren, Shenandoah, Page, Rockingham and Augusta counties, Va. Located within this region are a score of thriving towns and cities, the most populous of which are Staunton, Winchester, Waynesboro, Woodstock, Ft. Royal, Luray and Berryville. The chief stream of the valley is the Shenandoah river which unites with the Potomac in the picturesque water gap at Harper's Ferry.

Agriculture, stock-raising and flour-milling have long been important industries of the region; in the lower valley are numerous orchards of apples and peaches. In recent years dairy farming, the breeding of fine live stock and poultry farming have assumed large proportions. The rugged water gap at Harper's Ferry, the wooded hills and numerous grottoes and limestone caverns make the Shenandoah valley attractive for tourists.

The first white man to visit the valley was Louis Michelle, a Frenchman, in 1707; he was followed in 1716 by Governor Spotswood and his Knights of the Horseshoe. The first settlers to enter the region were Germans and Scottish-Irish who came in from Pennsylvania in the early 1730s. During the Civil War the valley was the scene of many bloody battles, especially those in which "Stonewall" Jackson participated.

See *History of the Lower Shenandoah Valley* (1890), ed., J. E. Norris; and J. W. Wayland, *A Bird's-Eye View of the Shenandoah Valley* (1924). (X.)

SHENANDOAH VALLEY CAMPAIGNS

In the American Civil War (1861–65) the Shenandoah Valley was often the scene of military operations; at two points in the war these operations rose to the height of separate campaigns possessing great significance in the general development of the war. From a military point of view the Shenandoah Valley was valuable to the army which controlled it as a requisitioning area, for in this fertile region crops and cattle were plentiful. There were, moreover, numerous mills and factories. For the Confederates the Valley was also a recruiting area. A macadamized road from Lexington via Staunton and Winchester to Martinsburg gave them easy access to Maryland and enabled them to cover Lynchburg from the north. By a system of railways which united at Gordonsville and Charlottesville troops from Richmond and Lynchburg were detrained within easy distance of five good passes over Blue Ridge, and as Strasburg in the Valley lies almost due west of Washington it was believed in the North that a Confederate army thereabouts menaced a city the protection of which was a constant factor in the Federal plan of campaign.

In the spring of 1862 the immense army organized by Gen. McClellan advanced and threatened to sweep all before it. The Confederates, based on Richmond, were compelled to show a front westward to the Alleghanies, northward to the Potomac and eastward to the Atlantic. The main armies were engaged on the Yorktown peninsula and the other operations were secondary. Yet in one instance a Confederate detachment that varied in strength between 5,000 and 17,000 contrived to make some stir in the world and won renown for its commander. Gen. Thomas J. Jackson with small means achieved great influence on the course of the war in the main theatre. The Valley operations in 1862 began by a retrograde movement on the part of the Confederates, for Jackson on March 12 retired from Winchester, and Banks at the head of 20,000 men took possession. Banks pushed a strong detachment under Shields on to Strasburg a week later, and Jackson then withdrew his small division (5,000) to Mt. Jackson. Banks, however, recalled Shields in accordance with orders from Washington, Jackson conceived that he was bound to follow Shields, and, when Shields stood at bay at Kernstown on March 23, with 7,000 men, Jackson at the head of 3,500 attacked and was badly beaten.

The proof thus afforded by Jackson of his inability to contend with Shields seems to have been regarded by the Federal authorities as an excuse for reversing their plans; Shields was reinforced by Williams's division, and with this force Banks undertook to drive Jackson from the Valley. A week after the battle of Kernstown, Banks moved to Strasburg with 16,000 men, and a month later (April 29) was at Newmarket, after much skirmishing with Jackson's rear-guard which burnt the bridges in retiring. Meanwhile Jackson had taken refuge in the passes of Blue Ridge, where he too was reinforced. Ewell's division joined him at Swift Run Gap, and at the beginning of May he decided to watch Banks with Ewell's division and to proceed himself with the remainder of his command to join Edward Johnson's brigade, then beset by Gen. Milroy west of Staunton. Secretly moving by rail through Rockfish Gap, Jackson united with Johnson and in a few days located Milroy at the village of McDowell. After reconnaissance Jackson concentrated his forces on Setlington Hill and proposed to attack on the morrow (May 8), but on this occasion the Federals (Milroy having just been joined by Schenck) took the initiative, and after a four hours' battle Jackson was able to claim his first victory. The Confederates lost 500 out of 6,000 men and the Federals 250 out of 2,500 men.

Meanwhile the army under Banks, now at Strasburg, had been largely sent elsewhere. Jackson's opportunity had come to destroy Banks's force completely. The Confederates numbered 16,000, the Federals only 6,000 men. Jackson availed himself of the Luray Valley route on the eastern or "blind" side of the Massanutton range to surprise the post at Front Royal as a preliminary to falling upon Banks. He captured the post, but failed to intercept Banks who escaped northwards by the turnpike road and covered his retreat across the Potomac by a rear-guard action at Winchester on May 25. On May 31 Frémont had reached Cedar Creek. McDowell was at Front Royal and Jackson had retired to Strasburg, where he was compelled to wait for a detachment to come in. This rejoined on the evening of June 1.

Ewell's division held Frémont back until Jackson was on his way to Newmarket. McDowell had sent Shields up the Valley by the Luray route. But Jackson gained Newmarket in safety and destroyed the bridge up to Port Republic by which Shields could emerge from the Luray Valley to join Frémont, who was left to cope with Jackson single-handed. Jackson's rear-guard impeded Frémont's advance, although a week later (June 7) Frémont at Harrisonburg located his enemy at Cross Keys and next day he attacked with 10,500 men. Shields was still at Luray. Jackson held Frémont with Ewell's division (8,000) and with the remainder moved to the left bank of the Shenandoah near Port Republic to await developments, for Shields had pushed forward a strong advanced guard under Tyler, whose vanguard (two squadrons) crossed the river while Frémont was engaged with Ewell. Tyler's cavalry was driven back with heavy loss. Jackson retained possession of the bridge by which Tyler and Frémont could unite, and next day he crossed the river to attack Tyler's two brigades. The engagement of June 9 is called the battle of Port Republic. Jackson with 13,000 men attacked Tyler with 3,000 men, and Tyler retired with a loss of some 800 men, leaving as many Confederates *hors de combat*.

A few days later Jackson received orders to quit the Valley and join the main army before Richmond, and President Lincoln simultaneously discovered that he could not afford to keep the divisions of Frémont, Banks and McDowell engaged in operations against Jackson; so the Valley was at peace for a time.

In stricter connection with the operations of the main armies in Virginia, the Confederates brought off two great *coups* in the Valley—Jackson's capture of Harper's Ferry and Martinsburg in the autumn of 1862 and Ewell's expulsion of Milroy from Martinsburg and Winchester in June 1863. The concentration of the Federal forces in north Virginia in May 1864 for the campaign which ultimately took Grant and Lee south of the James involved a fresh series of operations in the Valley. At first a Union containing force was placed there under Sigel; this general, however, took the offensive unwisely and was defeated at Newmarket. Next Hunter, who superseded Sigel in command in West Virginia and the Valley, was to co-operate with the Army of the Potomac. Grant detached Sheridan to join Hunter at Charlottesville, but Lee sent Hampton's cavalry by a shorter route to intercept Sheridan, and a battle at Trevillian Station compelled Sheridan to return and leave Hunter to his fate.

Meanwhile on June 13 Early added his command to the Confederate forces in the Valley. Early succeeded in interposing between Hunter and Lynchburg, and within a week drove Hunter out of Virginia by the Kanawha river route. Early then moved down the Valley turnpike unmolested. Expelling Sigel from Martinsburg on July 4, and crossing the Potomac opposite Sharpsburg, he soon appeared before Washington. Early, after creating serious alarm, retired, on July 13, by Leesburg and Snicker's Gap into the Valley at Winchester. Early soon after sent a detachment into Maryland to burn the town of Chambersburg. The alarm in the North for the safety of Washington was only quieted by the appointment of Sheridan to command in the Valley.

Sheridan's Campaign.—He arrived on the scene early in August. His mission was to drive Early up the Valley or, if the Confederates crossed into Maryland, to intercept their return, and in any case he was to destroy all supplies in the country which could not be consumed by his own army. Sheridan made Harper's Ferry his headquarters and concentrated at Halltown. Early retained his position about Bunker Hill, destroyed the Ohio railroad, and held the main road up the Valley until Sheridan moved out in force on Aug. 10. Early then retreated up the Valley to Fisher's Hill (Strasburg), where he expected to be

joined by Anderson's corps from Richmond. Sheridan had followed Early, but hearing of this reinforcement to the enemy, he decided to take up a defensive line at Halltown—the only point in the Valley which did not favour flanking operations—and await the arrival of adequate reinforcements. For a month the two armies had manoeuvred between Halltown and Strasburg, each commander hoping for such an increase to his own or decrease of his enemy's numbers as would justify attack. The Valley operations were aided indirectly by assaults and sorties about Petersburg. Grant aimed at preventing Lee sending reinforcements to Early until Sheridan's plans had been carried out. Meanwhile Early had been gathering up the harvests in the lower Valley, but on Aug. 20 Sheridan was able to report "I have destroyed everything that was eatable south of Winchester, and they will have to haul supplies from well up to Staunton." Sheridan in September could put 23,000 infantry and 8,000 cavalry into action, and at this moment he was visited by Grant, who encouraged his subordinate to seize an opportunity to attack the enemy.

The first encounter of Sheridan and Early took place on Sept. 19, about 2m. east of Winchester. Sheridan had crossed the Opequan and found the enemy in position astride the Winchester-Berryville road. Early was outnumbered and outfought, but he attributed his defeat to the enemy's "immense superiority in cavalry," and in fact Sheridan depicts Merritt's division as charging with sabre or pistol in hand and literally riding down a hostile battery, taking 1,200 prisoners. Early then retreated through Strasburg, but at Fisher's Hill behind Tumbling Run, where the Valley was entrenched on a front of 3m. between the Shenandoah river and Little North mountain, he rallied his forces and again detailed his cavalry to protect his left from a turning movement. But Sheridan repeated his manoeuvre, and again on Sept. 22 Early was attacked and routed, Gen. Crook's column having outflanked him by a détour on the western or Back road. Early now retreated to Mt. Jackson, checked the pursuit at Rode's Hill, and, evading all Sheridan's efforts to bring him again to battle, reached Port Republic on Sept. 25. In the first week of October Sheridan held a line across the Valley from Port Republic along North river to Back road, and his cavalry had advanced to Waynesboro to destroy the railroad bridge there, to drive off cattle, and burn the mills and all forage and breadstuffs. Early had taken refuge in Blue Ridge at Rockfish Gap, where he awaited Rosser's cavalry and Kershaw's division (Longstreet's corps), for Lee had resolved upon again reinforcing the Valley command, and upon their arrival Early advanced to Mt. Crawford and thence to Newmarket. The Federals retired before him, but his cavalry was soon to suffer another repulse, for Rosser and Lomax having followed up Sheridan closely on Oct. 9 with five brigades, the Federal cavalry under Torbert turned upon this body when it reached Tom's brook (Fisher's Hill) and routed it. Sheridan burnt the bridges behind him as he retired on Winchester, and apparently trusted that Early would trouble him no more and then he would rejoin Grant at Petersburg.

Sheridan at Winchester was now free to detach troops to aid Grant, or remain quiescent covering the Ohio railroad, or move east of Blue Ridge. He had resisted the demand of the Government, which Grant had endorsed, that Early should be driven through the Blue Ridge back on Richmond. Sheridan pointed out that guerrilla forces were always in his rear, that he would need to reopen the Alexandria railroad as a line of supply, that he must detach forces to hold the Valley and protect the railroads, and that on nearing Richmond he might be attacked by a column sent out by Lee to aid Early.

Early, however, showed great enterprise in following Sheridan down to Strasburg on Oct. 13 "to thwart his purposes if he should contemplate moving across the Ridge or sending troops to Grant." But as his forward position at Fisher's Hill could not be long maintained for want of forage, he resolved to attack Sheridan, who was in a defensive position along the line of Cedar Creek, and on the night of Oct. 18 he sent three divisions under Gordon to gain the enemy's rear, while Kershaw's division attacked his left and Wharton's division and the artillery engaged him in front. The attack was timed to commence at 5 A.M. on Oct. 19, when Rosser's cavalry was to engage Sheridan's cavalry and that of Lomax was to close the Luray Valley. This somewhat complicated disposition of forces was entirely successful, and Early counted his gains as 1,300 prisoners and 18 guns after routing the Federal corps VIII. and XIX. and causing Wright's corps (VI.) to retire. Yet before nightfall Early's force was in turn routed and he lost 23 guns. Sheridan had been called to Washington to consult Halleck, the "chief of staff," on Oct. 16, in reference to his future movements; for Halleck claimed to control Sheridan and often modified Grant's instructions to his subordinate. Before Sheridan could rejoin his army on Oct. 19 Early had attacked and routed it, but Sheridan met the fugitives and rallied them with the cry: "We must face the other way." He resolved to attack as soon as his troops could be reorganized, but, disturbed by reports of Longstreet's coming by the Front Royal road to cut him off at Winchester, hesitated for some hours; however, at 4 P.M. he attacked and drove back the Confederates and so recovered all the ground lost in the morning, and recaptured his abandoned guns and baggage.

After the battle of Cedar creek, Early again retreated. The Federal Government had agreed to Sheridan's proposal to fortify a defensive line at Kernstown and hold it with a detachment while Sheridan rejoined Grant with the main body. In Feb. 1865 the infantry remaining on each side was less than a strong division. Sheridan seized the opportunity to advance with 10,000 cavalry. Early delayed this advance with his cavalry, while he evacuated Staunton; he called up a brigade to defend Lynchburg and proceeded to Waynesboro to await developments. Sheridan feared to advance on Lynchburg leaving Early on his flank and decided to attack Early at Waynesboro; and on March 2 the Federal commander was rewarded by decisive victory, capturing 1,600 Confederates and their baggage and artillery. Early himself escaped and his cavalry dispersed to their homes in the Valley; all organized resistance in the Shenandoah Valley came to an end.

(G. W. R.)

SHENDI, a town in the Anglo-Egyptian Sudan in the *mudiria* (province) of Berber, on the right bank of the Nile in 18° 1′ N., 33° 59′ E., and 104 m. N.N.W. of Khartum by rail. Shendi possesses small manufactories of leather, iron and cotton; extensive railway workshops and a government experimental farm. It is the headquarters of the cavalry of the Egyptian army stationed in the Sudan. Thirty miles north are the pyramids of Meroë. In 1772 James Bruce stayed some time at Shendi—then governed by a woman—on his way to Egypt after visiting the source of the Blue Nile.

SHENG-KING: *see* MANCHURIA.

SHENSI, the historic province of Chinese civilization centring in the Wei valley, which has afforded a way eastwards from the northern slopes of the mountains of Central Asia via Lanchow-fu and Kungchangfu. Area, 75,270 sq. miles. Pop. estimates vary between six million and 17 million, nine million being a probable total. It is a valley rich in loess, which lends itself to cultivation, and it is protected on the east by a marked narrowing at Tungkwan (*q.v.*). Thus it lent itself to the establishment of a Government which spread its authority in directions north and south, as well as east and west, for Sian, the capital, was the chief city of the empire again and again until the 12th century A.D.

South of the Wei valley the province extends over the Tsinlingshan (*q.v.*) to include the upper Han valley, while to the north the province includes the south part of the high plateau of the Ordos, and is here bounded on the east by the Hwang-ho, where it flows deeply entrenched along a fault zone between the blocks of the Ordos and Shensi. The Great Wall of China follows the northern edge of the Lukwanlingshan across the Ordos plateau, and here marks the limit of the province over against the desert. The Ordos, including North Shensi, is a portion, geologically, of the Sinian mole, that is, of an ancient block now broken into sections, enclosed on the north-west, north and east by the Hwang-ho, which, in the north, runs just beneath one of the mountain-arcs bordering the Mongolian plateau, as they border the whole highland of Central Asia.

The climate north of the Tsinlingshan is characterized by long dry cold, with winds blowing out from the interior of Asia, and much dust, while in summer the rain supply may be very small. The climate south of the range, on the other hand, grades towards that of Szechwan, but is colder than the latter. The valleys of the Wei and Han are rich agriculturally, with wheat, cotton, and even rice in the Wei. Wheat is by far the largest crop. Peas, maize, millet, barley and fruits are grown. The cotton grown in many places is a variety of Tarim ancestry, which suits the native looms, and so has not been displaced by the American variety, which, however, grows better in Shensi than elsewhere in China. Cotton is often sown in April, on the opening of the rainy season, and harvesting occurs in later summer; the crop is 800,000–1,000,000 piculs per annum, and while the native cotton is used at home, the crop of the American variety is mostly sent to Tientsin for sale. There are several factories working cotton in Sian and a few with other industries, while some factories occur here and there in other parts of the province. Coal is mined at Hanchenghsien. Oil is mined farther north, near the Yen. Sian is the capital and Hanchungfu the chief city of the south.

See F. von Richthofen, *China*, vol. ii. (1882); L. Richard, *Géographie de l'Empire de Chine* (1905).

SHENSTONE, WILLIAM (1714–1763), English poet, son of Thomas Shenstone and Anne, daughter of William Penn of Harborough Hall, Hagley, was born at the Leasowes, a property in the parish of Halesowen, now in Worcestershire, but then included in the county of Shropshire. At school he began a lifelong friendship with Richard Jago, and at Pembroke College, Oxford, where he matriculated in 1732, he made another firm friend in Richard Graves, the author of *The Spiritual Quixote*. In 1742 he published anonymously a revised form of *The Schoolmistress, a Poem in imitation of Spenser. . . .* The original was Sarah Lloyd, teacher of the village school where Shenstone received his first education. He inherited the Leasowes estate, and retired there in 1745 to undertake what proved the chief work of his life, the beautifying of his property. He embarked on elaborate schemes of landscape gardening which gave the Leasowes a wide celebrity, but sadly impoverished the owner. He corresponded with many of the literary people of the day, especially with Jago, Dodsley, Lady Luxborough and Bishop Percy. The correspondence with Percy shows that Shenstone first suggested the collection of the *Reliques*. Shenstone died on Feb. 11, 1763.

His works were first published by his friend Robert Dodsley (3 vols., 1764–1769). The second volume contains Dodsley's description of the Leasowes. The last, consisting of correspondence with Graves, Jago and others, appeared after Dodsley's death. Other letters of Shenstone's are included in *Select Letters* (ed. Thomas Hill 1778). Samuel Johnson wrote the *Life* prefixed to his works in Chalmers's *British Poets*. *See* also Richard Graves, *Recollections of some particulars in the Life of the Late William Shenstone* (1788); H. Sydney Grazebrook, *The Family of Shenstone the Poet* (1890).

SHEPPARD, JOHN [JACK] (1702–1724), English criminal, was born at Stepney, near London, in December 1702, and was brought up in the Bishopsgate workhouse. He was apprenticed to a carpenter, and at the end of 1723 he was arrested as a runaway apprentice, and thenceforward, he says, "I fell to robbing almost every one that stood in my way," Joseph Blake, known as "Blueskin," being a frequent confederate. In the first six months of 1724 he twice escaped from gaol, and towards the end of that period he was responsible for an almost daily robbery in or near London. Eventually, however, his independent attitude provoked the bitter enmity of Jonathan Wild, who procured his capture at the end of July. Sheppard was tried at the Old Bailey and condemned to death, but, largely thanks to his accomplice, "Edgeworth Bess," he escaped from the condemned cell, and was soon back in his old haunts. In September he was rearrested and imprisoned in the strongest part of Newgate, being actually chained to the floor of his cell, but he escaped through the chimney to the roof of the prison, whence he lowered himself into the adjoining house. After a few days, concealment he was rash enough to reappear in the Drury Lane quarter. He was captured, hopelessly drunk, in a Clare Market tavern and reimprisoned, his cell being now watched night and day. On Nov. 16, 1724 he was hanged at Tyburn. He was then not quite twenty-two.

Sheppard has been a hero of romance, notably in Harrison Ainsworth's novel, *Jack Sheppard* (1839).

See *A Narrative of all the Robberies, Escapes, &c., of John Sheppard*, attributed to Daniel Defoe (London, 1724); *Newgate Calendar*, ed. Knapp and Baldwin; Griffiths, *Chronicles of Newgate*; *British Journal* (August, October 1724); *Weekly Journal* (August, September, November 1724); R. W. Postgate, *Murder, Piracy and Treason* (1926).

SHEPPEY, an island off the Kentish coast of England, included in the north-eastern parliamentary division of Kent. Pop. (1921) 26,344. It is the largest of the several low islands which are separated from the mainland by the ramifying creeks about the mouth of the river Medway. The strait isolating Sheppey is called the Swale. Sheppey is low-lying, with one small elevation slightly exceeding 200 ft. near the north coast, which presents slight cliffs towards the shallow sea. These are frequently encroached upon by the sea, while the flat shore on the south is protected by embankments. Sheppey is 10½ m. in extreme length from east to west, while the greatest breadth is about 5 miles. Sheppey is mostly treeless but very fertile, bearing much grain and vegetables; its name, meaning the "island of sheep," is still appropriate, as great flocks are bred of sheep noted for their mutton. On the west are the port of Queenborough and the naval station of Sheerness. From here the Sheppey light railway runs east through the island, serving Minster and Leysdown, which are in some favour as seaside resorts.

SHEPSTONE, SIR THEOPHILUS (1817–1893), British South African statesman, was born at Westbury near Bristol, England, on Jan. 8, 1817. When he was three years old his father, the Rev. William Shepstone, emigrated to Cape Colony. In the Kaffir War of 1835 Shepstone served as headquarters interpreter on the staff of the governor, Sir Benjamin D'Urban, and at the end of the campaign remained on the frontier as clerk to the agent for the native tribes. In 1838 he was one of the party sent from Cape Colony to occupy Port Natal on behalf of Great Britain. This force was recalled in 1839, when Shepstone was appointed British resident among the Fingo and other tribes in Kaffraria. Here he remained until the definite establishment of British rule in Natal and its organization as an administrative entity, when he was made (1845) agent for the native tribes. In 1848 he became captain-general of the native levies; in 1855 judicial assessor in native causes; and, in 1856, on the remodelling of the Natal government, secretary for native affairs and a member of the executive and legislative councils. This position he held until 1877. The main line of his policy was to maintain tribal customs as far as consistent with principles of humanity, and not to attempt to force civilization.

Shepstone's influence with the Zulus was made use of by the Natal government; in 1861 he visited Zululand and obtained from Panda a public recognition of Cetywayo as his successor. Twelve years later Shepstone attended the proclamation of Cetywayo as king, the Zulu chief promising Shepstone to live at peace with his neighbours. In 1874 and again in 1876 Shepstone was in London on South African affairs, and to his absence from Natal Cetywayo's failure to keep his promises is, in part, attributed. When in London in 1876 Shepstone received discretionary powers from the 4th earl of Carnarvon, then secretary of state for the colonies under which he went to Pretoria in Jan. 1877, and on April 12, issued a proclamation announcing the establishment of British authority over the Transvaal. Shepstone remained as administrator of the Transvaal until Jan. 1879; his rule was marked, according to Sir Bartle Frere, who described him as "a singular type of an Africander Talleyrand," by an "apparent absence of all effort to devise or substitute a better system" than that which had characterized the previous régime. Shepstone had been summoned home to advise the Colonial Office on South African affairs and he reached England in May 1879; on his return to Natal he retired (1880) from the public service. In 1883, however, he was commissioned to replace Cetywayo as king in Zululand. He was active in church matters in Natal, and a friend of Bishop Colenso. He opposed the grant of self-government to Natal. He died at Pietermaritzburg on June 23, 1893.

SHEPTON MALLET, a market town in the Wells parliamentary division of Somersetshire, England, 22 m. S.W. of Bath. Pop. of urban district (1931) 4,108. The old town extends in a narrow line along the river Sheppey, while the newer town has for its main street a viaduct across the river valley. The church of St. Peter and St. Paul is especially noteworthy. Consisting of a chancel, clerestoried nave, and aisles, it is Early English and Perpendicular in style, and contains a beautiful 13th-century oak roof of 350 panels, each with a different design; and a 15th-century pulpit of carved stone. The market cross, over 50 ft. high, and one of the finest in Somerset, was erected in 1500. Shepton possesses a grammar school of the 17th century, and a science and art school. There are large breweries, roperies, potteries, and, in the neighbourhood, marble, granite and lime works.

Shepton, before the conquest called Sepeton, was in the possession of the abbots of Glastonbury for four hundred years. The town received the grant of a market from Edward II.

SHERANI or SHIRANI, a Pathan tribe on the Dera Ismail Khan border of the North West Frontier Province of India who occupy the country and the Takht-i-Suliman, thence eastward down to the border of Dera Ismail Khan district. Sheranis are generally of middling stature, thin, but hardy and active. They have bold features, high cheek-bones, and are wild and manly. Their chief occupation is agriculture, but they carry on an extensive trade in Dera Ismail Khan district. There are two well-defined branches called Bargha and Largha, or the Highlands and the Lowlands. Marriage is adult. Dowry is paid and divorce is usually a repurchase of the woman for half the sum (less the dowry) received for her.

See Tribes and Castes of the Punjab and North West Frontier Province vol. iii. 1914.

SHERATON, THOMAS (*c.* 1751–1806), next to Chippendale the most famous English furniture-designer and cabinet-maker, was born in humble circumstances at Stockton-on-Tees and died at 8, Broad Street, Golden Square, on Oct. 22, 1806. He picked up drawing and geometry and appears to have been apprenticed to a cabinet-maker. Of his career as a maker and designer of furniture nothing is known until he is first heard of in London in 1790, to which he came probably while still a young man. It is not known to what extent, if at all, he worked with his own hands, or whether he confined himself to designing furniture. Such evidence as there is points to artistic, rather than mechanical work, after he began to write, and it is certain that he gave drawing lessons. The remarkable series of volumes of designs for furniture which he published during the last sixteen years of his life, and upon which his fame depends, were not a commercial success. He was a great artistic genius who lived in chronic poverty.

His first book on furniture was published in 1791 with the title of *The Cabinet-Maker and Upholsterer's Drawing Book.* It was issued in parts by T. Bensley, of Bolt Court, Fleet Street; there was a second edition in 1793 and a third in 1802. The designs in the book are exceedingly varied and unequal, ranging from pieces of perfect proportion and the most pleasing simplicity to efforts ruined by too abundant ornament. Some of the chair-backs, delightful in their grace and delicacy, show the influence of Hepplewhite and Adam—it has been suggested that he collaborated with the Adams. Sheraton, like his predecessors, made extensive use not so much perhaps of the works of other men as of the artistic ideas underlying them which were more or less common to the taste of the time. His slender forms and sweeping curves were, however, his own inspiration, and his extensive use of satin-wood differentiated his furniture from most of that which had preceded it.

Sheraton's books, like those of the other great cabinet-makers of the second half of the 18th century, were intended for the practical use of the trade, although it is reasonable to suppose that he obtained orders by the publication of his books and employed other cabinet-makers to manufacture the work. Of his own actual manufacture only one piece is known with certainty—a glass-fronted book-case, of somewhat frigid charm, stamped "T.S." on the inside of one of the drawers. It lacks the swan-necked pediment so closely associated with his style. *The Drawing Book* was followed in 1802 by *The Cabinet Dictionary, containing an Explanation of all the Terms used in the Cabinet, Chair and Upholstery branches, containing a display of useful articles of furniture,* illustrated with eighty-eight copperplate engravings. The text in alphabetical form, has a supplement with articles on drawing and painting, and a list of "most of the master-cabinet-makers, upholsterers, and chair makers," 252 in number, then living in and around London. Some of the designs show the tendency to the tortured and the bizarre which disfigured so much of Sheraton's later work. This debased taste reached its culmination in *The Cabinet Maker, Upholsterer and General Artists' Encyclopedia,* the publication of which began in 1804. It was to consist of 125 numbers, but when the author died only a few had been issued.

Many charming little work-tables bear Sheraton's attribution, and he designed many beautiful sideboards and bookcases. Sheraton's ingenuity had led him to devise many of the ingenious pieces of combination or "harlequin" furniture which the later 18th century loved. Thus a library table would conceal a step-ladder, a dressing table would be also a washstand and an escritoire—looking-glasses would enclose dressing-cases, writing-tables or work-tables. But his most astonishing fancy was an ottoman with "heating urns" beneath, "that the seat may be kept in a proper temperature in cold weather."

Sheraton's genius was less sane and less balanced than that of Chippendale, for despite his excursions into the Chinese and Louis Quinze manners, Chippendale always produced an impression of English work. Sheraton's adaptability, his readiness to receive foreign impressions, the lightness of his forms and the grace of his conceptions had about them a touch of the exotic which was heightened by his lavish employment of satin-wood and other beautifully grained woods susceptible of a high polish. The severe and balanced forms, the delicate inlay, the occasional slight carving in low relief, the painted enrichments, the variety of the backs and legs of his chairs produce an impression of lightness and grace that has never been surpassed; whether he designed a little knife-case or the body of a long clock, harmony, proportion and a delicate fancy were ever present. "Sheraton," like "Chippendale," has come to indicate a style rather than a personal attribution. Unfortunately his later extravagant creations in the Empire style had much to do with the development of a fashion of English Empire which finally ruined British furniture design.

See *Gentleman's Magazine* (1806), II., 1082; also "Memoir of Adam Black," in *Magazine of Art* (1883), p. 190.

SHERBORNE, a market town of Dorsetshire, England, 118 m. W.S.W. from London by the S.R. Pop. of urban district (1931), 6,542. It lies near the border of Somersetshire, on the southern slope of a hill overlooking the river Yeo, in a fertile, well-wooded district.

There is no evidence of Roman or British settlement, and it is probable that Sherborne (Scireburn, Shireburne) grew up after the Saxon conquest of the region in the middle of the 7th century. It is first mentioned in 705 as the place where St. Aldhelm fixed his bishop-stool for the new diocese of Western Wessex. Freedom from Danish attacks at the end of the 9th century was a factor in making Sherborne the capital of Wessex. In 978 Bishop Wulfsey introduced the stricter form of Benedictine rule into his cathedral of Sherborne, and became the first abbot. The see, which was united with that of Ramsbury in 1058, was removed to Old Sarum in 1075. On the separation of the offices of bishop and abbot in 1122, the abbot's fee was carved out of the bishop's manor, but did not include the town. Bishop Roger of Caen (1107–1139) built the castle. Its strength made Stephen force Bishop Roger to surrender it in 1139; it fell afterwards into the hands of Maud. It was later granted to the earls of Salisbury, who seem to have allowed it to fall into disrepair, for in 1315 and in 1319 the abbot of Sherborne was appointed to inquire into its condition. It was recovered by the bishop in 1355, and retained by the see until granted in 1599 to Elizabeth, who gave it to Sir Walter Raleigh. The town suffered very severely during the civil wars, the castle being besieged by the parliamentary forces in 1642 and 1645. Fairs held on the 8th of May, the 26th of July and the first

Monday after the 10th of October were granted to the bishop in 1227, 1240 and 1300. The abbey church of St. Mary the Virgin is a cruciform building with central tower, the nave and choir having aisles and clerestory. Some pre-Norman work appears in the western wall, the tower arches and south porch are Norman, and there are an Early English chapel and some Decorated windows. The church, however, was almost wholly reconstructed in the Perpendicular period, and is a fine example of that style. The colour-decoration in the choir; and the stone-vaulted roof with fan tracery are very fine. The almshouse known as the hospital of St. John the Baptist and St. John the Evangelist was founded in 1437 on the site of an earlier establishment, and retains a Perpendicular chapel, hall and other portions. Of the old castle, the gatehouse and other parts are of Norman construction, but the mansion near it was built by Sir Walter Raleigh.

After the decline of the mediaeval trade in cloth, lace and buttons were the only articles manufactured here until the introduction of silk-weaving in 1740. The town is now the centre of an agricultural region.

SHERBROOKE, ROBERT LOWE, Viscount (1811–1892), British statesman, was born on Dec. 4, 1811 at Bingham, Notts, where his father was the rector. He was educated at Winchester and at University College, Oxford. In 1835 he won a fellowship at Magdalen, but vacated it on his marriage in 1836, with Miss Georgina Orred (d. 1884). In 1841 Lowe moved to London, to read for the Bar ("called" 1842); but his eyesight began to fail, and, acting on medical advice, he went to Sydney, where he set to work in the law courts. In 1843 he was nominated to a seat in the New South Wales Legislative Council; owing to a difference with Gipps he resigned his seat, but was elected shortly afterwards for Sydney. In 1850 he went back to England, and began to write leaders for *The Times*. In 1852 he was returned to Parliament for Kidderminster in the Liberal interest. Between 1853 and 1858 he was secretary of the Board of Control and vice-president of the Board of Trade. In 1859 he went to the Education Office as vice-president of the Council in Lord Palmerston's ministry. In 1864 he resigned; in 1868 he became chancellor of the exchequer. In 1873 he was transferred to the Home Office, but in 1874 the government resigned. When the Liberals returned to power in 1880 he was raised to the peerage as Viscount Sherbrooke, but from 1875 till his death at Warlingham, Surrey, on July 27, 1892, his health was constantly failing, and by degrees he figured less and less in public life.

Bobby Lowe, as he was popularly known, was one of the most remarkable personalities of his day, with his tall, striking figure, albino complexion and hair, and faculty for epigram and irony. During the 'seventies the following epitaph was suggested for him by one of the wits of his day:—

Here lies poor old Robert Lowe;
Where he's gone to I don't know;
If to the realms of peace and love,
Farewell to happiness above;
If, haply, to some lower level,
We can't congratulate the devil.

His literary talent, though mainly employed in journalism, was also shown in a little volume of verses, *Poems of a Life* (1884). He married a second time, in 1885, but left no children.

See *Life and Letters* by A. Patchett Martin (London, 1893).

(H. C.)

SHERBROOKE, a city and port of entry of Quebec, Canada, and capital of Sherbrooke county, 101 m. E. of Montreal, at the confluence of the rivers Magog and St. Francis, and on the Canadian National, Canadian Pacific and Quebec Central railways. Pop. (1931) 28,933. It is the seat of a Roman Catholic bishopric and of the district courts, and contains manufactories of woollen and cotton goods and machinery, also saw and grist mills. It derives its name from Sir John Coape Sherbrooke (1764–1830), who from 1816 to 1818 was governor-general of Canada.

SHERE ALI KHAN (1825–1879), Amir of Afghanistan, was born in 1825, one of the sons of the amir Dost Mahommed, whom he succeeded in 1863. Supported by the viceroys of India, Lord Lawrence and Lord Mayo, Shere Ali remained on good terms with the British government for some years; but after the rebellion of his son Yakub Khan, 1870–74, he leaned towards Russia, and welcomed a Russian agent at Kabul in 1878, and at the same time refused to receive a British mission. This led to long negotiations, and ultimately to war, when the British forced the Khyber Pass in November 1878, and defeated the amir's forces on every occasion. Shere Ali fled from his capital and, taking refuge in Turkistan, died at Mazar-i-Sharif on Feb. 21, 1879.

SHERIDAN, FRANCES (1724–1766), wife of Thomas Sheridan (1719–1788) (*see* below) and mother of the dramatist Richard Brinsley Sheridan (*q.v.*) was the daughter of Dr. Philip Chamberlaine of Dublin. When only 15 years of age she wrote a story, *Eugenia and Adelaide,* published after her death in two volumes. She took Sheridan's part in the Kelly riots, writing some verses and a pamphlet in his defence. This led to her marriage in 1747 with the unpopular manager. It was by Richardson's advice that she wrote the *Memoirs of Miss Sidney Bidulph.* It was issued anonymously in 1761 with a dedication to Richardson, and had great success, both in England and France. A second part (2 vols.) was published in 1767. Two of her plays were produced in 1763 at Drury Lane, *The Discovery* and *The Dupe.* The former was one of Garrick's stock pieces, and Sir Anthony Branville one of his favourite characters. *The Dupe* was a failure and was only played once. Her last work was an Oriental tale, *Nourjahad,* written at Blois, where she died on Sept. 26, 1766.

See Alicia Lefanu, *Memoirs of the Life and Writings of Mrs. Frances Sheridan* (1824).

SHERIDAN, PHILIP HENRY (1831–1888), American soldier, was born at Albany, N.Y., on March 6, 1831. His parents, who had recently migrated from Ireland, moved to Perry county, O., a year after Philip's birth. Obtaining through his own endeavours an appointment to West Point, he graduated in 1853. He had gained some experience in fighting Indians on the frontier when the Civil War began in 1861. A first lieutenant at the time, he was soon promoted to captain, and in the spring of 1862 became colonel of the 2nd Michigan cavalry under Halleck in Tennessee. In July he was raised to the rank of brigadier general of volunteers as a result of his skilful conduct in the battle of Booneville (July 1). He was in charge of the 11th division of the Army of the Ohio under Buell in the battle of Perryville (Oct. 8); and under Rosecrans at Stone's river (Dec. 26) he won promotion to the rank of major general of volunteers. In the summer of 1863 he effectively supported Rosecrans in manoeuvring the Confederates under Bragg out of middle Tennessee. Following the latter into northern Georgia in September, Rosecrans met with a signal defeat at Chickamauga (*q.v.*) on the 20th, his army being driven in confusion back to Chattanooga, Tenn. Sheridan's cavalry division, though driven back in the course of the battle, helped to cover the retreat. In the subsequent fighting around Chattanooga (*q.v.*) Sheridan won considerable distinction, especially in his daring and brilliant charge up Missionary ridge (Nov. 25). This attracted the notice of Gen. Grant, who, when he became lieutenant general (March 1864) and assumed command of the Army of the Potomac in Virginia, placed Sheridan in charge of his cavalry. In this capacity he proved himself the most able cavalry leader on the Union side. His corps were active in the battles of the Wilderness (*q.v.*) and Spottsylvania Court House (May 5–21). While the latter was still in progress he was sent on a raid toward Richmond, in the course of which he cut the Confederate communications by destroying railroads and cutting telegraph wires. He returned to the main army in time to participate in the battle of Cold Harbor (*q.v.*). Soon afterward he set out upon a raid toward Charlottesville (June 7–26) for the purpose of co-operating with Gen. David Hunter in the Valley.

The success of these expeditions led to his appointment (Aug. 7) to the command of a newly formed Army of the Shenandoah with instructions to clear the Valley of the Confederates. This was the greatest opportunity of his military career, and he proved himself fully equal to it. His campaign was brilliant and decisive. He defeated Gen. Early at Winchester (Sept. 19) and again at Fisher's Mill (Sept. 22). Then followed an act concerning which he has often been severely censured. In order to make the region

useless to the Confederates, he destroyed all means of subsistence; so that one of the most fruitful regions in the South was left in utter desolation with non-combatants on the verge of starvation. At this time Sheridan was given the rank of brigadier general in the regular army. When a few weeks later (Oct. 19) the main body of his army was thrown into confusion by a surprise attack from Gen. Early at Cedar Creek, Sheridan, some 20 m. away, made his famous ride, rallied his troops, and turned defeat into victory. He was then commissioned (Nov. 8) major general in the regular army. He made another raid (Feb. 27–March 24) from Winchester to Petersburg, again destroying supplies and means of communication and defeating Early at Waynesboro. In April he turned Lee's flank at Five Forks and forced him to retreat toward Appomattox where he surrendered to Grant on April 9, 1865.

A month later Sheridan was placed in command of an American force on the Mexican border to watch the struggle between Maximilian, who had been set up as emperor of Mexico by Napoleon III. in 1864, and the Liberals seeking his overthrow. His presence greatly added to the effectiveness of American diplomatic protests to the French Government, thus hastening the collapse of that ill-starred venture. In the spring of 1867 Sheridan was placed in command of the Fifth Military district embracing Louisiana and Texas and stationed at New Orleans. Himself an advocate of extreme measures in dealing with the conquered South he soon came into conflict with President Johnson who opposed such policies. His unconciliatory measures led to his removal in Sept. 1867. He was then placed in charge of the Department of the Missouri. In the winter of 1868–69 he conducted a successful campaign against the Indians. In the latter year he was made lieutenant general by President Grant. During the Franco-German war of 1870 he accompanied the headquarters of the German army as the guest of the king of Prussia. In 1883 he was given chief command of the U.S. army, and five years later, shortly before his death, was raised to the rank of general. He died at Nonquitt, Mass., on Aug. 5, 1888.

In physical appearance Gen. Sheridan was short and stout, and rather harsh-featured. To those opposed to his policies, in peace as in war, he seemed gruff and needlessly severe, but to his friends he was kindly. Exceptionally gifted with personal magnetism, he was very popular with his troops. As a military leader he combined brilliant courage with careful, vigilant tactics. He was a devout Roman Catholic. In 1875 he married Irene, daughter of Gen. D. H. Rucker, U.S.A.

Sheridan's *Personal Memoirs* (2 vols.) were published in 1888. *See* also Davies, *General Sheridan* (1895); Newhall, *With General Sheridan in Lee's Last Campaign* (1866), Channing, *History of the United States*, vol. vi. (1925); W. G. Shotwell, *The Civil War in America* (1925). (A. M. A.)

SHERIDAN, RICHARD BRINSLEY BUTLER (1751–1816), third son of Thomas and Frances Sheridan, was born in Dublin on Oct. 30, 1751. At the age of 11 he was sent to Harrow school, where he spent six years.

After leaving Harrow he kept up a correspondence with a school friend N. B. Halhed who had gone to Oxford, and between them they published (1771) a metrical translation of Aristaenetus. They also wrote a farce entitled *Jupiter*, which was refused by Garrick and Foote and remained in MS. It contains the same device of a rehearsal which was afterwards worked out in *The Critic*. Some of the dialogue is very much in Sheridan's mature manner. The removal of the family to Bath in 1770–1771 led to an acquaintance with the daughters of the composer Thomas Linley. The eldest daughter, Elizabeth Ann (b. 1754), a girl of sixteen, the *prima donna* of her father's concerts, was exceedingly beautiful. Her portrait, by Gainsborough, hangs at Knole, Kent. She had many suitors, among them Sheridan, N. B. Halhed and a certain Major Mathews. To protect her from this man's persecutions, Sheridan escorted Miss Linley, in March 1772, to a nunnery in France, having secretly gone through the ceremony of marriage with her near Calais. He returned and fought two duels with Mathews, while Mr. Linley brought his daughter back to Bath. Sheridan was sent to Waltham Abbey to continue his studies. He was entered at the Middle Temple on April 6, 1773, and a week later he was openly married to Miss Linley.

Although he had no income, and no capital beyond a few thousand pounds brought by his wife, he took a house in Orchard Street, Portman Square, furnished it "in the most costly style," and proceeded to return on something like an equal footing the hospitalities of the fashionable world. His first comedy, *The Rivals*, was produced at Covent Garden on Jan. 17, 1775. It is said to have been not so favourably received on its first night, owing to its length and to the bad playing of the part of Sir Lucius O'Trigger. But at the second performance (Jan. 28) it at once took that place on the stage which it has never lost. His second piece, *St. Patrick's Day, or the Scheming Lieutenant*, a lively farce, was written for the benefit performance (2nd of May 1775) of Lawrence Clinch, who had succeeded as Sir Lucius. In November 1775, with the assistance of his father-in-law, he produced the comic opera of *The Duenna*, which was played 75 times at Covent Garden during that season. Sheridan now began to negotiate with Garrick for the purchase of his share of Drury Lane, and the bargain was completed in June 1776. The sum paid by Sheridan and his partners, Thomas Linley and Dr. Ford, for the half-share was £35,000; of this Sheridan contributed £10,000. The money was raised on mortgage, Sheridan contributing only £1,300 in cash. (*See* B. Matthews's 1885 ed. of Sheridan's Comedies pp. 29–31.) Two years afterwards Sheridan and his friends bought the other half of the property for £35,000.

The direction of the theatre seems to have been mainly in the hands of Sheridan. In February 1777 he produced his version of Vanbrugh's *Relapse*, under the title of *A Trip to Scarborough*. This is printed among Sheridan's works, but he has no title to the authorship. His task was to remove indecencies; he added very little to the dialogue. *The School for Scandal* was produced on May 8, 1777. Mrs. Abington, who had played Miss Hoyden in the *Trip*, played Lady Teazle, who may be regarded as a Miss Hoyden developed by six months' experience of marriage and town life. The lord chamberlain was only persuaded on grounds of personal friendship with Sheridan to license the play. There are tales of the haste with which the conclusion of *The School for Scandal* was written and of a stratagem by which the last act was got out of him by the anxious company, but we know from Sheridan's sister that the idea of a "scandalous college" had occurred to him five years before in connection with his own experiences at Bath. His difficulty was to find a story sufficiently dramatic in its incidents. The dialogue is so brilliant throughout, and the auction scene and the screen scene so effective, that the construction of the comedy meets with little criticism. *The School for Scandal*, though it has not the unity of *The Rivals*, nor the same wealth of broadly humorous incident, is universally regarded as Sheridan's masterpiece.

The Critic was produced on Oct. 29, 1779, *The School for Scandal* meantime continuing to draw larger houses than any other play every time it was put on the stage. In *The Critic* the laughable infirmities of authors, actors, patrons and audience are touched off with the lightest of hands; the fun is directed, not at individuals, but at absurdities that grow naturally out of the circumstances of the stage. It seems that he had accumulated notes for another comedy to be called *Affectation*, but his only other play was *Pizarro*, produced in 1799—a tragedy in which he made liberal use of the arts ridiculed in the person of Mr. Puff. He also revised for the stage Benjamin Thompson's translation, *The Stranger*, of Kotzebue's *Menschenhass und Reue*.

He entered parliament for Stafford in 1780, as the ally of Charles James Fox. He is said to have paid the burgesses five guineas each for the honour of representing them. His first speech in parliament was to defend himself against the charge of bribery, and was well received. Congress recognized his services in opposing the war in America by offering him a gift of £20,000 which, however, he refused. Under the wing of Fox he filled subordinate offices in the short-lived ministries of 1782 and 1783. He was under-secretary for foreign affairs in the Rockingham ministry, and a secretary of the treasury in the Coalition ministry. In those heated days of parliamentary strife he was almost the only man of mark that was never called out, and yet he had no

match in the weapon of ridicule.

Sheridan found his great opportunity in the impeachment of Warren Hastings. His speeches were by the unanimous acknowledgment of his contemporaries among the greatest delivered in that generation of great orators. The first was on Feb. 7, 1787, on the charges brought against Hastings with regard to the begums or princesses of Oude. Sheridan spoke for more than five hours, and the effect was such that it was unanimously agreed to postpone the final decision till the House should be in a calmer mood. Of this, and of his last great speech on the subject in 1794, only brief abstracts have been preserved; but the second, the four days' speech delivered in his capacity of manager of the trial, in Westminster Hall, on the occasion so brilliantly described by Macaulay, is given in Gurney's verbatim reports of the speeches on both sides at the trial, published at Sir G. Cornewall Lewis's instigation in 1859. There are passages of gaudy rhetoric, loose ornament and declamatory hyperbole; but the strong common sense, close argumentative force and masterly presentation of telling facts enable us to understand the impression produced by the speech at the time.

From the time of the break-up of the Whig party on the secession of Burke he was more or less an "independent member," and his isolation was complete after the death of Fox. When Burke denounced the French Revolution, Sheridan joined with Fox in vindicating the principle of non-intervention. But when it became apparent that France under Napoleon would interfere with the affairs of its neighbours, he employed his eloquence in denouncing Napoleon and urging the prosecution of the war. One of his most celebrated speeches was delivered in support of strong measures against the mutineers at the Nore. He was one of the few members who actively opposed the union of the English and Irish parliaments. When the Whigs came into power in 1806 Sheridan was appointed treasurer of the navy, and became a member of the Privy Council. After Fox's death he succeeded his chief in the representation of Westminster, and aspired to succeed him as leader of the party, but this claim was not allowed, and thenceforward Sheridan fought for his own hand. When the prince became regent in 1811 Sheridan's private influence with him helped to exclude the Whigs from power. Throughout his parliamentary career Sheridan was one of the boon companions of the prince, and his champion in parliament in some dubious matters of payment of debts. But he always resented any imputation that he was the prince's confidential adviser or mouthpiece. A certain proud and sensitive independence was one of the most marked features in his parliamentary career.

His last years were harassed by debt and disappointment. At the general election of 1807 he stood again for Westminster and was defeated, but was returned as member for Ilchester, at the expense apparently of the prince of Wales. In 1812 he failed to secure a seat at Stafford. As a member of parliament he had been safe against arrest for debt, but now his creditors closed in upon him. It may be regarded as certain, however, that the description of the utter destitution of the last weeks of his life given in the *Croker Papers* (i. pp. 288–312, ed. L. J. Jennings) is untrue. It was not without reason that his grand-daughter Mrs. Norton denounced the unfairness of judging the real man from unauthenticated stories; and against reports of his reckless management of his affairs we must set the facts that he had no source of income but Drury Lane theatre, that he bore from it for thirty years all the expenses of a fashionable life, and that the theatre was twice rebuilt during his proprietorship. Enough was lost in this way to account ten times over for all his debts. The records of his wild bets in the betting book of Brooks's Club date from the years after the loss, in 1792, of his first wife, to whom he was devotedly attached. He married again in 1795, his second wife being Esther Jane, daughter of Newton Ogle, dean of Winchester. He died on July 7, 1816, and was buried with great pomp in Westminster Abbey.

Sheridan's only son by his first marriage, THOMAS SHERIDAN (1775–1817), was a poet of some merit. He became colonial treasurer at the Cape of Good Hope.

BIBLIOGRAPHY.—*Memoirs of the . . . Life of . . . R. B. Sheridan, with a Particular Account of his Family and Connexions* (1817), by John Watkins made many false statements. The *Memoirs, etc.* (1825), compiled by Thomas Moore did not make full use of the papers submitted by the family. William Smyth (*Memoir of Mr. Sheridan,* 1840), who had been a tutor in Sheridan's house, was responsible for many of the scandalous stories connected with Sheridan's name. Of modern works and critical stories *see* W. Fraser Rae, *Wilkes, Sheridan, Fox* (1874), the *Letters and Journals* of Byron (especially vol. v. p. 411 *seq.,* ed. Prothero, 1901); Mrs. Oliphant, *Sheridan* (1883) in the "English Men of Letters" series; Percy Fitzgerald, *Lifes of the Sheridans* (2 vols., 1886); and the *Life of R. B. Sheridan* (1890) by Lloyd C. Sanders in the "Great Writers" series and W. Fraser Rae, *Sheridan: a Biography* (2 vols., 1896). The *Life of R. B. Sheridan* by Walter Sichel (1909) is the best account now available.

Among the numerous modern editions of Sheridan's plays, of which only *The Rivals* was published by the dramatist himself, may be mentioned: *Sheridan's Plays now printed as he wrote them* (1902), edited by W. Fraser Rae; *The Plays of R. B. Sheridan* (1900), edited by A. W. Pollard; and *Sheridan's Comedies* (Boston, U.S.A., 1885), with a valuable introduction by Brander Matthews. For further details consult the bibliography by J. P. Anderson in the *Life* by Lloyd C. Sanders.

SHERIDAN, THOMAS (1687–1738), grandfather of the dramatist, Richard Brinsley Sheridan (*see* above), was born at Cavan and educated at Trinity College, Dublin. He married Elizabeth, heiress of Charles MacFadden, and thereby restored to the Sheridan family Quilcagh House, which they had forfeited by their Jacobite sympathies. When Swift came to Dublin as dean of St. Patrick's, Sheridan was a schoolmaster of high repute, and the two men were soon close friends. Sheridan was his confidant in the affair of *Drapier's Letters;* and it was at Quilcagh House that *Gulliver's Travels* was prepared for the press. Through Swift's influence he obtained a living near Cork. His correspondence with Swift and his whimsical "Art of Punning" make clear from whom his grandson derived his high spirits. He was no mean scholar, and translated the *Philoctetes* of Sophocles (1725), the *Satires* of Perseus (1728), and the *Satires* of Juvenal (1739). His latter days were not prosperous. He offended Swift by fulfilling an old promise to tell the dean if he ever saw signs of avarice in him, and the friends parted in anger. He died in poverty on Oct. 10, 1738.

SHERIDAN, THOMAS (1719–1788), son of Thomas Sheridan (1687–1738; *see* above), was born in Dublin in 1719. His father sent him to Westminster; but he completed his education at Trinity college, Dublin, where he took his B.A. in 1739. Then he went on the stage, and wrote a play, *Captain O'Blunder, or the Brave Irishman,* which became a stock piece, though it was never printed. His first appearance in London was at Covent Garden in March 1744, when he acted for three weeks in a succession of leading parts, Hamlet being the first. In October he appeared at Drury Lane, playing Horatio in Rowe's *Fair Penitent,* and subsequently as Pierre in Otway's *Venice Preserved,* and in Hamlet and other parts. In 1747 he became manager of the Theatre Royal, Dublin, and married Frances Chamberlaine, the novelist. He conceived a scheme of British education, and to push this he lectured at Oxford and Cambridge, being incorporated M.A. in both universities. But the scheme did not make way, and in 1760 he was acting under Garrick at Drury Lane. As an actor, he is placed by Churchill (*Rosciad* l. 987) in the second rank, next to Garrick, but there is no hint of possible rivalry, and he is described as one whose conceptions were superior to his powers of execution, whose action was always forcible but too mechanically calculated, and who in spite of all his defects rose to greatness in occasional scenes. Through Sheridan's efforts Samuel Johnson had been given a pension, and so impressed was Lord Bute with Sheridan's own scheme for a *Pronouncing Dictionary* that he granted him a pension of £200 a year.

In 1764 he went to live in France, partly for Mrs. Sheridan's health, partly to study the system of education. His wife died in 1766 and soon afterwards he returned to England. In 1769 he published a matured *Plan of Education for the Young Nobility and Gentry,* and in 1780 his *General Dictionary of the English Language* (2 vols.). After his son's brilliant success he assisted in the management of Drury Lane, and occasionally acted. His *Life of Swift,* a very entertaining work in spite of its incompleteness as a biography, was written for the 1784 edi-

tion of Swift's works. He died at Margate on Aug. 14, 1788.

SHERIDAN, a city of northern Wyoming, U.S.A., at the confluence of Big and Little Goose Creeks, 3,737 ft. above sea-level; the county seat of Sheridan county and the largest city in the northern part of the State. It is on Federal highways 87E and 116, and is served by the Burlington (railway) route. Pop. (1920) was 9,175, 91% native white; in 1930 it was 8,536. The city lies in a broad green valley, surrounded by the snow-capped peaks of the Big Horn mountains. The Big Horn National Forest (1,136,000 ac.) in which are two living glaciers, many peaks 10 to 12,000 ft. high, over 200 lakes, and 1,200 m. of trout streams, is about 15 m. west. Sheridan is a division point on the Burlington, which maintains repair shops and an extensive tie-treating plant here; and is the wholesale and jobbing centre of a wide territory, devoted largely to stock-raising and the production of wool, diversified farming and dairying. Coal (sub-bituminous) is mined near the city, which has a large flour mill, beet-sugar factory, creamery, iron works, brick and tile plant and other manufacturing industries. The assessed valuation of property in 1927 was over $11,000,000, and bank debits totalled $46,881,545. The city was planned in 1882 by J. D. Loucks, who named it in honour of his commander in the Civil War. It was incorporated in 1884.

SHERIFF or **SHIRE-REEVE,** often called "high sheriff," the English and Irish executive authority in a county, or other place, often called his "bailiwick." The office also exists in about 20 ancient cities and boroughs, among which may be named London, Norwich, York, Bristol, Oxford, Lincoln, Chester and Canterbury in England, and Dublin, Cork, Limerick and other places in Ireland. In most of these the office is of an honorary nature. The office is at present an annual one, though this has not been always the case. Three names are put on the list by the chancellor of the exchequer and the judges of king's bench division on the morrow of St. Martin, Nov. 12, and the first name is usually pricked by the king in council in the February or March following. City and borough sheriffs are usually appointed by the corporations on November 9. London and Middlesex are specially provided for by the act of 1887, s. 33, and the sheriffs of the counties of Cornwall and Lancaster are separately appointed, the act not applying to them.

The shrievalty was at one time an important office. The appointment appears to have been originally by popular election, a right confirmed by 28 Edw. I. c. 8, but ultimately vested in the crown except where the office was hereditary. At one time contributions to the expense of the office were made by the magistrates and others of the county. "Sheriff-tooth" was a tenure on condition of supplying entertainment to the sheriff at the county court. Up to the 19th century "riding with the sheriff" was an incident of the assizes, the riders being some of the principal men of the shire who brought with them wine and victuals in order to assist the sheriff in showing hospitality to the judges.

To-day the duties of the sheriff depend on numerous statutes beginning with 2 Edw. III. c. 3 (1328). The most important is the Sheriffs act 1887, mainly a consolidating act applying to England only. The person nominated is usually a magistrate for the county, but anyone is eligible if he has land in the county. Exempt are peers, clergy, officers in active service, practising barristers and solicitors and others. Poverty is also a ground of exemption. The sheriff appoints his undersheriff. The duties of the office are both administrative and judicial. He attends on the judges at assizes and election petitions and is responsible for the execution of writs and of the sentence of death, acts as returning officer at parliamentary elections, prepares the panel of jurors for assizes and is liable for the safe custody of prisoners. He or his deputy sits to assess damages under the Lands Clauses Act 1845, and also in cases sent to the sheriff's court for the assessment of damages. The expenses of the office are partly met by the Treasury. A sheriff cannot during his year of office act as a magistrate for the county of which he is sheriff.

See Sir M. Hale, *A Short Treatise Touching Sheriff's Accompts* (1683); W. Greenwood, *Bouleuterion* (1685); *The Compleat Sheriff* (1696); F. Pollock and F. W. Maitland, *Hist. Eng. Law* (1898); W. S. Holdsworth, *Hist. Eng. Law* (1903); P. E. Mather, *Compendium of Sheriff and Execution Law* (1903); W. S. McKechnie, *Magna Carta* (1905).

Scotland is divided into 15 territorial sheriffdoms in each of which a sheriff exercises administrative and judicial functions; his administrative functions being partly statutory, partly the result of custom. He is Returning Officer in Parliamentary elections for constituencies within his sheriffdom. The appointment, tenure of office and judicial duties of a sheriff are fixed by the Sheriff Court (Scotland) Acts, 1907 and 1913. The sheriff, in his judicial aspect, is one of the judges of the Sheriff court of the sheriffdom. That court, exercising an extensive local jurisdiction, in matters civil and criminal, comprises, on its civil side, a court of first instance and an appellate court, but on its criminal side it has no general appellate jurisdiction. The sheriff sits as the single appellate judge in the Appeal court.

The original jurisdiction of the Sheriff court is, generally speaking, exercised by the salaried sheriff-substitutes attached to the sheriffdom. At the present day the sheriff and salaried sheriff-substitutes are appointed by the Crown on the recommendation of the secretary of State for Scotland. The sheriff, to be appointed, must be an advocate or a salaried sheriff-substitute of five years' standing. He is removable by order of secretary of State for Scotland proceeding upon a report of the Lord President of the Court of Session and the Lord Justice Clerk declaring the sheriff, by reason of inability, neglect of duty or misbehaviour, to be unfit for his office. The order of the secretary of State must lie before both Houses of Parliament for four weeks before it becomes operative. The qualification for appointment as salaried sheriff-substitute is that he shall be an advocate or a law agent in Scotland of five years' standing. The salaried sheriff-substitute is removable from office by the secretary of State for Scotland *de plano* upon a report by the Lord President and the Lord Justice clerk for inability or misbehaviour.

Honorary sheriff-substitutes are appointed by writing under the hand of the sheriff and they hold office during his pleasure.

Besides the sheriffs of counties, there is a sheriff of Chancery appointed by the Crown whose duties are confined to the service of heirs.

See W. J. Lewis, *Sheriff Court Practice* (1923).

Ireland.—The sheriff has much the same duties as in England His position is defined by numerous statutes, beginning with 53 Geo. III. c. 68 (1817).

United States.—The office of sheriff is generally elective. The sheriff has administrative and limited judicial authority. He sometimes serves for combined counties, as in England for Cambridge and Huntingdon. (J. WA.)

SHERIFFMUIR, a battlefield situated on the verge of the extreme north-western flank of the Ochils, Perthshire, Scotland, watered by Wharry Burn, an affluent of the Allan. It lies within the bounds of the parish of Dunblane, 2½m. E. by N. of the town. It was the site of an indecisive battle (Nov. 13, 1715) between the Jacobites, about 12,000 strong, under John Erskine, earl of Mar, and 4,000 Royalists under Archibald Campbell, afterwards duke of Argyll. Both sides, each of which lost 500 men, claimed the victory, although in point of fact Mar deemed it prudent to retreat. The "battle stone" enclosed by a railing marks the scene of the encounter.

SHERMAN, JAMES SCHOOLCRAFT (1855–1912), American politician, was born near Utica, N.Y., on Oct. 24, 1855. He graduated at Hamilton college in 1878 and was admitted to the bar in 1880. He was elected mayor of Utica in 1884. In 1886 he was elected to the U. S. House of Representatives and was returned continuously until 1908, excepting the term 1891–93. He was chairman of the Republican State convention in 1895, 1900 and 1908; and chairman of the Republican national committee in 1906. At the Republican national convention of 1908 he was nominated vice-president and was elected on the ticket with William Howard Taft. Four years later he was renominated, but died at Utica, on Oct. 30, 1912, shortly before the elections.

SHERMAN, JOHN (1823–1900), American financier and statesman, a younger brother of Gen. W. T. Sherman, was born at Lancaster, O., on May 10, 1823. He began the study of law

at Mansfield, O., and was admitted to the bar in 1844. For ten years he practised his profession with success, and with only casual interest in politics, but upon the repeal of the Missouri Compromise by the Kansas-Nebraska bill in 1854, he joined the great popular movement in Ohio against the policy represented by this bill, and was elected to Congress in the autumn of that year as an "Anti-Nebraska" man. In the summer of the next year he took an active part in the formal organization of the Republican Party in the State, and at the opening of Congress in December began a long career of public service. As a member of the House (1855–61) he quickly manifested the qualities which characterized his whole political life. Though a thorough and avowed partisan, he was within the party the counsellor of moderate rather than extreme measures, and thus gained on the whole a position of great influence. He was a member of the committee sent by the House in 1856 to investigate the troubles in Kansas, and drafted the report of the majority. In March of 1861 he took his seat in the Senate in which he sat continuously until he became secretary of the Treasury in 1877. His interest and efficiency in financial legislation in the House led to his appointment on the Senate committee of finance, and after 1867 he was chairman of this influential committee. He thus became associated with the enactment of all the great fiscal laws through which the strain of war and of reconstruction was sustained. He gave earnest support to the Legal Tender Act, and the substitution of the national for the State banking system. The Resumption Act of 1875, which provided for the return of specie payments four years later, was largely his work, and his appointment to the head of the Treasury department by President Hayes in 1877 enabled him to carry the policy embodied in the law to successful execution.

At the end of the Hayes administration he was again elected to the Senate from Ohio and held his seat until 1897. During this period he was largely concerned in the enactment of the Anti-Trust Law of 1890, and of the so-called Sherman Act of the same year, providing for the purchase of silver and the issuing of Treasury notes based upon it. In 1880 and 1888 he aspired actively to the Republican nomination for the Presidency, but failed to obtain the requisite support in the Convention. During the last years of his senatorial career he was chairman of the Senate committee on foreign affairs. Upon the accession of President McKinley in 1897, he became secretary of State; but under the tension of the war with Spain the duties of the office became too exacting for his strength at his age, and in April 1898 he resigned and withdrew into private life. He died at Washington on Oct. 22, 1900.

A selection from the correspondence of John Sherman and his brother Gen. W. T. Sherman was published as *The Sherman Letters* in 1894. Sherman published *Recollections of Forty Years in the House, Senate and Cabinet: an Autobiography* (Chicago, 1895). A volume of *Selected Speeches* was published in 1879. See *Life*, by T. E. Burton (1906).

SHERMAN, ROGER (1721–1793), American political leader, a signer of the Declaration of Independence, was born in Newton (Mass.), on April 19, 1721 (Old Style). He removed with his parents to Stoughton in 1723, attended the country school there, and learned the cobbler's trade in his father's shop. Removing to New Milford (Conn.), in 1743, he worked as county surveyor, studied law, and in 1754 was admitted to the bar. He was treasurer of Yale college in 1765–76, a delegate to the Continental Congress in 1774–81 and again in 1783–84, a member of the Connecticut committee of safety in 1777–79 and in 1782, mayor of New Haven in 1784–93, a delegate to the Federal Constitutional Convention of 1787 and to the Connecticut ratification convention of the same year, and a member of the Federal House of Representatives in 1789–91 and of the U.S. Senate in 1791–93.

He was on the committee which drafted the Declaration of Independence, and also on that which drafted the Articles of Confederation. His greatest public service, however, was performed in the Federal Constitutional Convention. In the conflict between the large State party and the small State party, he and his colleagues played the rôle of peacemakers. In the Federal Congress (1789–93) he favoured the assumption of the State debts, the establishment of a national bank and the adoption of a protective tariff policy. He was strongly opposed to slavery. He died in New Haven on July 23, 1793.

Lewis H. Boutell's *Life of Roger Sherman* (Chicago, 1896), based on material collected by Senator Hoar, is a careful and accurate work.

SHERMAN, WILLIAM TECUMSEH (1820–1891), American general, was born on Feb. 8, 1820, at Lancaster, O. He was descended from Edmond Sherman, who emigrated from England to the Massachusetts bay colony in 1634. His father, Charles R. Sherman, a judge of the supreme court of Ohio, died suddenly in 1829, leaving his widow with a family of young children. William was adopted by Thomas Ewing, a close friend of the father, sometime a senator of the United States and a member of the national cabinet. In 1836 he entered West Point, and on graduating near the head of his class he was appointed second lieutenant. His first field service was in Florida against the Seminole Indians. The usual changes of station and detached duty made him acquainted with the geography of all the Southern states. He also employed much of his time in the study of law. When the war with Mexico began in 1846 he asked for field duty, and was ordered to join an expedition going to California by sea. He was made executive officer in administration of local government till peace came in 1848 and the province was ceded to the United States. In 1850 he married Ellen Boyle, daughter of Thomas Ewing, then secretary of the interior.

In 1853 he resigned from the army and returned to California to conduct at San Francisco a branch of a St. Louis banking-house. He continued successfully in the management of this business until 1857. Afterwards for a short time he was engaged in business at New York and in 1858 practised law at Leavenworth, Kansas. In 1859, the state of Louisiana proposing to establish a military college, Sherman was appointed its superintendent. This institution was opened on Jan. 1, 1860, and here Sherman remained until the spring of 1861, when it was evident that Louisiana would join the states seceding from the Union. He thereupon resigned the superintendency and returned to St. Louis. Though his brother John Sherman was a leader in the party which had elected Lincoln, William Sherman was very conservative on the slavery question, and his distress at what he thought an unnecessary rupture between the states was extreme. Yet his devotion to the national constitution was unbounded, and he offered his services as soon as volunteers for the three years' enlistments were called out.

On May 14, 1861, Sherman was appointed colonel of a new U.S. infantry regiment, and was soon assigned to command a brigade in Gen. McDowell's army in front of Washington, serving with it in the first battle of Bull Run. Promoted brigadier-general of volunteers, Sherman was in August sent to Kentucky to serve under Gen. Robert Anderson. In October he succeeded to the command of the department. Within a month he reported that 200,000 men would be required for the Kentucky campaign. He was relieved of his post soon afterwards in consequence, but the event justified Sherman's view. He was soon re-employed in a minor position, and, at the head of a division of new troops, accompanied Grant's army to Pittsburg Landing. At the battle of Shiloh Sherman's gallant conduct gained him promotion to major-general. He took part in Halleck's advance on Corinth, Miss., and at the close of 1862 led the Mississippi column in the first Vicksburg campaign. He suffered defeat at Chickasaw Bayou, but the capture of Fort Hindman, near Arkansas Post, compensated to some extent for the Vicksburg failure. In Grant's final Vicksburg campaign Sherman commanded the right of the line.

After the surrender (July 4, 1863) Sherman was sent to oppose Gen. Johnston in the country about Jackson, Miss. In July he was made a brigadier-general in the regular army. When, after Rosecrans's defeat at Chickamauga, Grant was placed in supreme command in the west, Sherman succeeded to the command of the Army of the Tennessee, with which he took part in the battle of Chattanooga (*q.v.*). In March, 1864, when Grant became general-in-chief Sherman was made commander of the military division of the Mississippi, including his Army of the Tennessee, now under McPherson, the Army of the Cumberland,

under Thomas, and the Army of the Ohio, under Schofield. Making detachments for garrisons and minor operations in a theatre of war over 500m. wide, he assembled, near Chattanooga, his three armies, aggregating 100,000 men, and began (May 1864) the invasion of Georgia. After a famous campaign of careful manoeuvre and heavy combats (*see* AMERICAN CIVIL WAR), Sherman finally wrested Atlanta (*q.v.*) from the Confederates on Sept. 1.

His able opponent Johnston had been removed from his command, and Hood, Johnston's successor, began early in October a vigorous movement designed to carry the war back into Tennessee. After a devious chase of a month Hood moved across Alabama to northern Mississippi. Sherman thereupon, leaving behind Thomas and Schofield to deal with Hood, made the celebrated "March to the Sea" from Atlanta to Savannah with 60,000 picked men. After a march of 300m. Savannah was reached in December. Railways and material were destroyed, the country cleared of supplies, and the Confederate government severed from its western states. In Jan. 1865 Sherman marched northwards again, once more abandoning his base, towards Petersburg, where Grant and Lee were waging their final campaign. Every mile of his march northwards through the Carolinas diminished the supply region of the enemy, and desperate efforts were made to stop his advance. Gen. Johnston was recalled to active service but his forces were inadequate. Sherman defeated him and reached Raleigh, the capital of North Carolina, on April 13, having marched nearly 500m. from Savannah. Lee's position in Virginia was now desperate. Hood had been utterly defeated by Thomas and Schofield, and Schofield (moved 2,000m. by land and sea) rejoined Sherman in North Carolina. With 90,000 men Sherman drove Johnston before him, and when Lee surrendered to Grant Johnston also gave up the struggle.

Sherman had the good fortune to learn the art of command by degrees. At Bull Run his brigade was wasted in isolated and disconnected regimental attacks, at Shiloh his division was completely surprised owing to want of precaution; but his bravery and energy carried him gradually to the front at the same time as he acquired skill and experience. When therefore he was entrusted with an independent command he was in every way fitted to do himself justice. At the head of 100,000 men he showed, besides the strategy which planned the Carolinas march and the skill in manoeuvre which finally gained Atlanta, the strength of will which sent his men to the hopeless assault of Kenesaw to teach them that he was not afraid to fight, and cleared Atlanta of its civil population in the face of a bitter popular outcry. He is justly regarded as one of the great generals of the Civil War.

When Grant became full general in 1866 Sherman was promoted lieutenant-general, and in 1869, when Grant became president, he succeeded to the full rank. Gen. Sherman retired after being commanding general of the army for 15 years, in 1884. He died at New York on Jan. 14, 1891. An equestrian statue, by Saint Gaudens, was unveiled at New York in 1903, and another at Washington in the same year.

Sherman's *Memoirs* were published in 1875. *See* also Rachel Sherman Thorndike, *The Sherman Letters* (1894); *Home Letters of Gen. Sherman* (1909), edited by M. A. De Wolfe Howe; S. M. Bowman and R. B. Irwin, *Sherman and his Campaigns: a Military Biography* (1865); W. Fletcher Johnson, *Life of William Tecumseh Sherman* (Philadelphia, 1891); Manning F. Force, *General Sherman* (Great Commanders series) (1899); B. H. Liddell Hart, *Sherman* (1929).

SHERMAN, a city of northern Texas, U.S.A., 60 m. N. by E. of Dallas, in the Red River valley; county seat of Grayson county since 1848. It is on Federal highway 75, and is served by the Frisco, the Missouri-Kansas-Texas, the St. Louis Southwestern, the Southern Pacific, and the Texas and Pacific railways. Pop. (1920) 15,031 (84% native white and 14% negroes); 15,713 in 1930 by the Federal census. Cotton, grain and live stock are the principal products. There are large pedigreed seed farms near by, and coal, oil and gas fields within 100 m. The city has 32 wholesale houses and 56 factories. Its mills have a daily capacity of 34 carloads of flour, meal and feeds; its cotton gins and compresses handle 65,000–80,000 bales annually. In 1927 the factory product was valued at $10,978,223. Sherman is the seat of several colleges, including Austin (for men; Presbyterian, 1849) and two junior colleges (Carr-Burdette and Kidd-Key). The city has a commission-manager form of government. Sherman was incorporated as a town in 1858, and chartered as a city in 1895. It was named after General Sidney Sherman, commander of cavalry at the battle of San Jacinto.

SHERRINGTON, SIR CHARLES SCOTT (1861–), British physiologist, was educated at Cambridge, later going as professor to London and Liverpool universities, and finally to Oxford. He has been president of the Royal Society. He is a leading authority on the physiology of the nervous system, and the guiding principles of his work are to be found in his book, *The Integrative Action of the Nervous System.*

SHERRY is the most distinctively Spanish of all wines made in Spain. It is made from grapes grown in a district of which Jerez is the centre, a district which lies, roughly speaking, within an imaginary line drawn from Port St. Mary to Rota, San Lucar, Trebujena, Lebrija, Arcos, and back to Port St. Mary.

The vineyards of the Jerez district are divided into three main classes, according to the nature of the soil. The soil of the best vineyards, those where the finest grapes are cultivated, is calcareous; it is known as *albariza.* The soil of other vineyards is mostly or entirely clay; it is known as *barros.* Lastly, there are vineyards planted in sandy soil, known as *arenas,* from which much wine is made but of a distinctly inferior quality. The drier types of sherry are shipped under the names of *Amontillado* and *Vino de Pasto;* the richer wines under the names of *Oloroso* and *Amoroso.*

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'S HERTOGENBOSCH, the capital of the province of North Brabant, Holland, at the confluence of the rivers Dommel and Aa, which unite to form the Dieze, and a junction station 29½ m. S.S.E. of Utrecht (also known as 'sBosch, or den Bosch, French *Bois-le-Duc*). Pop. (1927), 41,273. 's Hertogenbosch is a well-built city. The Roman Catholic cathedral of St. John, the Janskerk, with its interior in a state of preservation rare in Holland, is one of the finest in the country. The grammar school was once attended by Erasmus.

SHERWIN, JOHN KEYSE (1751–1790), English engraver and historical painter, born in 1751 at East Dean in Sussex. His father was a wood-cutter employed in shaping bolts for shipbuilders, and the son followed the same occupation till his seventeenth year. He was befriended by William Mitford, upon whose estate the elder Sherwin worked, and was sent to study in London. He was first with John Astley, and then for three years under Bartolozzi—for whom he is believed to have executed a large portion of the plate of Clytie, after Annibal Caracci, published as the work of his master. He was entered as a student of the Royal Academy, and from 1774 till 1780 he was an exhibitor of chalk drawings and of engravings in the Royal Academy. Establishing himself in St. James's Street as a painter, designer and engraver, he began to mix in fashionable society. His drawing of the "Finding of Moses," introducing portraits of the princess royal of England and leading ladies of the aristocracy, hit the public taste, and sold largely. In 1785 he succeeded Woollett as engraver to the king, and he also held the appointment of engraver to the prince of Wales. He died on Sept. 20, 1790.

SHERWOOD, MARY MARTHA (1775–1851), English author, was born at Stanford, Worcestershire, on May 6, 1775, the daughter of the Rev. George Butt, D.D., then rector of Stanford. In 1803 she married her cousin, Captain Henry Sherwood, an officer in the British army, and subsequently accompanied him to India, where she devoted herself to charitable work and to writing. Her Indian story, *Little Henry and his Bearer,* was translated into many languages. Her best-known work, however, is *The History of the Fairchild Family* (3 pts. 1818, 1842 and 1847). Mrs. Sherwood wrote nearly a hundred stories of a religious type and tracts, mainly for the young. She died on Sept. 22, 1851.

See *The Life and Times of Mrs. Sherwood. From the Diaries of Captain and Mrs. Sherwood,* edited by F. J. H. Darton (1910).

SHERWOOD FOREST, one of the ancient English forests, in Nottinghamshire. It extended from Nottingham northward to Worksop, being over 20 m. long and from 5 to 9 m. broad. The soil is sandy and poor, and although a considerable portion has been brought under cultivation, the district preserves many traces of its ancient character. Sherwood was a crown forest from the time of Henry II. and a favourite hunting-ground of several kings; the land was divided between various lords of the manor, and its disafforestation was carried out at various times. The forest is traditionally noted as the retreat of Robin Hood. Considerable sections of the forest still remain, particularly near Mansfield, and around Rotherham and as parks at Wentworth and Wharncliffe.

SHETLAND or ZETLAND, a group of islands constituting a county of Scotland, and the most northerly British possession in Europe. It consists of an archipelago of more than 100 islands and islets, north-east of Orkney, between 59° 50′ and 60° 52′ N. and 0° 55′ and 2° 14′ W., and bounded on the west by the Atlantic and east by the North sea. The distance from Dennis head in North Ronaldshay of the Orkneys to Sumburgh head in Shetland is 50 m., but Fair Isle, which belongs to Shetland, lies midway between the groups. The islands occupy an area of 352,319 ac. (excluding water). Besides Mainland, the principal member of the group, the more important are Yell, Unst and Fetlar in the north, Whalsay and Bressay in the east, Trondra, East and West Burra, Papa Stour, Muckle Roe and Foula in the west, and Fair Isle in the south. The surface of the islands is irregular, frequently rising into considerable hills. Most of the scenery consists of treeless and barren tracts of peat and boulders, but the coast scenery is picturesque and grand, the cliffs, precipices of brilliant colouring, reaching a height over 1,000 ft. at some places. The shores are so extensively indented with *voes*, or firths—the result partly of denudation and partly caused by glaciers—that no spot in Shetland is more than 3 m. from the sea. There are freshwater lochs in the larger islands and numerous short streams. The principal capes are Sumburgh head, the most southerly point of Mainland; and Fitful head, on the south-west of the same island, 2 m. in length and nearly 1,000 ft. high, where Norna, the prophetess of Sir Walter Scott's *Pirate,* was supposed to have her abode and which the Norsemen called the White Mountain, from the colour of the clay slate composing it.

The geological character of the islands resembles that of northern Scotland. Old Red Sandstone, red grits, sandstones and marls and conglomerate occur in a narrow belt on the east side of Mainland and form the island of Bressay. In the western portion of Mainland there is a considerable tract of rocks of this age which are formed largely of intrusive diabase-porphyrite; similar volcanic rocks occur in Papa Stour. These are penetrated by granitic and felsitic intrusions; one of these masses in Papa Stour is a handsome pink felsite. Practically all the remainder of the islands is occupied by metamorphic schists and gneisses with which are associated dikes and masses of intrusive igneous rock.

History and Antiquities.—The word Shetland is supposed to be simply a modernized rendering of the Old Norse *Hjaltland,* of which the meaning is probably "high land." Of the prehistoric inhabitants remains exist in the form of stone circles (three in Unst and two in Fetlar) and *brochs* (of which 75 examples survive). The islanders were converted to Christianity in the 6th and 7th centuries by Irish missionaries, in commemoration of whose zeal several isles bear the name of Papa or "priest." Four stones with Ogam inscriptions have been found at different places. About the end of the 8th century both the Shetlands and Orkneys suffered from the depredations of Norse vikings, or pirates, until Harold Haarfager annexed the islands to Norway in 875. Henceforward the history of Shetland is scarcely separable from that of Orkney (*q.v.*). The people, more remote and less accessible to external influences, retained their Scandinavian characteristics longer than the Orcadians. The Norse language and customs survived in Foula till the end of the 18th century, and phrases of Norse origin still colour the speech.

Agriculture and Industries.—In spite of adverse climatic conditions, live stock is reared with a fair amount of success. The well-known Shetland breed of shaggy ponies is in steady demand. The native cattle, also diminutive in size, furnish fine beef and milk. The native sheep possess many of the characteristics of goats. Their wool is long and fine. It is customary to pluck the wool by hand rather than shear it. Black-faced and Cheviots are also found in some places. Large numbers of poultry and small pigs are kept. The lochs and tarns are well stocked with brown trout, and the voes and *gios,* or narrow inlets of the sea with steep rocks on both sides, abound with sea trout. Whales of various species are frequently captured in the bays and sounds, and whaling is carried on from a base on Olna firth, on Mainland. The grampus, dolphin and porpoise haunt the coasts, and seals are caught. There is an immense variety of water-fowl.

There has been no agricultural advance corresponding to that which has taken place in Orkney, mainly owing to the poverty of the soil. The majority of holdings are small crofts occupied mostly by peasants who combine fishing with farming. Crofting agriculture is conducted on primitive methods. There are over 1,700 crofts of under five acres, but the average holding is about eight acres. Only about one-fourteenth of the total area is under cultivation, oats and barley being the chief grain, and potatoes and turnips the chief green crops.

The distinctive manufacture is knitted goods of very delicate workmanship. The finest work is said to come from Unst, though each parish has its own speciality. Women do most of the farm work and spend their spare time in knitting. There is considerable trade in hand-woven, undyed tweeds. Fishing is the occupation of the men, and the real mainstay of the inhabitants. Formerly the fishery was completely in the hands of the Dutch, whose supremacy was destroyed, however, by the imposition of the salt tax in 1712. Then the fishery was neglected by the natives, who were content to use the "sixerns," or six-oared fishing boats, till the last quarter of the 19th century, when boats of modern type were introduced. Since 1890 the herring fishery has advanced rapidly, and the Shetland fishery district is now the most important in Scotland. The haaf or deep-sea catch principally consist of cod, ling and sethe or coalfish. Herrings are cured at Lerwick, on Unst, and at several other fishing stations. Communication with the islands is maintained by steamers from Leith and Aberdeen to Lerwick, the capital, Scalloway and other points.

Population.—In 1931 the population was 21,410, the females being in the high proportion of 124 to every 100 males. In 1931 there were 33 persons speaking Gaelic and English and none who spoke Gaelic only. The population has steadily declined since 1861, when it was 31,670. Only 24 islands of the group are inhabited, and in the case of some of them the population consists solely of a few lighthouse attendants, shepherds and keepers. The bulk of the inhabited islands are situated off the east and west coast of Mainland, two of them being outlying members of the group. From south to north they are as follows (the figures indicating the population in 1921). Fair Isle (127) lies 24 m. south-west of Sumburgh head, and is 3 m. long by about 2 m. broad. It has rocky cliffs, and North Haven, on the east coast, is almost the only place where landing can be safely effected. From the survivors of a vessel of the Spanish Armada the natives are said to have acquired the art of knitting the coloured goods for which they are noted. Mainland (18,268), the largest island, is 54 m. long and 21 m. wide, though the bulk of the island is much narrower than the extreme width would indicate.

In the promontory of Eshaness may be seen some wonderful examples of sea sculpture. The Grind of the Navir ("Gate of the Giants") is a staircase carved by the waves out of the porphyry cliffs. In the rock of Dore Holm is a natural archway, 70 ft. wide, and to the south-east of it are the Drougs, stacks of quaint shapes. Besides Lerwick (*q.v.*) the county town, one of the most interesting places in the island is Scalloway, the ancient capital, which stands at the head of a bay and has a pier, quays, warehouses and cooperages in connection with the fishing industry. The ruins of the castle built in 1600 by Patrick Stewart, earl of Orkney, stand at the east end of the bay. On the opposite side of the bay is Gallow hill, the old place of execution of witches and criminals. The *ting,* or open-air law court, assembled in former days on an island in the Loch of Tingwall (hence its

name), about 3 m. farther north. Off the south-eastern coast of Mainland, separated by a sound 1 m. broad and usually visited from Sandwick, lies the uninhabited island of Mousa, famous for the most perfect specimen of a Pictish *broch,* or tower of defence, in the British Isles. Hevera (28) lies off the west coast of Mainland, south of the two Burras. East Burra (169), about 4 m. long by 1 m. broad, is separated from Mainland by Clift sound, a narrow arm of the sea. West Burra (609), 6 m. long by 1 m. broad, with a very irregular coast-line, lies alongside of East Burra and contains a church. It is said to be the Burgh Westra of Sir Walter Scott's *Pirate.* Trondra (105), "Trond's island," is in the mouth of Scalloway bay. Bressay (583), 6 m. long by 3 m. broad, lies 1 m. E. of Lerwick, from which it is separated by the sound of Bressay, in which Haakon V., king of Norway, anchored his galleys on the expedition that ended disastrously at Largs (1,263). Ward Hill (742 ft.) is the sailors' landmark for Lerwick harbour. Bard head, the most southerly point, a haunt of eagles, has an archway at its foot, and on the west side the Orkney Man's cave—a great cavern with fine stalactites and a remarkable echo. Noss (6) is to the east of Bressay, from which it is separated by a channel 220 yds. wide. On the east coast the rocks form a headland called the Noup of Noss ("the peak of the nose"). Off the south-east shore lies the Holm, with which communication used to be maintained by means of the Cradle of Noss swing or ropes. Noss is utilized in connection with the rearing of Shetland ponies. Holm of Papal, "isle of the priest" (2), belonging to Bressay parish, lies south-east of Hildasay. Foula (149), 3½ m. long by 2½ m. broad, lies 27 m. W. of Scalloway, and 16 m. W. of the nearest point of Mainland.

The cliffs on its west coast are the home of myriads of seabirds and one of the nesting-places of the bonxie, or great skua. The natives are daring cragsmen. The only landing-place is the village of Ham, on the east coast. Vaila (10), in the mouth of the Bay of Walls, affords good pasturage. Papa Stour (119), "the big island of the priests," lies in the south-west of the great bay of St. Magnus. It is 2 m. by 3 m. and has very fine caves. Four miles north-west are the islets known as the Ve Skerries, where seals are found. Whalsay, "whale island" (855), 5 m. by 2½ m., is an important fishing station. Muckle Roe, "great red island" (189), roughly circular in shape and about 3 m. in diameter, lies in the east of St. Magnus bay. Grunay, "green isle" (9), Housay (72), Bruray (44), Bound (2) are members of the group of Out Skerries, about 4 m. N.E. of Whalsay. Yell (2,129), separated from the north-east coast of Mainland by Yell sound, is the second largest island of the group (17 m. by 6 m.), though towards the middle the voes of Mid Yell and Whale Firth almost divide it into two. It contains several *brochs* and ruined chapels and is a fishing station. Fetlar (224) lies off the east coast of Yell, from which it is divided by Colgrave sound and the isle of Hascosay (4) and is 5 m. by 6½ m. Uyea (9) lies south of Unst, from which it is divided by the narrow sounds of Uyea and Skuda. Unst (1,805), to the north-east of Yell and separated from it by Bluemull sound, is 12 m. by 6 m. It has been called the "garden of Shetland," and offers inducements to sportsmen in its trout and game. Near the south-eastern promontory stands Muness castle, now in ruins. Buness, near Balta sound, was the house of Dr. Laurence Edmonston (1795–1879), the naturalist. Near Balliasta are the remains of three stone circles. It is supposed the *ting,* or old Assembly, met at this spot before it removed to Tingwall. Farther north lies Haroldswick, where Harold Haarfager is believed to have landed in 872, when he annexed the Orkney and Shetland islands to Norway. Burra firth, in the north of Unst, is flanked by a series of magnificent cliffs. Muckle Flugga (3), which is situated about one mile north of Unst, is the extreme northernmost point of Shetland, and has long been the site of a lighthouse.

Shetland unites with Orkney to return a member to parliament. The island is divided into Mainland district and North Isles district. It forms a sheriffdom with Orkney and Caithness, and there is a resident sheriff-substitute at Lerwick, the county town. The county is under school board jurisdiction and Lerwick has a secondary school.

SHEVKET, MAHMUD (1858–1913), Turkish pasha. From 1901 to 1903 he was military governor of the Hejaz, in Arabia, then in what amounted to a state of war. He next went in a like capacity to Uskub (Skoplje), and there came in contact with the Young Turk movement, which had its headquarters in Salonika. In the spring of 1909 the Old and Young Turks were struggling for supremacy. A powerful Old Turk counter-revolution was prepared, but, in mid-April, the III. Army Corps, under Hussein Husni Pasha, marched from Salonika against Constantinople. At San Stefano Mahmud Shevket took over the command, and, after heavy fighting, on April 4 entered Constantinople.

Impressed by his victory, the National Assembly no longer dared to oppose the will of the Young Turks, and on April 26 voted the deposition of Abdul Hamid. Mahmud Shevket was the hero of the day. But he did not care for politics, which he considered had been the ruin of the Turkish corps of officers, and preferred to confine his activities to purely military matters. The next few years afforded him plenty of opportunities. In 1910–11 he put down a revolt of the Malissors with great energy, and in 1912 fought against the rebels in Albania. In the summer of 1912 he became minister of war, and in Jan. 1913 succeeded Kiamil as grand vizier. He took a very active part in army reforms, but he came into conflict with the Union Libérale, which took its orders from Sherif Pasha in Paris, and he was murdered by one of its members on June 11, 1913.

SHIAHS (SHIITES): *see* ISLAM.

SHIBARGHAN, a town and khanate of Afghan Turkestan. The town lies some 60 m. W. of Balkh. It has a citadel, but is not otherwise fortified, and is surrounded by good gardens and excellent cultivation. The khanate was allotted to the Afghans by the Anglo-Russian boundary agreement of 1873.

SHIBBOLETH, a Hebrew word meaning an ear of corn or a stream or river, used by Jephthah, probably in the second sense with reference to the river Jordan, as a test-word to distinguish the Ephraimites, who were unable to pronounce the *sh,* from the men of Gilead, at the passage of the Jordan (Judges xii.). The word *ciceri* was similarly used in the massacre of the French known as the Sicilian Vespers, and other "shibboleths" are known to history. The term is used of a watchword, catchphrase or cry, to which the members of the party adhere even after any significance which it may have had has disappeared.

SHIDEHARA, BARON (1872–), Japanese diplomat and statesman. He graduated in law at the Imperial university of Tokyo in 1895, and entered the diplomatic service in the following year. He was appointed Japanese minister to Holland in 1914, vice-minister for foreign affairs in 1915, and ambassador to the United States in 1919. He was created baron in 1920, and was one of the delegates to the Washington Conference in 1921–1922. He became minister for foreign affairs in the Kato Cabinet in 1924, and remained in his post until 1927.

SHIEL, LOCH, a lake near the Atlantic seaboard of Scotland, lying between the district of Moidart in Inverness-shire and the districts of Ardgour and Sunart in Argyllshire. The boundary line between the two counties is continued down the river Shiel to the sea. The loch is 17½ m. long and varies in width from 200 yd. to 1 m., and is only 11½ ft. above the sea. The maximum depth is 420 ft. with a mean depth of 81½ ft. Loch Dilate lies 1½ m. E. of Loch Shiel, into which it flows by the Polloch. It is 1½ m. long at its maximum, with a maximum depth of 55 ft. For fully three-fourths of its length Loch Shiel has a south-westerly direction, but at Eilean Fhianain (Finnan's island) it strikes towards the west. It receives the Finnan and other small streams and discharges by the Shiel to the salt-water Loch Moidart. On the north-west and south-east it is skirted by lofty hills, but the land at the western extremity in Ardnamurchan is low.

SHIELD-FERN, the name applied to ferns of the genus *Dryopteris* (called by some botanists *Aspidium* or *Thelypteris*), embracing, when regarded in a broadly inclusive sense, about 1,000 species, widely distributed throughout the world. The name is given because of the conspicuous shield-shaped indusia which, in many species, cover the spore-producing structures (*sporangia*) borne on the under surface of the fronds.

SHIELDS, FREDERIC JAMES (1833–1911), British painter and decorative artist, was born at Hartlepool, Durham, England, on March 14, 1833, the son of a bookbinder and printer. He was educated at the charity school of St. Clement Danes, and after drawing from the antique for a few months at the British Museum (1847), worked with firms of lithographers in London, Manchester and Halifax (1856). From 1867–75 he lived at Manchester, but after touring Italy settled in London in 1876. He was associated for many years with Brown, and with Rossetti, whose memorial window in the church at Birchington he designed. In 1896 he moved to Wimbledon, where he died on Feb. 26, 1911.

The oil painting and decorative designs to which he devoted himself in his later years were less suited to his talents than his earlier illustrative work (*e.g.*, the *Pilgrim's Progress* and Defoe's *Journal of the Plague Year*). He designed (1875–80) the stained glass and mosaic decoration for the duke of Westminster's chapel at Eaton, and (1887) the decoration for St. Luke's church, Camberwell. The decoration of the Chapel of the Ascension, Bayswater road occupied the last 20 years of his life. Exhibitions of Shields' work were held at the Brazenose club, Manchester (May, 1889), and at the Alpine club gallery (Oct., 1911).

See Mrs. Ernestine Mills, *Life and Letters of Frederic Shields* (1912).

SHIFNAL or **SHIFFNAL,** a market town of Shropshire, England, 17 m. E.S.E. of Shrewsbury on G.W.R. Pop. of parish (1921), 3,303. The church of St. Andrew is cruciform and full of fine details of late Norman, Early English and Decorated work. Trade is mainly agricultural, and cattle-fairs are held. The name of the town was Idsall when in 1591 a fund was raised by royal favour to rebuild it after a fire.

Within 6 m. E. of Shifnal are Tong, Boscobel and the nunnery of Whiteladies. Charles II. was concealed in the mansion of Boscobel in 1651. Whiteladies was a Cistercian nunnery. The surrounding wooded district was formerly part of Brewood Forest, which extended into Staffordshire. Rural dist. pop. (1931) 7,707.

SHIGATSE, one of the largest towns in Tibet, next in importance to Lhasa, the capital. The town, which is near the confluence of the Nyang Chu with the Tsangpo, contains about 9,000 inhabitants (exclusive of priests) and is about $\frac{3}{4}$ m. long and $\frac{1}{2}$ m. broad. It is an important station on the trade route up the Tsangpo from Lhasa, Batang and the east to Gartok. (*See* Tibet.) About 1 m. to the north-east is a monastery known as Konkaling, whilst to the south-west is the far-famed Tashi lhünpo monastery, the head of which, since the 17th century, has been second only to the Dalai-Lama, and is considered by some Tibetans to have even greater spiritual authority, though not temporal power. Between the Tashi lhünpo monastery and the city is the Thom, or open market, where all the business of the city is daily transacted. A wall about 1 m. in circumference surrounds the Tashi lhünpo monastery, within which are many temples and houses, four of the larger temples being decorated with gilded spires. A wealth of jewels and precious metals is said to enrich the images of Tashi lhünpo. There are about 3,300 priests. The city is protected by a fort, which stands on a low hill to the north-west. The municipal government is in the hands of two dēpen, assisted by resident Jongpons, who also watch the activities of the Tashi-Lama in the interests of the Dalai-Lama. The soil in the neighbourhood of Shigatse is rich and productive, and the elevation is between 11,000 and 12,000 feet.

SHIGNAN and **ROSHAN,** two small hill states east of the Badakshan province of Afghanistan. They extend eastwards from the Panja, where it forms the eastern boundary of Badakshan to the Pamirs. The native rulers of Roshan and Shignan claim descent from Alexander the Great, of whom legends are still current in the country about the upper Oxus. The two states were conquered by Abdur Rahman in 1882, but were assigned to Russia by the Durand agreement of 1893. Since that agreement Russia has retired from all districts previously occupied by her on the left bank of the Panja, or upper Oxus. Under Soviet rule they form a portion of one of several Soviet republics that border the Oxus.

SHIKAR, a hunting and shooting term used by anglo-Indians to denote game; it may also be used in a general sense for sport. The sportsman is called a shikari. (*See* Big Game and Shooting.)

SHIKARPUR, a town of British India, in the Sukkur district of Sind, Bombay. It is situated about 18 m. from the right bank of the Indus, with a station on the North-Western railway, 23 m. N.W. of Sukkur. Pop. (1921), 55,503. Shikarpur has been an important place in the past as commanding the trade route through the Bolan pass, and its merchants have dealings with many towns in Central Asia. Shikarpur was formerly the headquarters of a district of the same name. In 1901 two subdivisions of this district were detached to form the new district of Larkana, and the two other subdivisions were then formed into the district of Sukkur. The railway link between Baluchistan and Sukkur has seriously reduced the importance of Shikarpur in recent years, but the town retains its old trade in silks and precious stones.

SHILDON, town, Durham, England, 9 m. north-west from Darlington on the L.N.E.R. Pop. of urban district of Shildon and East Thickley (1931) 12,690. At New Shildon or East Thickley are extensive railway engine and wagon works.

SHILLING. An English silver coin of the value of 12 pence. The origin of the word is somewhat obscure. There was an Anglo-Saxon coin termed *scilling,* or *scylling,* worth about fivepence, which is said to be derived from a Teutonic root, *skil,* to divide, + *ling* on the analogy of farthing (*q.v.*). The silver shilling was first struck in 1504, in the reign of Henry VII. In Charles II.'s reign shillings were first issued with milled edges. In George IV.'s reign were issued the so-called "lion shillings," bearing the royal crest, a crowned lion on a crown, a design reverted to in the coinage of Edward VII. A shilling is token money merely; it is nominally in value one-twentieth of a pound, but one troy pound of silver is coined into 66 shillings. (*See* Token Money.) The shilling is equal to 24 cents, United States currency.

SHILLONG, a town of British India, the capital of Assam and the headquarters of the Khasi Hills district. It is situated on a plateau 4,978 ft. above the sea, 63 m. by cart-road S. of Gauhati, on the Brahmaputra. Pop. (1921) 17,203. Shillong practically dates from 1864, when the district headquarters were transferred from Cherrapunji. It was chosen as the seat of government in 1874, when the province of Assam was constituted. It contains a cantonment, Pasteur institute and research laboratory (for anti-rabies treatment), and schools for the education of European and Eurasian boys and girls. Its pleasant climate and delightful surroundings make Shillong a popular health and holiday resort. Every one of the public buildings and houses was levelled to the ground by the great earthquake of June 12, 1897, but they have since been rebuilt.

SHILLUH, the name given by the Arabized Moors to the Berber peoples of southern Morocco. They occupy chiefly the province of Sus. The name is said to be a corruption of *áshlūh* (pl. *íshlúh*), a camel-hair tent. They are of fine physique, strong and wiry, and true Berbers in features and fairness.

SHILLUK: *see* Nilotes.

SHILOH, a town of Ephraim, where for three centuries after the Israelite conquest of the Holy Land it was the depository of the Tabernacle and Ark of the Covenant. In its sanctuary the boy Samuel had his vision. With the removal of the Ark Shiloh's glory departed and by the time of Jeremiah (vii. 12) it was a heap of ruins. Its identification with the modern Seilūn, 2 m. S.E. of El-Lubbān (Lebonah) on an isolated hill affording an ideal site for a sanctuary and fortress, is not disputed. (E. Ro.)

SHILOH, BATTLE OF. This, the second great battle in the American Civil War, also called the battle of Pittsburgh Landing, was fought on April 6 and 7, 1862, between the Union forces under Grant and Buell and the Confederates under A. S. Johnston and Beauregard. In view of operations against Corinth, Mississippi, Grant's army had ascended the Tennessee to Pittsburgh Landing and there disembarked, while the co-operating army under Buell moved across country from Nashville to join it. The Confederates concentrated 40,000 men at Corinth and advanced on Pittsburg Landing with a view to beating Grant before Buell's arrival, but their concentration had left them only a narrow margin of time, and the advance was further delayed by the wretched

condition of the roads. Beauregard advised Johnston to give up the enterprise, but on account of the bad effect a retreat would have on his raw troops Johnston resolved to continue his advance. Grant meantime had disposed his divisions in camps around the Landing rather with a view to their comfort than in accordance with any tactical scheme. No entrenchments were made; Halleck, the Union commanding general in the West, was equally overconfident, and allowed Buell to march in leisurely fashion. Even so, more by chance than intentionally, Buell's leading division was opposite Savannah 9m. below the Landing, awaiting only a ferry, on the evening before the battle; Grant, however, declined to allow it to cross, as he thought that there would be no fighting for some days. At 6 A.M. on April 6, near Shiloh church (2m. from Pittsburgh Landing), the Confederate army deployed in line of battle, and advancing directly on the Landing, surprised and broke up a brigade of the most advanced Union division (Prentiss's) which had been sent forward from camp to reconnoitre. The various Union divisions hurriedly prepared to defend themselves, but they were dispersed in several camps which were out of sight of one another, and thus the Confederate army lapped round the flanks of each local defence as it encountered it. The two advanced divisions were swiftly driven in on the others, who were given a little time to prepare themselves by the fact that in the woods the Confederate leaders were unable to control or manoeuvre their excited troops. But the rear Union divisions, though ready, were not connected, and each in turn was isolated and forced back, fighting hard, towards the Landing. The remnant of Prentiss's division was cut off and forced to surrender. Another division had its commander, W. H. L. Wallace, killed. But on the other side the disorder became greater and greater, many regiments were used up, and Johnston himself killed in vainly attacking on a point of Wallace's line called the Hornet's Nest. The day passed in confused and savage scuffles between the raw enthusiasts of either side, but by 5:30 P.M. Grant had formed a last (and now a connected) line of defence with one brigade of Buell's leading division (Nelson's) and all of his own infantry that he could rally. This line was hardly 600yd. from the Landing, but it was in a naturally strong position, and Beauregard suspended the attack at sunset. There was a last fruitless assault, delivered by some of the Confederate brigades on the right that had not received Beauregard's order against Nelson's intact troops, who were supported by the fire of the gunboats on the Tennessee. During the night Grant's detached division (Lew Wallace's) and Buell's army came up, totalling 25,000 fresh troops, and at 5 A.M. on the 7th Grant took the offensive. Beauregard thereupon decided to extricate his sorely-tried troops from the misadventure, and retired fighting on Corinth. About Shiloh church, a strong rear-guard under Bragg repulsed the attacks of Grant and Buell for six hours before withdrawing, and all that Grant and Buell achieved was the reoccupation of the abandoned camps. It was a Confederate failure, but not a Union victory, and, each side being weakened by about 10,000 men, neither made any movements for the next three weeks.

See F. A. Shoup, "The Art of War in '62—Shiloh," *United Service*, ser. 3, vol. viii., p. 67–80 (1905); and S. M. Howard, *The Illustrated Comprehensive History of the Great Battle of Shiloh* (Gettysburg, S.D., 1921).

SHIMOGA, a town and district in Mysore, southern India. The town is situated on the Tunga river, and is the terminus of a branch railway. It has cotton ginning and pressing factories and iron and steel works. Pop. (1921) 15,090. The area of the district is 4,030 sq.m. In the east the Tunga, Bhadra and Varada rivers unite to form the Tungabhadra, which ultimately falls into the Kistna and so into the Bay of Bengal, while in the west a few minor streams flow to the Sharavati, which near the north-western frontier bursts through the Western Ghats at the celebrated Falls of Gersoppa (*q.v.*).

The western half of the district is mountainous and covered with magnificent forest, and is known as the Malnad or hill country, some of the peaks being 4,000 ft. above sea-level. The general elevation of Shimoga is about 2,000 ft.; and towards the east it opens out into the Maidan or plain country, which forms part of the general plateau of Mysore. Manganese is worked. The soil is loose and sandy in the valleys of the Malnad, and in the north-east the black cotton soil prevails. Shimoga presents much variety of climate. The south-west monsoon is felt in full force for about 25 m. from the Ghats, but the rainfall gradually diminishes to 31 in. at Shimoga station and to 25 in. or less at Chennagiri. The population in 1921 was 492,560. Rice is the staple crop; next in importance is sugar-cane; areca nuts are also extensively grown; and miscellaneous crops include vegetables, fruits, and pepper. The mineral products of the district include iron-ore and laterite.

SHINGLES. The popular name for the variety of herpes (*q.v.*) known as herpes zoster, from its tendency to extend in girdle fashion around the waist, *i.e.*, one or both sides of the chest. The rash of shingles in itself is but moderately painful, but the importance of the condition lies in the hyperaesthesia of the skin in neighboring parts supplied by the same nerve. This hyperaesthesia is such that the slightest touch causes a burning pain resembling that occasioned by touching a raw and highly sensitive surface. Associated with the pain due to the eruption are muscular and joint pains (possibly resulting from the enforced immobilization of the part) and these, in the form of cramps, may be even more severe than the superficial pain. As a result of such paroxysms of pain, sleep is interfered with, often to an important extent, and the patient looks tired and worried. Nevertheless, he is not ill as with an acute infective illness, though the temperature may be raised a little at times. Paroxysms of pain are often determined by extraneous causes, *e.g.*, in the case of herpes of the thigh by a full rectum, hunger, insufficient or excessive warmth. The real importance of the disease lies in the fact that the pain is often so severe that there is a danger that recourse may be made to morphia for its relief. In view of the duration of the associated neuralgic pain, the danger of inducing the morphia habit is very great, and use of morphia and other opiates must be avoided at all costs. Though distressing, the disease is never fatal, in spite of the popular belief that such is the case if the shingles extend right round the body. There is a relation between shingles and chicken-pox, for the two are apt to be associated in the same community and may even occur in the same individual simultaneously.

SHINTŌISM. Shintō or *"Kami-no-Michi"* (the Divine Way), the religion of Japan, still living among the Japanese people, is a designation given to the early religious belief of the Japanese soon after their first contacts with China. The first documentary appearance of the term Shintō is in the Book of the Emperor Yōmei in the *Nihongi* (Aston, Eng. trans., vol. i., p. 106).

Shintō has two main stages in the course of its development: one is naturalistic, the other cultural. In the two phases of its development, the one gives us an aspect of nature religion, while the other presents that of ethico-intellectualistic (or spiritualistic) religion, greatly influenced by Buddhism and Confucianism.

Nature Religion.—In Shintō as a lower nature religion we find nature worship, fetishism, spiritism, totemism and primitive monotheism. The primitive Japanese worshipped the sun, the moon, the rainstorm, thunder, wind and fire; earth, the sea, the mountain, the deity of the earthquake, volcanoes, wells, hot springs and stones or rocks; the serpent, the tiger, the wolf, the wild boar, the hare, even the silkworm and the louse, trees, herbs and cereals.

Anthropolatry.—Individual personages are also worshipped as *Kami* or deities in their lifetime as well as after their death, and we have Shintō shrines dedicated to special divine personages while living. The emperor is regarded as a "Visible Deity" (*Arahitogami* or *Akitsukami*), and some brave warriors or mighty heroes are also deities in human form. Later on the Ryōbu or Dual Shintō made good use of this form of religious syncretism. There is quite a number of examples of necrolatry and ancestor worship in Shintō. The sacred imperial regalia (or heirlooms), consisting of the mirror, sword and jewels, had originally a fetishistic virtue.

Litholatry, etc.—Particularly in Japan, sacred stones are regarded as fetishes (litholatry). Different phallic emblems of stone or wood, both male and female in shape, are not very uncom-

mon (phallicism). There is some evidence of totemism in primitive Shintō; *e.g.,* Kamo-Taketsunumi-no-Mikoto, the remote ancestor of the Shintō priests of the Kamo Shrine in Kyōto, was once believed to be a large divine crow, afterwards worshipped at a separate shrine. The father of the Emperor Jimmu was traditionally recorded to have sprung from the crocodile or dragon Sea-Goddess Toyotama-Hime, the consort of Hikohohodemi-no-Mikoto.

There is something like a primitive monotheism in Ame-no-Minakanushi-no-Kami, or the Divine Lord of the Very Centre of Heaven, amalgamated with another supreme deity, Kunitokotachi-no-Kami, in later Shintō.

Mythology.—Primitive Shintō appears as a higher nature religion in the heavenly drama of the rich mythology of the *Kojiki* (*Records of Ancient Matters*), the *Nihongi* (*Chronicles of Japan*) and the *Kogoshui* (*Gleanings from Ancient Stories*). A conflict between the sun and the rainstorm was graphically delineated in Japanese mythology as a momentous event in the Divine Age. Then a divine council was held to entreat the Sun-Goddess to restore peace and order to the world and to reilluminate it by emerging from the heavenly rock-cave in which she had taken refuge from the violence committed by the impetuous brother Susano-O-no-Kami. Then follows the banishment of the divine culprit Susano-O from heaven to earth.

Emperor Worship.—Then according to tradition, half mythical, half historical, the Japanese imperial lineage has continued unbroken from the Ancestral Sun-Goddess to the present emperor, who, like his predecessors, enjoys a divine right to the throne, representing in himself both Caesar and pope—as a divinity in humanity. Even nowadays, in the hierarchy of his theocratic as well as constitutional government, he is often phrased "saiseiitchi," or the complete unity of political governance and religious observances. Thus Shintō as a national or state religion culminates in the form of emperor worship, not only in its naturalistic but also in its ethico-intellectualistic stage. Therefore Japanese patriotism or loyalty has been suffused with religious zeal. Herein lies one of the peculiar characteristics of the life or essence of Shintō.

As to the course of development of Shintō in its cultural stage, it is polydemonistic (animistic) at the beginning, then polytheistic, and at last pantheistic, with a tinge of monotheism.

Such a naturalistic pantheism of Shintō is deepened and ennobled by a further idealistic or spiritualistic grasp of the Shintō-Deity. Hayashi-Razan, an eminent scholar of Chinese classics of the 17th century says: "The Deity is the Spirit of Heaven and Earth. The human mind partaking of divinity is an abode of the Deity, which is the Spiritual Essence. There exists no highest deity Ame-no-Minakanushi-no-Kami outside the human mind" (*Shintō-Denju*).

Bibliography.—W. G. Aston, *Encyclopaedia of Religion and Ethics,* article "Shintō" (1920); G. F. Moore, *History of Religions,* vol. i. (1922).

SHINWARI, a Durrani Afghan tribe occupying the northern slopes of the Safed Koh below Jalalabad. One clan, the Ali Sher Khel, live on the Doargai border of Peshawar district. The remaining three clans are Afghan subjects.

SHIP, the vehicle by which man conveys himself and his goods upon water. The earliest and most elementary form of ship was, doubtless, a log or one or two of them secured together to form a raft. The first conception of a vessel which can carry weights, not merely on account of its own buoyancy, but on account of the water it displaces, may be traced in the primitive craft fashioned by hollowing out tree trunks, by fire or such primitive tools as savage races could devise.

It was long before the principle of flotation by displacement was fully and universally understood, and we read of objectors to the introduction of iron ship construction arguing that "wood floats but iron sinks," yet it is this principle which makes possible the great ship as we know it to-day. Some glimmering of the future seems, however, to have enlightened Virgil when he wrote, "Rivers then first the hollowed alder felt" (Georg. i. 136, ii. 451). Alder is a heavy wood and not fit for rafts, but to make for the first time a dug-out canoe of alder, and so to secure its flotation, would be a triumph of primitive art.

PRIMITIVE CRAFT

Early efforts at shipbuilding may be classified in the following order: (1) rafts—floating logs, or bundles of brushwood of reeds or rushes tied together; (2) dug-outs—hollowed trees; (3) canoes of bark, or of skin stretched on framework or inflated skins (balsas); (4) canoes or boats of pieces of wood stitched or fastened together with sinews or thongs or fibres of vegetable growth; (5) vessels of planks, stitched or bolted together with inserted ribs and decks or half decks; (6) vessels of which the framework is first set up, and the planking of the hull nailed on to them subsequently. All these in their primitive forms have survived, in various parts of the world, with different modifications which mark a varied progress in civilization. On the northwest coast of Australia, for instance, is found the single log of buoyant wood, not hollowed out but pointed at the ends. Rafts of reeds are still used by the natives of the same continent. In New Guinea catamarans of three or more logs lashed together with rattan are commonly used, and similar forms appear on the Madras coast and throughout the Asiatic islands. On the coast of Peru rafts made of a very buoyant wood are in use, some of them as much as 70 ft. long and 20 ft. broad; these are navigated with a sail, and, by an ingenious system of centre boards, let down either fore or aft between the lines of the timbers, can be made to tack. The sea-going raft is often fitted with a platform so as to protect the goods and persons carried from the wash of the sea. Upright timbers fixed upon the logs forming the raft support a kind of deck, which in turn is itself fenced in and covered over. (The raft of Ulysses described in Homer [*Od.* v.] must have been of this class.) Thus the idea of a deck, and that of side planking to raise the freight above the level of the water and to save it from getting wet, are among the earliest typical expedients in the progress of the art of shipbuilding.

Dugout canoes of a single tree have been found associated with objects of the Stone Age among the ancient Swiss lake dwellings; other specimens have been extracted from the bogs of Ireland and the estuaries of England and Scotland. Whatever may have been the origin of the bark canoe, its construction was a step onwards in the art of shipbuilding, for the lightness and pliability of the material necessitated the invention of some internal framework. In those countries where suitable timber was not to be found, the use of skins or other water-tight material, such as felt or canvas, covered with pitch, giving flotation, demanded a similar framework to keep them distended and to bear the weight they had to carry. In this structure we have the rudimentary ship, with longitudinal bottom timbers, and ribs, and cross-pieces, imparting the requisite stiffness to the covering material. Bark canoes are found in Australia, but the American continent is their true home. In northern regions skin or woven material made water-tight supplies the place of bark.

The next step in the construction of vessels was the building up of canoes or boats by fastening pieces of wood together in a suitable form. Some of these canoes, and probably the earliest in type, are tied or stitched together with thongs or cords. The Madras surf boats are perhaps the most familiar example of this type, which, however, is found in the Straits of Magellan and in Central Africa (on the Victoria Nyanza), in the Malay Archipelago and in many islands of the Pacific. Some of these canoes show a great advance in the art of construction, being built up of pieces fitted together with ridges on their inner sides, through which the fastenings are passed. (*See* Captain Cook's account of the Friendly Islands, La Pérouse on Easter Island, and Williams on the Fiji Islands.) They achieved some of the advantages of a more elastic structure which gives ease in a seaway, and a comparative immunity where more rigid boats would not hold together. Vessels thus stitched together, and with an inserted framework, have from a very early time been constructed in the Eastern seas far exceeding in size anything that would be called a canoe, and in some cases attaining to 200 tons burthen.

From the stitched form the next step onwards is to fasten the

materials out of which the hull is built up by pegs or treenails; and of this system early types appear among the Polynesian islands and in the Nile boats, the prototype of the modern "nuggur." Some of the early types of boats belonging to the North Sea present an intermediate method, in which the planks are fastened together with pins or treenails, and are attached to the ribs by cords passing through holes in the ribs and corresponding holes bored through ledges cut on the inner side of each plank.

The ribs of the modern vessel are the development of the framework originally inserted after the completion of the hull of the canoe or built-up boat, but with the difference that they are now prior in the order of fabrication.

THE ROWING GALLEY

The earliest representations of Egyptian vessels carry us back to a period about 3,000 years before Christ. Some of these are of considerable size, as is shown by their twenty or more rowers, and by the cargo consisting in many cases of cattle. The earliest of all presents us with the peculiar mast of two pieces, stepped apart but joined at the top. In some the masts are shown lowered and laid along a high spar-deck. On the war galleys (*see* GALLEY) there is frequently shown a projecting bow with a metal head well above the water. This was doubtless used as a ram.

The double mast of the earlier period seems in time to have given place to the single mast furnished with bars or rollers at the upper part, for the purpose apparently of raising or lowering the yard according to the amount of sail required. The sail in some of the galleys is shown with a bottom as well as a top yard. In the war galleys during action it is shown pulled up like a curtain with loops to the upper yard. The steering was effected by paddles, sometimes four or five in number, but generally one or two fastened either at the end of the stern or at the side, and above attached in such a way as to be worked by a tiller.

The Egyptian ship as depicted by the tomb paintings, during the period between 3000 and 1000 B.C., was a ship proper as distinct from a large canoe or boat. It was, in fact, the earliest ship of which we have cognizance.

But credit for the further development of the ship and of the art of navigation clearly belongs to the Phoenicians. The earliest and almost the only evidence that we have of this development is to be gathered from Assyrian representations. The Assyrians were an inland people, and the navigation with which they were familiar was that of the two great rivers, Tigris and Euphrates, but after the conquest of Phoenicia we find that the war galley of the Phoenicians was represented on the walls of the palaces unearthed by Layard and his followers in Assyrian discovery. But the date does not carry us to an earlier period than 700 B.C. The vessel represented is a bireme war galley which is "aphract," that is to say, has the upper tier of rowers unprotected and exposed to view.

The Phoenicians at an early date constructed merchant vessels capable of carrying large cargoes, and of traversing the length and breadth of the Mediterranean. They in all probability (if not the Egyptians) invented the bireme and trireme, solving the problem by which increased oar-power and consequently speed could be obtained without great increase in length of the vessel.

Greek Vessels.—It is, however, to the Greeks that we must turn for any detailed account of these inventions. The Homeric vessels were "aphract" ("uncovered"), not even decked throughout their entire length. They carried crews of from fifty to a hundred and twenty men, who all took part in the labour of rowing, except perhaps the chiefs. The galleys do not appear to have been armed as yet with the beak, though later poets attribute this feature to the Homeric vessel. But they had great poles for use in fighting. The general characteristics are indicated by the epithets in use throughout the *Iliad* and the *Odyssey*. The Homeric ship was sharp and swift, hollow, black, vermilion-cheeked, dark-prowed, curved, well-timbered, with many thwarts. The stems and sterns were high, upraised, and resemble the horns of oxen. They presented a type of Mediterranean ship parallel with that of the Vikings' vessels of the North Sea.

The trireme was succeeded and in a measure superseded by the larger rates,—quadrireme, quinquereme, and so on, up to vessels of sixteen banks of oars. How these were arranged is the subject of much discussion and argument which cannot be dealt with in the compass of this article.

The terms "Aphract" and "Cataphract" meant "unfenced" and "fenced," and referred to the bulwarks which covered the upper tier of rowers from attack. In the aphract vessels these side plankings were absent and the upper tier of rowers was exposed to view from the side. Both classes of vessels had upper and lower decks, but the aphract class carried their decks on a lower level than the cataphract.

Early Construction.—As regards the construction of the vessel itself: in the cataphract class the lower deck was 1 ft. above the water-line. Below this deck was the hold, which contained a certain amount of ballast, and through an aperture in this deck the buckets for baling were worked, entailing a labour which was constant and severe on board an ancient ship at sea. The keel appears to have had considerable camber. Under it was a strong false keel, very necessary for vessels that were constantly drawn up on the shore. Above the keel was the kelson, under which the ribs were fastened. These were so arranged as to give the necessary intervals for the oar-ports above. Above the kelson lay the upper false keel, into which the mast was stepped. The stem rose from the keel at an angle of about 70° to the water. Within was an apron, which was a strong piece of timber curved and fitting to the end of the keel and beginning of the stern-post and firmly bolted into both, thus giving solidity to the bows, which had to bear the beak and sustain the shock of ramming. As steering was effected by means of two rudders, one on either side, there was no need to carry out the stern into a rudder post as with modern ships, and the stern was left, therefore, much more free, an advantage in respect of the manoeuvring of the ancient Greek man-of-war, the weapon being the beak or rostrum, and the power of turning quickly being of the highest importance.

After the ribs had been set up and covered in on both sides with planking, the sides of the vessel were further strengthened by waling-pieces carried from stern to stem and meeting in front of the stern-post. These were further strengthened with additional balks of timber, the lower waling-pieces meeting about the water-level and prolonged into a sharp three-toothed spur, of which the middle tooth was the longest. This was covered with hard metal (generally bronze) and formed the beak. The whole structure of the beak projected about 10 ft. beyond the stern-post. Above it, but projecting much less beyond the stern-post, was the "proembolion," or second beak, in which the prolongation of the upper set of waling-pieces met. This was generally fashioned into the figure of a ram's head, also covered with metal. Sometimes there was a second line of waling-pieces terminating in another boss. These bosses, when a vessel was rammed, completed the work of destruction begun by the sharp beak at the water-level, giving a racking blow which caused her to heel over and so eased her off the beak, releasing the latter before the weight of the sinking vessel could come upon it. At the point where the prolongation of the second and third waling-pieces began to converge inwards towards the stem on either side of the vessel stout catheads projected, which were of use, not only as supports for the anchors, but also as a means of inflicting damage on the upper part of an enemy's vessel, while protecting the side gangways of its own and the banks of oars that worked under them. The catheads were strengthened by strong balks of timber, which were firmly bolted to them under either extremity and both within and without, and ran to the ship's side. Above the curvature of the upper waling-pieces were the cheeks of the vessel, generally painted red, and in the upper part of these the eyes, answering to our hawse holes, through which ran the cables for the anchors. On either side the trireme, at about the level of the thranitic benches, projected a gangway resting against the ribs of the vessel. This gangway was planked in along its outer side so as to afford protection to the seamen and marines, who could pass along its whole length without impeding the rowers. Here, in action, the sailors were posted as light-armed troops, and when needed could use the

long supernumerary oars. The ribs, prolonged upwards upon an inward curve, supported on their upper ends the cross beams which tied the two sides of the vessel together and carried the deck. In the cataphract class these took the place of the thwarts which in the earlier vessels, at a lower level, yoked together the sides of the vessel, and formed also benches for the rowers to sit on. On the deck were stationed the marines, fighting men in heavy armour. The forecastle had a raised deck. In the stern the decks rose in two or three gradations, upon which was a kind of deck-house for the captain and a seat for the steerer, who steered by means of ropes attached to the tillers fixed in the upper part of the paddles, which, in later times at least, ran over wheels, giving him increased power. Behind the deck-house rose the flagstaff, on which was hoisted the pennant, and from which probably signals were given in the case of an admiral's ship. On either side of the deck ran a balustrade, which was covered for protection during action with felt or canvas. Above was stretched a strong awning of hide as a protection against grappling irons and missiles of all kinds.

All the Attic triremes appear to have been built upon the same model, and their gear was interchangeable. The Athenians had a peculiar system of girding the ships with long cables, each trireme having two or more, which, passing through eyeholes in front of the stern-post, ran all round the vessel lengthwise immediately under the waling-pieces. They were fastened at the stern and tightened up with levers. These cables by shrinking as soon as they were wet, tightened the whole fabric of the vessel, and in action, in all probability, relieved the hull from part of the shock of ramming, the strain of which would be sustained by the waling-pieces convergent in the beaks. These rope-girdles are not to be confused with the process of undergirding or frapping, such as is narrated of the vessel in which St. Paul was being carried to Italy. The trireme appears to have had two masts. In action the Greeks did not use sails, and everything that could be lowered was stowed below. The mainmasts and larger sails were often left ashore if a conflict was expected.

The crew of the Attic trireme consisted of from 200 to 225 men in all. Of these some 170 were rowers. Besides the rowers there were 10 marines and 20 seamen. The chief officer was the trierarch and next to him the helmsman, who was the navigating officer of the trireme. The economy of space was such that, as Cicero remarks, there was not room for one man more.

The improvement made in the build of their vessels by the Corinthian and Syracusan shipwrights, by which the bows were so much strengthened that they were able to meet the Athenian attack stem on, caused a change of tactics, and gave an impetus to the building of larger vessels—quadriremes and quinqueremes —in which increased oar-power was available for the propulsion of the heavier weights.

Roman Ships.—The Romans, who developed their naval power during the First Punic War, though it is clear from the treaty with Carthage, 509 B.C., that they had had some maritime interests and adventurings before that great struggle began, were deficient in the art of naval construction. A Carthaginian quinquereme, which had drifted ashore, served them for a model, and with crews taught to row in a framework set up on dry land they manned a fleet which was launched in sixty days from the time that the trees were felled. Their first attempt was, as might have been expected, a failure. But they persevered, and the invention of the "corvus," by means of which boarding was opposed to ramming tactics, gave them under Duilius (260 B.C.) victory at Mylae, and eventually the command of the sea. From that time onwards they continued to build ships of many banks, and seem to have maintained their predilection for fighting at close quarters. The larger vessels with their "turres," or castles, fore and aft, deserved Horace's description as "alta navium propugnacula." The "corvus" and the "dolphin" were ready in action to fall on the enemy's decks.

But the fashion of building big ships received a severe setback at the battle of Actium (31 B.C.), when the light Liburnian "biremes," eluding the heavy missiles of the larger vessels, swept away their banks of oars, leaving them crippled and unable to move, till one by one they were burnt down to the water's edge and sank. (Merivale, *Hist. of Romans under the Empire,* c. 28.) After this experience the Romans adopted the Liburnians as their principal model, and though the building of vessels with many banks continued for some centuries, yet the Liburnian type was so far dominant that the name was used generically to signify a man-of-war.

The building of large merchant vessels followed with more peaceful times. These craft were propelled by sails and not by oars. The great corn ships, which brought supplies from Egypt to the capital, were, if we may take the vessel described by Lucian as a typical instance, 120 cubits long by 30 broad and 29 deep. The ship in which St. Paul and his companions were wrecked carried 276 souls besides cargo. Even larger vessels than these were constructed by the Romans for the transport of marbles and great obelisks to Italy. Many of these vessels are reputed to have carried three masts, although the number is doubted by modern authorities. They had square sails, and on the main mast a topsail.

Meanwhile special vessels continued to be constructed for fighting purposes. In the war with the Vandals (A.D. 440–470) we hear of ships of a single bank, with decks above the rowers. These, we are told, were of the type which at a later date were called Dromons in allusion to their speedy qualities, a name which gradually superseded the Liburnian as indicating a man-of-war. During the following centuries the Mediterranean was the scene of constant naval activity. The necessity of improving galleys as regards speed and armament became more and more pressing. Greek fire and other detonating and combustible mixtures, launched by siphons or in the form of bombs, led to various devices by way of protective armour, such as leather or felt casing, or woollen stuffs soaked in vinegar.

Meanwhile the northern seas were breeding a new terror. The ships of the Vikings, propelled by oar and sail, were seagoing vessels of an excellent type. They were of various sizes, ranging from the *skuta* of about 30 oars to *ask* or *skeid* with 64 oars and a crew of 240, and to the still larger *dreki* or dragon boats, and the famous *snekkjur* or serpents, said to be represented on the Bayeux tapestry. Of these vessels we have fortunately a typical instance, though one of the smaller class, in the well-known Viking ship discovered in 1880 in a tomb-mound at Gokstad near Christiania (Oslo), whose dimensions are: length 78 ft., beam 16 ft. 7 in., depth 5 ft. 9 in., with high stem and stern; clinker-built of oak throughout, with 16 oars on either side. Of this general type were the vessels large and small which had by the 9th century or before that found their way into the Mediterranean. If, as is probable, the Danes who invaded England used the same class of vessel, Alfred the Great must, according to the *Saxon Chronicle,* be credited with improvements in construction, which enabled him to defeat them at sea (897). He built, we are told, vessels twice as long as those of the Danes, swifter, steadier and higher, some of them for 60 oars, and after his own design, not following either the Danish or Frisian types.

MEDIAEVAL SHIPS

The mediaeval galley was a one, two or three banked vessel, but used longer oars or sweeps than the paddling oars of the ancient vessels. It was the increase in the length and weight of the oar, which led to the employment of more than one man to an oar. With the longer oar the necessity arose of placing the weight at a greater distance from the power applying the lever. This was gained by the re-introduction of the *apostis,* which was practically a framework standing out on each side of the hull and running parallel to it; a strong external timber, in which the thowls, against which the oars were rowed, were set. By this means it became possible not only to arrange the oars horizontally, in sets of three or more of different lengths, instead of in banks one above the other obliquely, but also to apply the strength of three or four men (or even up to seven with the larger galleys and galleasses) for the motive power of each blade. As time went on oars of from 30 to 50 ft. came into vogue, the inboard portion of which was about one-third of the

length, and furnished with handles attached to the loom, the men for each oar being placed in steps. As commerce increased and merchant vessels gained in size, the necessity of being able to defend themselves against piratical attacks became more and more cogent, a necessity which ultimately led the way to the supersession of the galley by the sailing vessel.

The period of the Crusades was one of great activity in shipbuilding, in which the Venetians and the Genoese were the leaders in the Mediterranean, but the enterprise of England under Richard Coeur de Lion (1189–1199) shows that in the northern seas great efforts were being made in the same direction. Richard's fleet which sailed from Dartmouth consisted of 110 vessels, and its total in the Mediterranean after reinforcement was 230 vessels.

The whole period of the Crusades was, as regards naval matters, one of mixed fleets, in which the sailing vessels were mostly merchant vessels armed for fighting purposes. About this time we see the steering oar on the side of the ship gradually disappear, and the rudder slung at the stern becoming the usual means of directing the vessel's course. The advantage of high freeboard for longer voyages was appreciated. It was in northern waters that the big merchantman was most rapidly developed, as the needs of the merchants outgrew the armed galleys that had been brought to a high pitch of perfection by the Venetians and Genoese, and chartered by them nearly all over Europe. In the Mediterranean many features of this type were combined with those of the galley and produced the carrack of Genoa and the galleasse. The merchant vessels when prepared for war had forecastles and stern-castles erected on them, of which the one survives in name, and the other is seen in the poop of later times.

The invention of gunpowder, and the consequent use of cannon on board ship, was the cause of many new departures in building and armaments. In the galleys we find guns mounted in the bows, and broadside on the upper deck, *en barbette,* firing over the bulwarks. Soon, however, the need of cover suggested portholes cut for the guns, just as in the ancient galleys they had been cut for the oars. The desire to carry many guns led to many alterations in build, such as the tumble-home of the sides, the longer voyages undertaken, coupled with the desire for speed, to many improvements in rig, as well as to an increase in the number of masts and consequently larger spread of sail. About 1370–1380 French, Venetians and Spaniards were using the new artillery in action, and the policy of maintaining a navy composed of sailing vessels built for war, and not merely of armed merchant ships impressed for the emergency, soon began to take effect. There exists at Nuremberg an engraving believed to have been taken from a model of a 15th-century Flemish carrack which is remarkable for its detail and technical accuracy, in spite of the fact that considerable license must be allowed the artist. Her short foremast and tall mainmast, both surmounted by a top, each carries a single square sail; her stump mizen a lateen. The mizen top mounts a small gun. Her hull, with long forecastle and shorter aftercastle, is very full-lined forward and aft and is greatly strengthened externally. A stump bowsprit at a sharp angle takes the forestay and the bowlines of the foresail, and the anchor is suspended from it. Obviously at that period the Flemings built for strength rather than speed.

THE DEVELOPMENT OF THE SAILING SHIP

In England, Henry V. (1413) built large vessels for his fleet, "great ships, cogs, carracks, ships, barges and ballingers," some of which were of nearly 1,000 tons, but the generality from 420 to 520 tons. In the list of his fleet no galleys seem to be included. Meanwhile in the south the type of vessel called "caravel" was being developed, in which Portuguese and Spaniards dared the Atlantic and made their great discoveries. "Santa Maria," the flagship of Columbus (1492) in his attempt to reach the Indies by the Western route, is generally quoted as typical of this class, but research has cast doubt on her generally accepted dimensions and design and modern discovery is revealing a ship very different from the "replica" built in Spain for exhibition in the United States in 1892. The vessels in which Vasco da Gama first doubled the Cape of Good Hope (1497) were probably of similar type but larger. The ship of John Cabot (1497) in which he discovered Newfoundland must have been much smaller, as he had a crew of only eighteen men.

In England during the Tudor times a great advance in shipbuilding is to be observed; but the French then, as well as at a later period, were providing the best models for naval architecture. These big ships were armed at first with "serpentines," and later with cannon and culverins. The representations of them show several tiers of guns, four or even five masts, and enormous structures by way of forecastles and deck-houses aft. In spite of the general improvement in hull design, however, these ships had many weak points, chief among which, from the fighting point of view, was a beak bow surmounted by a square bulkhead, a feature inherited from the galley. Notwithstanding many expensive lessons, this feature was not finally abandoned in big ships until the early 19th century. As regards merchant vessels, the Genoese and the Venetians during the 15th and 16th centuries carried out great improvements. The "carracks" of the 16th century often reached as much as 1,000 tons burthen. There is a record of a Portuguese carrack captured by the English, of which the dimensions reached 165 ft. in length and 47 ft. in beam. She carried 32 pieces of brass ordnance and between 600 and 700 passengers.

Armada Ships.—The Spanish Armada (1588) was composed of 132 vessels, of which the largest was about 1,300 tons and 30 under 100 tons. Four galleys and four galleasses accompanied the fleet. The opposing fleet consisted of 197 vessels of which only 34 belonged to the royal navy. Of these the largest was the "Triumph" of about 1,000 tons. The "Ark Royal" the flagship of the English admiral, was of 800 tons, carrying 55 guns. Among the armed merchant vessels employed with the fleet was the "Buonaventure," the first English vessel that made a successful voyage to the Cape and India. The result to England of the defeat of the Spaniards was a great increase of mercantile activity. Merchants, instead of hiring Genoese or Venetian carracks, began to prefer building and owning home-built ships, and though the foreign merchant vessels appear to have been on a larger scale, yet, as seagoing craft, the English-built ships certainly held their own. At a rather later date many of their best qualities were marred by mounting a very much heavier armament without the necessary increase in dimensions. We hear also during this period of many improvements in details, such as striking topmasts, the use of chain pumps, the introduction of studding, topgallant, sprit and topsails, also of the weighing of anchors by means of the capstan, and the use of long cables. In the men-of-war the lower tier of guns, which, as in the galleys, had been carried dangerously near the water-line, began to be raised. This improvement, however, does not seem to have been generally adopted in the English ships till after the Restoration. Meanwhile, in the Mediterranean the galley was still in vogue, being only partially superseded by the great galleasses, six of which are recorded to have taken part in the battle of Lepanto (1571), in which the Venetians and their allies employed no less than 208 galleys with single banks and long sweeping oars.

East India Company's Fleet.—During the 17th century the expansion of trade and the increase of mercantile enterprise were incessant. The East India Company organized its fleet of armed vessels up to 600 tons, and fought its way through Portuguese obstruction to the Indian coast. The Dutch were also competing for the trade of the East and the West, and formed similar companies with this object in view. Conflicts owing to commercial rivalry and international jealousies were inevitable. Hence in the British navy the construction of large vessels such as the "Prince Royal" and the "Sovereign of the Seas" (*see* RIGGING), which may be considered as among the earliest types of the modern wooden man-of-war. English oak afforded the best timber for shipbuilding, and skilful naval architects, such as Phineas Pett, succeeded in constructing the kind of seagoing war vessel which eventually gave England the superiority in its struggle with other naval powers in this and the following century. This, however, was by no means easily gained. The Dutch and the French were not slack in the building of merchant vessels and men-of-war.

The French navy especially, under the fostering care of Colbert, was greatly strengthened. During the 18th century it was constantly found that the dimensions of French ships exceeded those of British ships of the same date, and that French vessels were superior in speed. This led from time to time to an increase of the measurements of the various classes of vessels in the British navy. These were now rated according to the number of guns which they were constructed to carry.

Nelson's "Victory."—A 90-gun ship of the line at the beginning of the 18th century averaged 164 ft. in length of gun deck, 47 ft. beam, and about 1,570 tons, while the 40-gun ships now ran to 120 ft. with 34 ft. beam and from 600 to 700 tons. These dimensions, however, were not always maintained, and towards the middle of the century the Admiralty seem to have recognized the consequent inferiority of their ships. The famous and ill-fated "Royal George," launched in 1756, was the result of an effort to improve the line-of-battle ship of the period. She was 178 ft. in length, 52 ft. in beam, was of over 2,000 tons, and carried 100 guns and a crew of 750 men. The "Victory," Nelson's flagship, was built nearly ten years later. Her dimensions were 186 ft., 52 ft., 2,162 tons, and she carried 100 guns. During the same period frigates, which were cruisers carrying their armament on one deck, were built to carry 32 or 36 guns, but in this class also the French cruisers were superior in speed and of larger dimensions. The remainder of the 18th century and the beginning of the 19th witnessed a continuous rivalry in naval architecture, the French and Spanish models being constantly ahead of the British in dimensions and armament. In the American war (1812) the same disparity as regards dimensions became apparent, and the English frigates, and sloops used as cruisers, were generally outclassed, and in some instances captured, by American vessels of their own rate. This as usual led to the construction of larger vessels with greater speed, and though, after the conclusion of the long war, the activity of the royal dockyards slackened, yet the great three-deckers of the last period, before the adoption of steam power, had reached a length of over 200 ft., with more than 55 ft. beam, and over 3,000 tons. (For the further development of warship construction, *see* under the respective classes, *e.g.*, BATTLESHIP, CRUISER, DESTROYER, etc.)

The end of the Napoleonic Wars heralded a very great change in the construction of merchant ships and the conduct of the shipping business, so that the years 1815 and 1816 mark the beginning of a new epoch unusually clearly. The steamship was firmly established, but her uses were very limited and the sailing ship was still predominant.

NINETEENTH CENTURY SAILING SHIPS

The two changes in the design of the sailing ship at the beginning of this period which had most influence on trade and naval architecture were the suppression of the armed merchantman and the encouragement of speed. There was every prospect of a long peace, and its possibilities were much exaggerated in the hopes of the moment, but it was realised that the armed merchantman, which was primarily designed as such, inevitably lost a good deal of her efficiency as a cargo carrier and was a poor substitute for a fighting ship. Merchantmen had been armed from time immemorial, and for protection against both pirates and the enemy it was a very necessary precaution. The ordinary cargo carrier had a very light armament, the number and calibre of her guns being limited by regulation as a precaution against her turning pirate. Her security was very largely maintained by the convoy system, but a number of the finest merchant ships had a very much more powerful battery and carried letters of marque, not because they wished to engage in privateering but because it relieved them of the onerous convoy regulations.

The big East Indiamen were typical of these, carrying between twenty and thirty guns, occasionally on two decks. They were not efficient fighting ships, for their ports were small and their decks were usually too encumbered with merchandise and passenger fittings to permit the guns' crews proper room to work. But the space taken by this battery very seriously interfered with their commercial value.

The East India Company had already lost its monopoly in the Indian trade and it was obvious that its exclusive rights in Chinese waters must soon go as well. The armed Indiamen that it had been building for over two centuries could only exist under a strict monopoly and allied to a military force. When the monopoly went it became necessary to introduce efficiency, greater effort and greater speed at once.

Blackwall Frigates.—These considerations led to the Blackwall frigates which succeeded the company's East Indiamen. They were owned by such firms as Joseph Soames and Green and Money Wigram on the Thames, and T. and W. Smith of Newcastle, and although they were a considerable improvement from the mercantile point of view they inherited many of the features and most of the appearance of the old East Indiamen. Most of the firms which ran them, indeed, founded their fleets on tonnage purchased from the Company, but they were maintained and run on very different lines and quickly showed their influence on trade. They were, however, heavily built, full-lined ships and although they made tolerably good passages it was by their power and seamanship rather than their lines.

It was in the United States that fine lines were favoured for speed, and perhaps the greatest change of all was in their shipyards. Ever since Colonial days American shipbuilders had realised the value of speed and had been far more successful in obtaining it than any of their rivals in other countries. The Baltimore clippers—not to be confused with the later clipper ships—had made a name for themselves in the latter part of the eighteenth century and they represented the improvement which American designers had been able to effect on the lines of the French luggers which visited their ports during the War of Independence and which impressed them greatly by their seaworthiness, speed and other qualities.

These Baltimore clippers were originally used very largely as pilot boats, almost invariably rigged as brigs or schooners, but they became popular in the coasting trade when land communications were difficult and uncertain. The greatest benefit of their speed, however, was found in their ability to carry a reasonable cargo at very high rates to the West Indian Islands and other European Colonies whose trade was supposed to be strictly closed to them, but whose inhabitants were very willing to do business and whose warships found it quite impossible to catch them at sea. In time of war they made ideal letters of marque ships and during the war of 1812–1814 they proved of inestimable value to their country, both as privateers and blockade runners.

They had exceedingly fine lines and were constructed as lightly as possible, so that for general cargo carrying they worked at considerable disadvantage as compared with the full-bodied vessel of greater carrying capacity. But for the cargoes paying high freights or for the carriage of passengers they showed a great superiority.

Atlantic Packet Ships.—The first striking commercial use to which they were put, apart from their contraband trade, was the Western Ocean packet service which opened with the establishment of the Black Ball Line between New York and Liverpool in 1816. To begin with the ships were not extreme in their type, their sail area was moderate and the tonnage of most of them lay between 350 and 500 burthen. They were, however, sufficient to attract attention by the great improvement which they effected on the services that had preceded them, and their adaptation of the Baltimore clipper design was rapidly developed on more extreme lines to cope with the mail, passenger and emigrant business that was increasing by leaps and bounds. At the same time the trade to China and the East was being developed, demanding a slightly different vessel, but the American designers proved themselves quite capable of evolving it. Trade steadily improved and large fortunes were made by enterprising merchants. This Eastern trade employed some of the finest ships in the American Merchant Service just as it had in the British, but their vessels were very much faster.

Clipper Ships.—It is generally agreed, however, that the "Ann McKim" which was built at Baltimore in 1832 for Isaac McKim of that city was the first real clipper ship. She was fully rigged

as a ship, square rigged on all three masts and had a tall tapering sail plan instead of the square plan that was later more greatly favoured for speed. But with her yacht-like lines, low freeboard and raking masts, stem and stern-posts, she completely satisfied the popular conception of a clipper ship, although her registered tonnage was only 493 on dimensions 143 feet by 31 feet beam by 14 feet depth of hold, drawing 11 feet of water forward and 17 aft. She made a number of noteworthy passages on the China trade for which she was designed before being sold into the Pacific, but although she was fast and seaworthy she took on board a lot of water and was very uncomfortable, faults which were found with practically all clipper ships.

This policy of the American builders had an almost immediate influence on ship design in Britain. The virtues of speed were recognised, whereas formerly convoy regulations and the like had made it impossible to hope for a good passage and speed had only been considered to be at all necessary for the carriage of fruit and slaves—"perishable cargoes" as they were somewhat cynically described.

It was in the coasting trade that they first made their influence felt. For many years the various coasting services, particularly on the East coast of Great Britain, had been maintained by cutter-rigged sailing craft, the smacks for the longer distances and the hoys for the shorter routes. These smacks varied in size up to 75 feet in length by 23 in beam, their burthen going up to 160 tons and more. The hoys were generally smaller but neither craft offered any great comfort to its passengers. The coasting trade therefore gave the steamers a great opportunity, and they were not slow to take it. Numerous coasting services were opened in the 'twenties and the Aberdeen shipowners replied to this new competition by producing an adaptation of the American clipper, the first vessels of the type being almost invariably schooner rigged and employed on the coasting service. Later they became more ambitious and rivalled the Americans on the Western Ocean and eventually on the Eastern trades.

The American owners were ill-disposed to give the British this place in the rapidly growing emigrant trade on the Atlantic and improved both the size and design of their vessels in order to meet the competition. Their ships became more and more extreme in their fine clipper lines, and by carrying sail until the last moment they made some magnificent passages which were fully advertised and appreciated at the time. In those days the emigrant had to provide his own food and very few of them had sufficient knowledge to bring on board enough for a prolonged voyage, so that fast passages were the best possible advertisement and the fastest ships skimmed the cream of the trade.

Auxiliary Sailing Ships.—While the steamship was making rapid progress in Europe the Americans were for the most part content to develop it on distinctive lines for their own local and coasting purposes. As far as their ocean trade was concerned they had the reputation of building and possessing the finest clipper ships in the world and they were satisfied with that. They tried auxiliary machinery on the North Atlantic in what was essentially a sailing ship in the case of the "Massachusetts" of 1845, a 751-ton ship with an Ericsson screw propeller. She was not a success and was soon afterwards sold to the United States Navy. The auxiliary principle had already been tried in Britain in the case of Green's Blackwall frigates "Vernon," "Owen Glendower" and "Earl of Hardwicke," with lifting paddles. Their engines of 32 horse-power were intended to give a speed of five knots in a calm but they were very seldom satisfactory. In the 'fifties there had been a craze for them in the Australian trade and many prominent shipowners were ruined by them.

In 1849 the British Navigation laws were repealed and the American clipper ships were able to bring cargoes of China tea to British ports. Their appearance created a sensation, and one or two British builders, both at Aberdeen and on the Clyde, were tempted to copy them and produce fast sailing clipper ships of large tonnage. Until 1854, however, they were handicapped by the old rules of tonnage measurement which only took length and beam into consideration and left depth untaxed. The result was a short, deep ship not approaching the Americans in speed.

The first American clipper to load tea for the British market was the "Oriental," one of the extreme American ships of her day which brought a cargo of tea to London at £6 per forty cubic feet, while the best that the British ships could obtain was £3.10 per 50 cubic feet. She arrived in the West India Docks early in December 1850, 97 days out from Hong Kong, and created a sensation. The immediate result was that the British clippers "Stornoway" and "Chrysolite" were ordered at Aberdeen in spite of the tonnage laws, the first of their type. Although they were remarkably fast vessels in normal weather their lack of beam lost them speed in strong winds, but this fault was rectified in later designs.

In spite of their opportunities in this market, it was not long before the Americans deserted it, for the discovery of gold in California caused an unprecedented rush from the Eastern States and, as the passage by way of Cape Horn was technically a coasting run, it was reserved to American ships, their clipper owners having nothing to fear from cheaply-manned foreign competition. There was little enough cargo to be carried, but any number of gold seekers, so that in the early 'fifties a number of American clippers were built, growing more and more extreme in their fine lines, and made large profits.

The British clipper shipowners were developing the China and the Australian trade in the same way, although their ships never approached those of the Americans in their fineness. Freight and passage rates were both high and it was possible to earn an excellent dividend on a ship with very limited cargo capacity. Many British owners went to American yards for their tonnage, particularly to that owned by Donald McKay of Boston, but at the same time there were magnificent ships turned out by British establishments. As a general rule the hard wood British ship lasted longer than her American rival which was built of soft wood, but the first cost was considerably higher—some 25 per cent—and in any circumstances these clippers were driven so hard that few of them lasted many years on the first class services.

Large Sailing Ships.—It was the promise of the Australian trade that caused Donald McKay to build his masterpiece, the "Great Republic" of 1853. She was the biggest ship in the world and was one of the first vessels to be rigged as a four-masted barque. Failing to obtain backing among shipowners, McKay determined to run her himself between the United States and Australia. Her registered tonnage was 4,555 and in order to keep the crew within reasonable limits she was fitted with patent double topsails and a 15 horse-power steam engine on deck for handling the yards and working the pumps. Her hull was of oak and pine, iron strengthened, and she attracted great attention. Unfortunately she caught fire and had to be scuttled while loading for her maiden voyage, so never went to sea as McKay had originally designed her. He was forced to sell her and her purchaser cut down her rig considerably but even then she was too big to be run to satisfactory profit on commercial service. She did good work trooping in the Crimean and American Civil Wars before she finally foundered, as the "Denmark" of Liverpool, in the North Atlantic in 1872.

From the early 'sixties American shipping, which until then had been predominant, suffered an eclipse and this is frequently but erroneously ascribed to the effect of the American Civil War. It is true that a handful of Confederate cruisers captured a number of ships owned in the North, and that many American shipowners transferred their big sailing ships to foreign flags in consequence. The real explanation is that American enterprise was turning towards the West, where there were golden opportunities. The conservative element would not abandon the wooden sailing ship with which they had made their reputation, while Europe had seen the advantages of steam and iron so that the handicap was changed. In the late 'sixties composite construction, that is to say wooden planking on an iron framework, became popular and such famous ships as the "Cutty Sark" were built after this fashion.

For many years the sailing ships had one great advantage over the steamers in that the huge coal consumption of the latter's machinery made it very difficult to run them at a profit on routes

where coal was dear or where the bunkering stations were far apart. As steamers became more economical this handicap was gradually removed, and the opening of the Suez Canal in 1869 forced sailing ship owners to cut down their running expenses and increase their carrying capacity if they were to compete with the steamer. Clipper freights were no longer to be obtained, and without them the fine-lined clippers could not be run at a profit. Not only would they not stow sufficient cargo, but they made it necessary to maintain a large crew. The ship rig, that is to say the sailing vessel with yards on all her masts, had been introduced in the early days of convoys and fleet tactics in order that speed might be regulated by backing the squaresails on the mizzen. It was maintained by most of the fast ships after the convoy days had ended more or less as a matter of tradition, for under all plain sail it made very little difference to the actual speed of the ship, while the barque rig, in which the aftermost mast was fore and aft rigged and the others square, meant a very considerable economy in men. Thus, although the full-rigged ship did not disappear rapidly, many of the new ships laid down were barque rigged and many existing ships were converted, while owners no longer gave orders for extreme clippers but insisted on a fair carrying capacity. Some of these vessels with fuller lines made remarkably good passages, and they were invariably more comfortable than the clippers.

Iron sailing ships also became almost universal on account of the saving on their weight in their hull, and finally the steel ship came into existence for the same reason. In the early 'nineties there was a considerable revival in the construction of sailing ships in Great Britain, invariably designed to carry the maximum load at reasonable speed with the smallest possible crew. The British yards turned out a considerable number of ships at this time but still more, proportionately, were built for French owners who had the greatest assistance in running their ships by the navigation bounties offered by the Government, bounties that were so considerable that it paid a shipowner to take a sailing vessel round the world without a ton of cargo on board. The Germans also built a number of large sailing vessels, some with auxiliary machinery, principally for their trade with the nitrate ports on the West coast of South America.

The American sailing ship owners lost the greater part of their enthusiasm for square rigged ships when the trans-Continental Railways finished the Californian trade, although a few were built even into the present century. The "Atlas" of 1902 was their last big iron ship, but some owners favoured the wooden construction with which they had made their name right into the 'nineties, the "Aryan" of 1893 being the last. Until a very much later date, however, American owners took an interest in the multiple masted schooners which they made peculiarly their own. Although they were sent on ocean voyages these schooners were particularly adapted for the American coastal trade, where they carried large cargoes with very small crews; the wooden 6-masted "Wyoming" (3,730 tons built in 1909) and the steel 7-masted "Thomas W. Lawson" (5,218 tons built in 1902) were extreme specimens of this type.

Modern Sailing Ships.—The Germans have continued to build a number of big sailing vessels, both with and without auxiliary power, until the present day. One reason for this is that the German regulations insist on sail training before an officer can receive any of his certificates. The "Padua" built in 1926 of 3,064 tons gross is a fine example of these ships. More economical in men are the auxiliary schooners, with square topsails on alternate masts, built by the Vinnen Company after the war, of which the "Werner Vinnen" of 1,859 tons, built 1922, may be taken as typical. The Danish East Asiatic Company had a big auxiliary training ship rigged as a five-masted barque built at Leith in 1921, the "Köbenhavn," of 3,901 tons.

Apart from these, however, and a few sail training ships built for naval purposes, the large sailing vessels now at sea are principally old ships which have passed under the various Scandinavian and other flags to be run as cheaply as possible at the end of their days. The last surviving British square rigged ship at sea (1929) is the "Garthpool," a four-masted barque of 2,842 tons built as the "Juteopolis" in 1891.

During the World War a large number of wooden auxiliary schooners were built, as rapidly as possible, to replace losses caused by the German submarine blockade, but the great majority of these have been broken up since the Armistice.

INTRODUCTION OF STEAM AND IRON

A revolution in the history of the ship may be said to have occurred with the changes from sails to steam engines for propulsion and from wood to iron for construction. These proceeded together, but at first very slowly. Conservative tendencies in many quarters, notably at the British Admiralty, strongly resisted the introduction of the steam ship, while the marine engine itself was undoubtedly somewhat imperfect and extravagant in fuel in its early stages. As already stated, there was still much ignorance of the principle of flotation by displacement, and it was urged by the unenlightened that iron would not float and was therefore unsuitable for ship construction. Even amongst those who realised the fallacy of this argument it was asserted that an iron ship would be far more easily damaged in the event of her touching the ground than a wooden one, while there existed the very real difficulties of preserving the bottom from the action of the sea and fouling by weeds and barnacles, and of compensating the compass for the errors produced by local attraction. With regard to the strength of the ship, experience showed that iron construction was better able to withstand rough usage than wood, and examples were not lacking of iron and wooden ships being stranded together by the same gale and under similar circumstances and the iron ship getting off little the worse, while the wooden ship became a total wreck. A remarkable instance of the endurance of iron ships was that of the "Great Britain," which, in 1846, ran ashore in Dundrum Bay in Ireland and settled on two detached rocks; she remained aground for eleven months, was subsequently got off, and afterwards did good service. In due course a suitable composition was discovered for painting the underwater surface of iron ships, while trials carried out in the "Rainbow" at Deptford and the "Ironside" at Liverpool went far towards providing the solution for correcting the compass.

One of the earliest iron craft on record was a boat apparently intended for passenger service, built on the banks of the river Foss in Yorkshire in 1777. In 1787 a canal lighter was constructed with a shell of iron plates, and for many years iron and wood were used in conjunction for the construction of what were known as composite ships.

For warships iron was at first objected to because it was thought that the enemy's shot would cause more serious damage to them than it would to a wooden ship, but this again was proved to be a fallacy.

PADDLE WHEEL STEAMERS

In 1786, James Rumsey drove a boat on the Potomac four miles an hour by means of a power pump. About the same time John Fitch produced his oar-driven steamboats. A more practicable device was to be the paddle wheel. The "Charlotte Dundas," constructed by Symington in Scotland in 1801–2, was one of the earliest of these vessels. She proved her utility for towing work on the Forth and Clyde Canal. Fulton, having witnessed the success of this craft, in 1807 constructed the "Clermont" on the Hudson River in America. The engines for the vessel were made by Boulton and Watt in England. She proved very popular as a passenger boat between New York and Albany. The first steamer to make a regular sea voyage was the "Phoenix" which, in 1809, steamed from Hoboken in New Jersey to Philadelphia. In 1812 Bell produced his steamer "Comet," which carried passengers between Glasgow, Greenock and Helensburg. She was 42 feet long, 11 feet broad, 5½ feet deep, and was driven by a one-cylinder engine. The success of these early steamers soon produced others, and in 1814 there were five steamboats on the Thames, while the "Marjorie," built on the Clyde, was brought through the Forth and Clyde Canal and then down the East Coast to this river.

In the United States the monopoly that had been granted to

Robert Fulton to maintain steamships on the waters about New York tended to check progress for a time, although it is doubtful whether he would have been able to develop his steamers so rapidly had it not been granted. As other inventors and engineers found themselves able to construct steamers Fulton's monopoly forced them further afield, and resulted in the development of the steamship business on other American waterways and then along the Eastern coast of the United States.

Similarly in Great Britain the steamship was first only used as a passenger carrier and tug along rivers and canals, but gradually increased competition forced the steamer to seek other spheres and in doing so she found herself able to perform short coasting voyages. She then became a passenger carrier along the coast to the various holiday resorts, her novelty being her principal attraction. It was not long before it was realised by the owners that the steamship was capable of very much more than this and vessels were built to cross the North Sea, the Straits of Dover and the Irish Sea. They were all modelled on the sailing ships that they replaced and all carried auxiliary sail either on masts or on their funnel, while the low-pressure machinery was very wasteful and incapable of giving any considerable speed. The various methods of propulsion which had been experimented with in the eighteenth and earliest years of the nineteenth centuries, including a rudimentary screw propeller and jet propulsion, gave way to the side paddle wheel which remained in favour for many years.

Atlantic Crossing.—It was not long before steamship owners aspired to cross the Atlantic by steam. The sailing packet "Savannah," which had been designed to run on the service between New York and Havre, was given auxiliary steam machinery and crossed the Atlantic from Savannah in May and June 1818. She only used her engines for 80 hours of the voyage, but arrived in Cork with her coal consumed. Afterwards she visited the Baltic, where she aroused great interest. Although this is generally recorded as the first steam Atlantic crossing, the small use to which she put her machinery really robs her of that honour.

The ship to which it really belongs is very generally omitted in the histories, the Dutch steamer "Curaçao." She was built at Dover in 1826 for the cross Channel service and was then renamed "Calpé," a wooden paddler of 438 tons register whose paddles were driven by independent engines. As soon as she was completed she was purchased by the Dutch Government as a man-of-war but was employed on the mail service to their West Indian Colonies. She left Rotterdam on her first passage to the West Indies in April 1827 and took a month to do the voyage, after which she made the regular sailing each year, until she was required as a warship during the troubles in Belgium in 1830, after which she never returned to the mail service.

The next steamer to perform the feat was the "Royal William," whose performance was particularly remarkable on account of the fact that she was built in Quebec with the idea of running from that port to Halifax. Samuel Cunard, who afterwards founded the great Atlantic company, was one of her owners. Trade depression and an epidemic of cholera spoiled her chances on the trade for which she was designed and she did no better as a tug. Her owners, being forced to consider her sale and thinking that they would get a better price for her in Europe than in Canada, sent her across the Atlantic in 1833. She took 25 days to do the passage and burned 330 tons of coal. Afterwards she was sold for £10,000 and later served in the Portuguese Navy as a transport and in the Spanish Navy as a warship until she was finally condemned in 1847.

Regular Atlantic Passages.—These early steamship passages across the Atlantic were more or less haphazard, but it soon became the object of the owners to provide a regular service. Pending the construction of suitable tonnage the 703-ton steamer "Sirius," which had been built for the Irish Sea service, was chartered in 1838 by the British & American Steam Navigation Company. She was considered a big steamship in her day and was one of the first steamers to be fitted with a condenser instead of using salt water in her boilers, one of the milestones of steam engineering at sea. She sailed from London to New York by way of Cork with 100 passengers and although she was grossly overloaded to modern ideas she made the passage in safety. Within a few hours of her arrival in New York a very much bigger and finer steamer, the "Great Western," which had been constructed with the idea of continuing the Great Western Railway across the Atlantic, arrived after a crossing of 15 days from Bristol. She had a tonnage of 1,440 and was regarded as the finest steamship of her day.

After this several other Atlantic liners were built but all the services were irregular and maintained by a heterogeneous collection of ships, suitable and unsuitable. It was when Samuel Cunard founded the line which still bears his name in the year 1840 that a new policy in shipping produced a revolution in shipbuilding—the construction of sister ships. He started operations with four transatlantic ships and one small feeding steamer in Canadian waters.

The sister ships "Britannia," "Acadia," "Columbia" and "Caledonia" were wooden steamers built on the Clyde, their tonnage according to the rule then in use being about 1,150 on dimensions 207 feet by 34 ft. 2 in. by 22 ft. 2 in. depth of hold and their two-cylinder side-lever paddle engines of 740 I.H.P. being sufficient for an average speed of nine knots in favourable circumstances. The coal supply of these ships was the chief anxiety of their designers, and their passenger accommodation was not equal to the sailing packets which they rivalled, but the regularity of their passages compensated for the fact that they were frequently beaten by the sailing ships in a fair wind. They were barque rigged and had a considerable area of canvas which was set whenever circumstances were favourable.

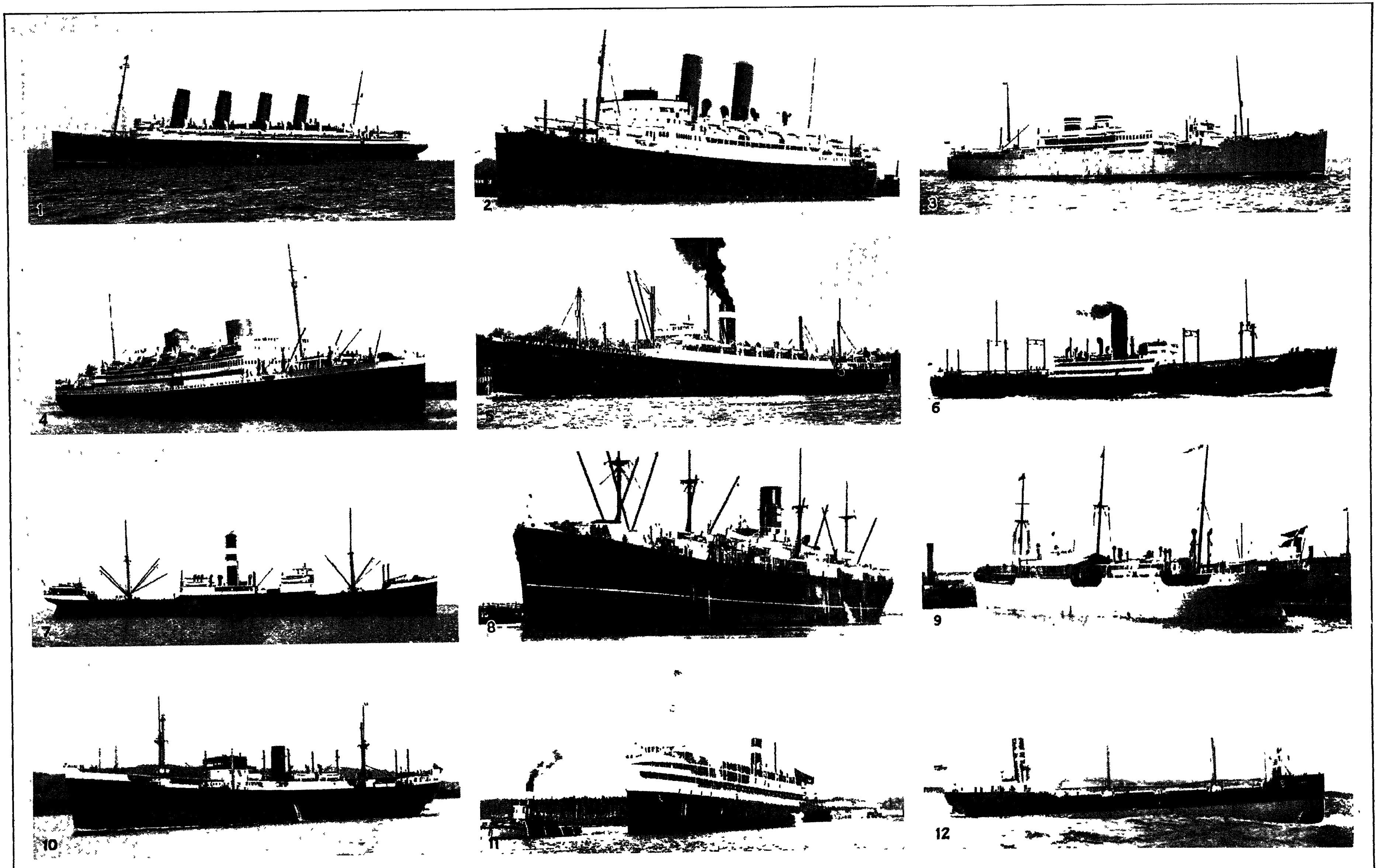
Long Distance Steamers.—In the meantime, although the North Atlantic crossing had attracted popular attention to the exclusion of most other services, great progress was being made in the long distance routes. When the General Steam Navigation Company, the oldest British purely steamship company, was founded in 1824 its promoters had the intention of running steamship services all over the world as material improved, and had every confidence that this would come about.

In 1825 the steamship "Enterprise" had proved that it was possible for a steamer to reach India, although at the same time she proved that it was not a commercial proposition. It had been suggested in 1822 to establish a company for the purpose of maintaining a steam service to India and a naval officer was sent out to arouse popular enthusiasm. Within two years 80,000 rupees had been raised in Bengal by public subscription, to which the Government of India added 20,000 rupees and announced that the whole sum would be given as a prize to the first steamer that could contrive two round voyages between Great Britain and India before 1826, the stipulated time for each passage being 70 days.

This prize caused a syndicate to purchase the paddle steamer "Enterprise" of 479 tons when under construction on the Thames and to fit her out with a fore-and-aft rig to compete for the prize. Her dimensions were 122 feet by 27 and she had an engine of 120 nominal horse power which was designed for nine knots speed but which could be relied upon for six or seven only. She sailed from Falmouth on August 19, 1825 and reached Calcutta 113 days out, including ten days spent coaling at St. Thomas and the Cape of Good Hope. The Government of India awarded her half the promised prize and then purchased her as a warship.

The long route by way of the Cape having proved unprofitable for steamers, the East Indian Government surveyed the Suez route and had steamships built to maintain a more or less regular service from Bombay to Suez, whence the mails and passengers were conveyed across the Isthmus to the Mediterranean. In the early days of the service the European end was maintained by sailing vessels.

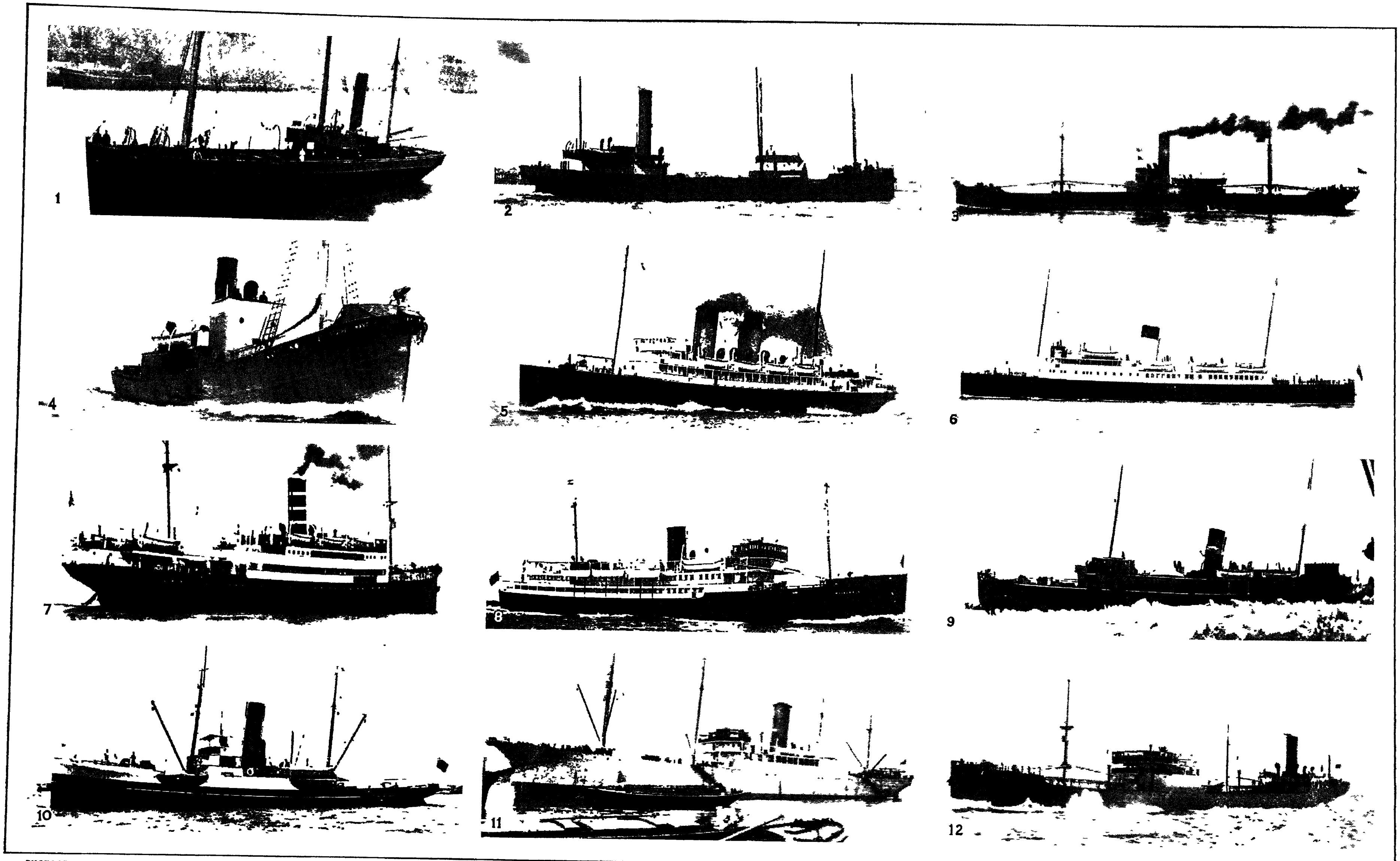
The improvement and finally the real practicability of the overland route was brought about by the Peninsular and Oriental Line, which started in 1834 to maintain a mail service between Great Britain and the Spanish and Portuguese ports in competition with the sailing mail packets maintained by the Government. It was then the Peninsular Line, but in 1839 the service was ex-



BY COURTESY OF (1) THE CUNARD STEAMSHIP COMPANY LTD.; PHOTOGRAPHS, (2-12) THE NAUTICAL PHOTO AGENCY

MODERN PASSENGER AND CARGO SHIPS

1. The four-funnel passenger liner "Mauretania," the fastest ship crossing the Atlantic in 1928. 2. "Duchess of Bedford," 20,000 ton cabin-class ship for the Canadian trade, the latest of her type. 3. A 14,500 ton intermediate liner, "Highland Monarch," used for the South American trade. 4. "Asturias," first-class 22,000 ton motor liner for South American trade. Shape of funnel obviates possibility of exhaust echo's confusing officer on watch. 5. "Minnekahda," a post-war liner devoted to the third-class tourist trade and the carrying of cargo. 6. "Beaverburn," modern transatlantic cargo liner, a type credited with remarkable speed and economy. 7. "Dramatist," a typical steam cargo liner. 8. "Suffolk," one of a fleet of frozen-meat carrying ships that serve the Australian trade. 9. "Selandia," a small 4,950 ton craft built in 1912. This ship was the first ocean going motor ship. 10. "Clan Macdonald," an up-to-date motor cargo liner. 11. "Naronic," passenger carrier of the type in common use on the Great Lakes. 12. "Livingstone," a modern Canadian grain carrier for the Great Lakes trade, designed to pass through Welland Canal and unload alongside ocean-going steamers



PHOTOGRAPHS, THE NAUTICAL PHOTO AGENCY

DIFFERENT TYPES OF STEAMSHIPS

1. "John Bowes," the first steam collier, as reconstructed and now running
2. "Felspar," modern British coasting collier
3. "Sheafarrow," modern ocean collier built on the arch principle
4. "Southern Wave," late type of whale catcher as used in the Antarctic
5. "Hibernia," typical of the standard type of turbine packet in British waters for many years
6. "Worthing," an up-to-date British packet with closed-in deck. The single funnel interferes as little as possible with passenger accommodations
7. "Leda," a medium-speed Norwegian packet, typical of the vessels crossing the North Sea
8. "Waialeale." This steamer shows the latest trend in American packet design
9. "Minto," a modern icebreaker
10. "Rescue," a tug of the type used for salvage work
11. "Dominia," modern, large-type cable ship
12. "El Oso," typical tank steamer of the post-war period

tended to Alexandria to connect with the East India Company's steamers and the company became the Peninsular and Oriental Line. It was not until 1854 that the East India Company abandoned its end of the service, although its irregularities and the poor steamships employed on it were the cause of constant complaint.

Steamships of a type practically identical with those of the Cunard Line, but of rather greater tonnage varying from 1,700 to 1,900, were built in 1839 for the West Indian mail service for which the Royal Mail Steam Packet Company had obtained a Royal Charter. At that period the British West Indian colonies were of much greater importance than in more modern times, and the service was heavily subsidised in order to overcome the very great difficulties of coal supply on the route. This service was afterwards extended to the Brazilian coast and the River Plate, causing a steady increase in the size of the ships, although they were for long built on the same principle.

This was very largely due to the fact that the Admiralty had a considerable influence on their design in return for the mail subsidy, and insisted on the ships approximating the wooden paddle frigates of their day whose vulnerability, although frequently pointed out by experts, had not yet been proved in action. The hulls therefore all followed approximately the same lines, the owners only being allowed a reasonably free hand in the matter of machinery, in which the economy which was so essential was steadily improving.

The Screw Propeller.—Private shipowners who were untrammelled by the conditions of their subsidy were anxious to improve on the paddle wheel and in 1836 both Francis Pettit Smith, an Englishman, and Captain John Ericsson, a Swede, patented practical screw propellers although the principle was not new. The year 1839 saw a ship built to each of these principles, the "Archimedes" to Smith's patent and the "Robert F. Stockton" to Ericsson's. They were neither of them large vessels, but they both proved the superior economy and power of the screw and led to more important ships being built.

The most important of these steamers was the "Great Britain," which was laid down in dry dock at Bristol in 1839 and floated out in 1844. She was not only noteworthy on account of her dimensions, which were 322 feet by 51 by 32 feet 6 inches depth of hold, which gave her a tonnage of 3,448 according to the old burthen measurement, but also because she was constructed of iron in spite of the great prejudice of the Navy against that material. She was designed by I. K. Brunel, whose intention was originally to make her a paddle steamer. But he was so greatly impressed by the performances of the "Archimedes" on a cruise round the British coast that he altered it and fitted screw machinery, reinforced by a big sail area on six masts.

Her machinery consisted of a simple engine with four cylinders each 88 inches in diameter, with a stroke of 72 and with indicated horse power of 2,000 at five lb. per square inch pressure, a speed of twelve knots being obtained on trial. Her stranding on the Irish coast in 1846, when she had to withstand the gales of a whole winter in an exposed position, finally convinced shipowners that iron construction was both strong and practical.

In 1847 the Americans brought out their first transatlantic steamers to their own ideas, the "Hermann" and "Washington," which were run by the Ocean Line between New York and Bremen by way of Southampton in return for a heavy subsidy. They were ships of 1,850 tons each with paddle engines of 1,400 tons, giving them a speed of eleven knots, their hulls being on the lines of the less extreme Atlantic sailing packets. They maintained their service with fair success until the reversal of the United States subsidy policy in 1857, when they were sent to end their days in the Pacific. In 1850 a second American transatlantic service between New York and Havre was started with the "Humboldt" and "Franklin."

American Atlantic Design.—The straight stem of these two ships made them differ greatly in appearance from their British rivals and was purely an American conception which was introduced by Mr. E. K. Collins when he started the Collins Line under the American flag in 1849. The first fleet consisted of the wooden paddle steamers "Atlantic," "Arctic," "Baltic" and "Pacific," practically sister ships of 2,860 tons, with beam engines of 2,000 I.H.P. They were a great improvement on the existing material and although they were so well built and extravagantly fitted that it was necessary to obtain an additional subsidy they were the most noteworthy ships on the Atlantic in their day. In 1856 they were joined by the "Adriatic," of 5,888 tons gross with engines of 4,000 I.H.P. designed for a speed of 13½ knots, which marked the high water mark of American paddle steamer construction on the Atlantic. When the subsidy on which the company relied was suddenly withdrawn after two disasters the service collapsed and although Commodore Vanderbilt constructed somewhat similar ships to maintain the Stars and Stripes on the Atlantic they were soon withdrawn and for over thirty years American steamship development was practically confined to the rivers and coasts of the country, and the Pacific trade.

While these big paddle steamers were being built the screw propeller was being introduced into European Atlantic companies, beginning seriously with the foundation of the Inman Line in 1850. This company, which was intended to improve the emigrant service, began with iron screw steamers—the first of under 2,000 tons—barque rigged and still maintaining a full spread of canvas. Its example was soon followed. The North German Lloyd and Hamburg American Companies in Germany, and the Compagnie Générale Transatlantique in France, saw the opportunities of the great Continental fields of emigration with up-to-date steam tonnage and were soon encroaching on the third class traffic which was the last stronghold of the sailing packet.

The Cunard Line was endeavouring to carry on in its traditional way, in spite of the fact that by then the naval conditions were considerably relaxed, but it was gradually being forced into line. For its mail ships it remained faithful to the paddle until the early 'sixties, the "Scotia" of 3,871 tons which was launched in 1862 being the last and finest of the type. It had, however, changed from wood to iron with the "Persia" of 1856 and had purchased the screw steamer "British Queen" of 773 tons in 1850. On the experience gained with her the company had the "Alps" and "Andes" built for the West Indian service in 1851 and were so satisfied with them that the screw steamer "China" of 2,529 tons was practically contemporary with the "Scotia" and in spite of her smaller size showed her advantages in competitive service trials.

The "Himalaya."—In 1853 the Peninsular and Oriental Line, although they were not destined to abandon the paddle for some years afterwards, built the iron screw steamer "Himalaya" which was the biggest vessel of her type in the world, having a gross tonnage of 3,438 on dimensions 340 by 46·2 by 34·9 feet depth of hold. Her trunk engines gave her a speed of 13·9 knots on trial, and yet were sufficiently economical to permit her to stow enough fuel to undertake long voyages under steam which showed a profit. After one or two voyages on her owners' service she was taken up as a transport for the Crimean War and so impressed the Admiralty that they bought her and employed her as a naval trooper until the 'nineties. She was then converted into a coal hulk and still (1928) performs that duty at Portland.

"Great Eastern."—The "Great Eastern" is perhaps the most discussed steamship that has ever been built, and the most historic failure. She was originally conceived by Mr. I. K. Brunel on the success of the "Great Britain," and in 1851 a company was floated for the purpose of building her and trading to the East. At that period steam navigation to the East and Australia was greatly handicapped by the lack of coaling facilities, and the "Great Eastern" was specially designed to ply between England and either Calcutta or Colombo, where smaller steamers and sailing vessels could pick up her cargo and passengers and distribute them to various destinations. Her dimensions of 692 feet on the upper deck by 82·5 feet beam and 30 feet draught gave her a gross tonnage of 18,914, and it became necessary to take particular precautions that her hull should have the requisite strength. She was therefore not only given a double bottom, but a tubular upper deck and was one of the strongest ships ever

built. The hull and the paddle engines were built by Messrs. Scott Russell and Co. on the Thames, while James Watt & Co. of Birmingham built the screw engines, for Brunel had decided to provide alternate methods of propulsion, the greatest fault in the original design. Mr. Scott Russell of the building firm designed the details of her hull and gave her the wave line principle in which he believed. The paddle engines indicated 3,411 horse power, while the screw engines which drove a four-bladed propeller indicated 4,886. Altogether 6,500 square yards of canvas were set on her six masts and she was fitted with ample bunker accommodation for a long voyage, in addition to large holds and passenger accommodation.

Fearing for the narrowness of the river, Brunel insisted that she should be launched broadside on and was so anxious to avoid the huge mass taking charge that he checked her too soon on the ways and she stuck fast for three months. This delay, and the subsequent work of launching her, drove the original company into liquidation and she was purchased for use on the North Atlantic, a service for which she was not designed and was most unsuitable. The result was that she was a most expensive failure except for the excellent work that she did in laying the Atlantic cable.

By this time the screw steamer was invading most of the trades of the world, including the coastal. The Americans were building up a fine coasting fleet to their own requirements, differing very materially from European ideas of design. Most of the European nations were following suit, while steam colliers were even invading the coal trade between the North East coast of England and the Thames, which was regarded as the stronghold of the sailing ship. The first was the 273-ton "Q.E.D." which was really an auxiliary, schooner rigged, with the smoke from her low-powered screw machinery carried up through her mizzen mast. This vessel made her appearance in 1844. Eight years later, however, the first real iron steam collier was put into service, the "John Bowes." This steamer had dimensions 151 ft. 9 in. by 26 ft. 3 in. and was one of the first ships to be fitted with tanks for water ballast. Rebuilt out of all recognition, she is still busy on the Spanish coasting trade as the "Valentin Fierro."

A far more important result of her success was that it caused the introduction of the steam tramp, a cargo vessel which was open to charter on any trade instead of running to a definite schedule. Before that time all steamers were built for definite services and chartering for bulk cargoes was unusual, this business being left almost entirely to the sailing ship.

The Expansion Engine.—Increased economy was still the aim of the engineer, and this led to the introduction of the expansion engine, in which the steam was used in a second cylinder at a lower pressure after it had done its work in the first. It was an invention of James P. Allaire, the American engineer, in the year 1824, but at that time it failed owing to the low pressure used. As steam pressure increased John Elder, the head of what is now the Fairfield Yard on the Clyde, brought out his compound engine which employed the steam in two stages, and which did much to overcome the disadvantages of the steamship on long routes on which coaling stations were rare.

The first vessel to be so fitted was the "Brandon" of 1854, a screw steamer designed for the trade between London and Limerick, and fitted with a vertical engine having the cranks diametrically opposite to one another. Her coal consumption on trial was returned as 3¼ lb. per I.H.P. per hour, as compared with the 4 to 4½ lb. which was the utmost economy to which the simple engine could aspire. Although built for a short distance service she was employed as a transport in the Crimean War and her success caused the compound engine to be very generally adopted, while the steam pressure steadily increased.

As this pressure increased it became possible to add a third stage to the engine and triple expansion machinery came into being. In France this system was sponsored by M. Benjamin Normand of the famous firm of Havre shipbuilders, who took out a patent in 1871 and installed his first set two years later. In England a patent was taken out by Dr. A. C. Kirk, a colleague of John Elder, who tried a triple expansion engine and machinery first in 1874 in the 2,083 ton steamer "Propontis."

Water Tube Boilers.—The original installation of the "Propontis" was fed by water tube boilers, in which the water passed in tubes through the flame instead of the flame passing in tubes through the water as in ordinary mercantile practice. These boilers, which are now generally adopted in all navies and in many merchant ships, had already been introduced in France but had given much trouble. Those installed in the "Propontis" were no more satisfactory than those of French men-of-war which had been so fitted in the 'forties and she is generally described as a failure, but when new boilers were installed with reduced pressure she continued to work satisfactorily for many years.

In 1881 the "Aberdeen" of 3,616 tons, designed to run on the Australian trade in which economy was more obviously necessary than in any other, was fitted with Kirk's triple expansion engines. On trial she reduced her coal consumption to 1·28 lb. per I.H.P. per hour and was a most satisfactory vessel on service, although this abnormally small consumption was naturally increased under working conditions. Her success caused a very large number of steamers of all kinds, which had originally carried compound engines, to be tripled by the addition of a third cylinder during the 'eighties and 'nineties.

At the end of the nineteenth Century steam expansion was taken one stage further and a few quadruple expansion engines were built for marine use, but their employment was strictly limited.

Twin Screws.—In 1862 the first full-powered twin screw steamer, apart from certain experiments in the very earliest days of steam, was built on the Thames. She was the 400-ton "Flora" and although her builders, Messrs. Dudgeon, made a speciality of twin screw steamers and built the far larger "Ruahine" in 1865 for the Panama, New Zealand and Australian Royal Mail Company, the idea did not attract the liner companies until the "Notting Hill" of 1881 proved the advantages of the system on the North Atlantic. Even so the single screw was not abandoned at once and as recently as 1896 first class liners were built with one shaft only, in spite of the uneasiness caused by several serious accidents.

As the power of ships increased the danger of broken shafts was multiplied, and triple and quadruple screw ships came into being at a later date, although serious disadvantages were involved.

Turbine Ships.—The experimental "Turbinia," built at Wallsend on the Tyne in 1894 and given turbine engines invented by the Hon. Charles Parsons, revived one of the earliest principles of employing power and proved that it was capable of being used at sea. Her dimensions were 100 feet by 9 feet beam by 3 feet draught, her displacement being 44½ tons. The original machinery installation consisted of three steam turbines, totalling 2,000 shaft horse power and each driving a shaft carrying three screws in order to overcome the disadvantages of high propeller speed. During the Diamond Jubilee Naval Review of 1897 she was taken down to Cowes secretly and suddenly dashed out among the assembled ships at what was then the astounding speed of 34½ knots. Naturally she caused a great sensation and the Admiralty built two turbine-engined destroyers which unluckily came to grief, the one by stranding and the other owing to her light construction. There was a tendency to blame the machinery, which had nothing to do with either mishap, and it was some time before Mr. Parsons could persuade commercial shipowners to take an interest in his invention.

The "King Edward" of 1901 was the first merchant steamer to be given turbine machinery, a Clyde passenger steamer which is still running after material alterations. She was followed by the cross Channel packet "The Queen" of 1903 which proved herself greatly superior in speed and far more economical than the paddlers which had preceded her on the service between Dover and Calais. The next important ships to be built on this system were the Allan Liners "Virginian" and "Victorian" of 1904, ships of about 10,750 tons gross each with a trial speed of nearly 20 knots. With all these ships there was a certain amount of trouble in the early days, but the turbine made steady

progress and proved its reliability in the Cunard Liner "Carmania" (19,566 tons) of 1905, which is still running with her original machinery and whose success resulted in the turbine being adopted by the Cunard steamers "Mauretania" and "Lusitania," which were the biggest and fastest liners in the world when they were built in 1907. In 1928 the "Mauretania" still held the Atlantic record which she lowered in 1910.

The 22-foot steam launch "Charmian" was the first vessel in which intermediate gearing between the turbine and the propeller was tried, the experiments taking place on the Tyne as early as 1897 and being practically contemporary with similiar experiments carried out on the Continent. It had long been realised that the efficient speed of the turbine was far too great for the propeller, which was the reason why multiple screws were fitted to the shafts of the early passenger steamers. In 1909 these experiments had produced sufficient promise to warrant the cargo steamer "Vespasian" having her old triple expansion engines taken out and turbine machinery with single reduction mechanical gearing substituted. The great increase in speed and economy which was immediately obtained drew attention to the possibilities of the turbine for cargo as well as fast passenger vessels, and from this it became evident that the gearing, whether it was single or double reduction, was of the greatest advantage even at the maximum speed so that the direct coupled turbine is now regarded as obsolete at sea. Other experiments have been made with hydraulic gearing of the Foettinger and other principles to obtain the same result, while many regard the electric drive, which is described below, as being little more than another form of gearing.

In the "Otaki," a triple screw cargo steamer built for the New Zealand Shipping Company in 1908, Messrs. Denny of Dumbarton the shipbuilders, co-operating with the Parsons Steam Turbine Company, made a successful effort to combine the advantages of the turbine and reciprocating engines. This ship was given a triple expansion engine on each of the two wing shafts, the steam exhausting from them into a low pressure turbine on the centre one. In competitive trials with two ships of similar hull design but more normal engines she averaged a knot greater speed with eleven per cent less coal consumption, although for a cargo vessel the interruption of the after holds by the three shafts was recognised as a serious disadvantage.

For passenger steamers the system promised even greater economy and was later fitted into several large liners, notably the White Star steamer "Olympic" (built 1911, 46,439 tons gross) with conspicuous success.

After the war the same idea was put forward by German engineers in the Bauer-Wach system, in which the disadvantages of the three shafts are avoided by placing the turbine directly abaft the reciprocating engines on the same shaft, with a clutch which disconnects it automatically when it is desired to manoeuvre. An economy of 15 per cent and more has been proved possible with this system, which is particularly well suited for cargo ships and which is being installed in a number of existing vessels just as compound engines were converted into triple expansion in the 'eighties and 'nineties.

HULL IMPROVEMENTS—INTRODUCTION OF STEEL

Improvements in the hulls of steamers were introduced steadily while machinery was being improved, principally with the idea of increasing the strength and carrying capacity and reducing the weight of hull necessary. Iron had shown itself to be superior to wood in these respects, and the next step forward was the introduction of steel for shipbuilding. In 1876 a small steel paddler was built for river service in Burma and in the following year the British Navy built two fast dispatch vessels, the "Iris" and "Mercury." The first sizeable merchant ship to be so built was the "Rotomahana," a ship of 1,777 tons built by Denny on the Clyde for the Union Steamship Company of New Zealand in 1879. Within a few months she was followed by a very much bigger and more important ship, the Allan Liner "Buenos Ayrean" of 4,005 tons for the Canadian mail service. Although it was recognised that steel offered advantages in every direction except, possibly, durability, to begin with its general adoption was checked by the difficulty of obtaining supplies, but in the early eighties this was overcome and many steel ships were laid down. The form of the hull was also the subject of numerous experiments in the constant effort to increase the carrying capacity on the same or smaller tonnage, and for this reason several revolutionary designs were brought forward. One of the most striking and permanent of these was the turret deck steamer which was evolved and built by the Doxford Shipyard of Sunderland. In this type a curve in the side above the water line gave a narrow deck with a broad extreme beam, and for some time it permitted a great economy in dues.

The "Turret" of 1892 was the first ship of this type and was laid down by Messrs. Doxford on speculation but bought by Messrs. Peterson Tate & Co. for the Canadian trade. Other steamship lines took up the turret deck steamer enthusiastically, particularly the Clan Line, but many of its advantages were negatived by the amendment of port and canal regulations and although these steamers were capable of carrying a very large cargo and were excellent seaboats if properly treated, in inexperienced hands they were apt to give trouble and they gradually fell out of favour.

DIESEL SHIPS

The Caspian steamer "Wandal," which was built by Messrs. Nobels in 1903, was the first sizeable ship to be given an internal combustion engine, but in her case it was used to generate electricity for the main drive.

Engines in which the charge was exploded by a hot bulb or an electric spark were found suitable for small craft soon after they had become general in automobiles on land, but their size was strictly limited. In the year 1892 Dr. Rudolf Diesel took out his patent for an engine in which the charge was exploded by raising its temperature by compression while it was still inside the cylinder, and ships propelled by such units, which have been built up to very large sizes and which many consider to be preferable to steam plants, are invariably termed "diesel-engined."

The "Wandal" was followed in 1906 by the "Venoge," a motor barge on Lake Geneva, and in 1910 the motor tanker "Vulcanus" of 1,179 tons marked a great improvement in size. Two years later the motor ship "Selandia" was commissioned by the Danish East Asiatic Company, which is still one of the principal advocates of the diesel engine, and is running successfully to this day. Her dimensions were 370 feet by 53·2 by 27·1 depth of hold, her gross tonnage being 4,950. She was a twin screw ship, each shaft being driven by an 8-cylinder four-stroke cycle engine with cylinders $20\frac{7}{8}$ inches in diameter by $28\frac{3}{4}$ inches stroke, totalling a brake horse power of 2,450 at 140 revolutions per minute and driving her at a speed of twelve knots. She was rigged as a three-masted schooner and the absence of funnel attracted general attention. Its suppression is now quite usual with some owners, while others prefer to run the exhaust from the engines up through funnels and make their motor ships practically indistinguishable from steamers.

After the success of the "Selandia," for although all the early diesel-engined ships had a certain amount of difficulty with their machinery she was a distinct success and very economical, a series of ships was built steadily improving in size, efficiency and economy. War practically held up experimental work in that connection as far as merchant ships were concerned, but the diesel improved rapidly in submarines and the Germans brought it to a very high pitch of perfection. In Great Britain the result of Admiralty experiments were also placed at the disposal of the mercantile engineers at the end of the war. Several submarine diesels were fitted into German cargo ships after the war, their speed being geared down to the efficient speed of the propeller as in the case of the turbine, with satisfactory results.

To begin with the diesel engine was more or less confined to the cargo vessel, but after the war it was realised that its adoption in large passenger vessels would mean a very considerable saving in space and running costs, although the first costs were considerably higher than in the case of the steamer. After several trials in comparatively small ships, in 1924 the "Aorangi" of 17,491 tons was built at the Fairfield Yard on the Clyde for the

Union Steamship Company of New Zealand and has proved most successful on the service between Vancouver and Australia. She was followed in 1925 by the "Gripsholm" of the Swedish American Line, a ship of 17,716 tons designed for service between Sweden and the United States. There was considerable doubt as to the wisdom of building this ship, for the diesel shows to its best advantage on long runs, but she has proved an unqualified success. In the same year a great advance in tonnage was made with the 22,000-ton "Asturias," built at Belfast for the Royal Mail Steam Packet Company, and the diesel-engined passenger liner is now firmly established. Messrs. Harland and Wolff, the builders of the "Asturias," have specialised in a big double-acting Diesel built on the lines of Messrs. Burmeister and Wain of Copenhagen, one of the earliest diesel builders, and have developed high powers.

The "Augustus" of 32,650 tons, built for the Navigazione Generale Italiana in 1927, was the largest motor liner in the world in 1928. In deference to public opinion all these large passenger motor ships have been given funnels, the majority of them two, but the builders have evolved a typical Diesel funnel, short and very stout, which does much to obviate the echo which can prove exceedingly troublesome when the exhaust is carried through a funnel of ordinary design, particularly in fog.

The relative advantages of steamships and motor ships are still the subjects of infinite discussion and argument, each type possessing very real advantages for certain work.

The Still Engine.—In the Scott-Still engine, first fitted in the Blue Funnel Liner "Dolius" of 5,994 tons in 1924, an effort is made to combine the steam and diesel systems, but although a remarkable economy has been obtained this is still in the experimental stage.

ELECTRIC DRIVE

Electric propulsion at sea, the power in that case being generated by the internal combustion engine, was first tried by Nobels in the "Wandal" on the Caspian in 1903, a vessel that has already been mentioned as the first motor ship. The German Navy adopted it in the case of the submarine salvage vessel "Vulcan" in 1907 and it was also tried in 1913 in a Canadian Lake vessel, the "Tynemount," where the current was generated by two Diesel engines of 250 B.H.P. apiece. She was followed by the Swedish "Mjolner," in which the current was generated by two turbines of 450 S. H. P. each. The American Navy, which has since brought the system up to its highest pitch of perfection, first tried it in their steam collier "Jupiter" of 20,000 tons displacement, in which the turbine generator was of the Curtiss type and where the results were so successful that the system has been adopted in their latest and biggest battleships. The "Jupiter" is now the aircraft carrier "Langley." For cruisers and destroyers, however, the United States Naval authorities have found that mechanical gearing is better.

Since the war there has been a growing tendency to favour electric propulsion for merchant ships, particularly in America, and with the benefit of the experience gained in the American Navy it has been possible to install large powers with perfect success. The most striking case is the Panama-Pacific Liner "California," employed on the intercoastal trade between New York and California. She is a ship of 20,325 tons built in 1928, her electric machinery generated by turbines giving her a speed of 18 knots. She is being followed by two sister ships. A similar installation has been chosen for the Peninsular and Oriental Liner "Viceroy of India," launched on the Clyde in 1928, and apparently for the new 1,000-foot White Star Liner under construction at Belfast.

SPECIAL TYPES OF POWER SHIPS

As the steamship improved and as the shipping business became more complicated and exacting, special types came into existence in considerable numbers.

Train Ferries.—The 417-ton steam train ferry "Leviathan," built in 1849 for the North British Railway Company to run across the Firth of Forth from Granton to Burntisland, was the first of a type which has now become quite general and which has been built to large size on several services. Almost at the same time another was built to cross the Tay at Dundee, but both these ferries were later replaced by bridges. In 1878 the Philadelphia and Reading Railroad built their first ferry steamer to run across New York Bay and in the early 'eighties the Danes started a train ferry from Korsor to Nyborg. The idea of a similar service to run across the Straits of Dover has constantly been suggested without success and an ambitious scheme for a train ferry between Sweden and England is now being discussed, but numerous difficulties have arisen in each case and the only train ferry on a large scale in Great Britain is that running from Harwich to Zeebrugge and employed very largely for the carriage of French and Italian fruit to England. The biggest ship of the train ferry type in which the trains run straight on to the rails on the deck of the ship is the "Contra Costa" in California, a wooden vessel with a gross tonnage of 4,483, built in 1914, but big vessels are now building and projected in which the rolling stock is lowered on to the rails by cranes.

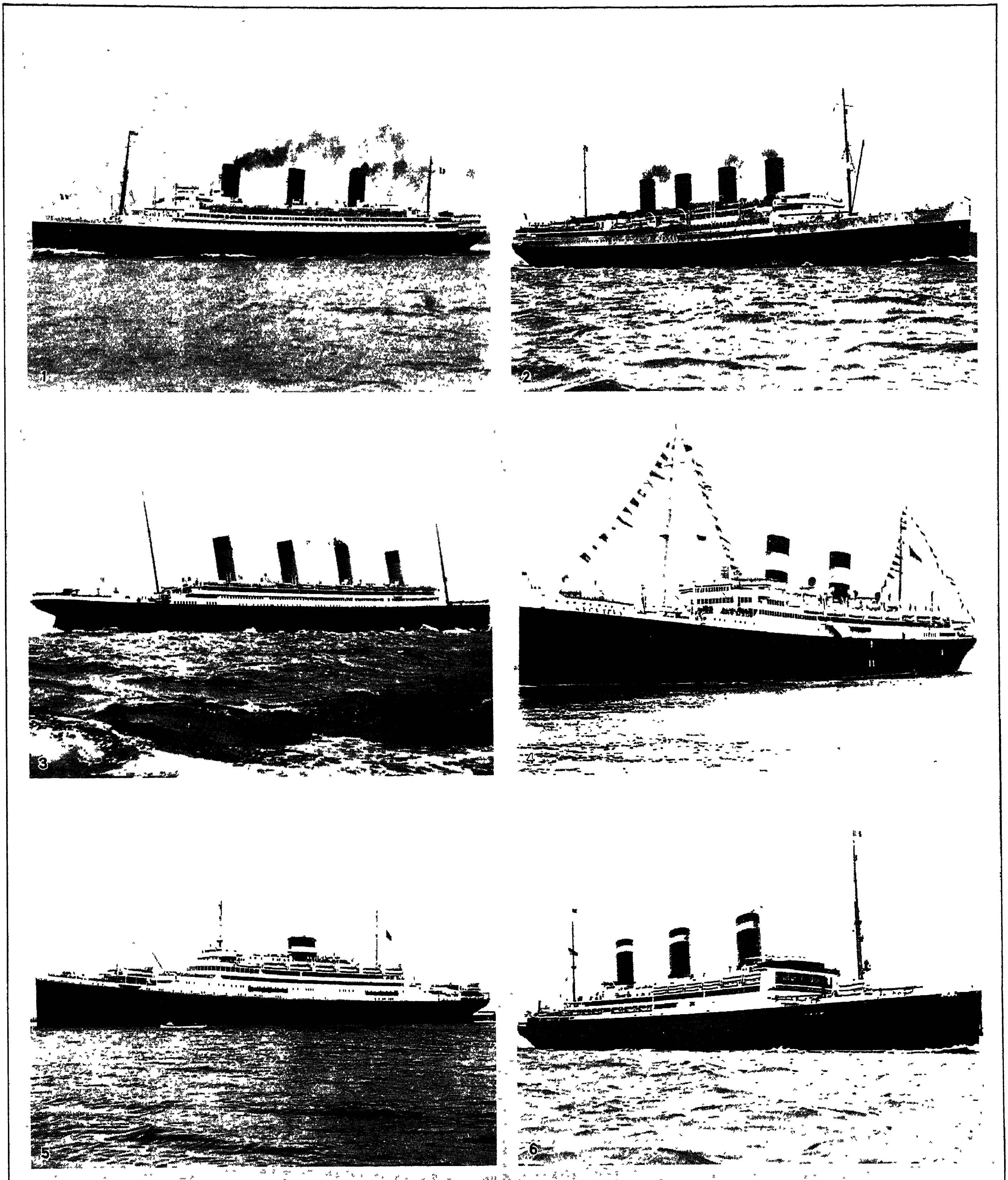
Steam Trawlers.—In the early 'seventies several attempts were made to introduce steam trawlers in the South of England, but they were not successful. Some years later a shipping slump caused numerous steam tugs to be laid up and the experiment was tried of using some of these for trawling. Most of these were paddlers, the first being the "Messenger" which made her first trip to the fishing grounds in 1877, but the experience gained in her and other converted ships showed that the paddle was unsuitable for the purpose. Experiments with screw boats were tried in the early 'eighties and were an immediate success, the design developing rapidly and producing some of the finest sea boats afloat. At the present time practically every maritime country has its big fleet of power trawlers and drifters. The internal combustion engine has made great strides in vessels of this type recently and electric machinery has also been tried on occasions.

Icebreakers.—"Eisbrecher I.," launched in 1871, was the first specially designed icebreaker to be built. She was planned on the experience gained a few years previously by a Russian shipowner named Britneff, who reconstructed the bow of the steamer "Pilot" in such a way that she could be driven on to the ice in the hope that she would break it by her own weight. In practice she was too small and light for this purpose, but the idea was appreciated and is embodied in all modern icebreakers, some of which run to a large size.

Tankers.—The increased consumption of oil for various purposes made it necessary to evolve some means of carrying it in bulk instead of in barrels as it had been carried from the earliest days of whaling. The first suggestion was in 1863, when the sailing vessel "Ramsey" had a few tanks built into her hold to carry oil in bulk in addition to stowing barrels in the ordinary way in her 'tween decks. From 1869 to 1872 the sailing vessel "Charles," of 794 tons, was carrying oil in 59 iron tanks which were built into her holds and which completely filled them. The problem of keeping ironwork oil-tight was not then fully understood and these tanks were far too weak, with the result that in the working of the ship under sail constant leaks developed and eventually she was burned at sea. Several other ships were converted in similar fashion, mostly for the trade across the Atlantic to Havre and Antwerp, but they were all failures.

In 1872 the Red Star Line of Philadelphia started a new system by having the steamship "Vaderland" of 2,748 tons built by Palmers on the Tyne with the idea of carrying a large cargo of oil in bulk in addition to her passengers. All the authorities were against this scheme on grounds of safety, and she was used for passenger and cargo only, as were also the "Nederland" of 1873 and "Switzerland" of 1874 which were designed on similar lines. This prohibition of the carriage of oil in passenger vessels exists to-day.

In 1879 Nobels, who have already been noted for their work in building the pioneer motor and electrically driven ship, built a number of tank steamers to carry oil on the River Volga and attained considerable success with them. These steamers attracted some attention at the time, but the idea that oil would be safer in a sailing vessel than a steamer was still generally held and in 1886 the sailing ships "Andromeda" and "Crusader" were fitted



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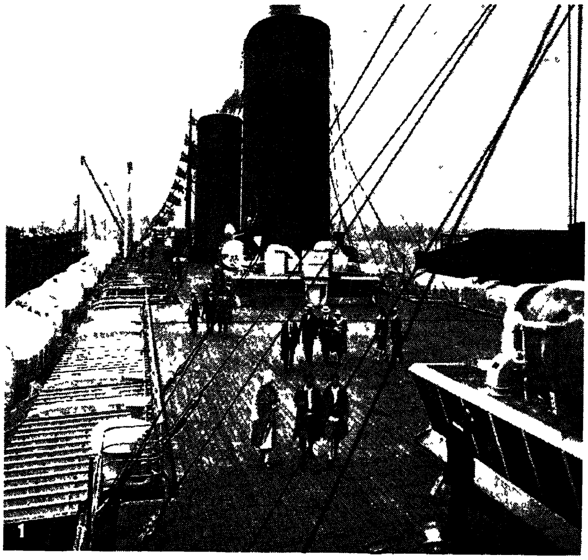
MODERN TRANSATLANTIC SHIPS

1. S.S. "Île de France" of the French Line
2. S.S. "France" of the French Line
3. S.S. "Olympic" of the White Star Line
4. Motorship "Augustus," of the Navigazione Generale Italiana Line
5. Motorship "Saturnia," of the Cosulich Line
6. S.S. "Leviathan" of the United States Lines, Inc.



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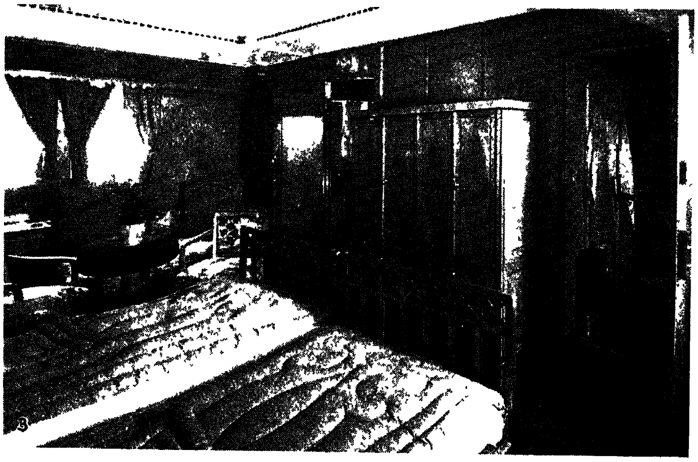

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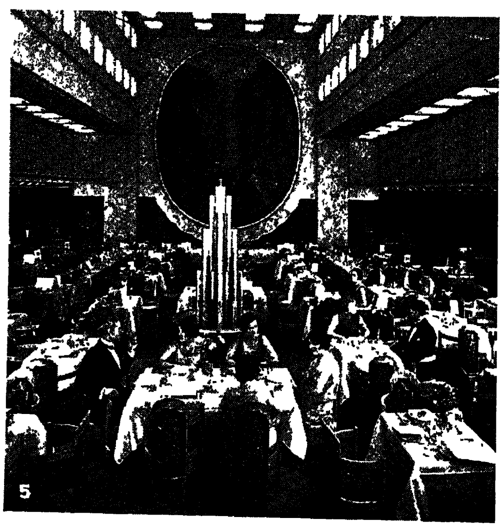

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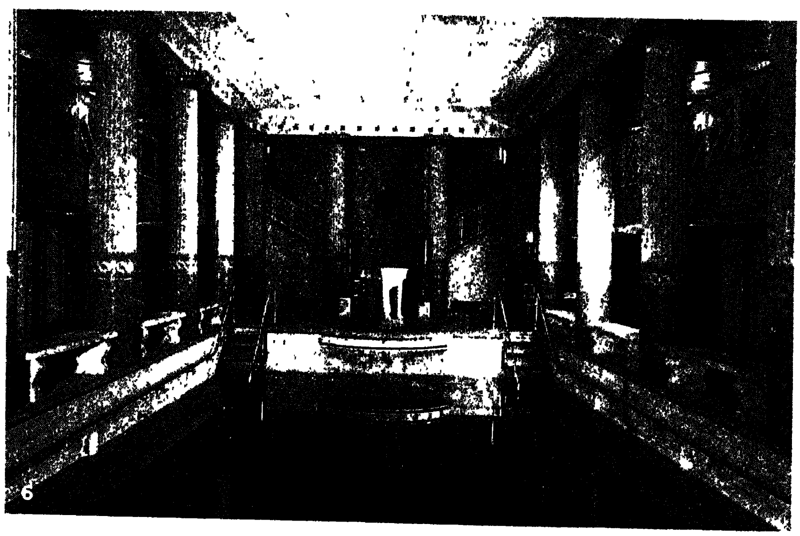

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BY COURTESY OF (1, 2, 5) THE FRENCH LINE, (4) THE INTERNATIONAL MERCANTILE MARINE COMPANY, (3, 6) THE CUNARD STEAMSHIP COMPANY, LTD.

SCENES ON SHIPBOARD

1. Looking along the upper deck of the S.S. "Île de France." Passengers promenading; life-boats seen on both sides of ship
2. Café terrace, comfortably furnished on one of the lower decks of the "Île de France"
3. Large stateroom in the "Berengaria"; every convenience possible has been installed
4. Smoking room, first class, in the "Virginia," Panama Pacific Line steamer, early American period design
5. Spacious dining saloon embodying all features of the modern up-to-date restaurant, "Île de France"
6. Swimming pool for the passengers on board the "Berengaria"

with cylindrical tanks on an improved system for the purpose. Their designers attained a considerable measure of success in making their tanks oiltight, but in the same year the firm which is now Messrs. Armstrong Whitworth and Company and which still makes a speciality of tanker construction, designed and built the first real tank steamer on modern lines.

The "Gluckauf" had a deadweight capacity of 3,000 tons and a speed of 10½ knots, her engines being placed right aft for safety as is still almost invariably done in tankers. Her hull was subdivided into tanks and arrangements were made for pumping them on a principle which is still used.

Since the war a large number of tank steamers have been built, although it is one of the most difficult trades to cater for and to maintain. In spite of numerous experiments it remains almost invariably a one-way cargo, so that the ship has to be exceedingly economical on account of the return journey in ballast. A large cargo is desirable for the ocean route and 13,000 tons deadweight and more is now quite a usual size, while the speed seldom exceeds eleven knots. On account of their tremendous length and unequal strain, the design of these tankers involves very careful considerations of strength and the majority of modern types are built on the longitudinal system, with great attention paid to fore and aft stresses.

Packet Steamers.—When the screw superseded the paddle for overseas work, the older fashion survived in the excursion steamers round the British coast, where shallow draught was generally necessary to get alongside the piers, and in the cross Channel services. The growing Continental trade and the limitations in draught imposed by the French and Belgian harbours brought the paddle packet steamer to a high pitch of perfection in the last days of the 19th century, ships of well over 2,000 tons gross with a speed of 22 knots and excellent seaworthiness being built in considerable numbers, mostly on the Clyde. No more of these big cross Channel paddlers were built after the turbine had proved its possibilities, but many other steamers propelled in this way, much smaller and rather slower, were built for the various excursion routes in the summer. Most of these again were excellent sea boats and were able to perform valuable minesweeping service during the war.

In the United States, however, where the huge inland waterways favour the side wheel, the paddle steamer has been brought up to its highest state of development. The biggest ships of this type in the world are the "Greater Buffalo" and "Greater Detroit," built in 1923 for service on the Great Lakes, each having a gross tonnage of 7,793 and being driven by three cylinder compound engines.

Standardised Ships.—In the early days of the World War mercantile construction was almost completely suspended in Great Britain, Germany and France in favour of warships, but it received a great impetus in the United States. When the German submarine campaign caused an acute shortage of tonnage it had to be resumed in an intensified form in Britain, while from 1917 the Americans launched a shipbuilding campaign unprecedented in the history of the industry. In order to save time and money wherever possible, standardised shipbuilding came into vogue. It had existed within certain establishments for many years, the German yards particularly specialising in certain types and turning out large numbers of sister ships for various owners. During the World War, however, it was carried right through the various countries and in some cases the inland steel works, usually employed on bridge construction and the like, were utilised for fabricated ships with lines as straight as possible which were only put together and launched in the shipyards. Owing to the difficulties of supply many of these standardised ships were given machinery unsuited for their type and the construction of the hull was frequently hasty, so that they have found themselves severely handicapped in competitive trading since the Armistice.

In the United States wood was very largely used, both for full-powered ships and auxiliaries, but there was no time to permit the timber to season and they were built of "green" timber. Similarly a number of vessels of various types—lighters, tugs, tankers, etc.—were built of ferro-concrete, the rapidity with which they could be turned out compensating for their excessive weight in wartime, although only one or two of them survived more than a few months of peaceful trading.

In criticising these war built standard ships there has been a very general tendency to forget the peculiar circumstances in which they were built and the necessity of getting something that would float into the water as quickly as possible. Their utility in competitive trading in peaceful circumstances was a secondary consideration. The United States Shipping Board, a State department formed to run the tonnage so built in America, was left with a large number of ships on its hands for which no purchasers or managers could be found, but many of them have since the peace been converted to Diesel or electric power and their running expenses greatly reduced.

The Cabin Liner.—From the very early days of regular services, the older and smaller units of the various companies were put on intermediate services at reduced prices, and these ships gradually came to be known as cabin class ships. Very few ships were specially built for the class until 1914, when the Canadian Pacific Line commenced a long series with the "Metagama" and the "Missanabie," ships with a gross tonnage of about 12,500 and speed of 16 knots, having accommodation for 520 passengers in the cabin class, paying a fare approximating to the second class fare in the bigger ships, and 1,200 in the third class. Since then the type has been taken up enthusiastically by various companies, particularly on the North Atlantic, until the present development is the "Duchess of Atholl" and her sisters, also owned by the Canadian Pacific Line, having a gross tonnage of roughly 20,000, a sea speed of 17 knots and single reduction geared turbines supplied by oil fired high-pressure boilers which give the remarkable economy of 0·64 lb. of oil fuel per s.h.p. per hour for all purposes.

Fast Cargo Liners.—There has been a noteworthy tendency to build fast cargo liners since the war, ships with a sea speed of 14, 15 and 16 knots, but carrying cargo only to regular schedule. Both steamers and motor-ships have been built for these services and have found great favour with shippers. Great economy in running has been obtained with the result that they have secured a considerable proportion of the trade which was formerly carried by tramp steamers.

High Pressure Steam.—In steamers this remarkable economy has been made possible very largely by the employment of high pressure steam. The Clyde passenger steamer "King George V.," built by Messrs. Denny in 1926 in conjunction with Messrs. Yarrow, the boilermakers, and the Parsons Steam Turbine Company, had the first noteworthy installation apart from unsuccessful experiments made half a century ago. She was a steamer of 791 tons gross, burning coal under water-tube boilers working at a pressure of 550 lb. to the square inch with the steam temperature raised to a maximum of 750 degrees Fahrenheit. This ship considerably exceeded her contract speed of 20 knots on trial and has proved a success in many ways, particularly with regard to economy. But numerous adjustments and alterations have had to be made since her launch.

In modified form high pressure steam has resulted in very considerable economies, both in fuel consumption and weight. Although no steamer has yet been built with anything approaching the 550 lb. of the "King George V.," the general tendency is to increase the pressure both for naval and for mercantile work and 400 lb. is becoming quite usual.

Express Luxury Liners.—The White Star Liner "Oceanic" of 1871 was the first of the modern type of express luxury liner, which attracts more attention than any other type, but which can exist economically only on the direct service between Europe and the United States. The White Star Line had then just been founded for the purpose of engaging in the Australian trade, and for that purpose had bought the name and houseflag of one of the most famous of the clipper ship companies. Events had caused the directors to change their intentions and the first ships were put on service between Liverpool and New York, the "Oceanic" being the pioneer. These ships differed very materially

from the accepted type of screw steamer, having over ten beams to their length and being designed on the somewhat revolutionary lines advocated by the late Sir Edward Harland of Messrs. Harland and Wolff, the Belfast shipbuilders. The tonnage of the "Oceanic" was 3,707 and while she was fully rigged as a 4-masted barque her single screw engines gave her a sea speed of 14·75 knots, and she proved herself an unqualified success after being generally condemned on theoretical grounds by the experts. Three years later the "Germanic" and "Britannic," the latter still afloat as a Turkish Government ship, were built with a gross tonnage of 5,000 and speed of 16 knots.

The Guion Line, which until then had been engaged principally in the emigrant trade, then entered the race for the Atlantic Blue Riband with the "Arizona" of 1879, a ship of 5,147 tons with a sea speed of 16·25 knots. An improved edition of the same design was the same company's "Alaska" of 1881, her gross tonnage being 7,142 and her speed 17·75 knots. In the "Oregon," which was built just before the company got into serious financial difficulties and which eventually sank in collision with a small schooner, the gross tonnage went up to 7,375 and the speed to 19 knots.

The reply of the Cunard Line was the construction of the "Umbria" and "Etruria" at the same establishment which had turned out the big Guion ships, Elder's Fairfield Yard. They were ships of 8,120 tons with a speed of 19·5 knots and they marked the final development of the single screw express liner on the Atlantic. Although they were specially designed to compete with the "Oregon," that ship had passed to the Cunard Line before they were completed.

The next great improvement was the design of the "City of New York" and "City of Paris," when the twin screw system was adopted for express ships. They were built for the Inman Line in 1889 but were better known under the flag of the American Line to which they were transferred in 1893. These ships secured the Atlantic Blue Riband and were the last big Atlantic liners to be built with the old-fashioned clipper stem. When it was desired to transfer them to the American Line Congress only permitted them to hoist the Stars and Stripes on condition that two ships of at least equal tonnage were built in American yards, which resulted in the "St. Louis" and "St. Paul," of 11,630 tons and 21 knots speed, being built in 1895, the first big Atlantic liners to be built in the United States since the 'sixties.

The White Star Line replied to these ships with the "Teutonic" and "Majestic" in 1889, ships which had a great struggle with the "New York" and "Paris" for the Atlantic record. In 1893 the Cunard Line secured the Blue Riband without doubt with the "Campania" and "Lucania" of just under 13,000 tons with a sea speed of 22 knots.

In 1897 the German companies, which had built up a big business in comparative obscurity beside the companies racing for the Blue Riband, came out with the "Kaiser Wilhelm der Grosse" of the North German Lloyd, which lowered the record very considerably. She had a gross tonnage of 14,350 and a speed of 23 knots. Their rivals, the Hamburg American Line, built the 14,500-ton "Deutschland" to compete for the record, but on their experience with her they decided to follow the policy of comfort and good cargo capacity on more moderate speed, a policy which was also followed by the White Star Line after the "Teutonic." The North German Lloyd on the other hand steadily lowered their own record with the three ships which followed in the same series and to the same general design—the "Kronprinz Wilhelm" of 1901, the "Kaiser Wilhelm II." of 1902, and the "Kronprincessin Cecilie" of 1906. Each of these ships marked a further advance in size and speed.

Before the last named could be tried at her best the Cunard Line had built the "Lusitania" and "Mauretania" with the financial assistance of the British Government, which wanted the Cunard Company to remain a purely British concern at a time when the International Mercantile Marine, under the guidance of Mr. Pierpont Morgan, was absorbing company after company. The former was built on the Clyde, the latter on the Tyne, and they differed slightly in minor details. The "Mauretania's" dimensions are 762·2×88×57·1 feet depth of hold, giving her a gross tonnage of 31,938, while her quadruple screw direct coupled turbine engines have a designed shaft horse power of 68,000, intended for a speed of 25 knots. The "Lusitania" was sunk by a German submarine during the war; the "Mauretania" has the unique distinction of holding the Atlantic Blue Riband for 22 years and when 20 years old proving herself capable of steaming at 29 knots to the rescue of a disabled cargo ship.

When these two ships were built their use as auxiliary cruisers by the Navy had a very considerable influence on their design, but experience in the early days of the war showed that they were far too extravagant with fuel for this purpose, although the "Mauretania" and other big and fast ships later proved themselves to be extraordinarily useful both as transports and hospital ships. The Germans had precisely the same experience with their express liners which had been heavily subsidised as auxiliary cruisers.

Maintaining their policy of avoiding excessive speed, the Hamburg American Line answered these Cunarders with the biggest steamers in the world. The first of the series was the "Imperator," now the Cunard "Berengaria." She was launched in 1912, her dimensions being 886·3×98·3×57·1 feet depth of hold and her original gross tonnage 51,969. The second of the series was the "Vaterland" which is now the "Leviathan" of the United States Lines. Her dimensions were increased to 907·6×100·3×58·2 depth of hold, and her gross tonnage was 54,282. It is now 59,957. The third ship was the "Bismarck," now the White Star "Majestic," similar to the "Vaterland" but slightly longer.

Post-war Policy.—Immediately after the war nearly all the lines had to engage immediately in a shipbuilding programme to replace casualties, although shipbuilding prices were at their highest level. The general tendency was to build a moderate-sized ship with good cargo capacity and comfortable passenger accommodation at reasonable rates. The Cunard Line brought out the "Franconia" type of five ships of just under 20,000 tons gross with a speed of 17 knots, while the Hamburg American Line built four ships of the "Deutschland" type, having a sea speed of 16 knots and a tonnage of rather less than 21,000.

This tendency was broken by the Compagnie Générale Transatlantique, which in 1926 built the "Ile de France," a ship of 43,548 tons gross with direct acting turbines of 52,000 s.h.p. and a trial speed of 24 knots. The North German Lloyd, which had built up its fleet steadily since the Armistice, responded by laying down the "Bremen" and "Europa," ships of 46,000 tons each, with a legend speed of 26½ knots on service. They have geared turbines and considerable weight is saved by a boiler pressure of 375 lb. to the square inch, while their design is revolutionary in many features, particularly in the bulb bow under the waterline from which most satisfactory results were hoped. The "Bremen," launched in 1929, beat all Atlantic records, but was outstripped by the "Europa" on her first voyage to New York in March, 1930. Both the White Star and Cunard Lines have planned ships of over 1,000 feet in length in answer to this Continental competition but construction is slow and many of their details have been kept secret. It has, however, been announced that the White Star liner will be given turbo-electric propulsion.

The express Atlantic liner tends to become more and more luxurious to cope with the demands of the first class passengers, but many travellers elect to be carried by the cabin ships at a lower charge. No first class ship can find favour on the Atlantic without all the qualities of a floating hotel—private bathrooms to the majority of the cabins, gymnasia, swimming baths, a long range of public rooms, and such luxuries as a Ritz Carlton restaurant for those who do not care for the ample menu provided in the first class dining saloon. Naturally the prices in such ships are high and their appeal is limited, but there appears to be sufficient patronage for all the ships of the type which the premier lines can afford to build. The cost of each of the 1,000-foot liners which are being built by the Cunard and White Star Lines is estimated at between five and six million pounds.

(E. A.; F. C. Bo.)

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SHIPBUILDING. Ships have existed from the earliest ages; but it is only in comparatively recent days that the design and building of ships has become a science, more or less exact. Ships have now to perform a great variety of duties; and experience has shown the necessity of a corresponding variety of types and the great progress made in recent years in steel manufacture and shipbuilding and engineering practice has enabled great advances to be made in the size and capabilities of the several types of ships. The duties which a ship is required to perform, the conditions of employment and the general progress in shipbuilding and marine engineering practice, determine her leading features; but whatever the type of ship the fundamental theoretical principles underlying the design are the same.

THEORETICAL SHIPBUILDING

Stability.—A ship floating at rest in still water is in the same condition as any other floating body and the rules of elementary hydrostatics must be satisfied. These are that (1) the weight of the ship must equal the weight of water displaced known as the *displacement*: and (2) the centre of gravity of the ship and the centre of gravity of the water displaced—known as the centre of buoyancy—must be in the same vertical line. It is further necessary that the ship upon being slightly disturbed from its position of equilibrium, should tend to return to that position, when the equilibrium is described as stable. Should the ship on receiving such a disturbance tend to move still farther the equilibrium is unstable: and the intermediate case where she tends to remain in the new position is described as a condition of neutral equilibrium.

Of the various modes of disturbance to which a ship may be subjected it is sufficient for practical purposes only to consider that caused by rotation about a horizontal axis, the displacement remaining unaltered. Such a rotation can in general be resolved by the ordinary statical rules into two rotations about perpendicular axes and it is convenient to consider the question with reference to (1) an axis parallel to the fore and aft M.L. plane of the ship and (2) an axis at right angles to this plane; these rotations result in stability conditions known as transverse stability and longitudinal stability respectively.

Transverse Stability.—In fig. 1 W L is the water-line when upright, and W′ L′ is the waterline when ship is inclined through a small angle θ. The displacement is assumed constant. G is the centre of gravity: B the centre of buoyancy in upright and B′ the centre of buoyancy in the inclined position. The forces acting on the ship are as shown and constitute a couple $W\times GZ=W\times GM\ \sin\theta$. $GZ=GM\sin\theta$ is termed the *righting lever.*

As drawn, the couple tends to restore the ship to the upright and consequently the equilibrium is stable. If G were above M the couple would tend to capsize the ship and the equilibrium would be unstable.

Hence for stability of equilibrium the centre of gravity must be below the point M, and the moment of stability is proportional to GM. When θ is indefinitely small the point M tends to a fixed limit and is then termed the *metacentre,* the distance GM being known as the *metacentric height.* It is found that in ships of ordinary form for inclinations up to approximately 15° the point of intersection of the vertical is through the points B and B′ coincides very nearly with the metacentre, so that within these limits the moment of stability is approximately $W\times GM\sin\theta$.

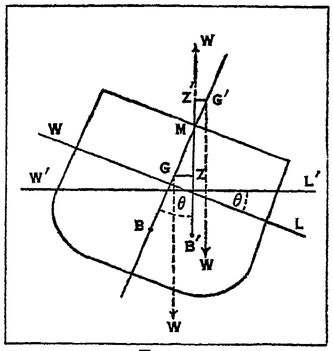


FIG. 1

The position of the centre of gravity can be calculated when the weights and positions of the several parts are known. The position of the metacentre depends entirely on the geometry of the immersed portion of the ship. A simple analytical investigation shows that the axis of rotation must pass through the centre of gravity of the water plane—which point is known as the *centre of flotation*—and that the height of the metacentre above the centre of buoyancy is equal to the moment of inertia of the water plane about the axis of rotation divided by the volume of displacement; with the usual notation, i.e., $BM=\frac{I}{V}$. These quantities, together with the position of the centre of buoyancy are found by the ordinary methods adopted for ship calculations and the position of M in the ship found. Thus by selecting the underwater form any desired value of GM can be obtained; such value differs in various types of ship, experience determining the desirable figure for each type.

Typical values of metacentric height for various classes of ships are as follows:—

Class of ship	Approximate GM in feet
Battleship	5 or more
Cruiser	3 or more
Torpedo boat destroyer	$1\frac{1}{2}$–2
Liner	1 –2
Cargo steamer	2
Tug	$1\frac{1}{2}$–2
Sailing vessel	3 –4
Shallow draught vessel	very large: 12 or more

Changes in metacentric height are caused by alteration in displacement or in the position of the centre of gravity, and it is necessary to investigate the stability in several conditions. The position of the centre of buoyancy and metacentre are readily calculated for several W.L.'s which correspond to calculable displacements; and the position of G for any given condition can be calculated. The results are conveniently shown on a *metacentric diagram* in which the curves of height of metacentres and vertical positions of the centres of buoyancy are set up from a line intersecting the W.L.'s at 45°.

Inclining Experiment.—The calculation of the position of G is a lengthy and laborious process and is inevitably of a more or less approximate nature. When the ship is nearly complete a check is obtained on the position of G by use of the properties of metacentric stability. This is termed an inclining experiment and is carried out by moving a known weight (w) through a known transverse distance (d), thereby producing a couple tending to incline the ship. This couple is resisted by the stability couple of the ship and a position of equilibrium is reached at some angle θ which is directly measured by pendulums. We then have

$$w\times d=W\cdot GM\ \sin\theta.$$

The GM in the inclining condition is thus known at once: the position of M is known from the metacentric diagram and consequently the vertical position of G for this condition determined.

The position of G in any other condition is readily obtained by a simple process of algebraic additions.

Large Inclinations.—The intersection of the two verticals through the centres of buoyancy in the upright and the inclined condition is the fixed point M only when the inclination is small. For larger inclinations it becomes necessary to investigate the matter further. For all practical purposes it is sufficient to assume that the centre of buoyancy remains in the same transverse plane, when the ship is inclined. The conditions are as indicated in fig. 2 and the righting lever is $GZ=GM' \sin\theta$. The point M′ is known as the *pro-metacentre* and it is important to note that in general its position alters with the angle of inclination. The problem now is to determine the value of BM', for which there is no simple formula.

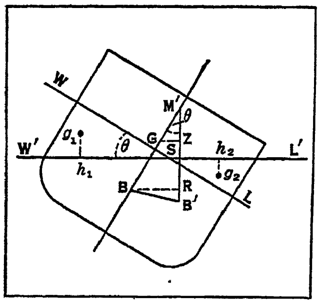


FIG. 2

If v be the volume of either wedge and g_1, g_2 their respective centres of gravity:

Then $V\times BR=v\times h_1h_2$.

Also $GZ=BR-BG \sin\theta$

whence the righting moment

$$W\times GZ=W\left[\frac{v\times h_1h_2}{V}-BG\sin\theta\right].$$

This is known as *Atwood's* formula. Thus the value of the righting moment at any angle resolves itself into evaluating the expression $v\times h_1h_2$. Several methods can be adopted, one of the most convenient being that introduced by Barnes and published in Trans. Institute of Naval Architects 1861.

A different method of approaching the problem has generally been adopted in France; the investigation being due to Reech and first published in his memoir "Construction of Metacentric Evolutes for a Vessel under different Conditions of Lading" (1864). These methods enable GZ to be obtained for a fixed displacement for any angle and the curve obtained by plotting these values as ordinates on a base of angles furnishes a *curve of stability* and a similar curve can be obtained for any desired displacement.

All such methods are cumbersome, and the method now universally adopted for obtaining GZ at large angles of inclination is that described in papers by Merrifield and Amsler in Trans. Institute of Naval Architects (1880 and 1884). With this method in which the work can be expeditiously carried out by the use of the integrator, the value of GZ is obtained for a number of constant angles at varying displacements. The curve obtained for a fixed angle by plotting GZ as ordinates on a base of displacement is known as a *cross curve of stability*: and a similar curve can be obtained for any desired angle. It is obvious that either set of curves can be readily constructed when the other is available. In carrying out these calculations it is necessary to make certain assumptions, the principal of which are that all openings in weather deck and in ship's side up to the weather deck are covered in and made watertight and that all weights in the ship are fixed.

The slope of the curve of stability for small angles, the maximum value of GZ and the angle at which it occurs, and the angle at which GZ vanishes and upon reaching which the ship is about to capsize, determine the character of the curve. Other important factors influence the curve, viz., the freeboard, an increase in which tends to lengthen-out the curve and thus make the vanishing angle larger; and the position of C.G. which affects both the initial stability and the range. To sum up, initial stability is dependent essentially on beam and position of C.G. while range is dependent essentially on freeboard and position of C.G.

A very interesting and instructive theoretical exercise is to plot the curves of centres of buoyancy and of pro-metacentres as the ship turns through 360°. The matter was first fully investigated by Dupin in 1822. Dupin also investigated the properties of the *curve of flotation,* which is the envelop of all possible waterlines for the ship when inclined transversely at constant displacement.

Dynamical Stability.—The dynamical stability of a ship at any angle is defined as the work done in inclining the ship from the upright. Its value is conveniently obtained by integrating the curve of stability, *i.e.,* dynamical stability $=W\times\int_0^\theta GZ\cdot d\theta$, and a curve of dynamical stability on a base of angles is readily obtained.

Sailing Ships.—A ship with sails is subjected to the wind-pressures on the sails and upper works and to the water pressures on the hull. The wind pressure on the sails is dependent on the wind velocity and on the form and area of the sails; and the amount of sail that can safely be carried is contingent upon the existence of large statical stability at moderate angles of heel.

The stability of a sailing vessel is usually estimated by assuming all plain sail to be placed in a fore and aft direction and to be subject to a normal pressure of 1 lb. per sq.ft. corresponding to a wind of about 16 knots. The resultant pressure of the wind is taken as acting through the C.G. of the total sail area, this point being known as the *centre of effort.* The resultant pressure of the water on the hull is assumed to pass through the centre of gravity of the immersed M.L. plane: this point is known as the *centre of lateral resistance.* Then if h be the distance between these points in feet, A the sail area in sq. ft. and α the angle of heel, then the following equation is approximately true.

$$W\times GM\sin\alpha=\frac{Ah}{2240}$$

or

$$\sin\alpha=\frac{Ah}{2240\,W\times GM}.$$

The reciprocal of this expression, *i.e.,* $\frac{2240\,W\times GM}{Ah}$ is a measure of the capability of the ship under sail of resisting heel and is termed *power to carry sail.* Its value varies with the size and type of ship, the value for boats and yachts being 3–4 and in full-rigged sailing ships 15–20. For further information as to the desirable stability requirements for yachts, reference can be made to Dixon Kemp's "Yacht Architecture."

Dynamical stability is of the first importance in sailing ships in order to provide against the risk of capsizing when struck by a sudden gust of wind or a succession of such gusts. By equating the dynamical stability to the work done on the ship by a sudden gust of wind, the heeling effect caused by such a gust is readily found.

Longitudinal Stability.—The problem of longitudinal stability is in all respects similar to that for transverse stability. If L be the length of ship between draught marks it can be readily shown, that, defining the change of trim as the sum of the differences of draught forward and aft the moment to change the trim one inch is given by the expression $\frac{W\times GM_L}{12\times L}$. The effect in changing trim of any longitudinal disturbing moment is then at once obtained.

Stability when Damaged.—When a ship is damaged in the neighbourhood of the W.L. her initial stability conditions will, in general, be adversely affected. Underwater damage may adversely affect stability or may improve it. The resultant condition of the ship will depend upon the extent of the damage and the degree of her sub-division into W.T. compartments; and it is necessary to investigate stability under given conditions of damage to ensure that the ship will not capsize upon receiving damage to the extent decided upon as reasonably likely. For warships in particular it is desirable to know the effect of damage on the flotation of the ship and in the British service it is the practice to supply to ships what is known as a *flooding board* on which is indicated the sinkage, angle of heel, and the effect on trim caused by flooding each W.T. compartment below water in the ship.

Stability in General.—The consideration of the stability of a ship when inclined about a longitudinal and a transverse axis is generally all that is necessary for practical purposes; but the

general theory of the stability of ships abounds in interesting problems in applied mathematics. Of these may be mentioned investigations by Dupin, Guyou and Greenhill, of stability when ship is inclined in any direction; Greenhill's investigation of the stability of a ship carrying oil or molasses; and Froude's and White's investigations of stability amongst waves.

ROLLING OF SHIPS

A ship at sea is subjected to the action of waves which set up rolling, pitching and other oscillatory motions, of a more or less complex character. Of these, in general, rolling is the most important, and it is sufficient in considering rolling to neglect the influence of other oscillations.

Unresisted Rolling.—It is convenient first to consider the ship as rolling in still water and to neglect the influence of resistance; when it follows from a simple investigation that for small angles of inclination the period of roll—the *period* being defined as the time of a single complete oscillation, *i.e.,* out to out and back again—is given by the expression

$$T = 2\pi\sqrt{\frac{K^2}{m \cdot g}}.$$

where K is the mass radius of gyration of the ship about the axis of rotation and m is the metacentric height.

The theory now generally accepted for the unresisted rolling of ships amongst waves is due to Froude, and is based on the proposition that the forces acting on a ship among waves tend to place her normal to the wave sub-surface passing through the ship's centre of buoyancy. To simplify the investigation Froude also assumed that the wave profile was a curve of sines, instead of the trochoid which more nearly represents actual waves, and that the ship was rolling broadside on in a regular series of similar waves of given dimensions and given period. It was also assumed that the ship's rolling in still water was isochronous, and that the period of rolling was given by the theoretical expression already referred to, viz.:

$$T = 2\pi\sqrt{\frac{K^2}{m \cdot g}}.$$

For the reasons underlying the assumptions made and for the complete investigation of the equations of motion, etc., reference can be made to Froude's papers in Trans. I.N.A. (1861 and 1862). It may be stated broadly that the ship oscillates as in still water, but has superposed on these oscillations a series of oscillations governed by the wave-slope and the relation existing between the period of the ship and that of the wave. An interesting case arises when the ship's period is equal to the period of the wave, when at the passage of each successive wave crest and hollow the inclination of the ship is increased, so that but for the effect of resistances and the departure from synchronism at large angles of roll, she would inevitably capsize.

Resisted Rolling.—It remains to consider the practical case of actual rolling of ships in which resistance has important effects. In still water resistance causes a degradation of the amplitude of roll until the ship finally comes to rest. A similar degradation is caused when the ship rolls amongst waves. After the theoretical consideration of unresisted rolling already described, attention was given by Froude and others, first to resisted rolling in still water, and the method adopted was to roll an actual ship in still water to as large an amplitude as could be obtained and then observe the diminishing amplitude at each successive roll until she eventually came to rest.

A curve plotted with number of rolls as abscissae and amplitude of roll as ordinates gave a curve of *declining angles.* From this curve a second curve was made, called the *curve of extinction,* with angles of roll as abscissae and angle lost per swing as ordinates. Particulars of such curves obtained by experiment on H.M.S. "Revenge" can be seen in Sir W. White's I.N.A. paper of 1895. With these curves as data Froude proceeded to investigate the relation between the degradation of amplitude and the resistances causing such degradation. Making the assumption that the resistance to rolling varies as the angular velocity, it is readily shown that the period is slightly increased and the amplitude progressively diminished by the resistance. In actual cases although part of the resistance varies as the angular velocity, part also varies as the square of the angular velocity. This leads to an equation of motion not in general susceptible of analytical solution, but the solution can be obtained by a process of graphic integration. If it be assumed that the motion be simple harmonic then the equation of the curve of extinction can be approximately expressed by the empirical formula:

$$\text{Angle lost per swing} = -\frac{d\Theta}{dn} = a\Theta + b\Theta^2$$

where Θ = extreme angle in degrees reached at any particular oscillation, n the number of oscillations and a and b are coefficients which can be determined in a particular case.

Froude considered that the surface friction and the head resistance of keels and deadwood was responsible for the resistance varying as the second power of the angular velocity and that the creation of a small wave at each roll causing dissipation of energy was responsible for the resistance varying as the first power of the angular velocity. These views have been generally confirmed as the expression for the decrement, viz., $a\Theta + b\Theta^2$ fits the curve of extinction of practically any ship fairly well if the coefficients a and b are judiciously selected. The experiments on "Revenge" referred to above were carried out in the light and in the deep conditions and before and after bilge keels were fitted to the ship.

The outstanding result of these experiments was the unexpected large increase in the value of the "b" coefficient after bilge keels were fitted and other experiments confirmed the result. Mr. R. E. Froude, after experimenting with a deeply submerged plane oscillating in water, found that the head resistance of the bilge keels only accounted for about one-fourth of the energy lost in a single swing due to the increased value of the "b" coefficient; and some cause other than head resistance must be operating to account for the discrepancy. The matter has since been closely investigated in other directions and it is generally agreed that bilge keels become effective not only by virtue of the head resistance developed but by indirectly influencing the streamline motions which would exist if there were no bilge keels. At the same time during the early portion of the swing the bilge keels set in motion a considerable mass of water the energy from which is for the most part dissipated; motion of the ship ahead intensifies this loss and combined with the increase of other resistances at high speeds produces a more rapid extinction. For detailed consideration of this portion of the subject reference can be made to papers of the I.N.A. by Professor Bryan in 1900 and Mr. A. W. Johns in 1905 and 1909.

The problem of resisted rolling among waves was investigated by Froude, who after considering other methods developed and adopted the process of "graphic integration" which is an exact method of determining the motion of a ship, having given the elements of the ship's rolling in still water and the wave-series acting upon her. Reference should be made to Froude's paper in Trans. I.N.A. 1875.

Analytical consideration of the equation of motion shows that the ship has a free oscillation which in time dies out, leaving a forced oscillation in the period of the waves. Actual observation of rolling, however, shows that a ship seldom completely forsakes her own natural period of roll; this is due to departure from exact uniformity in the waves encountered. For consideration of special conditions reference can be made to papers by M. Bertin in Trans. I.N.A. for 1894 and 1895. In a paper read at I.N.A. 1896 Mr. R. E. Froude investigated the probable maximum amplitude of roll when the ship is under the influence of a non-synchronous and non-harmonic swell. Further papers read at the I.N.A. in 1896 and 1898 by Professor Kriloff dealt exhaustively with the whole motion of a ship including pitching and rolling.

Methods of Reducing Rolling.—Considerable attention has been given to the reduction of rolling: in warships to obtain

steadiness of gun platform and in liners to ensure the comfort of passengers. Of all such methods the fitting of bilge keels has been the most important and successful. Attention was drawn by Froude to the great value of bilge keels in diminishing rolling and demonstrated by him in 1892 by experiment with "Perseus" and "Greyhound." These two ships were alike in every essential particular except that bilge keels were fitted to "Greyhound," and it was found that the rolling of "Greyhound" was only about one-half that of "Perseus." Subsequent trials with other vessels substantiated the general conclusions as to the effectiveness of bilge keels.

Another method of reducing rolling in a seaway to which considerable attention has been given is by the use of water chambers. The action is mainly automatic and the motion of the water in the tank is not to be controlled to any extent except that the tank can be put out of action by throttling the motion or by emptying. The first ship fitted was "Inflexible" in which was provided an open rectangular tank extending across the ship. It was tried out at sea by Sir Philip Watts who also experimented on rolling models of "Edinburgh." In essence the method consists in fitting across the ship one or more tanks of such shape that when filled to a suitable height with water the motion of the water from side to side as the ship rolls is such as to retard the rolling. The water chamber reduces the angle of roll chiefly by modifying the righting couple acting upon the ship throughout her rolling; it increases the righting couple which opposes the motion as the ship heels over, thereby reducing the amount of heel and on the return roll it lessens the righting couple and causes the ship to move more slowly than she otherwise would; her angular momentum on reaching the upright is consequently less and she tends to roll less the other way. (*See* papers by Sir P. Watts, Trans. I.N.A. 1883 and 1885.) The tanks were of some use in reducing rolling but were excessively noisy, and extensive use has not been made of them.

In comparatively recent times the idea has been revived in a more elaborate form and the anti-rolling tank first projected by Frahm has been fitted in several ships. This tank is of U form extending from side to side of the ship athwartships and consists essentially of two vertical columns connected by a horizontal tube at the bottom; the water fills the latter completely and about one-half of the vertical tanks. The upper parts of the vertical tanks are connected by an air pipe which is fitted with a valve or throttle by means of which the motion can be controlled. To prevent eddying during motion fixed baffles are arranged at the sides. One set of tanks is fitted near each end of the ship. It can be shown that once the shape of the tank is fixed the period is also more or less fixed and is practically independent of the amount of water.

For further information reference should be made to the paper by Frahm in Trans. I.N.A. 1911 Pt. I: and for the complete mathematical investigation see Mr. Woollard's paper Trans. I.N.A. 1913 Part II.

The general conclusions reached may be summarized as follows:—(1.) The "powerfulness" of the tank, or its capacity for affecting rolling depends principally on the proportion of the ship's metacentric height lost by virtue of free water surface in the tanks. There is also a relatively small hydro-dynamical effect from the inertia of the water in motion from side to side. (2.) The period of the tank depends on its shape, particularly the area of the constricted channel at the bottom; it is almost independent of the amount of water contained and of the degree to which the flow is resisted. (3.) If a ship be likened to a pendulum, the ship and tank are equivalent to a double pendulum; to get the best results the period of the tank should be slightly less than that of the ship. (4.) The tank is effective in stopping heavy rolling but is useless or disadvantageous among very short waves and should then be put out of action. The U tank has been fitted in some liners and warships but as it does little to reduce moderate rolling it has not made much headway. More recently the adoption of an anti-rolling tank, open to the sea, has been projected. The use of anti-rolling tanks in general has not found much favour and they are open to practical objections.

The idea of using a weight moving from side to side to prevent or reduce rolling at sea was tried by Sir John Thornycroft in a yacht of about 230 tons displacement, the moving weight being 8 tons. The weight was worked automatically by apparatus controlled by two pendulums, one of which—a long period pendulum—remained vertical and the other—a short period pendulum—placed itself perpendicular to the effective wave slope. The apparatus is heavy and cumbrous, but is sound in principle, and effected a reduction in rolling of about one-half in the yacht in which it was fitted (*see* Trans. I.N.A. 1892).

Diminution of rolling by the use of the gyroscope was investigated by Dr. O. Schlick and an arrangement fitted in the S.S. "See-bär." The ship was of 56 tons displacement having a metacentric height of 1·64 ft. and a period of roll of 4·14 seconds. The flywheel of the gyroscope weighed 1,100 lb. and was 1 metre in external diameter, revolving at 1,600 revolutions per minute. The axis of the flywheel was initially vertical, and the casing containing the wheel was capable of revolving about a horizontal athwartship axis, the centre of gravity of the apparatus lying slightly below this axis. A brake was fitted to control the longitudinal oscillation of the casing. When the wheel was revolving and the axis held by the brake, no effect was produced on the motion of the ship; but when the axis was allowed to oscillate freely in the middle-line plane the period of roll was lengthened to 6 seconds, but no other extinctive effect was obtained. By suitably damping the longitudinal oscillations of the gyroscope, however, by means of the brake, a large extinctive effect resulted, and during the trials made, the apparatus practically stopped all rolling motion. (For detailed account of the principle of action, details of the gear, and description of trials, *see* Trans. I.N.A. 1904 and 1907.)

A further development of the gyroscopic method is the apparatus devised by Sperry. This consists essentially of two main gyroscopes rotating and precessing in opposite directions; the plane of precession being horizontal and the axes of rotation normally athwartships. The two gyroscopes thus combine against roll but they neutralize each other as far as yawing is concerned. An auxiliary gyroscope maintains true horizontal. The principle of action can be stated briefly as follows:—As soon as the ship has rolled through a very small arc, an electrical contact connected to the auxiliary gyroscope is established making a current which actuates the precession motors of the main gyroscopes and these continue working until the ship is again horizontal. The gear has been fitted in several ships, one being the U.S. Navy transport "Henderson" of 10,000 tons and it has been generally satisfactory. One of the later gyroscopic installations is that in the U.S. liner "Hawkeye State" of about 20,000 tons displacement. The total weight of the equipment is of the order of 200 tons.

Pitching and Heaving.—The laws governing pitching are identical with those for rolling but there are important numerical differences, the principal of which are due to the fact that the longitudinal stability is very large and period consequently short and that the resistance is relatively great. To keep decks dry it is important that the ship should pitch with the wave instead of remaining level and thus shipping water. In a large number of vessels the period for pitching is approximately one-half of that for rolling but the maximum angles are considerably less. An exhaustive series of experiments on mercantile ship models in waves has been carried out at the N.P.L., *see* Trans. I.N.A. 1922. Reference can be made to this paper for details.

When a ship is in still water her natural period of oscillation in a vertical direction known as *dipping* oscillation is given by the expression $2\pi\sqrt{\frac{12\,W}{gT''}}$ where W is the displacement in tons and T'' the tons per inch immersion. When the ship is amongst waves these dipping oscillations may synchronize with the waves and set up considerable vertical oscillations known as *heaving* and defined as the actual rise and fall produced in a seaway. Heaving motions are favourable to seaworthiness since waves are less likely to break on board.

Dipping oscillations are frequently caused by pitching or rolling giving rise to uneasy motion. This action may be of importance in ships whose sides near the waterline have a considerable slope to the vertical since any rolling motion is then accompanied by vertical oscillations of the centre of gravity. Uneasy rolling of a peculiar character also results from interference between the rolling and pitching movements of a ship. This takes place when the centres of gravity of the wedges of immersion and emersion for moderate angles of heel are separated by a considerable distance longitudinally.

RESISTANCE AND PROPULSION

A ship is propelled by the thrust on the propellers; and when the ship is in steady motion the thrust on the propellers must equal the resistance of the ship. It is convenient to consider first the resistance of the ship assuming the propeller to be removed and the ship to be towed at uniform speed through undisturbed water. The power thus expended in towing the ship is termed the *effective horse power.* This power is considerably less than the power exerted by the propelling machinery at the same speed; and the relation between the two—known as the *propulsive coefficient*—and the effect of the propellers on the resistance of the ship will be discussed below under *Propulsion.*

Resistance.—In an incompressible perfect fluid it can be shown that a body of "fair" form moving uniformly at a considerable depth below the surface does not experience any resistance to motion. For purposes of investigation it is convenient to impress upon the whole system a velocity equal and opposite to that of the body, which then becomes motionless in a uniform stream of the fluid. The motion is then termed steady. The particles of fluid move along paths termed "stream lines," and the surface formed by all the stream lines passing through a small closed contour is termed a "stream tube." The motion of the fluid in a stream tube is such that the flow along the tube is constant, and that Bernoulli's energy equation is satisfied. The other conditions affecting the flow and determining the forms of the stream lines are purely geometrical and depend on the form of the body. The motion in a perfect fluid flowing past bodies of a few simple mathematical forms can be investigated analytically but in the general case the forms of the stream lines can only be obtained by approximate methods.

Components of Resistance.—In actual practice the motion of a ship on the surface of the sea is subject to resistance through various causes. Frictional resistance results from the rubbing of the water past the surface of the hull and in the great majority of ships is responsible for a large proportion of the total resistance. Eddy resistances are caused by abrupt changes of shape and any local discontinuities such as shaft brackets. Resistance due to wind is experienced on the hull and upper works. Also, the stream line motion causes a diminution in the relative velocity of the water at the ends of the ship; this decrease of velocity is, in accordance with the energy equation, accompanied by an increase in pressure resulting in an elevation of the surface of the water at those places. Thus a wave is formed at the bow and stern, which requires an expenditure of energy for its maintenance and adds to the resistance. Eddying is caused by abrupt beginnings or endings, particularly the latter, in the water lines and underwater fittings. The resistance from this cause is usually small except with full forms when it may become relatively large.

Air resistance in itself is generally of little importance on a calm day; and the prejudicial effect of wind and rough weather on the speed of ships is largely due to the action of the waves and currents and the irregular motions of the ship. The combined effect on the ship's speed is frequently large but indeterminate. Valuable investigations on ships are being made under sea conditions to ascertain quantitative effects and some useful results have been recorded in Trans. I.N.A.

The difference between the total resistance and that due to skin friction is termed the residuary resistance, the principal component of which is the resistance due to wave-making. The action of the waves is such as to distort the stream lines near the hull, and the form of the waves is in turn affected by the frictional wake; it follows that the frictional and wave-making resistances of a ship are to some extent mutually dependent. It is convenient to neglect the interaction of these constituents and treat each independently; and practical justification for this assumption is furnished by the close agreement between the results of experiments on models and on ships, where the proportion of frictional to total resistance differs greatly.

Wake.—Since the action and the reaction of the water pressure on the hull of a ship are equal and opposite, forward momentum is generated in the water such that the increase of momentum per second is equal to the total resistance. The water participating in the forward movement is termed the *wake*; and the portion of the wake in the vicinity of the propellers has a considerable effect upon the propulsion of the ship. Experiments on a model were made by Mr. Calvert (Trans. I.N.A. 1893) to determine the wake velocity. The magnitude of the wake was measured at various positions in the length and its maximum velocity was found to be 0·67 times the speed of the model. Abreast the screw the mean velocity ratio over an area of the same breadth as the model and of depth equal to the draught was 0·19 ft. of which about 0·05 ft. was ascribed to frictional resistance. A theoretical investigation by Froude in Reports of the British Association 1874 suggests the approximate extent of the frictional wake and its velocity distribution based on the equality of the resistance to the momentum added per second. It is to be noted that when a ship is propelled in the ordinary way at uniform speed the momentum generated in the sternward race from the propeller is equal and opposite to that of the forward wake due to the hull; the motion of the water as a whole thus consists of a circulatory disturbance advancing with the ship but having no linear momentum.

Frictional Resistance.—Practically the whole of the resistance at low speeds and a considerable proportion of it at higher speeds is due to surface friction. Its magnitude is usually estimated from the results of experiments made by towing planks coated with various surfaces. The most important of such experiments were those made in 1871 by Froude in the experiment tank at Torquay, to obtain the laws of variation of resistance with the speed, the length and the nature of the surface. A dynamometric apparatus by which the planks were towed was used to register the resistance; the planks were given a fine edge at each end to avoid eddy-making and were fully immersed in order that no waves should be formed. For the complete results see Reports of the British Association 1872 and 1874; but the following extract gives a summary, n being the index of the speed at which the resistance varies, A the mean resistance per square foot of surface over the length stated, and B the resistance per square foot at the after end of the plank; both A and B refer to a velocity of 10 ft. per second in fresh water.

Length of Surface in Feet

	2 ft.			8 ft.			20 ft.			50 ft.		
	n	A	B	n	A	B	n	A	B	n	A	B
Tinfoil .	2·16	·30	·295	1·99	·278	·263	1·90	·262	·244	1·83	·246	·232
Paraffin .	1·95	·38	·370	1·94	·314	·260	1·93	·271	·237	..	..	..
Varnish .	2·00	·41	·390	1·85	·325	·264	1·85	·278	·240	1·83	·250	·226
Fine sand	2·00	·81	·690	2·00	·583	·450	2·00	·480	·384	2·06	·405	·337
Calico .	1·93	·87	·725	1·92	·626	·504	1·89	·531	·447	1·87	·474	·423
Medium sand .	2·00	·90	·730	2·00	·625	·488	2·00	·534	·465	2·00	·488	·456
Coarse sand	2·00	1·10	·880	2·00	·714	·520	2·00	·588	·490	..	..	..

These results are in accordance with the formula:—

$$R = fwS\frac{V^n}{2g},$$

R being the frictional resistance, S the area of surface, V the speed, w the density of the water, f a coefficient depending on the nature and length of the surface, and n the index of the speed; the values of f and n are obtained from the above table. The resistance then varies as the density of the water, but is independent of its pressure; it diminishes as the length of the surface increases on account of the frictional wake which reduces the relative velocity between

the water and surface towards the after end. The index n is 1·83 for a varnished surface equivalent to the freshly painted hull of a ship. When applying the data to ships of length greater than 50 ft. the coefficient B denoting the resistance 50 ft. from the bow, is assumed to remain unaltered at all greater distances astern. The velocity of rubbing is assumed equal to the speed of the ship, any variation due to stream-line action being neglected. The wetted surface S when not directly calculated can be estimated by approximate formulae.

Many other reliable experiments have been made on the resistance of smooth planks from time to time. The results obtained are all in reasonable agreement with Froude's, with the exception of those due to Gebers, in whose experiments particular care was taken to obtain an exceptionally smooth surface and to eliminate parasitic resistance. In general, coatings of varnish and many other compounds give about the same resistance if the surface is reasonably smooth and hard; and it is assumed that the coefficients for the varnished planks can be applied to the freshly painted ship's surface. Alternative extrapolation of the plank data has been proposed by Baker and also by Gebers. These give ship resistances somewhat less than Froude's, but so far Froude's results are almost universally used with practical success. The subject is continuously under investigation and experimenters are seeking to formulate, if possible, a more rigorous basis for assessing the skin friction resistance of ships. The plank results are intended for application to a ship with clean surface. After the ship has been some time out of dock the growth of weeds and barnacles causes a considerable increase in skin friction resistance.

Wave Resistance.—The resistance due to wave making, inconsiderable at low speeds, is of importance at moderate speeds and constitutes the greater portion of the total resistance at high speeds. As already stated it is convenient to regard the problem as one of steady motion in a stream flowing past a stationary ship. The stream tubes, originally of uniform width, become broader on approaching the bow of the ship and attain their greatest breadth close to the stem. Near amidships the tubes become smaller and enlarge again near the stern. The changes in size and velocity in the stream tubes lead to corresponding alterations of pressure in accordance with the energy equation, and these alterations appear as elevations and depressions of the surface forming the statical wave system. If this were a permanent system, no resistance to the motion of the ship would result. But the surface disturbance is subject to the dynamical laws underlying the propagation of waves; and consequently the wave formation differs from the statical wave, the crest lagging astern of the statical wave crest, and the ship is followed by a train of waves whose lengths are appropriate to the speed. The energy in the wave system travels backward relative to the ship at one-half its speed; and the resistance to the ship's motion is due to the sternward drain of the wave energy which has to be replaced by work done on the ship.

The form of the wave system is not susceptible of complete mathematical investigation; but the circumstances are approximately realized and the conditions considerably simplified when the actions of the bow and stern of the vessel are each replaced by the mathematical conception of a "pressure point." This consists of an infinitely large pressure applied over an indefinitely small region of the water surface; it is assumed to move forward in place of the ship through still water, or, equally, to be stationary in a uniform stream. The resulting wave system has been investigated by many investigators, including Lord Kelvin. Recently the theory has been still further developed; and it is possible to calculate the wave resistance of simple ship-shape forms by purely mathematical methods with a fair degree of accuracy. All the results are in agreement in many respects with those of actual observation for ships and models.

The figure, reproduced from Froude's, Trans. I.N.A. 1877, shows the bow-wave system obtained from a model; this is illustrative of that produced by ships of all types.

Two types of waves accompany a ship—(1) diverging waves having sharply defined crests placed in echelon, the foremost wave alone extending to the ship; (2) transverse waves limited in breadth by the diverging crests and reaching the sides of the vessel throughout its length. Since the bow diverging waves are not in contact with the ship, except at the bow, the energy spent in their maintenance travels away from the ship and is lost entirely. A diverging wave system of similar form but smaller dimensions attends the passage of the stern; and the resistance due to the diverging system of waves is the sum of its components at the bow and stern, increasing with the speed, and depending considerably on the shape of the bow and stern.

On the other hand the combined transverse bow and stern wave systems produce a stern wave in contact with the ship, and the resistance due to the resultant transverse wave system depends on the phase relation between the waves of the two systems. The effect of the combination on the wave resistance was investigated by Froude (Trans. I.N.A. 1877) by means of experiments on a series of models having the same ends, but in which the length of parallel middle body was varied. At constant speed, curves of residuary resistance on a length base consisted of humps and hollows, the spacing of which was constant for a given speed and approximately equal to the wave length appropriate to the speed; the amplitude of the fluctuation diminished as the length increased. For a given length the residuary resistance in general increased at a high power of the speed; but it was also subject to a series of fluctuations whose magnitude and spacing increased with the speed. A full analysis was made by R. E. Froude in 1881, and showed that a reduction in resistance occurred when the echo of the bow wave crest coincided with the trough of the stern wave; and conversely that the resistance was abnormally increased when the crests of the two systems coincided. The fluctuation in the resistance was smaller when the length of middle body was greater, owing to the greater degradations of the bow wave system at the stern through viscosity and lateral spreading. With very considerable lengths of middle body, the height of the bow wave system at the stern was insufficient to produce interference or to affect the resistance.

From these experiments certain deductions were made as to the dependence of the speed of a ship (V knots) on its length (L feet) and the slightly different length (L^1) between component bow and stern waves; these deductions are to a great extent confirmed by experience with ships of all classes, and may be stated thus:—for economic propulsion at a speed V the length L of the ship should be generally equal to or slightly less than V^2, corresponding to the "favourable" value of 1·2 of the ratio $\frac{V^2}{L^1}$. Vessels of extremely high speed such as torpedo-boat destroyers are an exception, the value of $\frac{V^2}{L}$ being then frequently as great as 4, which approximately coincides with the highest "favourable" value of $\frac{V^2}{L^1}$. These early experiments by Froude were especially valuable in directing attention to the important influence of length of ship on resistance; and his conclusions have been verified and amplified by Taylor, Baker and other experimenters in more recent times.

Law of Comparison.—The complex nature of wave resistance renders any simple estimate such as that for frictional resistance, impossible of general application. There is no simple law connecting wave resistance with size, form and speed. The effect of size alone can be eliminated by means of the "principle of similitude" enunciated by Newton, and the law of comparison is the application of this principle to the resistance of ships. To W. Froude is due the credit of making the application, which he did in the following terms:—

"If the linear dimensions of a ship be n times those of its model, and the resistances of the latter be R_1, R_2, R_3, · · · at speeds V_1, V_2, V_3, · · · , then the resistances of the ship at the corresponding speeds, $V_1\sqrt{n}$, $V_2\sqrt{n}$, $V_3\sqrt{n}$ · · · will be R_1n^3, R_2n^3, R_3n^3, · · · and, therefore the effective horsepowers at corresponding speeds are increased in the ratio $n^{7/2} : 1$."

This law is applicable to the residuary resistance but not to frictional resistance, the laws governing which so far as is known do not satisfy the conditions underlying the principle of similitude stated above. Consequently in applying the law of comparison to ships and models where the linear ratio is considerable, the residuary resistance alone should be compared by that means, the frictional resistance being independently calculated for ship and model. When the ships compared do not differ considerably in linear dimensions, the law may be extended to total resistance without appreciable error. Before the law of comparison could be accepted as applicable to ships it was necessary to test it practically and the first tests of this kind were made by W. Froude on H.M.S. "Greyhound" for the Admiralty, the results being recorded in Trans. I.N.A. 1874.

"Greyhound" was towed at a number of speeds, draughts and trims and the resistance, speed and other data carefully measured. Experiments were also made on the model under corresponding conditions. Similar, but much less exhaustive experiments were made by Yarrow on a torpedo boat (*see* Trans. I.N.A. 1883). In each case the measured resistance of the ship was greater than that deduced from the model experiments, particularly in "Greyhound"; but having regard to the deteriorated condition of the surface of the hull it was considered that the agreement was close enough to justify the method adopted for powering ships. This method or its equivalent with modifications in detail has been used ever since, and is practically justified by the results obtained by ships on speed trials. There are, however, certain unexplained inconsistencies in converting the results deduced from models to the ship scale which are allowed for by empirical factors based on experience. These require further experimental elucidation. The adoption in quite recent years of means of ascertaining the thrust exerted by the propellers of ships on trials may help in clearing this up. Other experiments have been made, notably some by Kempf at Hamburg on long cylinders, as a result of which in 1923 an alternative basis for assessing the skin friction of ships was proposed. Further experiments are in progress by Kempf, and the results of these and other efforts should afford valuable data for assessing the true skin friction of ships.

Model Experiments.—As a result of the "Greyhound" trials the accepted method of estimating the horse-power required for a new ship is by running a scale model under corresponding conditions in an experiment tank fitted and equipped for the purpose. The law of comparison is applied to the residuary resistance, or, if used for the total resistance, a "frictional correction" is made. In 1871, W. Froude constructed a tank and suitable apparatus at Torquay for the British Admiralty. In 1886 a new tank was inaugurated at Haslar from the designs and under the supervision of R. E. Froude, such improvements being introduced as experience at Torquay had shown to be desirable. Similar establishments have been instituted by several foreign governments and by some private firms. One of the more recent and up-to-date tanks is that at Teddington forming part of the National Physical Laboratory. This tank was opened in 1911: it is used for general research and is available for undertaking private work required by shipbuilding firms. A brief account of some of the earlier experiment tanks with their equipment is given by Dr. Glazebrook in a paper in Trans. I.N.A. 1909.

Experimental Results.—Some records of the experiments made at the various tanks have appeared from time to time; a few of those made at the Admiralty tanks have been published through the I.N.A. The "Greyhound" experiments have already been mentioned; other papers of fundamental importance to which reference can be made are those recording the "Merkara" results 1876; experiments on the effect produced on wave-making resistance by varying the length of parallel middle body, 1877; papers in 1888 and 1892 on the "constant" system of notation of results of model experiments used at the Admiralty Experimental Works; and some results of a systematic series of model experiments by R. E. Froude in 1904.

The rapid growth in numbers, size and speed of merchant ships in the present century led to the establishment of the Teddington Tank. Many valuable papers dealing with the resistance, form and other properties of merchant ship types are recorded by G. S. Baker and his staff in the Trans. I.N.A. and other societies. Other experimenters in this country and abroad have also published valuable results. The experiments made cover a wide field and include not only resistance and propulsion but such matters as manoeuvring, rolling and pitching; and in general give guidance on a number of special points in design, information regarding which could only be obtained on full scale with great expense and labour.

When the resistance has been obtained from a model experiment, or deduced by the law of comparison from data obtained with a vessel of similar type, the effective horse-power required is known; and by adopting a suitable value for the propulsive coefficient based on the model screw propeller efficiency and other factors the indicated or shaft horse-power is determined. If model experiments or data for exactly similar ships are not available, one approximate method of estimating the power which is commonly used is expressed by the formula—

$$\frac{(\text{Speed})^3 \times (\text{Displacement})^{\frac{2}{3}}}{\text{I.H.P.}} = C,$$

C being called the Admiralty coefficient. The value of C varies considerably and care must be taken that the values selected for comparison are appropriate to ships of similar type and of corresponding lengths and speeds and also type of machinery.

Another method of obtaining approximate estimates of the power required for ships of ordinary types is from curves of resistance drawn on a base of simple functions of the speed, length and displacement, the curves being passed through the spots obtained from a large number of results of model experiments with different classes of ships. Curves of this character have been constructed by Admiral D. W. Taylor, U.S.N. and A. W. Johns (*see* Trans. I.N.A. 1907). By the use of such curves the residuary resistance, or residuary horse power is obtained; the frictional resistance being calculated independently.

Apart from model experiments on the actual design under consideration the most serviceable method of estimating power, and one capable of very general application is to use the results of a methodical series of model experiments. These consist of a series of experiments on systematic variants of a parent form or forms. The first of such a series was carried out by R. E. Froude, and the results published in Trans. I.N.A. 1904. Subsequently Taylor in his book "Speed and Power of Ships," and G. S. Baker in papers in Trans. I.N.A. 1913 and later, greatly increased the range of type ship. The curves thus obtained, used with discretion, are most valuable to a designer of all types of ships. Reference can be made to the records referred to for very interesting details and particulars of various sizes and forms of ships. The value of such curves is greatly enhanced by the fact established experimentally that the resistance of a ship of given length and displacement depends primarily on the shape of the curve of transverse areas, the maximum beam and the shape of the waterline. If these features are maintained the shape of section, profile and other features can be varied over wide limits without appreciable change of resistance.

Shallow Water.—When ships are run at high speeds in comparatively shallow water a considerable change takes place in the resistance and power corresponding to a particular speed. As depth of water decreases the stream lines tend to two dimensional instead of three dimensional flow. This accentuates the stream line variation of speed and pressure and increases the frictional resistance and also the eddy making due to the discontinuous motion set up. The more rapid variation of pressure also increases the wave making if there is any. As the water becomes shallower there is an increase in the wave length appropriate to a given speed which entails considerable alteration in the wave pattern. In particular the speed at which conjunction of wave length takes place is diminished and the "hump" in the resistance curve occurs at a lower speed. Consequently at speeds above middle of "hump" resistance is diminished and at those below middle of "hump," increased by shallowness of water. There are other factors affecting the situation such as the increased local disturbance

immediately surrounding the ship, and the modification to the increase of frictional resistance referred to above caused by the large dimensions of the wave accompanying the ship.

In addition to the foregoing considerations, which relate to the shape of the ship, the restricted nature of the flow also affects the performance of the propeller, often prejudicing its efficiency; further the speed of rotation of the shaft and consequently the power exerted may be affected, resulting in an increase in the loss of speed. In general, shallowness of water causes a reduction in speed, but for high speed ships such as torpedo boat destroyers, there may be a reduction in resistance at top speeds due to the change in wave formation, and as a result on certain shallow water speed trial courses there is an appreciable increase in the obtainable speed. The phenomenon is so complex that recourse must be made to experiment data to estimate the quantitative effect in any specific case. Model experiments have proved most useful in this respect and results of experiments covering a large range of conditions are available. Some results of trials of actual ships in various depths of water have also been published and reference should be made to papers in Trans. I.N.A. and other shipbuilding societies for further information.

Similar, but generally less intensified effects are produced if a ship is proceeding along a channel of restricted breadth. In practice the matter is generally of small importance, as restrictions are laid down as to the speed at which ships are allowed to use such channels. An extreme case of the effect of shallowness of water sometimes occurs when towing boats or barges at speeds large enough to cause a solitary wave of translation. The resistance at larger speeds is then often less than at low. Scott Russell was the first to draw attention to this phenomenon and special canal boats have been built to take advantage of it.

Acceleration.—When the speed of the ship is not uniform the resistance is altered by an amount depending on the acceleration, the inertia of the ship and the motion of the surrounding water. The effect may be regarded as equivalent to a virtual increase in displacement; and in the "Greyhound" experiments Froude found this increase to be about 20% of the displacement. This value is probably approximately correct for all ships of ordinary form.

PROPULSION

The action of a marine propeller consists fundamentally of the sternward projection of a column of water termed the propeller race. The change of momentum per unit time of this water is equal to the propeller thrust which during steady motion is balanced by the resistance of the ship. If we assume that the passage of the ship does not affect, and is uninfluenced by, the working of the propeller, and neglect all losses of energy except that due to the astern motion of the race, it can be shown that the maximum efficiency is $\frac{2V}{V+v}$ where V is the speed of the ship and v the sternward speed of the propeller race relative to the ship. The quantity $v-V$ is termed the *slip* and $\frac{v-V}{v}$ *the slip ratio* S. It follows that the maximum theoretical efficiency is given by the expression $\frac{1-S}{1-\frac{1}{2}S}$.

In the ideal case then the best result is obtained when the sternward velocity imparted to the water is small; that is, when the propeller acts upon as large a body of water as possible. The efficiency will be small if the slip is large. These tendencies are broadly confirmed in practice but they are modified by the losses incidental to the particular form of propulsive agent adopted. These additional losses are caused by friction of the propelling surfaces, rotation or deflection of the propeller race, shock and turbulent flow. The foregoing considerations apply to propulsion by oars, paddle wheel, hydraulic jet and to the screw propeller. The use of oars and paddle wheels is now generally confined to small vessels in sheltered waterways and the hydraulic jet propeller owing to internal losses and other factors has up to the present not been employed except for rare and special purposes. Passing reference may be made to propulsion by sails, ships with aerial propellers and the experimental rotor ship. Such ships are relatively few in number and importance.

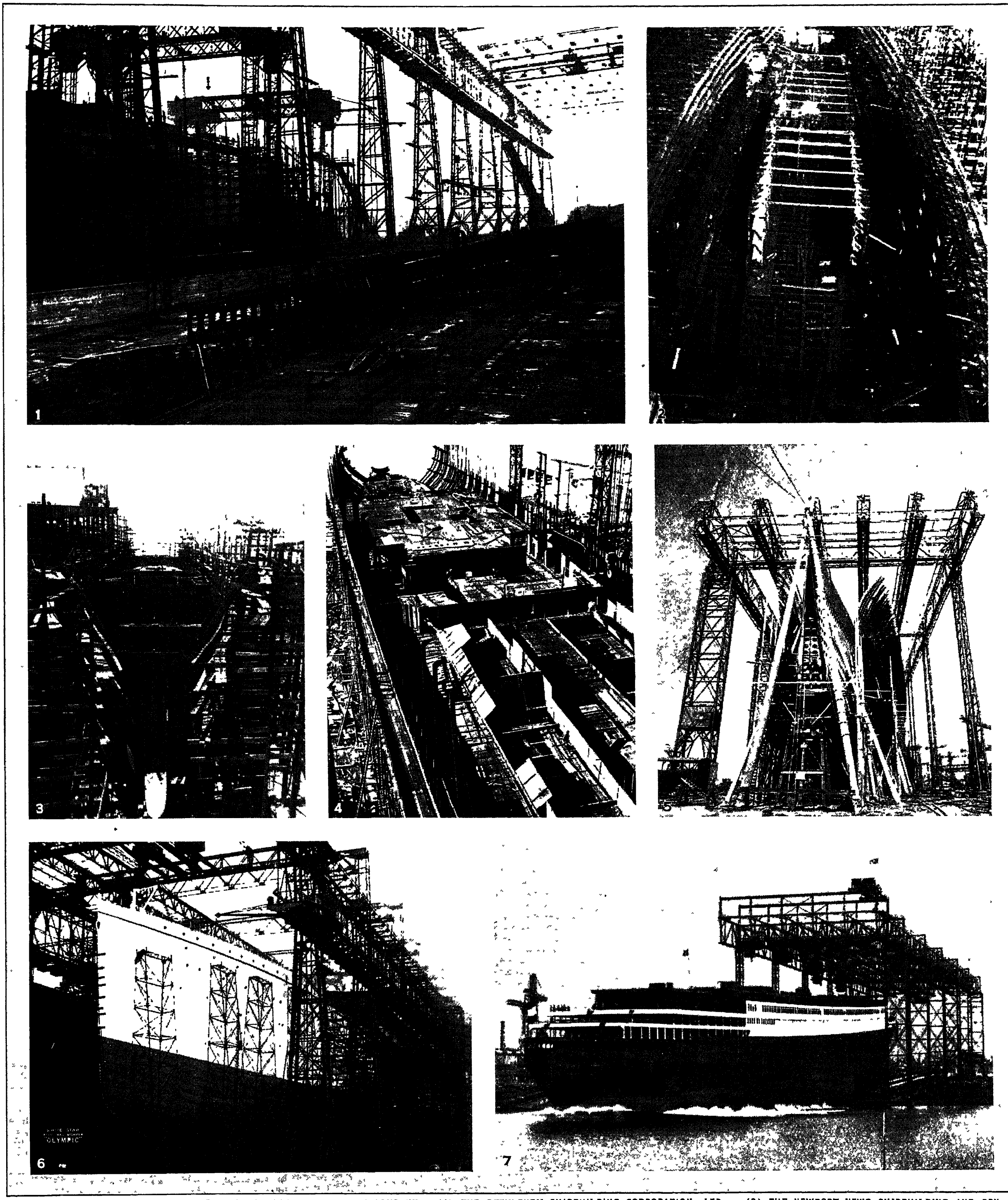
The screw propeller is by far the most extensively used especially for seagoing ships and the remaining remarks herein have reference to this form of propulsion. If v be the apparent speed of advance of the screw propeller, that is the product of the revolutions and pitch; and V the speed of the ship carrying the propeller, then the slip is $v-V$ and the apparent slip ratio is $\frac{v-V}{v}$. This notation corresponds to that previously used, $v-V$ being then defined as the absolute velocity of the race. The pitch of the propeller divided by its diameter is termed the *pitch ratio.*

The theory of the action of the screw propeller has been the subject of consideration by many investigators. Professor Rankine in Trans. I.N.A. 1865 assumed that the propeller impressed change of motion upon the water without change of pressure except such as is caused by the rotation of the race. Sir G. Greenhill, Trans. I.N.A. 1888 assumed conversely that the thrust is obtained by change of pressure, the only changes of motion being the necessary circumferential velocity due to the rotation of the screw, and a sufficient sternward momentum to equalize the radial and axial pressures. This idea was further developed by R. E. Froude in 1889 who concluded that the propeller probably obtained its thrust by momentarily impressing an increase of pressure on the water, which eventually results in an increase of velocity about one-half of which was obtained before and one-half abaft the screw. A lateral contraction of the race accompanies each process of acceleration. These general conclusions have been in some degree confirmed by experiments carried out by D. W. Taylor (Proceedings of the American Society of Naval Architects, etc., 1906) and by Professor Flamm, who obtained photographs of a screw race in a glass tank, air being drawn in to show the spiral path of the wake. Professor Burnside (Proceedings London Mathematical Society 1918) considered the problem mathematically and confirmed some of R. E. Froude's results; he also took into account in a general way the effect of the proximity of the stern of the ship.

The problem has also been attacked from an entirely different angle and a theory was propounded by W. Froude in which the action of each elementary portion of the blade surface is separately estimated from the forces on planes moved through water at various speeds and at different angles of obliquity (*see* Trans. I.N.A. 1878). The investigation is of importance though it does not completely represent the actual conditions; for the deductions from a small element moving through undisturbed water are applied to the whole blade; the disturbance of the water when a blade reaches it and the consequent effects of each element on adjoining elements and of one blade on another are not taken into account. The momentum theory of R. E. Froude has been strikingly confirmed by some exhaustive experiments in a wind channel; and it is found that when the velocity deduced from this theory combined with certain interference factors is applied to the blade element theory of W. Froude in the light of modern experiment data, good agreement is obtained with actual practical results in the case of narrow bladed screws such as air propellers.

In recent years the general application of the circulation theory to hydrodynamical problems has resulted in the conception of the vortex theory of the screw propeller. This theory when more fully developed promises not only to clarify the physical nature of propeller action but to assist the quantitative estimating of propeller performance. The large wide blades used in marine propellers and the confused nature of the water flow at the stern of a ship make the application of theory to all marine screw propeller problems extremely complicated.

Experiment Results.—The complicated nature of screw propeller problems was recognized early and recourse was made to model experiments for information on thrust and torque of propellers of various proportions at different speeds and revolutions. These experiments have necessarily been made on a small scale; but some which have been made on larger propellers have sug-



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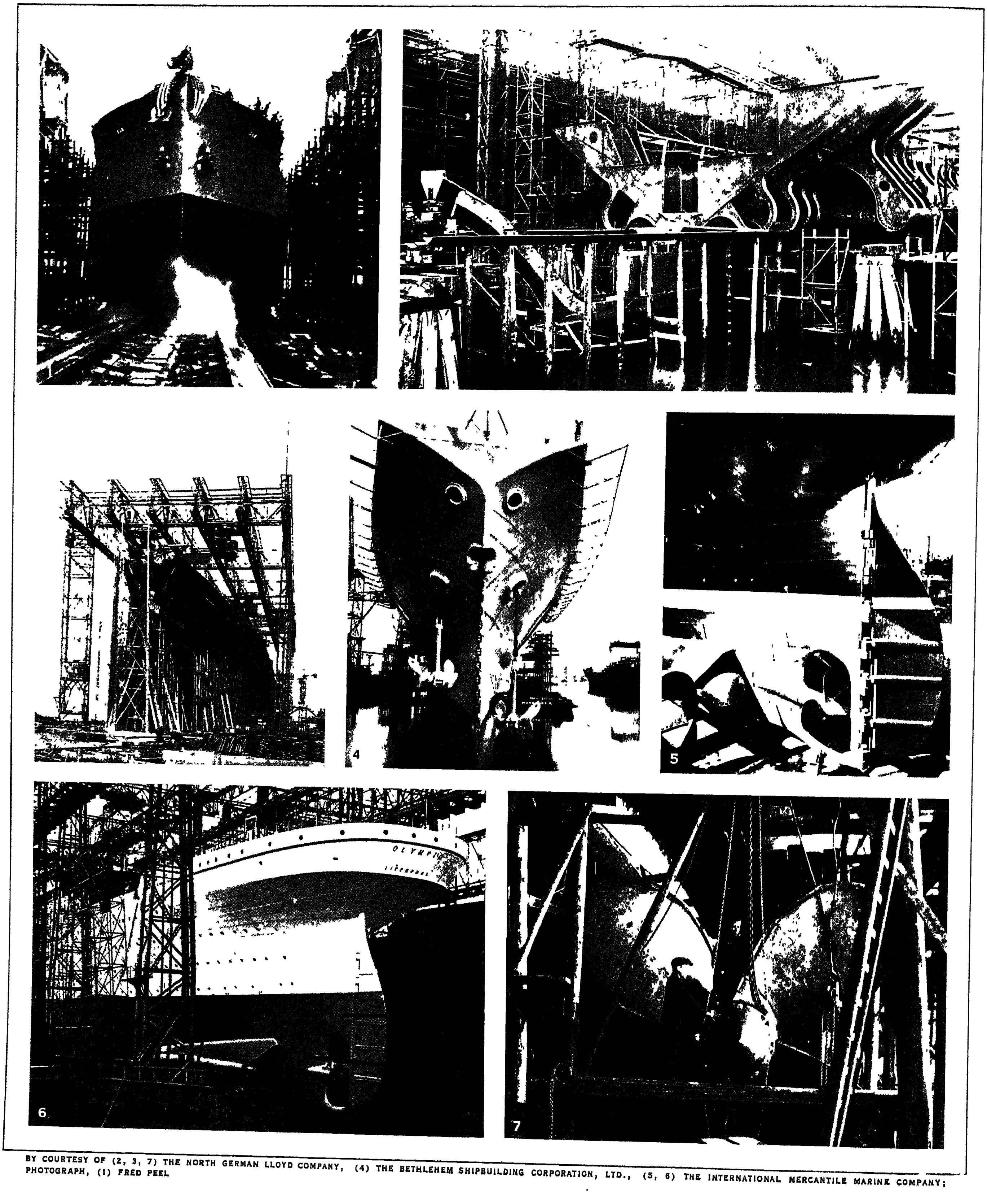
SHIPS UNDER CONSTRUCTION

1. Laying the keel of the S.S. "Olympic," first step in actual construction of a ship
2. U.S.S. "Lexington," late type of aeroplane carrier, building well under way
3. Work in progress on the S.S. "Algonquin"
4. View of the S.S. "Bremen," from above and looking toward the stern. The lower decks of the ship are being laid
5. Another view of the S.S. "Bremen," showing immense frame of steel-work that surrounds a ship under construction
6. The S.S. "Olympic," with practically all of the work completed. The ship has been painted and is ready for launching
7. The S.S. "Bremen" sliding from the ways at the Aktiengesellschaft Weser Yards in Bremen, Germany

SHIPBUILDING



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BUILDING BIG SHIPS

1. Sliding down the ways. The "Sun" being launched
2. Erecting the propeller frames of the German passenger liner "Europa." These steel frames support the propeller shafts
3. The "Bremen," sister ship to the "Europa," in an advanced stage of construction. The steel plates which form the outer hull are being attached
4. Bow view of the U.S. Navy Airplane carrier "Lexington." Its use requires the unique bow design shown
5. Rear view of the English passenger liner "Olympic," showing the rudder and two of the three propellers
6. View of the "Olympic," on the ways, ready to be launched
7. Installing one of the four propellers on the "Bremen"

gested that the scale effect if any is not large; and it is generally assumed that the results of model experiments on propellers can be applied to ship propellers in accordance with the law of comparison, no correction being made for skin friction. The most important sets of experiments published covering the proportions of screw propeller met with in practice have been made by Froude, Taylor, Durand and Schaffran. A paper by Taylor in Transactions of the American Society of Naval Architects and Marine Engineers 1924 shows that these experiments made on different sizes of models in different parts of the world practically corroborate each other. The experiments of R. E. Froude cover a very complete range and the results can be used for most practical problems. (*See* Trans. I.N.A. 1908.) The thrust horsepower is given by Froude in the following formula:—

$$H = \cdot 003216 D^2 V^3 \times B \frac{p+21}{p} \times S \frac{(1-\cdot 08S)}{(1-S)^2}$$

where H is the thrust horsepower, V speed of advance in knots and D the diameter in feet; p is the *effective* pitch ratio calculated from the revolutions for zero thrust. For full sized screws Froude considers this is 1·02 times the face pitch ratio; for modern screws it is probable that the ratio should exceed 1·02. The "blade factor" B depends only on the type and number of blades; its value for various "disc area ratios," *i.e.*, ratio of total blade area (assuming the blade to extend to the centre of shaft) to the area of a circle of diameter D is given in the following table:—

Disc area ratio	·30	·40	·50	·60	·70	·80
B for 3 blades elliptical	·0978	·1050	·1085	·1112	·1135	·1157
B for 3 blades, wide tip	·1045	·1126	·1166	·1195	·1218	·1242
B for 4 blades, elliptical	·1040	·1159	·1227	·1268	·1294	·1318

Reference should be made to the paper for curves of efficiency obtained.

Interaction Between Ship and Screw.—In the foregoing theoretical and experimental consideration it has been assumed that the propeller is advanced into undisturbed water, which is very different from the conditions existing behind the ship. The vessel is followed by a body of water in complex motion called the "wake." It is assumed that this water has a uniform forward velocity V^1 over the propeller disc, V being the speed of the ship; the speed of advance of the propeller is then $V-V^1$; and the expression $\frac{V^1}{V-V^1}=w$ is termed the *wake value*. The propeller acts generally as a screw advancing into undisturbed water at speed $V-V^1$ and the real slip is $v-(V-V^1)=v-\frac{V}{1+w}$; w is in general a positive fraction so that the real slip is greater than the apparent slip $v-V$; and real slip must be taken into account in the design of propeller dimensions.

The influence of the screw also extends sufficiently far forward to cause a diminution of pressure on the after part of the ship, thereby causing an increase in resistance. The thrust T, exerted by the screw working behind the ship must be sufficient to balance the tow rope resistance R. This increase of resistance as well as this diminution of pressure is conveniently expressed as a fraction t of the thrust exerted by the screw, whence it follows that $T(1-t)=R$. The power exerted by the propeller or the thrust horsepower is proportional to $T\times(V-V^1)$; the effective horsepower is $R\times V$ and the ratio of these two,

$$\frac{RV}{T(V-V_1)}=(1-t)(1+w)$$

is termed the ***hull efficiency***. The hull efficiency value does not differ greatly from unity with different positions of the screw. An account of an interesting series of experiments to determine the values of w and t is given by W. J. Luke, Trans. I.N.A. 1910.

The total propelling efficiency or propulsive coefficient is the ratio of the effective horsepower (RV) to the indicated or—in turbine driven ships—the shaft horse power. Its value is generally of the order of 0·5. In some recent ships devices such as the contra-propeller have been fitted. In essence this consists of an addition to the hull in front of, or abaft, the propeller, of blades to guide the water to, or away from, the propeller; thus eliminating the rotary motion in the race. Some gain in efficiency is obtained in certain cases, particularly for single screw vessels. Such gain in efficiency is wholly or partially offset by the increased resistance due to the fixed blades themselves and the device is probably of greater value in the case of propellers of large slip and consequently low efficiency.

Cavitation.—The phenomenon of cavitation arises when there is interference with the natural flow of water to the screw. It is accompanied by excessive slip and reduction in thrust and consequently very much reduced efficiency. The diminution of pressure accompanying the acceleration of the water ahead of the screw may in certain circumstances be sufficient to bring about these conditions. Such circumstances arise when the depth of immersion is small and consequently the original pressure low, when tip speed is excessive and when the blade area is relatively small in relation to the thrust. Some experiments were carried out on T.B.D. "Daring" by S. W. Barnaby in 1894 for an account of which and the results obtained *see* Trans. I.N.A. 1897. Later experiments have shown that the circumstances referred to above all have their effect, the critical pressure causing cavitation varying to some extent with the type of ship and with the details of the propeller.

STRENGTH

A ship in a seaway is subjected to variable forces, which induce stresses in the pieces and their connections which make up the hull structure. Most of the forces depend on the action of the sea and cannot be predicted with precision; and at the same time the hull structure is so complex that a quantitative theoretical analysis of the stresses in the parts is in general of value only for comparative purposes. Such comparisons with the results of experience give the only real guide as to the adequacy of the strength of new ships and to the proper distribution of the minimum quantity of material necessary.

Longitudinal Bending.—The greatest straining actions to which vessels of ordinary proportions are subject, are due to inequalities in the longitudinal distribution of the weight and the buoyancy. In the standard calculations the ship is regarded as a beam—(1) on a trochoidal wave of length equal to that of the ship and height $\frac{1}{20}$ of the length, with the crest amidships this condition is known as "hogging." (2) On a similar wave with the trough amidships, the "sagging" condition. The ship is balanced on the wave to satisfy the necessary elementary conditions of equilibrium and curves of buoyancy and weight per foot run plotted on the base of length. The resulting curve obtained by plotting the differences of the several ordinates of buoyancy and weight gives the curve of loads. By integrating this curve a curve of shearing force is obtained, which integrated in its turn gives the curve of bending moment. The conditions of equilibrium ensure that the end ordinates of the shearing force and bending moment curves are zero. The maximum bending moment, frequently expressed as a ratio of the product of the ship's length and displacement, occurs near amidships.

The stresses at a transverse section due to bending are obtained from the usual beam formula $\frac{p}{y}=\frac{M}{I}$; M being the bending moment, I the moment of inertia about the neutral axis, y the distance from the neutral axis and p the intensity of stress. In calculating I, only the continuous longitudinal portions of the structure are assumed effective and a deduction from the area of material in tension is made for rivet holes. The stresses thus obtained vary considerably with the type and size of ship. It is clear that the actual straining actions on a ship necessarily vary with the type, and the stresses allowable calculated on a uniform basis of applied forces must vary accordingly. With regard to size, the larger the ship there is less likelihood of meeting waves

as long as herself, and the proportion of height to length of the largest waves is generally less than that assumed. (For particulars of waves actually observed reference may be made to a paper by Dr. Vaughan Cornish, Journal of Royal Society of Arts, 1912.) For these reasons greater calculated stresses are allowable in large ships than in small or moderate sized ships. For small ships a limiting stress of 6 tons per sq.in. is frequently adopted, with an increase to 8 tons per sq.in. for portions in tension where high tensile steel is used. For large ships the calculated stresses frequently exceed 8 tons per sq.in. compressive and 10 tons per sq.in. tensile.

The validity of the assumption made that the ordinary theory of bending is applicable to the case of a ship was tested and confirmed in 1903 by experiments made on H.M.S. "Wolf" by Sir John Biles. (*See* Trans. I.N.A. 1905.) The experiments were made both in still water and at sea, the extension or compression of the structure at various points being measured by strain indicators. As a result of these experiments it may be said in general that the stresses corresponding to any particular external conditions closely agree with those calculated on the usual theory of bending; but the waves encountered during the sea trials were such that the maximum stress then obtained was considerably less than that in the condition assumed in the standard calculations.

Several refinements for calculating stresses among waves have been suggested, none of which have come into general use. Some of these are the Smith correction (Trans. I.N.A. 1883), and the modifications due to heaving and pitching and rolling oscillations (*see* Trans. I.N.A. 1890, 1896, 1898). In addition to the direct stresses resulting from longitudinal bending, shearing stresses are experienced which in some cases are appreciable. Such stresses reach a maximum at or near a quarter of the length from either end, and at the height of the neutral axis. It is sometimes necessary to give special consideration to the thickness of plating and the connections in this neighbourhood.

Transverse Bending.—Stresses due to transverse bending may be of importance in certain cases; and some means of comparing the transverse strength of vessels is desirable. In a ship well subdivided by transverse bulkheads it is difficult to determine how far the stresses at intermediate sections are influenced by the neighbouring bulkheads, positions at which transverse stiffness is very great indeed. But by taking a section midway between two bulkheads assumed far enough apart to have no influence on the section considered, a method of comparison has been worked out. For further information reference can be made to papers by Dr. Bruhn in Trans. I.N.A. 1901, 1904 and 1905.

Local Stresses.—In addition to the stresses due to longitudinal and transverse bending, there are numerous local stresses for which provision must be made. These include stresses caused by water pressure, heavy blows from the sea on side, deck and upper works, reactions of moving parts of machinery, blast from gun fire, etc. The supports provided are determined by experience and by the requirements of the particular vessel.

It is important that discontinuities and abrupt changes in the distribution of material should be avoided so as to maintain as uniform a distribution of stress over any section as possible. Where large openings have necessarily to be cut, "compensation" is introduced by adding material near the edge of the opening.

Vibration.—A ship like any other elastic structure has a natural period of vibration; and when synchronizing vibrations from whatever cause are impressed on the ship very marked vibration may result. The principal causes of vibration in a steamship are:—(1) The reciprocating parts of the engines, if unbalanced cause vibrating forces and couples in a vertical plane. In twin screw ships torsional oscillations in transverse planes may also result when the engines are working in opposite phase. (2) The rotating parts of the engines cause vertical and horizontal oscillations; and variation in crank effort also tends to produce torsional oscillation particularly in single or two-cylinder engines. (3) Unbalanced propellers produce vibration principally at the stern. (4) The uneven resistance which a propeller experiences during its revolution gives rise to vibrations. This condition results when (1) the propeller blades pass too close to the hull; (2) when the propeller breaks the surface of the water; and (3) when the flow of water to the propeller is imperfect, due either to "cavitation" or the screening effects of shaft and propeller supports. (5) Various items of auxiliary machinery set up independent vibrations.

The adoption of the steam turbine has eliminated many of the causes of vibration referred to above. In general it can be said that vibration in a ship can only be avoided by removing its cause; it not infrequently happens that the addition of further stiffening results in increased vibration.

Reference can be made to papers in Trans. I.N.A. of Dr. O. Schlick (1884 to 1901), of Mallock (1895) and of Nicholls (1924).

Steering.—The information available on the steering and manoeuvring qualities of ships is largely due to the results of trials with British warships. These include observations of the paths when turning under different angles of helm, at various speeds, with and without assistance from the propellers, and with variation in certain features of the hull which influence steering. One of the first attempts at plotting the curve traversed by a ship under the action of her rudder, and the position of the ship at any instant with reference to that curve was made by Sir P. Watts in 1877 on H.M.S. "Thunderer." Similar experiments were carried out on "Yashima" (Trans. I.N.A. 1898).

When the path of the ship is plotted, the bow of the ship is nearer to the centre of the circle or curve in which she turns, than the stern. The ship may be regarded as going ahead and turning or pivoting about a point well forward in the middle line; this is termed the "pivoting point" and the middle line is, at this point, a tangent to the curve concentric with and similar to that described by the centre of gravity of the ship. The angle between the middle line and the tangent to the curve traced out by the centre of gravity is termed the "drift angle." The maximum distance that the ship's centre of gravity travels in her original direction after the helm is put over is termed the "advance"; and the perpendicular distance between the original line of advance and the ship's position after turning through 16 points is known as the "tactical diameter."

It is convenient to investigate the forces acting on the ship in three stages, (1) when the helm is put over, (2) when the ship has finally picked up her circular course, and (3) the intermediate stage when the ship is accelerating but yet has gained some of her rotational velocity. The character of the forces acting during (1) and (2) can be ascertained, and the type of motion under the complex conditions represented by (3) will consist of a gradual replacement of motion at (1) by that at (2).

As soon as the helm is put over the first effect is to alter the stream line motion at the stern. The stream lines against and in front of the rudder are expanded so that their velocity is reduced and pressure increased. This leads to a force on both rudder and deadwood; and the eddying behind the rudder causing a reduction of pressure accentuates the effect. The net result is that a considerable force acts at the stern, the lateral component of which tends to turn the ship, and the component in fore and aft direction adds resistance to the ahead motion of the ship. The proportion of this force due to the deadwood is unknown, but in many modern ships in which the deadwood is considerably cut away this force is small. The portion due to rudder pressure can be calculated from the results of experiments on plates moving obliquely through the water. This force varies with the shape of the rudder and approximately as its area, the angle of helm and the square of the speed; and can be expressed by the formula, $P=KAV^2$ where K depends on the angle of helm and the shape of the rudder. At the maximum helm angle (usually 35°) K is about 1·2; but when applying this a liberal allowance should be made for the reduction of V due to resistance under helm. In actual practice the old formula—

$$P=1\cdot 12AV^2\sin\theta$$

where P is the force in lbs., A the area of rudder in sq.ft., V the speed of the ship in feet per sec. increased by a percentage to allow for propeller race and θ the angle of helm, has been found to give good results at maximum helm angle. Both the lateral and angular

movements of the ship are accompanied by the motion of a mass of water which may be regarded as virtually increasing the mass and moment of inertia of the ship.

The handiness of a ship is mainly dependent on the relation between the moment of rudder pressure for a given angle, and the virtual moment of inertia. If the inertia is comparatively large, the ship will turn slowly under helm. Unhandiness is usually experienced at low speeds when rudder pressure is small, and in shallow water when the virtual inertia is increased by the reduction of the flow of water from one side of the ship to the other. Improvement in such cases has been obtained in certain ships with unbalanced rudders by filling in the after deadwood, the loss from the increased inertia being more than compensated by the greater turning moment due to the pressure on the deadwood.

When the ship is turning steadily in a circle the forces acting are the pressure on rudder and deadwood, the centrifugal force, the thrust of the propellers, and the pressures on the hull. The pressure on the rudder is now less than when the helm is first put over, both by virtue of the fact that the effective rudder angle is less, and that the speed of the ship has decreased.

Heel When Turning.—When the helm is first put over, the pressure on the rudder causes a small inward heel. As the rotational speed of the ship increases the small inward heel is succeeded by a steady outward heel, caused by the couple formed by the centrifugal force and the lateral resistance diminished by the (usually) small couple due to the rudder pressure. If when turning, the helm be put quickly amidships, the opposing couple due to rudder pressure is removed, and the outward heel is momentarily increased. Instances have occurred of ships with small stability and comparatively large "rudder couple" capsizing through this cause.

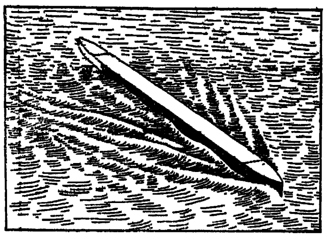

Fig. 3

Types of Rudders.—Rudders used in ships are of two general types (1) unbalanced, and (2) balanced.

The unbalanced rudder, supported at its forward edge, is in stable equilibrium when amidships; and for this reason and its simplicity of construction is preferred when the force required to put the rudder hard over is sufficiently moderate to enable steering to be performed by hand or by an engine and gear of moderate size. For high speeds and large manoeuvring powers the unbalanced rudder is generally unsuitable; and balanced rudders, in which about one quarter of the area is usually placed before the axis, are adopted in order to reduce the force required and the work done to obtain large angles of helm. A balanced rudder is unstable amidships, and if left free, comes to rest at a moderate angle on either side of the middle line. Unbalanced rudders, extending up to, or above the waterline and comparatively narrow longitudinally, are generally fitted in the merchant service (*see* figure 4). Somewhat greater efficiency when using small or moderate angles of helm is obtained with rudders of this type, as for a given pressure on the rudder, the turning moment on the rudder and consequently the power required in the steering gear is less. For fast liners a type of balanced rudder is sometimes adopted (*see* figure 5).

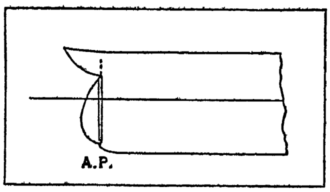

Fig. 4

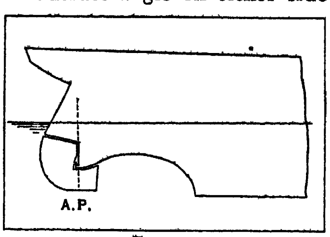

Fig. 5

For warships where the steering gear has to be kept below waterline for protection, broader and shallower rudders are adopted; and for the reason above stated balanced rudders are now practically universal in warships (*see* figure 6).

When a ship is going astern manoeuvring is performed with some uncertainty and additional rudders have sometimes been fitted at the bow; these are generally for use in confined waters where it may be necessary to go astern for a considerable period. Rudders of special form and characteristics such as the Kitchen rudder and the Flettner rudder, have been fitted to some modern vessels.

Experimental Results.—Experiments have been made to ascertain the effects of angle of helm, time of putting helm over, and draught and trim of the ship, on the turning properties of the vessel. In general it is found that the tactical diameter diminishes with increase of helm angle. In ships having unbalanced rudders and hand steering gear considerable time is required to put the helm over at full speed; consequently the tactical diameter and the advance are greater at high speeds than at low speeds. With power worked steering gear with which the helm can be put hard over in from 10–20 seconds at any speed, the speed is found to have little influence on the path described when turning. In the case of torpedo boat destroyers a marked increase in tactical diameter and in advance occurs at high speeds. A moderate variation in mean draught has little effect, but additional trim by the stern results in a greater space being required for turning.

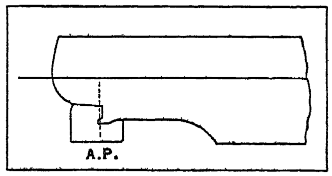

Fig. 6

By working one propeller ahead and the other astern the space required for turning may be shortened, but the time of turning is frequently increased. The path described is generally tortuous in character and depends on the relation between the revolutions of the propellers. In a single-screw ship, with the propeller well immersed, the upper blades experience greater resistance to rotation than the lower blades; hence a right-handed screw tends to turn the ship's head to starboard, and starboard helm is necessary. The reverse is occasionally experienced when the upper portion of the screw is incompletely immersed.

PRACTICAL SHIPBUILDING

Design.—In order that a naval architect may be in a position to prepare a design for a new ship he must first be informed as fully as possible of the requirements which he is to meet. These include the trade or service on which the ship will be engaged; the important features that it is desired to embody (*e.g.*, in a warship the armament and protection to be carried); the speed and endurance to be aimed at, and any limitations in dimensions or cost. In the case of a British warship design the requirements are laid down in the first place by the naval staff. The Director of Naval Construction then prepares outline or sketch designs complying as nearly as possible with these requirements; and after full discussion one of these designs is selected and approved. This design is then worked out in detail, and complete drawings and specifications prepared.

The problems of naval design differ in many respects from those occurring in connection with merchant ships (*q.v.*). Usually the most important consideration is that of weight; for it is necessary to obtain the greatest possible offensive power, defensive qualities and speed in as light and small a ship as practicable. This has led to many interesting developments in structural design; materials of high elastic strength are employed wherever possible, and scantlings are cut to the greatest possible extent consistent with safety. Many fittings and fixtures, and even minor portions of the hull, are made of aluminium alloy or other light materials; and great progress has been made in designing the arrangement of structure so that the material is disposed, as far as practicable, where it is most effective in contributing to the strength of the ship. The importance of this can be realized when it is remembered that in a high-speed ship every ton saved enables the ship as a whole to be lightened by about three tons. The designer's experience is also called upon to dispose the armament so as to be as effective as possible in all directions, and avoid mutual interference by gun blast, to ensure that such protection as is carried shall shield the vitals of the ship for a minimum expenditure of

weight, and to arrange the main and auxiliary machinery so that it encroaches as little as possible on other portions of the ship, particularly those devoted to the accommodation of the personnel and the stowage of ammunition. The form of the ship is largely determined by consideration of the minimum resistance at high speed; in addition adequate stability has to be provided under all conditions (including the cases when the ship has been damaged by gunfire or after attack by mine or torpedo) and the trim and seaworthiness of the ship rendered satisfactory.

The information prepared by the naval architect and supplied to the shipbuilders consists usually of a sheer drawing showing the form of the ship, a profile, various sections and a plan of each deck showing the general arrangement, and the structural sections. With these is a complete specification laying down the materials to be used and their scantlings, and containing a description of all internal arrangements, the fixtures, fittings and stores to be supplied, and the trials to be finally carried out.

The method adopted for designing a ship cannot be described here at length. It may be observed, however, that the process is tentative, approximate dimensions, form and horse-power being first assumed and the design worked out sufficiently to ascertain whether it meets the requirements. If it fails to do so, or if any defects are revealed, the dimensions, etc., are altered and the process repeated until a design is obtained which satisfies the conditions imposed. The success of the final design depends on the skill and experience of the naval architect, who has to base his plans on his knowledge of existing ships, whilst introducing such improvements as he is able, having regard to progress in materials and machinery and more accurate knowledge of the conditions of service.

Materials.—Ships are in general built of mild steel, which is a ductile material, easily worked, differing entirely from the hard and brittle steels from which tools are made. Its ultimate strength is about 28 tons per square inch. High tensile steels are used largely for important parts of the structure of warships and liners; their strength varies from 33 to approximately 40 tons per square inch. The stem, stern frame, rudder frame, hawse pipes, etc., are generally made of cast steel (26 tons per square inch or less), cables, davits and similar fittings of wrought iron (22 tons), whilst naval brass, gunmetal or phosphor bronze are used for many internal fittings. All materials used are subjected to a variety of tests before being worked into the ship in order to ensure that the quality of material is up to the standard required.

Structural Arrangements.—The steel used in ship construction is worked in the form of plates or rolled sections which are generally angle bars or channels (⊏). They are connected together by rivets, hammered or pressed hot; and the joints are designed so that the strength of the connection is as nearly as practicable equal to that of the material it connects. In addition a large number of joints have to be made watertight or oiltight. This is ensured by closely spacing the rivets so as to draw the plates or bars well together, and by caulking the edges. The latter operation consists of splitting the material at or near the edge, and, using a tool like a cold chisel, hammering the split portion hard against the adjoining plate or bar. This effectively prevents the passage of oil or water between the two surfaces; but with thin plates it is sometimes supplemented by inserting between the bearing surfaces of the plates a "stopwater" consisting of tape steeped in composition.

Cruiser.—The structural arrangement of a typical warship is illustrated by the perspective drawing of a cruiser (fig. 7). The various portions of the structure are lettered and indicated on the diagram. The vessel has two distinct skins or bottoms, viz.: the outer bottom which forms the outside of the hull and transmits the water pressure to the general structure of the ship, and the inner bottom which is also watertight and whose function is to save the ship if the outer bottom is damaged or pierced. In this vessel the thickness of the outer bottom is one inch at or near the keels and behind the outer protective plating at the sides, and slightly less on the bilge. The inner bottom, though thinner, is also worked so as to assist the longitudinal strength of the structure. The space between the two bottoms, termed the double bottom, is utilized as far as possible for the stowage of oil fuel and reserve feed water.

The inner and outer bottom are connected together by two systems of frames (shown in the diagram)—longitudinal and transverse. The former are worked continuously throughout the central part of the ship in order to contribute as effectively as possible to the longitudinal strength; this system of framing, with the

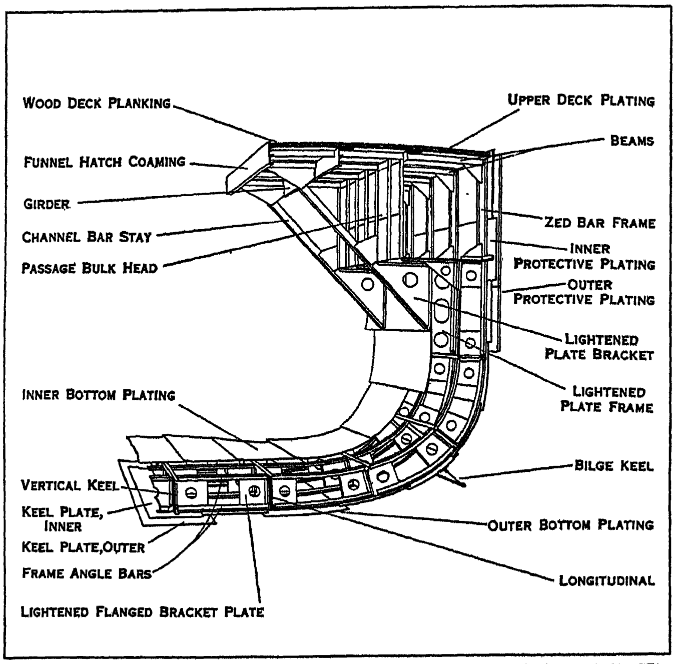

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FIG. 7.—MIDSHIP SECTION OF SMALL CRUISER

longitudinals predominant, is an important feature of the structure of all large warships. The frame at the middle line—termed the vertical keel, is specially strengthened in order to resist the stresses undergone when the vessel is in dock. The transverse frames (spaced about 4 feet apart) are of minor importance and are worked in short lengths between the longitudinals. Those shown in the figure consist of angle bars and bracket plates stiffened at the edges and lightened by holes; in another system of construction frequently adopted the two brackets are replaced by a single plate lightened by holes which are long enough to permit access through them. Certain of the longitudinal and transverse frames are made watertight or oiltight so as to subdivide the double bottom into a number of cells, which are useful for stowage purposes, and, moreover, limit the ingress of seawater in event of the outer bottom being damaged.

The upper deck is formed of steel plating sheathed with wood and supported by beams worked transversely and slotted through the longitudinal girders shown. These girders with the deck plating (which is thickened amidships) are of great importance in connection with the longitudinal strength; and in some ships they have been increased in number and the beams correspondingly reduced. An interesting feature shown on the diagram is the bilge keel which is fitted in order to reduce the ship's rolling in a seaway. At the ends of the vessel the system of construction is considerably modified, the principal framing being transverse and the double bottom being no longer worked. Adequate watertight subdivision is still provided by the watertight bulkheads and decks, of which the former are more closely spaced than amidships.

In larger warships—battleships and battlecruisers—the system of construction does not differ in principle from that described above for a cruiser. The thickness of plating is greater and the scantlings in general are heavier; and there are several decks which are supported by pillaring (or bulkheads), extending down from deck to deck to the inner bottom where the loads are finally balanced by the water pressure transmitted through the framing. The armour instead of forming a portion of the structure (as in the cruiser shown) consists of separate hard plates bolted to the

ship's side, which is recessed for the purpose; the framing beneath is frequently strengthened in order to support the heavy localized weight. In other respects the structure of a battleship and that of a cruiser are generally similar.

Destroyer.—The destroyer construction is different from that of a cruiser, for there is no double bottom and the important framing is worked transversely and closely spaced (about 21 inches). Owing to the disproportionate weight of machinery which these

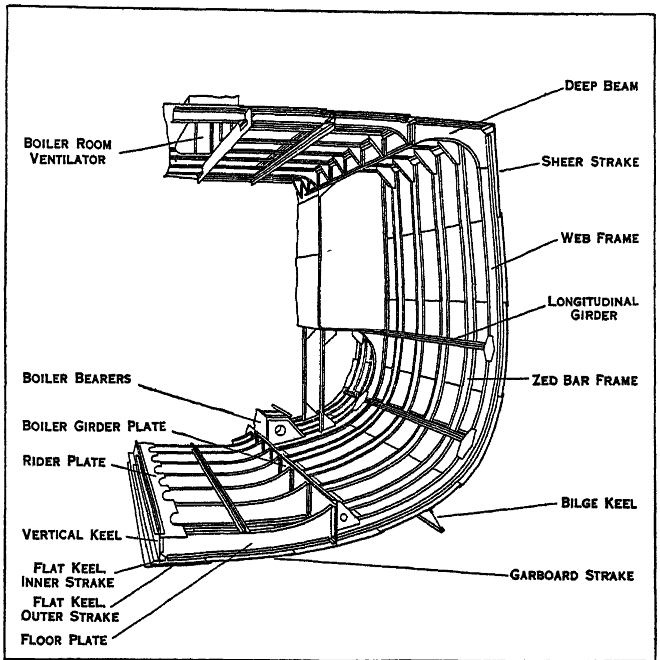

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FIG. 8.—MIDSHIP SECTION OF A DESTROYER

vessels have to carry, the lower part of the framing is adapted to form supports to the boilers and engines; in the ship illustrated the ordinary frames are interrupted and replaced near the middle line by heavy floor plates. Deepened or "web" frames are worked at intervals in order to provide adequate transverse strength and stiffness. Each frame is connected to a beam supporting the deck above.

The longitudinal frames, which are generally slotted over the transverses, are few in number; but they render valuable assistance to the general as well as the local strength by stiffening the thin plating in their vicinity and preventing it from buckling under a compressive load. They are of particular importance under the deck where they form an integral and valuable portion of the structure which would otherwise be too severely stressed in a seaway. The thickness of the shell plating amidships is in places as small as 0·17 inch; together with the deck, vertical keel and all parts contributing to the longitudinal strength it is made of special quality steel capable of withstanding high stress without injury.

Sloop.—The structure of this well-known type of naval auxiliary craft generally resembles that of a light mercantile ship. The framing is transverse and closely spaced (21 inches). The thickness of the shell plating is about ¼ inch.

Submarine.—The structure of an "L" class submarine is designed primarily to resist the water pressure when submerged. Except for the vertical keel and the local supports to machinery, the framing is therefore wholly transverse and is fitted in the form of rings spaced about 21 inches apart. The thickness of the main hull plating is about ½ inch, and that of the ballast tanks ¼ inch. The transverse strength is supplemented by the bulkheads fitted at intervals.

Watertight Subdivision.—An efficient system of watertight subdivision is particularly important in all classes of warships; for without it any degree of damage below the waterline would lead to the withdrawal of a ship from action, if not to its ultimate loss. In arranging the subdivision it is necessary to localize the influx of water due to small damage, *e.g.*, perforation by fragments of bursting shell, as well as to provide against large damage due to running aground, or being struck by a torpedo or mine. For this reason fairly minute subdivision is required; the main transverse bulkheads (which in merchant ships constitute the whole, or nearly the whole, of the watertight partitions below the "freeboard deck") are supplemented in warships by minor transverse and longitudinal watertight bulkheads; moreover in general, every deck and flat is made watertight. By these means the buoyancy, as well as the stability of the ship is preserved; and if due care has been taken to maintain the watertightness of the various bulkheads, etc., a warship should be able to continue in action after being holed in a large number of places.

It may happen that the injury to the ship, although insufficient to sink her, may lead to a large heel or trim, which would prevent the ship being manoeuvred in action or her guns being fired. To remedy this, means are provided for correcting heel and trim by flooding compartments on the opposite side or end of the ship; suitable compartments are selected for this purpose, and large valves fitted so that the spaces may be quickly flooded when desired. Information is also supplied to the commanding officer on the effect of flooding each compartment, so as to enable a rapid decision to be made in emergency as to any flooding that may be desirable. An important feature of the subdivision of warships is that the main transverse bulkheads are made as far as practicable *intact*. They are not pierced by doors or any other fittings except the necessary electric leads and power pipes, which are placed as high as possible, and, whenever it can be arranged, above the waterline.

Ventilation.—The fittings of warships include those used in direct connection with the armament of the ship (*see* also ORDNANCE: *Naval*), the steering gear, the watertight hatches and doors, the arrangements for pumping, flooding, draining and fresh and salt water supply, the anchor and cable arrangements, the ventilation and many others. It is impossible in the space available to give even a brief description of these fittings or of the installations of which they form part, but the principles underlying the ventilation system of a modern warship will be outlined. In the living spaces of the ship, and in the ordinary storerooms, magazines, etc., it is of the greatest importance that a definite supply of fresh air should be available.

On the other hand, in compartments such as washplaces, latrines, stores where food is kept, and auxiliary machinery compartments—in short in any spaces where foul or overheated air is generated—the first consideration is to remove this air directly overboard and not allow it to penetrate into other parts of the ship. This is effected by fans which exhaust from the spaces in question and deliver the exhausted air into the open. The air required to replace that exhausted is allowed to enter as it will through hatches or doors; although not usually fresh it is sufficiently pure for supply to the spaces for which this "exhaust" system of ventilation is adopted.

In the main engine rooms a combination of both systems is employed; the heated air is removed by large exhaust fans and the fresh air supplied by smaller fans and also allowed to enter naturally through hatches. In the boiler rooms the supply of fresh air to the furnaces ventilates also the compartments themselves. In order to obviate the passage of air trunking as far as possible through watertight bulkheads a large number of small fans are required; in a modern cruiser about 70 fans are fitted for the ventilation of the ship (*i.e.*, in addition to those for the main machinery spaces), and they are capable in the aggregate of supplying and exhausting about 100,000 cubic feet of air per minute.

As regards the arrangements in the spaces themselves, experience has shown that the most successful method is to fit both supply and exhaust high up in the compartments. The fresh air, owing to its greater density, sinks soon after entry, flows over the floor of the space and finally drives out the lighter foul air which has risen. A vigorous movement of air is required under tropical conditions, whereas in cold climates the contrary is the case. This difficulty is overcome by controlling the speed of the fans, so as to vary the quantity of air they supply, and by providing means for

altering the direction and amount of the supply at any point. Steam heaters are also fitted near some of the fans, so that, when necessary, the air supplied may be warmed to a comfortable temperature before it is distributed in the ship. Natural ventilation by cowls, windsails, etc., although used extensively in mercantile vessels is only used in warships for small spaces situated near the open and when required under tropical conditions as an auxiliary to the ordinary ventilation. (W. J. B.)

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SHIPBUILDING: MERCANTILE. As a ship is a most complex engineering structure, the process of design requires considerable experience and skill, allied with sound judgment. When a shipowner orders a new vessel he must in the first instance have a clear idea as to the size and type and the other properties desired in order to suit the particular trade in which it will be engaged. These requirements will include the weight and space required for cargo, the number of passengers and type of accommodation for them, the speed to be attained, and the distance to be run without replenishing the fuel supply. One important factor which must not be omitted is the permissible draught of the ship, since the depth of water available in many harbours is limited. In addition it is desirable to decide in which Classification Society, if any, the vessel is to be classed, since this will determine the details of the scantlings to be employed. It is also necessary to decide whether the method of propulsion is to be by steam engines —either reciprocating or turbine or a combination of these—or by an oil engine. The choice of machinery depends upon many considerations, chiefly of an economic character, and it is by no means easy to decide which will be the most suitable to meet given conditions.

With this information at his disposal, the shipbuilder is in a position to prepare his preliminary designs and to determine the most suitable dimensions. The settling of the most suitable dimensions is a task calling for considerable care, since the whole success of the ship will depend upon the solution of this problem. With given dimensions the weight of the ship's structure including hull, equipment and machinery can be calculated, and this weight together with the weight of the cargo to be carried (known as the *deadweight*) must not exceed the displacement of the ship at the required draught.

In addition, the depth of the vessel must be such that the distance from the water line to the deck must not be less than that given in the Tables of Freeboard. This distance, known as the *freeboard*, varies with the size of the ship and the nature and extent of the erections above the deck, and has been determined as the result of many years observations and experience. When dimensions giving a suitable deadweight and freeboard have been determined, the capacities of the various holds are calculated in order to ensure that there will be a sufficient volume to enable the cargo to be carried—for example, it will be clear that very different capacities will be required to house the same total weight of iron ore or of light piece goods.

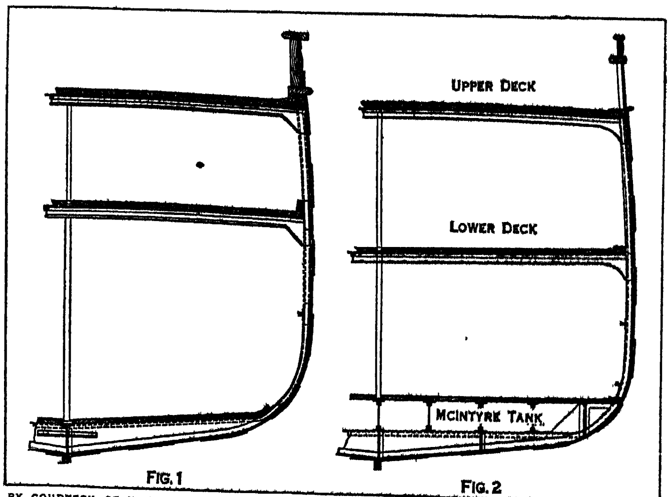
If the ship is intended to carry passengers, regard must also be paid to the requirements as to the effective subdivision of the ship into watertight compartments, the object being to obtain a vessel which will remain afloat if 1, 2 or sometimes even 3 compartments are laid open to the sea by damage through collision or otherwise. The present official British regulations on this subject were formulated on the recommendations of a Committee appointed by the Board of Trade immediately after the sinking of the "Titanic" in April 1912 with the loss of some 1,500 passengers and crew. (*See* SHIPPING: *Registration, Classification and State Regulation.*)

The determination of a suitable breadth in relation to the depth calls for some care, since upon this depends the stability of the vessel, a vital factor, since the stability must be sufficient for safety but must not be so excessive as to cause the ship to roll uncomfortably in a seaway.

Finally, regard must be paid to the various official regulations of the countries between which the ship is intended to trade.

The designer will usually have, to guide him, the details of some successful ship or ships previously built to fulfil the same or similar conditions, and he will probably know what measure of success or popularity the respective features of such vessels have earned in service. The dimensions can in this event be readily fixed to provide the necessary speed and deadweight, stability and seaworthiness, and the cost of the vessel determined. On the other hand, if the departures from previous vessels or from the usual practice be very great, much will depend upon the designer's skill and judgment.

Outline drawings must first be prepared, based on dimensions which are considered suitable, and the various calculations made for this assumed design. These calculations will include the various factors to which reference has been made, and, if it is not intended to class the vessel with one of the recognized Classification Societies, questions of strength will have to be considered. If, however, the vessel is to be so classed, it may be assumed that the scantlings required by the Rules of such Society will provide generally sufficient strength. If the calculations show that the dimensions assumed do not enable the required conditions to be fulfilled, the dimensions must be modified and the calculations repeated, the process being continued until a satisfactory result is obtained. As soon as the dimensions selected for the vessel are found to be appropriate, more complete drawings are put in hand and the final calculations pertaining to the displacement, weights of hull and equipment, deadweight and capacity, centre of gravity and trim, while metacentric diagrams and curves of stability are also made.



BY COURTESY OF THE INSTITUTE OF NAVAL ARCHITECTS

FIG. 1.—MIDSHIP SECTION OF AN IRON SAILING VESSEL, ABOUT 1860
FIG. 2.—MIDSHIP SECTION OF AN IRON SCREW STEAMER, ABOUT 1860

In the case of the construction of large passenger vessels, complete drawings and specifications are prepared by the shipowners or by naval architects employed by them. In other cases, shipbuilders work in close connection with the shipowning companies and the business relations are of a very simple character, the shipowner being content to send a note of the principal dimensions, deadweight, capacity and type of ship required and to stipulate that the ship shall receive the highest class of one of the recognised Classification Societies, leaving the determination of the details of the design in the hands of the builders.

In any case complete design drawings and detailed specifications are necessary for the shipyard operations, and if not supplied must be prepared by the shipyard staff. The principal plans required are the sheerdraught and the profile and deck plans which show the general arrangement. The sheerdraught consists of an elevation showing the vessel's longitudinal contour, the position of the decks, the water line or line at which she will float, and certain other lines parallel to this and equally spaced below it, which are also called water lines, and of a series of vertical lines equally spaced from stem to stern called square stations; of a body plan showing the sectional form of the ship at the square stations—supposing her to be cut by transverse planes at these stations; and of a half breadth plan showing the form of the ship at the several water lines, supposing her to be cut by horizontal planes at the level of these lines. The profile and deck plans show all the internal arrangements of the vessel, the holds and spaces set apart for cargo, the position of the engines and boilers, the accommodation provided for the passengers and crew, and all the principal fittings throughout the ship. The midship section shows the structural arrangements of the vessel and the dimensions—or scantlings—of the more important parts of the structure. The specification is a statement of all the particulars of the vessel, including what is shown on the drawings as well as what cannot be shown on them. The quality of the materials to be used is carefully defined, and it is clearly stated how items not manufactured by the shipbuilders are to be obtained.

Practical Shipbuilding.—Practical shipbuilding requires a knowledge of the properties of materials used in the construction of ships, and also an acquaintance with the methods, means, and machinery by which, after delivery in the shipyard, the materials are brought to the required shapes, erected in their proper relative positions, connected together and completed so as to form a structure which shall fulfil the intentions of the design. The varieties of ships are very great and are constantly changing, and thus new problems are continually presented to the shipbuilder. There is also an ever increasing demand for rapid production which necessitates a constant search for simplification of methods of work, for labour-saving and time-saving machinery, for improved means of handling material in the shipyard, and for workshops which will more completely prepare and finish their products before dispatch to the shipyard.

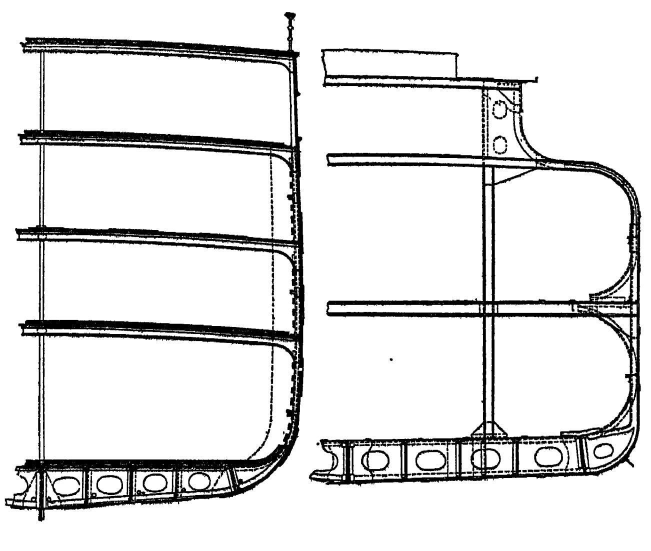
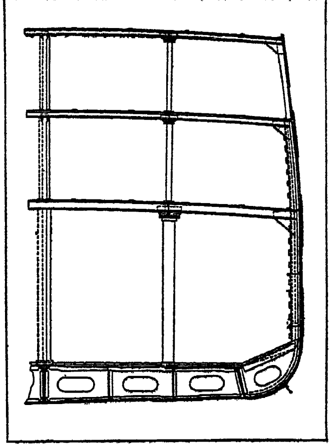


FIG. 3 FIG. 4

BY COURTESY OF THE INSTITUTE OF NAVAL ARCHITECTS

FIG. 3.—MIDSHIP SECTION OF A PASSENGER AND CARGO STEAMER, OF ABOUT 1860. FIG. 4.—MIDSHIP SECTION OF A TURRET DECK STEAMER, 1905

Whatever the size of the ship or the type to which she belongs, the general principles of construction remain very much the same in all cases. The exterior parts—the bottom, sides and decks—supply the strength required for the structure as a whole. The bottom and sides are spoken of as the *shell* or *outside plating* and are, with the decks, kept to the proper shape by means of frames running across the ship like the rafters in a roof or the ribs of a body. These are called *transverse frames* where attached to the shell or *beams* where they run under the decks. At the bottom of the ship where special strength must be provided to support the structure against grounding and in dry dock, the frames are considerably increased in depth and are known as *floors*. The tops of the floors are held upright in their correct relative positions by girders running lengthwise; one at the middle line being called the *centre keelson*, and others nearer the sides *side keelsons*.



BY COURTESY OF THE INSTITUTE OF NAVAL ARCHITECTS

FIG. 5.—MIDSHIP SECTION OF A CARGO STEAMER, ABOUT 1909

In all merchant vessels except those of small size an *inner bottom* is provided, the space between the inner and outer bottoms being utilised for carrying either water ballast or oil fuel. In such cases the centre keelson is called the *centre girder* and the side keelsons are called *side girders*. The centre girder is made continuous, and the deep transverse plates forming the floors extend from the centre girder to the ship's side. The side girders are fitted in pieces between the floors, and are said to be *intercostal*. Occasionally in large vessels one of the side girders is made continuous and the floors in that case are fitted *intercostally*. In modern vessels it is the practice to fit solid plate floors on every second or every third frame only, the remaining floors being built up of bulb angle bars inside the outer bottom and under the inner bottom with short bracket plates between them, the bracket plates being attached to the centre and other fore and after girders by short angle bars. Floors built up in this way are called *bracket floors*. Where, however, special local stresses have to be met, as in the machinery space or at the forward end of the ship, solid plate floors are fitted on every frame.

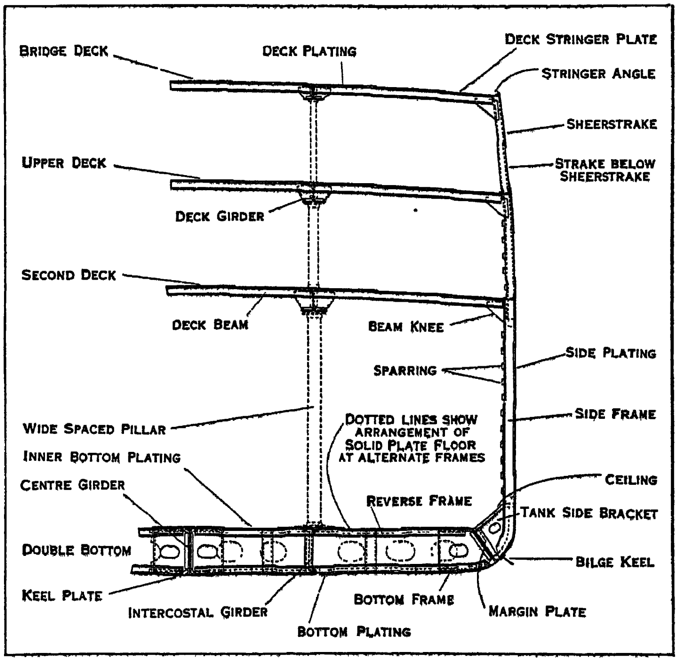


FIG. 6.—MIDSHIP SECTION OF A CARGO VESSEL, 1928

The inner bottom is generally stopped short at the side of the

ship and drops nearly vertically, thus forming a convenient pocket for drainage known as the *bilge,* the boundary plate of the double bottom being called the *margin plate.* The side frames outside the double bottom are attached to the margin plate by plate brackets called *tank margin brackets.*

Besides the ordinary framing, the transverse strength of the ship is much increased by the partitions fitted to divide up the internal spaces of the ship, which are called *bulkheads,* and which may be watertight or non-watertight as the circumstances of the case require. At the extreme ends of the ship the shell plating

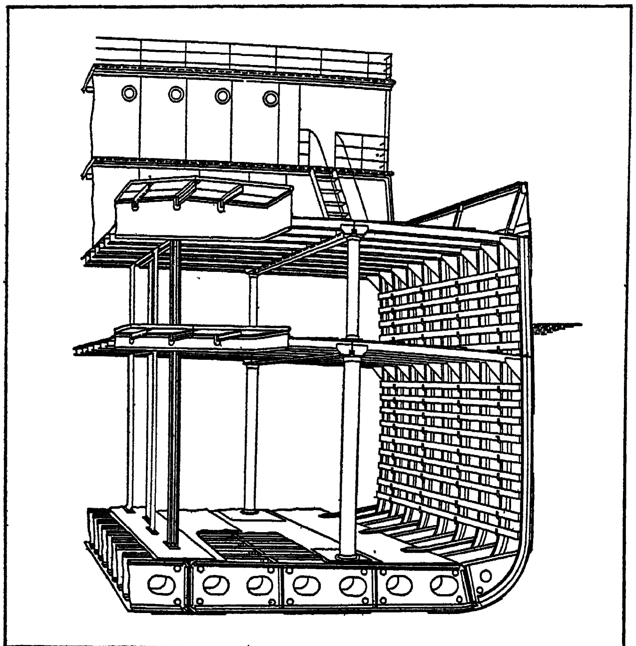


FIG. 7.—GENERAL PERSPECTIVE OF A CARGO VESSEL

on the two sides is attached to forgings or castings which are known as the *stem* at the fore end and the *sternframe* or *sternpost* at the after end. Towards the bow of the vessel particularly, additional supports are introduced to enable the ship to withstand the heavy blows of the sea in bad weather and are called *panting* stringers and *panting* beams, panting being the term applied to the movements which occur in the side plating if sufficient stiffness is not provided. At the stern a deep floor, called the *transom,* is attached to the upper part of the sternframe to form a base for the overhanging part of the stern which is known as the *counter.* To assist the beams in holding the decks in their correct position, vertical *pillars* are introduced in large numbers, but to avoid loss of space and inconvenience in handling cargo ordinary pillars are often dispensed with and a few strong pillars widely spaced with deep girders under the deck are fitted instead.

The general spacing of the frames varies from about 20 inches in small ships to 36 inches in large vessels; 36 inches is however common in ships of moderate size.

The whole tendency of modern shipbuilding is in the direction of simplifying the construction by redistributing the material, concentrating on the more important parts of the main structure, the remainder being treated largely on the basis of local considerations. The changes which have occurred over a period of years will be appreciated by a study of the construction of typical vessels from 1860 to 1928. (Figs. 1 to 7.)

The foregoing description may be regarded as covering mercantile vessels generally, with the exception of that large part of the mercantile marine devoted to the carriage of oil in bulk, a trade which has grown to such dimensions that in 1927 about 10% of the total world's tonnage consisted of oil-carrying vessels. These ships differ in many important particulars from ordinary cargo-carrying vessels. The oil carrying space, which usually extends for about half the total length of the ship, is divided by transverse bulkheads into tanks about 30 feet long. These tanks are subdivided bv a continuous *longitudinal centre line bulkhead* which extends from the keel to the weather deck. In order to provide for the expansion of the oil due to varying temperatures, an *expansion trunk* is provided usually by fitting a continuous fore and aft bulkhead between the upper deck and the deck below. The space between the expansion trunk and the ship's side is known as the *summer tank,* and is used as an additional space for oil cargo when light oils are carried. Vessels of this type are nearly

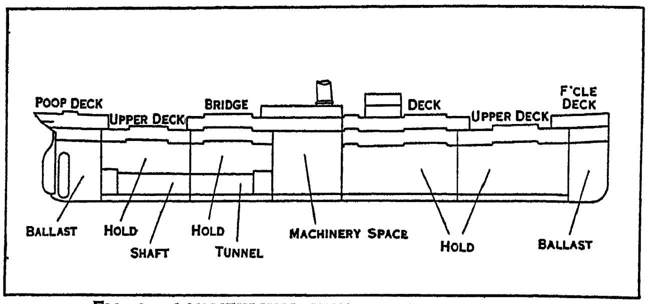


FIG. 8.—LONGITUDINAL SECTION OF A CARGO SHIP

all built on the *longitudinal system of framing.* In this system, designed by Sir Joseph Isherwood, instead of closely spaced transverse frames, deep frames formed of plates and angles known as *transverses* are fitted at intervals of about 10 feet. The shell and deck plating is supported by continuous longitudinal frames called *longitudinals,* which pass through slots in the transverses but are cut at the bulkheads, to which they are bracketed. The middle line and transverse bulkheads are stiffened in a similar manner, so that at each longitudinal there is a continuous horizontal girder right round the tank. The main features of this system will be clearly understood by reference to fig. 9, which shows the construction of a typical tanker.

The Isherwood system has also been applied to ordinary cargo vessels. The success which has attended this system has led to introduction of designs on which the framing at the bottom and deck is longitudinal, while ordinary vertical framing is retained at the ship's side. A number of ships have been built on this combination system and have proved satisfactory.

The most recent development in ship construction has been

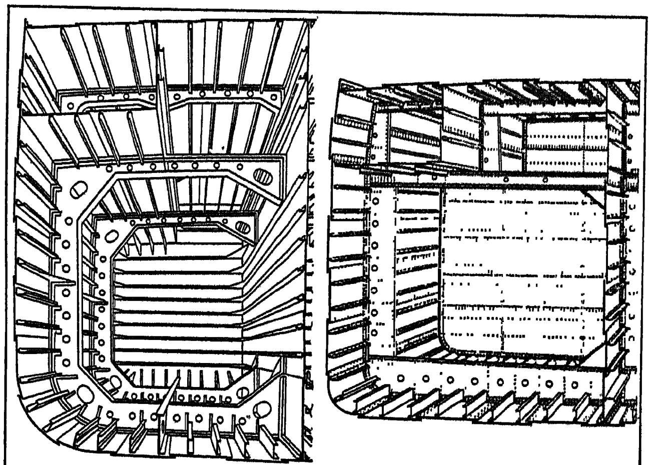


FIG. 9 FIG. 10

FIG. 9.—INTERNAL VIEW OF AN OIL TANK STEAMER BUILT ON THE ISHERWOOD PRINCIPLE. FIG. 10.—INTERNAL VIEW OF AN OIL TANK STEAMER BUILT ON THE BRACKETLESS SYSTEM

the introduction of the Isherwood *bracketless system,* which is a modification of the normal longitudinal framing in which the brackets attaching the longitudinals to the bulkheads are dispensed with. This has necessitated a rearrangement of the spacing of the transverses and the provision of special strengthening of the shell and deck plating in the neighbourhood of the bulkheads, and results in a great simplification of the structure and of the work of erection (see fig. 10).

Laying Off.—This is the name given to the process of drawing the lines of a ship to full size in plan and elevation in

order to determine the exact dimensions of the more important parts of the ship's structure, as the sizes of the various members must correspond with one another in order that, when assembled, there may be no irregularity or unfairness in the surface of the ship. The process is carried out on a specially planed and blackened wooden floor of such a size as to take in the full depth of the ship in its width. The room in which the floor is situated is called the *mould loft,* and is an important adjunct of the shipyard drawing office.

The principles of the methods of the projections of the various lines and planes are exactly to those followed in practical solid geometry, and do not call for any detailed explanation.

In different localities and in the construction of different types of ships, the extent to which the process of laying off to full size is employed varies considerably. In some yards laying off on a large scale on paper is relied on almost entirely, and very little full size work on the floor is considered necessary, particularly in the case of ships the lines of which have very little curvature over the greater part of their length.

The primary object in laying off a ship is to determine the exact shape of each of the frames, and these are drawn down on the *scrieve board,* which is an auxiliary mould loft floor constructed conveniently near the frame bending shop, which has copied on it all the information necessary for the correct shaping of the frames in the ship. All the frame lines are shown on the scrieve board, and the complete section of the frame surface for both sides of the ship is shown for each frame.

Special wood moulds are prepared giving the spacing of the rivet holes in the frames and floors, while wood battens are prepared on which are marked off the spacing of the rivet holes in the floors and keelsons.

Great progress has been made in recent years in the art of laying off, and wood moulds and battens can be prepared to suit the requirements of the different deck and shell plates, frames and beams so that it is possible to shape and punch the rivet holes in about 90% of the material before the vessel's keel is actually laid.

On account of the sharpness of form at the ends of the ship it is usual to make a wooden pattern of the exact shape of the plates at these parts from the structure after the frames have been erected, but in some instances even this has been unnecessary, and practically the whole of the material has been prepared in advance.

Materials.—Ships of the present day are almost invariably constructed of the material known as *mild steel,* which consists of iron with a small percentage of carbon, manganese, phosphorus and sulphur, a typical mild steel containing

	%
Carbon	·17
Manganese	·48
With not more than	
Phosphorus	·03
and Sulphur	·04

Mild steel is very tough and ductile, and differs from the hard steel out of which tools are made in that it will not take a *temper; i.e.,* if heated and plunged into oil or water the sudden cooling has very little effect upon it, whereas with tool steels a great change takes place—the steel becoming very hard and usually brittle. This quality of tempering depends chiefly on the amount of carbon in the steel, mild steel containing less than ·25%. Before being accepted for use in shipbuilding, steel is required to be submitted to a tensile and to a bend test. For the purpose of the tensile test, strips are cut from the plates or bars and are machined to give a parallel part about 2 inches in width of at least 8 inches in length. Two marks are made, 8 inches apart, and the strip is secured in a testing machine constructed so that the ends of the strip can be gripped by strong jaws beyond the parallel parts. The jaws are then gradually pulled apart, the amount of the pull required to break the strip being registered, and also the extent to which the strip stretches in the length of 8 inches before breaking. The tensile strength varies between 26 and 32 tons per square inch calculated on the original sectional area of the parallel part before breaking, and the elongation in the 8 inches is not less than about 20%. In addition to the tensile test, sample strips 2 inches in width are cut and are bent double by hammering or in a press until the bend is a semi-circle the diameter of which is 1½ times the thickness of the plate. As an additional test the strips are sometimes heated and plunged into water to cool them suddenly before bending.

The steel used for making rivets is similarly tested, and samples of the finished rivets are also taken and are hammered into various shapes (some hot and some cold) to ensure that the metal is soft and ductile and suitable for the work.

The testing of ship steel is practically always carried out under the supervision of one of the Classification Societies, and their principal requirements in this respect may be tabulated as follows:—

Ship steel	Lloyd's register	British corporation	Bureau veritas	Germanischer Lloyd
Plates	26–32	28–32	27–32	26–31
Bars	26–32	28–33	27–32	26–31
Rivets	25–30	25–30	24–29	21·5–30

(*Figures given represent stress in tons per sq. in.*)

The testing is carried out at the steel works, and if the material is passed each plate and bar is stamped with the brand of the Classification Society and with an identification mark which would enable it to be traced back to its origin should it prove unsatisfactory in course of being worked in the shipyard.

The stem and sternframe are generally made of forged iron, but are also made of cast steel. Castings are tested by being let fall on hard ground and are then slung in chains and hammered all over, flaws being detected by the sound produced. To test the quality of the steel in the casting, small pieces which are cast on for the purpose are removed and tested in the same manner as the samples cut from the plates and bars; these test pieces should have about the same tensile strength as those cut from plates, but a little less ductility may be permitted.

The last few years have witnessed the introduction of a new type of material known as *Special Quality Steel,* which possesses elastic properties superior to ordinary mild steel. This material can withstand a stress of about 15 tons per sq. in. without suffering any permanent deformation, as compared with a much lower figure—say 7 or 8 tons per sq. in. for mild steel. The superior properties of the new material are obtained chiefly by exercising great care to see that in the course of manufacture the temperature of the steel does not fall below a given critical temperature before the operation of rolling is completed. On account of its superior properties certain reductions in scantlings are allowed, which result in a saving of weight of steel in a moderate sized vessel of about 10%. Several ships have been constructed of this material, and have proved quite satisfactory, although the experience available does not yet permit of any definite conclusions.

The sections of the steel bars in common use are named as follows:

A Angle	*D* H-bar	*G* Half round
B Tee	*E* Bulb Plate	*H* Cope Iron
C Channel	*F* Bulb Angle	

The vertical portion of the *H, T,* channel and bulb sections is called the *web* and varies from about 3 inches to 12 or even 17 inches in depth; the horizontal parts are called the *flanges,* this term being applied to both branches of an angle. The flanges of channels and bulb angles vary from 2½ inches to 4 inches in breadth and in an angle bar from 2½ inches to 8 inches. The thickness varies from ¼ inch to ¾ inch. These dimensions taken together are known as the scantlings of the material. The thicknesses of the plates in common use generally lie between ¼ inch and 1 inch. Thinner or thicker plates or bars are obtainable, but are not often used. Plates are of varying sizes as required but in general vary from about 4 feet to 8 feet in breadth and from 20 to 30 feet in length, the actual size used depending upon the dimensions of the ship and the facilities for working in the shipyard. Bars are supplied in lengths of from 20 to 80 feet as re-

quired or as may be limited by the means of transport between the steel works and the shipyard. The various plates and bars in a ship are connected together by *rivets*. Types of rivets are distinguished by the names of the heads and points as follows:

A. Countersunk head
B. Snap head
C. Pan head
D. Pan head with conical or swelled neck
E. Countersunk point
F. Rough hammered point
G. Snap point hand work
H. Snap point machine work

The pan head rivet with swelled neck (*D*) is the most commonly used, as it is convenient to handle and gives sound work. The snap head (*B*) and the pan head (*C*), without cones under the heads, are used only for small work, while the countersunk head is only employed where a flush surface is desired. The countersunk point (*E*) is used on the outside of the shell and other places where a flush surface is required; elsewhere the rivet is finished off with a rough hammered point (*F*). Where riveting is done by hydraulic machinery, rivets having snap heads (*B*) and snap points (*H*) are used. Rivets vary in diameter from about $\frac{5}{8}$ inch to $1\frac{1}{4}$ inch, depending on the thickness of the plates to be connected, the diameter being usually about $\frac{1}{4}$ inch more than the thickness of the separate plates. The lengths of the rivets are as required to go through the total thicknesses of the plates and leave enough material properly to form the points. The distance from centre to centre of the rivets is spoken of as the pitch, and is usually expressed in diameters. For connecting plating to framing or beams the pitch is usually 7 diameters; for securing edges which must be watertight, the pitch is from $4\frac{1}{2}$ to 5, or if the edges are to be oiltight $3\frac{1}{2}$ diameters. In the butts and edges of shell plating the pitch varies from $3\frac{1}{2}$ to $4\frac{1}{2}$ diameters. In some positions rivets like the above cannot be drawn into place and properly hammered up; resort is then made to rivets which have screwed points, called *tap rivets*. The rivet is screwed up by means of the square head which is chipped off after the rivet is hove up tight.

Course of Construction.—On the receipt at the shipyard of the design drawings and specifications, steps are taken to put in hand the detailed drawings of the structural arrangements which will enable materials for the various parts to be ordered from the manufacturers and will provide information for the guidance of the workmen in the erection of the structure.

A wooden model of half the exterior surface of the ship, called the *half-block* model, is immediately prepared from the sheer drawing, generally to a scale of $\frac{1}{4}$ inch to the foot. On its surface are carefully drawn the main frames, the edges and butts of the shell plating, the positions of the decks, and other features which will influence the detailed arrangement of the framing and plating. The work on this model is carried out concurrently with the laying-off of the ship so as to be complete by the time the latter is sufficiently far advanced to enable full size measurements of the breadth of the plates to be obtained. The lengths of the plates are then measured from the model and the breadths from the mould loft floor (a small surplus on the net measurements being allowed to provide for inaccuracies), and the whole of the shell plating is ordered from the steel works.

For flat or nearly flat surfaces such as keel plate, bulkheads and decks, the detailed arrangements are made on drawings from which the dimensions are taken for ordering the material while the drawings themselves constitute working plans which are issued for general guidance in building the ship. In addition to these principal structural drawings a very large number of detailed plans showing the arrangement of passenger and crew accommodation, systems of piping and ventilation and numerous other details are necessary. Very much of the success achieved in actual building will depend upon the efficiency of the drawing office, which must supply accurate and detailed working plans, which must be ready as soon as required. Each firm has its own system of work in these departments but experience shows that the more thorough and systematic the work in the drawing office and its adjunct, the mould loft, the better the general result.

A very important record kept during the building of the ship is the cost of materials and labour, a very careful account being kept of the workmen's time whether employed on piece or by the day. Many different systems are in vogue but the aim in all cases is to record the cost of the labour in each trade and the detailed cost of the various parts of the ship.

The first stage in the actual erection of the vessel is the laying of the keel blocks, a task undertaken by the shipwrights assisted by labourers. The blocks consist of several pieces of rough, rectangular timber about 12 inches square and 4 to 6 feet in length, laid on top of each other to the height required. The top block is called the cap piece and is of oak. The spacing of the blocks depends to some extent on the size of the ship, but is usually about 4 feet. It is essential that the ground under the keel blocks should be firm and hard, otherwise the blocks may sink when weight becomes concentrated on them during building and the keel may consequently droop from a straight line. The upper surface of the blocks must be at such a height from the ground that men, especially riveters, can do their work with facility under the bottom of the vessel and that when launched the vessel may move down into the water without striking the ground. The last named is a very important consideration, and thus it happens that the first thing to be settled before the blocks are laid is how the vessel is to be launched. The tops of the blocks are securely adjusted to a slope of about $\frac{5}{8}$ inch per foot run from bow to stern. The shipwrights at the same time prepare the uprights for the staging and erect them in suitable positions round the building berth. The platers begin to prepare the keel, framing and bulkheads as soon as the material is delivered and the laying off and mould making are sufficiently advanced for the purpose.

Details of Structure: *Keels.*—The keels of small vessels usually consist of a stout flat bar placed vertically and attached to the garboard strakes by through rivets. In larger ships the keel usually consists of a wide horizontal plate running along the centre line of the bottom, the sides being turned up as necessary to follow the shape of the bottom.

Framing.—The framing varies considerably with the size and type of the ship. In small vessels a frame usually consists of an angle bar, called a *frame bar*, extending from the centre line to the gunwale. To the frame bar is riveted another angle called a *reversed bar*, in such a way as to form a built up Z bar, while at the bottom the frame and reversed frame are separated in order that both may be attached to the *floor plates* which form deep girders across the bottom to give the required strength when the vessel is resting either on the ground or on the keel blocks. The usual procedure in constructing a complete frame and floor is as follows: From the scrieve board the shape of the section of the frame is transferred to the bending slabs, the outline being drawn in with chalk; the frame bar is drawn from the furnace and while hot is bent to the required shape and given the necessary bevel. The reversed bar is prepared in the same way except that the inner edge of the frame and floor must be worked to. The floor plate requires to be cut to shape. The frame, reversed frame and floor all being prepared, are placed together in their respective positions over the outline of the frame on the scrieve board, the final adjustments made, and rivet holes marked and punched and the work secured and riveted up. In many instances the frame is formed of a bulb angle, in which case the reversed bar is fitted only on the upper edge of the floor plate and does not extend up the ship's side. In vessels fitted with double bottoms the frame bar extends from the tank side margin plate to the gunwale but the general process of marking and bending proceeds as described above.

Double Bottoms.—There are a considerable number of variations used in the construction and arrangement of double bottoms. At the centre line immediately over the flat keel plates there is a vertical girder the full depth of the double bottom, connected to the flat keel plate and to the centre plate of the inner bottom by continuous double angle bars. This centre girder may or may not be watertight, according to the desired tank arrangements.

The floor plates, which extend from the centre girder to the margin plate, are provided on their edges with angle bars for attaching them to the outer and inner bottoms, to the centre girder and to the margin plate. As will be seen, the margin plate cuts completely through the transverse frames, and special brackets are fitted to maintain the transverse strength. The chief advantages derived from cutting the frames at the margin plate are the ease with which watertight work is secured and the rapidity with which this part of the structure can be proceeded with. Except where it is desired that the floors should be watertight, manholes are punched for the purpose of providing ready access to all parts of the bottom. Between the centre girder and the margin plate one or more intercostal girders are fitted, these girders consisting of plates fitted in short lengths between the floors, to which and to the inner and outer bottoms they are attached by short pieces of angle bar.

With a view to rendering the bottom more easily accessible it is now customary to fit plate floors at every second or third frame only, the intermediate floors being built up of angles or bulb angles connected together by plate brackets. Such floors are known as bracket floors. Solid floors must be fitted on every frame under the machinery and at the forward end of the ship.

Decks.—The decks are very important parts of the structure from the point of view of both transverse and longitudinal strength, but their number and position necessarily vary considerably with the size and type of the vessel. In bulk cargo ships the number of decks is reduced to a minimum, and some ships having a depth of about 32 ft. have been built with one deck only, while in a similar passenger ship there might be three decks.

Decks are supported primarily by the *deck beams,* which are usually formed of bulb angles and are attached to the side frames by a number of plate knees. The beams may be fitted either to every frame or to alternate frames, and are in turn supported by *deck girders,* the latter being carried by pillars which may be closely spaced, say at every second frame, or may be spaced as much as 30 feet apart. The decks are generally completely plated over, the thickness of the plating being greatest on the top deck, and each deck being less in thickness than the one above. Thus in a ship with three decks the top deck might be ·50 inch in thickness and the two lower decks ·40 inch and ·30 inch respectively. The strake of deck plating next the ship's side is called the *stringer plate* and is attached to the shell plating by an angle bar known as the *stringer angle.* In passenger ships it is customary to sheathe the steel decks with wood, usually pitch pine 2½ inches in thickness, where exposed to the weather, and to lay a composition of which the principal ingredient is sawdust about 1½ inches thick inside the passenger accommodation. In cargo ships the steel deck is left bare except in the crew's accommodation.

Shell or Outside Plating.—The outside or shell plating forms the watertight skin of the ship and also contributes the major part of the structural strength. The plating is arranged lengthwise in a series of *strakes* about 60 inches in breadth, the overlaps of adjacent strakes being called *seams.* The plates are usually about 30 ft. in length and adjoining plates in the same strake are overlapped, these joints being known to shipworkers as *butts.* Thickness of the plating is governed by the necessity for providing sufficient structural strength, and this thickness is usually maintained for half the vessel's length, from whence it is tapered off to the ends where the thickness is about two-thirds of the midship thickness. The mould loft supplies templates and battens for the different plates in each strake, and it is not uncommon for a very large part of the shell plating to be shaped and punched before the framing is erected.

Watertight Bulkheads.—In regard to the general arrangement and method of stiffening a watertight bulkhead, bulkheads are assembled on some convenient flat surface and the rivet holes marked in the plating and stiffeners, after which they are transferred piece by piece and erected in their proper positions in the ship.

Erection.—The system and order of erection of the vessel varies in different districts, but the following general description may be considered as typical. After the keel blocks have been erected and faired, the flat plate keel is placed in position and the centre girder erected. The floors in the double bottom are then erected and the tank margin plate, the inner bottom plating and the outer bottom plating are attached to the floors. The side frames are then hoisted into position, and the deck beams, deck plating and side shell plating erected. The various parts of the ships are temporarily secured by bolts, great care in the meantime being taken to see that the correct form of the vessel is maintained.

As each part of the work is completed by the platers it is ready for the riveters and caulkers, and these trades follow on without delay. Platers usually work in squads composed of three or four platers, a marker boy and a number of labourers or helpers, the number depending on the size or weight of the plates and also on the facilities of the yard for handling such material. On the work of a large vessel many such squads may be employed. The riveters also work in squads, a squad consisting of two riveters, a holder-on (whose duty it is to hold a large hammer against the head of the rivet while the point is being hammered down on the opposite side of the plate by the riveters), and a heater boy. Hand riveting is being largely supplanted by riveting executed by pneumatic hammers, while for those parts which can be riveted before being erected in position hydraulic riveting is employed. After the riveting is completed all watertight work is caulked, this process consisting of forming a shallow ridge along the edge of the plate to force this edge into close contact with the surface of the adjacent plate. A very important part of a caulker's work is testing the various watertight double bottom compartments or oil bunkers by filling them with water. A pressure is applied by means of a stand pipe carried to an appreciable height above the surface of the tank.

When the work on the hull is completed, the vessel is ready to be launched after being painted. It is usual to defer painting as long as possible so that the black mill scale on the plating may be exposed to the atmosphere and thus more readily removed. Red and white lead, oxide of iron and oxide of zinc form the basis of most of the paints used on steel ships.

Vessels Carrying Oil in Bulk.—The vast expansion in the use of oil as a motive power in all branches of engineering has led to a corresponding increase in the amount of tonnage devoted to the transport of oil in bulk, and at the present time oil-carrying vessels form some 10% of the tonnage of the mercantile marine. In the early stages of the industry the oil was transported in barrels or in special tanks fitted in the holds, but this system was found to be very uneconomical and vessels were accordingly designed to carry the oil in bulk, the first ship of this kind being the "Gluckauf," built in 1886.

The design of oil-carrying ships has passed through various phases, but for a considerable number of years past the great majority have been constructed on the longitudinal system of framing, more generally known as the Isherwood system. The oil is carried in tanks which form the structure of the ship, the boundaries of the tanks being formed by the skin of the ship, by transverse bulkheads spaced about 30 feet apart and by a middle line fore and aft bulkhead, which extends from the keel plate to the top deck. The second deck extends inwards from the ship's side for about one-quarter the breadth of the vessel and is united to the upper deck by a continuous longitudinal bulkhead, the space between this bulkhead and the middle line bulkhead being known as the expansion trunk, which permits of the expansion of the oil due to variations in temperature and also restricts the amount of movement of the oil when the ship rolls. The spaces between the expansion trunk and the ship's side, called summer tanks, are also used for cargo when oil of light density is carried. The form of the vessel between the transverse bulkheads is maintained by a continuous deep girder right round the ship called a transverse, the transverses being usually spaced about 10 feet apart. The shell and deck plating is supported by channels and bulb angles called longitudinals, spaced about 30 inches apart and extending continuously between the transverse bulkheads, to which they are attached by plate brackets. The middle line and transverse bulkheads are stiffened in a similar

manner by strong vertical webs in association with bulb angle horizontal stiffeners. Several hundred vessels have been built on this system and have proved very successful, the only trouble experienced having been in the rivets attaching the longitudinals to the bulkheads. To overcome this difficulty a new design, known as the bracketless system, has recently been introduced. The outstanding feature of this system is the entire elimination of the brackets attaching the longitudinals to the bulkheads, the discontinuity at the transverse bulkheads being compensated for by the fitting of local doublings on the shell plating.

Motorships.—A revolutionary change in the mercantile marine was foreshadowed by the appearance in 1910 of the first ocean-going vessel to be driven by internal combustion engines. Progress in this direction was naturally retarded by the World War, and it was only about 1921 that the construction of motorships was commenced on a large scale. Since then the development has been very rapid, and at the present time about 50% of new ships are of this type.

Viewed from an economic standpoint, a comparison between motor-engined and steam driven vessels, the ship being the same in each case, indicates that—

(a) there is an increased first cost;

(b) the wage cost per ship tends to be less, while the cost of handling oil on the ship is much below that required for coal;

(c) there is a greatly reduced consumption of fuel—which fuel, though costly, yet costs less in the aggregate than coal.

(d) there is an increase in the deadweight available for cargo, due principally to the reduction in the weight of the fuel carried;

(e) there is also an increase in the capacity of the space available for cargo.

The actual differences must necessarily vary with the size and type of ship, but for a steamer carrying about 8,000 tons deadweight the coal consumption per day would probably be about 30 tons, whereas for a motorship oil would only be consumed at the rate of about 8 tons. Allowing an average weight of coal of 1,000 tons, which has to be deducted from the available deadweight of 8,000 tons, the coal-burning ship can only carry 7,000 tons, whereas the motorship carries about 7,750 tons, or about 10% more. The increase in the space available for cargo would amount to about the same percentage.

In the early days of motorships trouble was necessarily experienced from mechanical defects in the machinery, due primarily to the high temperature of combustion of the gases in the engine cylinders. Much patient research work has overcome these troubles, and the fact that many of the largest modern liners have been fitted with motor machinery, and perform their voyages to schedule without any question of breakdown, indicates that the motorship now occupies an established position and that these ships will in all probability form an increasing percentage of the world's tonnage.

Launching.—When the steel work of the hull has been practically completed the vessel is ready for launching. It will be appreciated that the operation of transferring to the water a ship whose weight in the case of the largest vessels might amount to as much as 17,000 tons requires considerable forethought and is not unattended with some risk. The launching ways are erected at about one-third of the breadth of the ship on each side and consist of two sets of ways, the fixed or ground ways and the sliding ways. The fixed ways commence near the bow and extend for the full length of the ship, being carried out as near low water mark as possible in order to ensure that there shall be ample depth of water—say from 3 to 6 feet—over the ends of the ways, to ensure a successful launch. These fixed ways consist of solid baulks of timber varying from 15 to 60 inches in breadth, according to the size of the ship to be launched, and are laid on closely-spaced supporting blocks. The sliding ways, known as the cradle, are laid on top of the ground ways, the space between the ways and the hull being filled up with timber neatly fitted to the vessel's shell plating. The ways are laid with an inclination of about ⅝ inch per foot in order that the ship may slide easily into the water. Two or three days before the launch, the cradle which has been fitted in place temporarily is taken adrift and the surfaces of both the fixed and sliding ways are thickly covered with melted tallow; when this has hardened it is smeared with soft soap, after which the sliding ways and the various making up pieces of the cradle are replaced. Until the moment of launching, the sliding ways are locked to the ground ways by means of a dagger, one either side at the forward end. To launch the vessel the two daggers are released simultaneously, and the vessel usually commences to move of its own accord. When launched in open water the vessel is brought up when clear of the ways by dropping an anchor. When launched in a narrow river the vessel must be stopped quickly before the stern strikes the opposite bank, and this is done by leading strong steel wires from the bow and attaching them to heavy piles of chain, the friction of the chain as it is dragged over the ground gradually bringing the vessel to rest. (W. S. A.)

SHIPBUILDING: WORLD'S STATISTICS. The shipbuilding of the world during the last generation has undergone considerable changes. Statistics are not available in detail for more than some 30 years, dating back to the time when steam was definitely replacing sail. About 1880 there was as much sailing ship tonnage in existence as steam, but by the beginning of the present century the sailing ships were less than a quarter of the world's total tonnage, and to-day they are a very rapidly decreasing quantity, being only about 3%.

Tonnage statistics are generally given in gross tons, and for vessels which are of 100 gross tons and upwards. There are of course a large number of smaller vessels mainly engaged in the coasting trades which are below that size. Table I. gives the annual shipbuilding output of the principal maritime countries since 1894, and Table II. gives the amount of motor ships built since the war.

The motor ship began its practical existence in 1911, and in 1919 there were about ¾ of a million tons in existence, whereas in 1928 the figure was probably about 4½ million tons. It will be

TABLE I. *The Gross Tonnage of Sea-Going Merchant Vessels of 100 Tons Gross and Upwards Launched in the Principal Maritime Countries of the World for Each Year Since 1894*

Year	World	U.K.	U.S.A.	Germany	France	Holland	Japan	Italy
1894	1298	1047	45	120	20	15	3	5
1895	1172	951	42	88	29	8	2	6
1896	1459	1160	78	103	45	12	8	7
1897	1277	952	34	140	49	20	7	13
1898	1828	1368	110	153	67	19	11	27
1899	2042	1417	146	212	90	34	7	49
1900	2158	1442	191	205	117	45	5	68
1901	2441	1525	268	218	178	30	37	61
1902	2336	1428	223	214	192	69	27	46
1903	1961	1191	211	184	93	59	35	50
1904	1935	1205	189	202	81	55	33	30
1905	2316	1623	107	255	73	44	32	62
1906	2638	1828	169	318	35	67	42	31
1907	2496	1608	217	275	62	69	66	45
1908	1678	930	159	208	83	59	60	27
1909	1472	991	80	129	42	59	52	31
1910	1792	1143	178	159	81	71	30	23
1911	2570	1804	96	256	125	93	44	17
1912	2802	1739	194	375	111	99	58	25
1913	3263	1932	228	465	176	104	65	50
1914	2790	1684	163	387	114	118	86	43
1915	1173	651	157	..	25	113	49	22
1916	1560	608	383	..	43	180	146	57
1917	2733	1163	821	..	19	149	350	39
1918	4967	1348	2602	..	14	74	490	61
1919	6589	1620	3580	..	33	137	612	83
1920	5705	2056	2349	..	93	183	457	133
1921	4320	1538	995	509	211	232	227	165
1922	2436	1031	97	526	185	163	83	101
1923	1563	646	96	345	97	66	72	67
1924	2184	1440	90	175	80	64	73	83
1925	2129	1085	79	406	76	79	56	142
1926	1629	640	115	180	121	94	52	220
1927	2221	1226	124	290	44	120	42	101
1928	2693	1446	86	376	81	167	104	59

The figures given (all from Lloyd's Register Book) are in 1000's of gross tons (000's omitted), and exclude vessels built on the Great Lakes. The particulars for Germany where shown blank were not available. The shipbuilding output for Italy now includes Trieste.

TABLE II. *The Gross Tonnage of Motor Ships (Included in Table I.) which was Launched in the Years Shown*

Year	World	U.K.	U.S.A.	Germany	France	Holland	Japan	Italy
1920	170	87	20	..	..	18	..	6
1921	293	102	32	33	..	14	..	14
1922	202	78	2	47	..	5	1	10
1923	222	87	13	47	9	6	1	7
1924	499	237	21	96	..	15	16	27
1925	842	267	24	279	24	32	16	101
1926	702	202	16	70	34	55	28	153
1927	864	356	39	116	17	86	18	50
1928	1180	428	25	177	55	85	59	36

seen from Table II. that although the motor ship is comparatively a recent introduction, the production, which was 170,000 gross tons in 1920 was no less than 862,000 in 1927.

Motor ships are now being built by all the principal maritime countries, more particularly by Germany and Italy, Germany having launched more than the United Kingdom in 1925, and Italy having built 75% of that built in the United Kingdom in 1926. In 1927, however, the United Kingdom had about its proportionate share of motor shipbuilding. Although not included in the table, mention must be made of the specialization in Sweden and Denmark of the building of motor ships, Denmark having launched 64,000 tons, and Sweden 62,000 tons in 1927.

Table I. which gives the total shipbuilding, shows a very great fluctuation in the tonnage launched from year to year. For example, the tonnage launched in 1897 was 1,277,000, whereas that launched in 1901 was 2,441,000. If another period be taken, the output in 1909 was 1,472,000, whereas the amount in 1913 was 3,263,000. The same kind of variation is observable with the United Kingdom, where the tonnage output for 1908 was 930,000, whereas that in 1913 was 1,932,000.

It would thus appear that there is a great fluctuation in the demand for new ships, and it may roughly be stated that the maximum production of new ships is about twice the minimum production. It also appears that this variation from the maximum to the minimum and back again occurs more or less regularly every 6–7 years.

The war period 1914–18 was, of course, very abnormal, and the statistics show that the special endeavours made to build merchant ships during the war were continued until about 1920–21, particularly in the United States. It will also be seen that, as a result of the war, the shipbuilding facilities of the world were doubled, whereas the actual demand for new ships in the world after the war period had not in 1928 reached pre-war requirements.

The United Kingdom is the greatest shipbuilding country in the world. Whereas in 1894 the great majority of ships were built in the United Kingdom, yet other countries, particularly Germany, rapidly developed. For the 9 years 1905–13, the United Kingdom built nearly two-thirds of the world's ships. In the 6 years ending 1927, which may very fairly be taken as the post-war period, the share of Great Britain had fallen to approximately 50%. This is due to the greater development of motor shipbuilding on the continent of Europe, and to high costs. (W. S. A.)

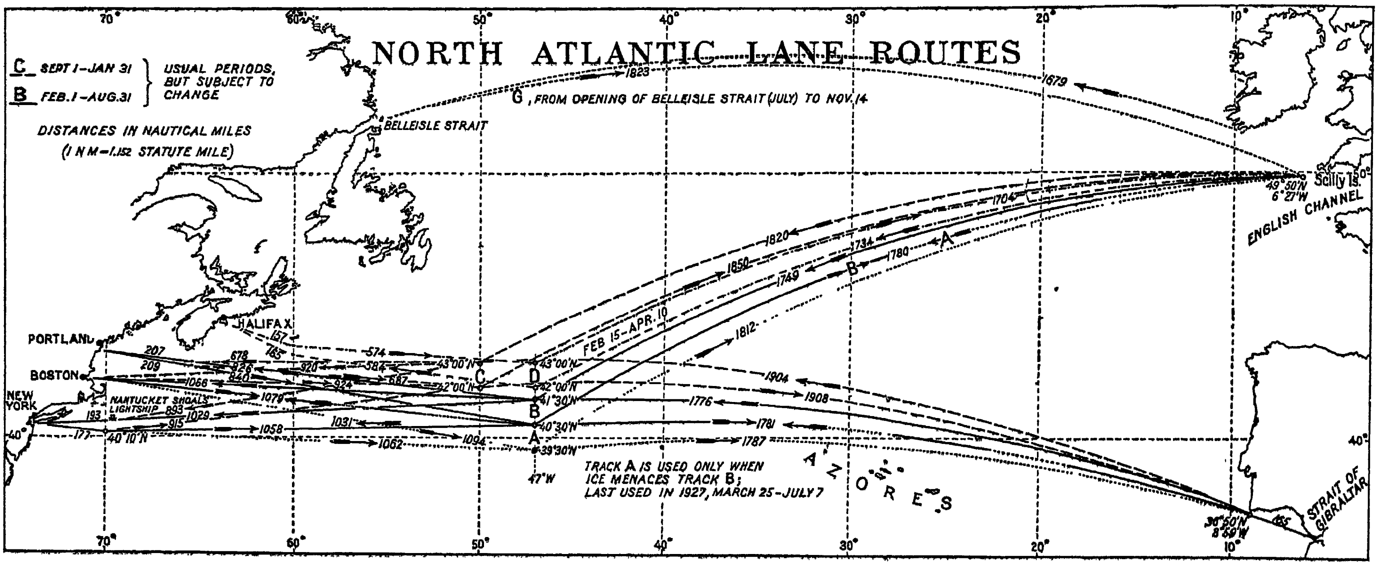
SHIPKA PASS, in Bulgaria, a pass in the Balkans, celebrated as the scene of fierce fighting in the Russo-Turkish War of 1877–78. The main road from Rumelia to Bulgaria, leading from Sistova by Tirnova and Eski Zagra to Adrianople, crosses the Balkans near the village of Shipka, and this passage was of necessity an important point in the Russian plan of operations. The road does not pass between high peaks, but crosses the main ridge at the highest point; it is therefore not a pass in the ordinary sense of the word. Near the summit, running parallel, and close to the road is a series of three ridges, some 200 ft. high, and about 2 m. from north to south, which formed the position for a force holding the pass. It was originally held by a Turkish force of about 4,000 men with 12 guns, prepared to resist the Russian advance. On July 17 they repelled a feeble attack from the north, and the following day faced round and drove back an attack by Gourko from the south. These attacks were to have been simultaneous, but Gourko, having met with unexpected resistance, was a day late. Though so far successful, the Turks evacuated their strong position, and it was occupied by the Russians on July 19.

Suleiman Pasha, having concentrated with Reouf Pasha and driven Gourko across the Balkans at the end of July, moved to the Shipka on Aug. 21 and attacked. The Russian force there, including five battalions of Bulgarians, then numbered 5,000, but that day a regiment from Selvi brought their numbers to 7,500, and this force held the position against 30,000 Turks for three days, when heavy reinforcements arrived. The fighting continued till the morning of the 26th, when Suleiman, his troops being exhausted, and having lost 10,000 men, entrenched himself in the position he then occupied in a semi-circle round the southern end of the Russian position. Having called up more battalions from Yeni Zagra, after a four days' artillery bombardment, he attacked on September 17 and was repelled with a loss of approximately 3,000 men.

There was no more fighting on the Shipka till the general advance of the Russians after the fall of Plevna. Radetzky's command of about 60,000 men advanced from Gabrova on Jan. 5, in three columns. Radetzky, with the central column, moved by the main road and attacked the Turks, who still faced the position on the summit, while Skobelev and Mirski, crossing by trails some 3 m. to the west and east of the Turkish position, attacked their reserves on the far side, about Shipka and Shenova, where Vessil Pasha (who had succeeded Suleiman in command) had formed an entrenched camp. These flank columns made their way over the mountains, deep in snow. Mirski attacked alone on Jan. 8, as Skobelev's advance had been delayed, but the following day both columns attacked, and after fierce fighting the Turks surrendered. The force on the summit had that day repulsed, with heavy loss, a frontal attack by Radetzky, but they were included in the surrender. Their numbers were 36,000, including 6,000 sick and wounded, and 93 guns. The Russian losses were 5,500.

Not only were the Turkish attacks on the Shipka unsuccessful, but they were made without object. At the end of July, when Suleiman forced Gourko back over the Balkans, the moral equilibrium and the plan of operations of the Russians had been upset by the second battle of Plevna, and the Shipka ceased to have any strategical importance for the time being. Had Suleiman at that time followed up Gourko and joined Mehemet Ali, or moving round acted with Osman against the Russian flank, the evacuation of the Shipka would have been compulsory. Suleiman, knowing nothing of strategy, preferred to act independently, and his action was supported by the still more ignorant ministers at Constantinople. The Shipka was merely a geographical point until the Russians were prepared to advance, but, fortunately for them, the Turks chose to waste an army in fighting for it throughout the critical period of the operations. Suleiman divided his forces and used up his troops in costly frontal attacks on Mt. St. Nicholas, the southern and strongest point of the position, whereas a well-supported flank attack would probably have met with success. The manner in which he sacrificed his men earned for him the name of the "Shipka butcher." (J. H. V. C.)

SHIP LANES OF THE NORTH ATLANTIC. The sinking of the U.S. mail steamer "Arctic" in October 1854, by collision with the French steamer "Vesta," in a thick fog while on passage from Liverpool to New York, resulted in a loss of about 300 lives. This disaster inspired Lieutenant M. F. Maury, U.S. Navy, then superintendent of the "Depot and Observatory," Navy Department, to include in his *Sailing Directions* published in 1855 a section on "Steam Lanes Across the Atlantic." Therein he graphically depicted and recommended the establishment of a lane or strip of ocean for the steamers to go out and another for them to come in so that not only would the liability to danger from collision between steamers, as well as between steamers and sailing vessels, be lessened, but a new resource upon the high seas would, in many cases of wreck and disaster, be afforded to those in distress. The lane to Europe crossed the 50th meridian of west longitude in latitude 42°, and was from 15 to 20 m. wide; the lane from Europe crossed the 50th meridian of west longitude 200 m. to the northward and was from 20 to 25 m. wide, the lat-



ter being made wider on account of the large percentage of fogs, the greatest width in both lanes being given where most fog was expected.

The U.S. Hydrographic Office, Navy Department, established in June 1866, first called attention in 1872 to the necessity of lanes across the North Atlantic ocean between U.S. ports and the region south of Ireland and England. This was followed by successive endeavours principally presented to the maritime world through the monthly *Pilot Chart of the North Atlantic Ocean.* One of these charts, issued in Dec. 1887, carried in addition to amended Maury's lanes the admonition that the dangers most in mind were fog, ice and the fishing fleet off the Grand Banks, and the Hydrographic Office strongly recommended for adoption the lanes shown.

The International Marine Conference, held in Washington in 1889, attended by delegates from 26 maritime countries, provided: "Steamer lanes for trans-Atlantic navigation are not adopted, although the various steamship companies are urged to adopt regular routes for vessels of their own line." In 1891 at a conference between representatives of five of the principal trans-Atlantic steamship companies, the Cunard, White Star, Inman, National and Guion lines, certain routes were formally adopted, to be followed by all vessels of those lines.

The adoption of these safe and well-defined routes between Sandy Hook (and Boston) and the Fastnet could but be regarded as most important in its bearing upon the safety of navigation in the North Atlantic ocean, and especially gratifying to the Hydrographic Office, as the most essential features of the tracks were exactly what had been recommended on the pilot charts for years.

At the International Convention for Safety of Life at Sea, London, 1913–14, at which representatives of 14 maritime nations were represented, convened subsequent to the "Titanic" disaster, the following was adopted: "The selection of the routes across the North Atlantic in both directions is left to the responsibility of the steamship companies, nevertheless the High Contracting Parties undertake to impose on these companies the obligation to give public notice of the regular routes which they propose their vessels should follow, and of any changes which they make in them. The High Contracting Parties undertake, further, to use their influence to induce owners of all vessels crossing the Atlantic to follow as far as possible the routes adopted by the principal companies."

With but minor changes the routes used by the principal steamship companies before the London convention were continued to be used until 1924, when the companies working for a North Atlantic track agreement adopted with but minor changes the North Atlantic lane routes A, B, C, D and G, are shown on the accompanying chart, which routes are seasonal and provide for safety from danger of ice, fog and collision with fishing vessels on the Grand Banks. (C. S. K.)

SHIP-MONEY, a tax, the levy of which by Charles I. of England without the consent of parliament was one of the causes of the Great Rebellion. The Plantagenet Kings of England had exercised the right of requiring the maritime towns and counties to furnish ships in time of war; and the liability was sometimes commuted for a money payment. Notwithstanding that several statutes of Edward I. and Edward III. had made it illegal for the crown to exact any taxes without the consent of parliament, the prerogative of levying ship-money in time of war had never fallen wholly into abeyance, and in 1619 James I. aroused no popular opposition by levying £40,000 of ship-money on London and £8,550 on other seaport towns. On Feb. 11 1628, Charles I. issued writs requiring £173,000 for the provision of a fleet to secure the country against French invasion and for the protection of commerce, and every county in England was assessed for payment. This was the first occasion when the demand for ship-money aroused serious opposition. Lord Northampton, lord-lieutenant of Warwickshire, and the Earl of Banbury in Berkshire, refused to assist in collecting the money; and Charles withdrew the writs.

A further writ was issued in Oct. 1634 and directed to the justices of London and other seaports, requiring them to provide a certain number of ships of war of a prescribed tonnage and equipment, or their equivalent in money, and empowering them to assess the inhabitants for payment of the tax according to their substance. The distinctive feature of the writ of 1634 was that it was issued, contrary to all precedent, in time of peace. The citizens of London immediately claimed exemption under their charter, while other towns, demurred to the amount of their assessment; but no resistance on constitutional grounds appears to have been offered to the validity of the writ, and a sum of £104,000 was collected. On Aug. 4 1635, a second writ of ship-money was issued, directed on this occasion, as in the revoked writ of 1628, to the sheriffs and justices of inland as well as of maritime counties and towns, demanding the sum of £208,000, which was to be obtained by assessment on personal as well as real property, payment to be enforced by distress. This demand excited growing popular discontent, which now began to see in it a determination on the part of the king to dispense altogether with parliamentary government. Charles, therefore, obtained a written opinion, signed by ten out of 12 judges consulted, to the effect that in time of national danger, of which the Crown was the sole judge, ship-money might legally be levied on all parts of the country by writ under the great seal. The issue of a third writ of ship-money on Oct. 9 1636, made it evident that the ancient restrictions, which limited the levying of the impost to the maritime parts of the kingdom and to times of war or imminent national danger, had been finally swept away, and that the King intended to convert it into a permanent and general form of taxation without parliamentary sanction. Payment was,

refused by Lord Saye and by John Hampden (q.v.), a wealthy Buckinghamshire landowner. The case against the latter (*Rex* v. *Hampden, 3 State Trials,* 825) was heard before all the judges in the Exchequer Chamber, Hampden being defended by Oliver St John (q.v.) and Robert Holborne, and lasted for six months. Seven of the 12 judges, headed by Finch, chief justice of the common pleas, gave judgment for the Crown, and five for Hampden. In 1639 Charles ventured again to issue a writ of ship-money, but for the comparatively small sum of £70,000. In 1641, by an Act of the Long Parliament, introduced by Selden, the illegality of ship-money was expressly declared.

Bibliography.—*See* John Rushworth, *Historical Collections,* vols. I., II., III. (1659–1701); Strafford's *Letters and Despatches,* edited by W. Knowler (London, 1739); S. R. Gardiner, *History of England from the Accession of James I. to the Outbreak of the Civil War,* vols. III., VI., VII., VIII. (London, 1883–84); *Constitutional Documents of the Puritan Revolution* (London 3rd. Edition 1906).

SHIPPARD, SIR SIDNEY GODOLPHIN ALEXANDER (1838–1902), British colonial administrator, was educated at King's college school and Oxford, and was called to the bar in 1867. He was attorney-general of Griqualand West from 1873–7, when he was made acting recorder of the high court of Griqualand. From 1880–5 he sat as a judge of the supreme court of Cape Colony; and he was British commissioner on the Anglo-German commission in 1884–5 for settling the claims of British subjects at Angra Pequena and other parts of the south-west coast. Shippard, while at Oxford in 1878, had discussed with Cecil Rhodes the plan of the projected British advance in south central Africa. He saw in the German annexation of Damaraland and Namaqualand the first step in a design to secure for Germany territory stretching from ocean to ocean. Consequently when after the Warren expedition of 1885 he was chosen to organize the newly acquired British possessions in Bechuanaland he saw in his appointment an opportunity for forestalling the Germans, and also the Boer adventurers who likewise sought to be beforehand with Britain in the countries north of the Limpopo.

At the end of 1887 he went to Grahamstown to induce the high commissioner (Sir Hercules Robinson—afterwards Lord Rosmead) to sanction the conclusion of a treaty with the Matabele King Lobengula binding that ruler not to cede any territory to any other power than England. He failed, and then telegraphed to Cecil Rhodes at Kimberley to come and try the effect of his eloquence. Rhodes came, and by taking upon himself all pecuniary responsibility succeeded in obtaining the requisite sanction. The treaty was signed and British interests secured. Shippard thenceforth governed Bechuanaland with conspicuous success. He was administrator, chief magistrate and president of the Land Commission for British Bechuanaland, and resident commissioner for the Bechuanaland Protectorate and the Kalahari. He was created K.C.M.G. in 1887. In 1896 he played an unofficial part in the negotiations between Robinson and the Johannesburg reformers after the Jameson Raid. He then returned to England, where he died on March 29, 1902.

SHIPPING, HISTORY OF. From the dawn of history all that is adventurous and inventive in man has responded to the challenge of the sea. It was, no doubt, on inland waters that the art of navigation had its birth, in the discovery that a fallen tree would bear a man's weight down stream, and that, by the use of a pole or a rough paddle, he could check, accelerate and direct its course; but once equipped with the knowledge that what would float could also be propelled and steered, man was led irresistibly, by the quest for food and the instinct for discovery, to venture out upon the great waters.

The transition from the dug-out or the Egyptian reed-raft to the ship proper, from the river ferry service to the trading voyage, was achieved in prehistoric times. Recorded history rings up the curtain on sea-going ships equipped with oars or sails as alternative means of propulsion and with some rudimentary form of steering gear; capable of repeated voyages, with cargo as well as with passengers, between port and port. Shipping, as an industry, is as old as civilization itself. Without shipping, indeed, civilization must have been still-born. Seas and straits, mountains, marshes and deserts, set definite limits to the range and volume of migration and intercourse by land. Even to-day, water transport is easier and cheaper than land transport for the carriage of heavy or bulky commodities over long distances, and in ancient times the advantages were still more decisively in its favour. So the earliest civilizations grew up on the sea coasts or on the banks of navigable rivers, and the development of shipping, as a means for exchanging the products of distant countries, and establishing contact between races of varied cultures, has been a prime factor in all subsequent progress.

The Phoenicians.—Some scholars have believed that maritime intercourse between India and Chaldaea can be traced back so far as 3,000 B.C., and there is no doubt as to the great antiquity of Egyptian, Malay and Arabian navigation. The greatest seafarers of the ancient world, however, were the Phoenicians. Long before Solomon chartered ships from Hiram of Tyre to bring him gold from Ophir, ivory, and apes and peacocks, they had begun to plant trading depôts and colonies round the shores of the Mediterranean, and to distribute from their great emporiums, Tyre and Sidon, the products of Asia, collected by overland or coastal routes. The Phoenicians, indeed, although manufacturers as well as traders, were the first people whose greatness depended primarily on their shipping. Ezekiel's lament for Tyre presents a graphic picture of a State deriving its prosperity, like 17th century Holland, from a highly developed carrying and entrepôt trade.

The rise of Tyre and Sidon was due to their position at the meeting point between East and West. By the 6th or 7th century B.C., the overland route to the East had been supplemented by the development of a regular sea trade following the coastal routes from India to Egypt, Chaldaea and up the Tigris to Babylon. For many centuries the Levant remained the great focal centre of world commerce. The trade of the Mediterranean itself, in classical times, was shared by the Greeks with the great Phoenician colonies, such as Carthage and Utica in Africa and Gades (Cadiz) in Spain; but it was not till the *pax Romana* removed the impediments presented by perpetual wars and the scourge of piracy, that the Mediterranean era in the history of shipping could reach its full height.

The Roman Empire.—For shipping, as for other branches of industry and commerce, the earlier empire was a golden age. The Roman legions, the Roman laws, and the Roman roads made possible the manufacture and exchange of goods on a greatly increased scale, and the Roman fleets were strong enough to suppress or at least to curb, the activities of pirates. Imperial Rome itself depended, like Great Britain to-day, on oversea supplies of food-stuffs, and the annual import of 20,000,000 bushels of corn from Egypt, later supplemented by supplies from Africa, stimulated the activities of shipbuilders and shipowners.

Ships were now capable of considerable voyages. So early as the 5th century B.C., the Carthaginian Hanno had explored the west coast of Africa, and in Roman times the fleets of Juba of Numidia brought hunting dogs from the Canaries. The Phoenicians of Gades pushed up to Cornwall and the Scillies, and traded for tin with the inhabitants of Britain. Most important of all, Hippalus, in the 1st century A.D., observed the periodicity of the monsoons, and opened up the direct sea route from Egypt to India, with the result of a great increase in the traffic with the East. The Romans, indeed, deliberately encouraged the sea trade with India, in order to avoid the payment of tolls to the Parthians on the overland route, and the *Periplus of the Erythraean Sea*—a combination of "sailing directions" and commercial guide-book—bears witness to the magnitude of the traffic.

Shipping in classical times was already a well organized trade. The rights of owners, shippers, and passengers were clearly defined by law. While the ship-owner was often also the owner of the cargo, it was equally common for merchants to charter a ship, or space for the carriage of their goods. Syndicates were formed to finance particular voyages. The laws relating to bottomry (money borrowed for necessaries on the security of the ship) and to general average (the contribution made by each interest to a sacrifice, such as jettison, incurred for the common safety) were

already taking shape. Demosthenes pleaded in shipping causes. The laws of the Rhodians as to average and contracts of affreightment were quoted by jurists in comparatively modern times. Under the empire, Carthaginian ship-owners had a regular agent at Ostia; port development was systematically undertaken.

The carrying capacity of the larger ships frequently went up to 250 tons, and was much greater in some vessels employed for special purposes, such as the carriage of the Vatican obelisk to Rome. They were, however, bad sea-boats. Classical shipbuilding had developed along two lines. The galley, a long, narrow, oared craft, with great tactical mobility, was the man of war. The merchant ship was a broad, deep, sailing vessel, using sweeps only as auxiliaries, built for carrying capacity, but slow, clumsy, and incapable, owing to her very simple rig, of sailing near the wind. Winter voyages were almost unknown, and even in summer, ships seldom ventured far from land. The record passage from Rome to Egypt was nine days; the corn convoys probably took about 25 days on the direct voyage from Alexandria to Ostia; but about mid-July the Etesians, a strong north-westerly wind, stopped the direct traffic, and drove the corn ships to follow the inshore tracks along the coasts of Syria and Asia Minor. The voyages of St. Paul, with their frequent stoppages and search for a safe harbour in which to winter, were typical of all early navigation. The direct sea-route to India was an exception due to the influence of the monsoon. It was by hugging the coasts that the Phoenicians came to Britain. Even if the ships had possessed greater sea-keeping capacity, the rudimentary state of navigational science, necessitating frequent landfalls, would have made long ocean passages impracticable.

Mediaeval Shipping.—Between classical times and the beginning of modern history, there was little real progress. So long as the galley held her own as the ship of war and the merchantman was incapable of ocean voyages, the Mediterranean remained the natural centre of sea-power and commerce. After the decline of Byzantium, the Italian city States, Genoa, Pisa, and above all, Venice, dominated the trade routes with their galley fleets, and exploited them mainly with bluff apple-bowed sailing-vessels that showed little improvement on the classical models. In the north, the Norsemen appear to have used the long-ship, or an adaptation thereof, for trading as well as for fighting, but the English, French and German merchantmen of the early middle ages were sailing vessels of the old type.

The great stimulus to the development of northern shipping came from the fisheries. The importance of salt fish in mediaeval times can hardly be over-estimated. It was indispensable to inland centres during the long Lenten fast; it was indispensable as a winter provision, and for the supply of armies. The Channel and North sea fisheries were the first school of English seamanship, and the rise of the federation of Hansa towns, during the 13th and 14th centuries, was largely due to their control of the great Scania herring fishery at the entrance to the Baltic. The Hanseatics did not themselves engage in the fishery; but they purchased and distributed the bulk of the catch.

English shipping was confined, at first, to the fisheries and the short sea trades. The first impetus to longer voyages came with the third crusade, which introduced English seamen to the more advanced Mediterranean designs, and led to the promulgation of the Laws of Oléron, a codification of the existing customary law governing maritime affairs. Progress was hampered, however, by the fiscal policy of the Plantagenet kings which, aiming at revenue rather than protection, involved the grant of large concessions to foreigners. The export of wool fell mainly into the hands of the Hansa; direct sea trade with the Mediterranean was mostly controlled by the Italians; and those who controlled the trade carried the goods. The demands on shipping for war service also impeded the development of trade. The galley never became really acclimatized in England, the king's ships were few, and the bulk of the fleets were merchantmen serving on obligation of tenure, like the ships of the Cinque ports, or on requisition. With no strong standing navy, piracy was rampant, and private war, as between the fleets of Yarmouth and the Cinque ports, not uncommon. Moreover, the hire of requisitioned ships was often paid irregularly or not at all. Thus the prolonged wars of Edward III. were ruinous to ship-owners, and their complaints led, in the reign of Richard II., to the first abortive attempt at navigation laws, for the encouragement of English shipping. On the other hand, the French connection led to a brisk traffic with the English possessions, and the Bordeaux trade in Gascony wines and Toulouse woad was an invaluable nursery of seamen for the ocean trades. The pilgrim traffic to the shrine of Santiago de Compostela in Spain also encouraged the building of larger ships.

The Ocean Routes.—In the 14th and 15th centuries the art of shipbuilding made great strides. The carrying and sea-keeping capacity of the carrack, the speed and handiness of the caravel, gave an impetus to maritime enterprise, which was further stimulated by a great advance in the science of navigation. The compass had been introduced in the 12th century; the cross-staff and astrolabe enabled the latitude to be calculated. The discovery of Greenland by the Norsemen in the 10th century was the chance result of an Icelandic voyager being blown out of his course; but the exploring voyages of the Portuguese caravels down the west African coast were the product of the scientific school for navigation established by Henry the Navigator at Chagres.

There is real significance in the fact that the mother of Henry the Navigator was an Englishwoman, the daughter of John of Gaunt, for his activities foreshadowed the decline of the Mediterranean and the rise of the oceanic Powers. Yet down to the last decade of the 15th century England was of small consequence at sea. The Italians, who had already developed marine insurance on modern lines as an aid to oversea commerce, dominated both the internal and the external trade of the Mediterranean. Through their grip on the Levant, they controlled the commerce with India and the Far East. Genoese carracks and Venetian merchant galliasses carried the trade with England and Flanders. In the north the Hansa had a strangle-hold on the Baltic trade, and carried its fish, grain, and timber as far west as Portugal. Hanseatic and Flemish merchants shared with the Merchant Adventurers the export of half-made cloth from England to Flanders. Oil and wine came to England from Spain mainly in Spanish bottoms. Portugal monopolized the traffic with Guinea and the Atlantic islands. To English ship-owners remained the Gascony trade, and a share in the North sea fisheries and the voyage to Iceland for stock fish.

Before the century was over the new era had begun. The greatness of Venice and Genoa rested on their control of the rich trade with the East. As shipping and navigation improved, the oceanic Powers turned their attention to the discovery of a sea route to India and Cathay. This was the real object of the Portuguese expeditions, and in 1498 Vasco da Gama arrived at Calicut, after doubling the Cape of Good Hope. Six years earlier, Columbus, seeking a new route to Asia, discovered the West Indies. In 1497 John Cabot, with an English commission, landed in North America.

These discoveries, it must be remembered, represented voyages into uncharted seas, peopled, in the imagination of the time, with devils and monsters. The science of navigation was still in its infancy, and an error of 600 miles in reckoning the longitude was nothing uncommon. Hygiene was yet more rudimentary, and crews died like flies from scurvy and fever. Yet the spirit of adventure and the lure of trade triumphed over every obstacle. The early discoveries were followed up. In 1519–22 Magellan circumnavigated the globe. Colonization and regular trade followed hard on the heels of discovery.

The opening of a direct sea route to India, and the discovery of gold and silver in America had momentous consequences. Venice, hampered by continental wars and the advance of the Turks, steadily declined. The silks and spices of the East, the treasure of Mexico and Peru, poured into Spanish and Portuguese ports. The long Indian voyage, the colonial trade, and the slave traffic from Guinea to the colonies stimulated the building of large ships, and after the union of the two crowns in 1581, Spain stood out as incomparably the greatest of maritime Powers.

The Rise of England.—Meanwhile Henry VII. and Henry VIII. were nursing the development of English shipping by navi-

gation laws, strictly enforced in the vital Bordeaux trade, by wise commercial treaties, by laws for the encouragement of the fisheries, by the incorporation of the Trinity House in 1513, and by a bounty on the construction of large merchantmen. Henry VIII. created the first permanent navy of sailing warships.

Under Elizabeth the pent up national energies burst forth. Already Englishmen had traded, on sufferance and at peril, with Guinea and Brazil. The Spanish and Portuguese monopoly was now boldly challenged. Drake, at Cadiz, shattered the prestige of the galley. The Armada campaign revealed England as the predominant naval power. While English squadrons and privateers harried the Spanish trade, English merchantmen pushed into the Levant and along the Guinea coast. Drake's voyage of circumnavigation (1577–80), and his capture of a carrack in 1587, with the secret papers of the East India trade, opened the way to the East. Attempts to find a north-east or a north-west passage to Asia led to the opening up of trade with Russia, and to the first British settlements in North America. The grip of the Hansa was roughly thrown off. The adoption of the galleon as the English ship of war led to the development of merchantmen far superior to the clumsy Hanseatic and Flemish hulks, or the antiquated Portuguese carracks. A bounty of 5/– a ton, on the construction of ships over 100 tons, stimulated shipbuilding. Insurance of English ships and cargoes passed from Italian to English hands.

A return of 1560 (not quite complete) shows that England possessed 76 ships of 100 tons and up, 21 of them owned in London. In 1582 London had 62, and the whole country 177, and there is little doubt that this number had greatly increased by the end of the reign. Most of the larger ships belonged to the great chartered companies—the East India Company, the Levant Company, the Muscovy Company, the Guinea Company and others—by whom the bulk of the foreign trade was carried on, or to individual members of those companies; but it is clear, from documents relating to the bounty system, that many ships were built by private speculators to be chartered to merchants.

The age of Elizabeth was, nevertheless, something of a false dawn, so far as English shipping was concerned. Under the first two Stuart kings an inefficient fleet allowed Dunkirk and Barbary corsairs to swarm in the Channel, and a weak and corrupt administration hampered the development of the national energies.

The Dutch as Carriers.—Meanwhile the sturdy Dutchmen, assisted by cheap capital and business-like methods, were constituting themselves the general carriers of the world's trade. The Dutch herring fishery in the North sea had become prominent in the 15th century. At the beginning of the 17th, it employed from 1,500 to 2,000 sea-going busses every year. The import of salt for curing, and the export of the cured fish to the Baltic, and to the Catholic countries of southern Europe, employed many larger vessels, supplied Holland itself with grain, wine and shipbuilding materials, and laid the foundations of the carrying and entrepôt trade.

No nation, perhaps, has been so exclusively maritime and commercial in its interests as 17th century Holland. Its industries, apart from the fisheries, were relatively unimportant; but it had succeeded to the position of the Hanseatic League as the entrepôt for the Baltic trade, and the products of central Europe came to its ports down the Rhine. Much of the Mediterranean trade had fallen into Dutch hands, and during the Spanish war, the Dutch had ousted the Portuguese from the East Indies, and effected settlements in the West Indies and Guiana. Contemporary English authors admit that English shipowners were everywhere losing ground to competitors with better financial backing and lower working costs.

Until the strong government of the Commonwealth provided England with an efficient navy, Dutch predominance was never effectively challenged; but the East India Company, founded in 1599, still preserved a fair show of prosperity, and the political troubles in England had given a stimulus to oversea expansion. By the middle of the 17th century New England, Virginia, Maryland, the Carolinas, the Bermudas and several West Indian islands had been at least partially settled, and the demand for slave labour in the plantations foreshadowed a revival of the Guinea trade. A great new field for trade and shipping was being opened, and the one fear was that this too would fall into Dutch hands.

The British Navigation Acts.—Commercial rivalry, combined with political animosity, found its expression in the Cromwellian and Stuart navigation laws of 1651 and 1660, which confined the plantation trade exclusively to English vessels, and forbade the import of goods from European countries except in English ships, or ships belonging to the country of origin, "or to such port where the said goods can only be or most usually are first shipped for transportation." Three hard-fought wars left the British predominant at sea, and the restrictions of the navigation laws in full force. Their effect was an increase in the demand for English shipping, reflected in higher building costs and higher freights, with the result of increasing the severity of Dutch competition outside the reserved trades. At the end of the century, Sir William Petty estimated that nearly half the mercantile tonnage of Europe was under the Dutch flag, and so late as 1775, Adam Smith declared that the Dutch carrying trade was much greater than that of any other nation.

On the other hand, the growing demands of the reserved colonial trade proved a powerful stimulus to English shipping. British tonnage is said to have doubled between the Restoration and the Revolution of 1688, and all through the 18th century it continued to grow. In 1700 the total clearances of British shipping at ports in Great Britain amounted to 270,000 tons; by 1770 they had risen to 700,000. In 1771 the slave trade alone employed 190 vessels. By this time Dutch shipping was beginning to decline, owing mainly to the exhaustion consequent on continental wars. French shipping, carefully fostered by Colbert and later Ministers, is said to have employed, in 1730, about 600 vessels in the West Indian trade, and 900 in the traffic with Spain, Portugal and the Mediterranean, but it was always a somewhat artificial growth and suffered ruinous losses in the English wars. Spain, depending on treasure rather than on trade, had sunk into lethargy.

The 18th century was an era of colonization. Shipping created new markets for British goods, and the demands of those markets still further stimulated the activities of shipping. Some relaxations had to be made in the oppressive restrictions of the navigation laws, and the revolt of the United States made an irreparable breach in the whole colonial system; but British shipping continued to expand. The industry was becoming modernized. Except for the East India Company, the chartered companies had mostly faded out, leaving a clear field for the individual shipowner. The underwriters at Lloyd's Coffee House made London the greatest marine insurance market in the world and systematized the collection of shipping intelligence. The ships themselves showed no fundamental difference from those of the 17th century, but the invention of the sextant in 1731 and of the chronometer in 1735 made navigation more reliable. Great explorers, such as Captain James Cook, built up a mass of information relating to coasts, winds and currents. Charts and sailing directions became more numerous and more reliable. The compulsory registration of shipping (1786), and a number of laws regulating marine insurance and passenger traffic, brought shipping under some measure of control by the State.

Britain Becomes Predominant.—It was, however, the coincidence of the Revolutionary and Napoleonic Wars with the Industrial Revolution that gave British shipping a clear predominance over all rivals. While the inventions of Arkwright and Crompton gave an unprecedented stimulus to British commerce, the great manufacturing and trading centres of the Continent were paralysed by invasion; the French and Spanish flags were swept from the seas, and with her inclusion in the continental system, Holland finally lost her hold on the carrying trade. So great was the demand for British manufactures and colonial goods that, despite the loss of some 9,000 vessels by war risks alone, the tonnage on the register of the British empire increased from 1,540,000 tons in 1792 to 2,616,000 in 1814.

The biggest ships, ranging up to 1,000 tons or over, were the East Indiamen. Protected by their monopoly, the Company spared no expense in the production of strong, handsome, well armed ships, capable of beating off privateers, and even French

frigates, but too costly for any other trade. In the West Indies trade, competition was keen, and a faster, more economical ship was produced, averaging from 250 to 300 tons. The East Indiamen went out one year and came back the next. The West Indies traders, 700 or 800 of which often cleared in a single year, made an average of one round voyage in the year, or slightly better. Ships engaged in the trade with the Mediterranean and the north of Europe were mostly smaller and the average of all ships engaged in the foreign trade proper works out, for the years 1793–1801, at 195 tons. The average tonnage of vessels in the Irish traffic—then counted as foreign—was 80. From northern and Scottish ports the whalers, sturdy vessels, often very long-lived, set out, to the number of 100 to 150 a year, for Greenland and the south seas, often to spend two, three or even four years abroad before their return.

Among the cross-trades, those from the West Indies to North America, and from Newfoundland to Portugal with stockfish, were specially important. The coasting trade also reached great dimensions, especially the carriage of coals to London, which dated back to Plantagenet times, and gave employment to vessels larger than many of those employed in foreign trade. In 1798 the average size of colliers arriving in London was 228 tons.

Origins of Steam.—The first years of the 19th century were marked by the emergence of a rival to challenge the universal dominion of sail. The first successful steamer ever constructed was the "Charlotte Dundas," on the Firth and Clyde Canal, in 1802. In 1807 Fulton's "Clermont" began a regular service between New York and Albany. In 1812 Bell's passenger steamer "Comet" began to run on the Clyde. For some years, however, the use of steam was confined to tugs and river craft, and small passenger steamers constructed for short voyages, such as coasters and cross-Channel packets. For ocean voyages, steam was regarded as, at most, an auxiliary to sail.

Apart from the early experiments in steam, the first 30 or 40 years after the close of the Napoleonic wars saw little progress in British shipping. Now that British trade was worldwide in its scope, the navigation laws had become a clog on commerce, and a series of reciprocity treaties with various powers, beginning with Prussia and Denmark in 1824, made wide gaps in the system. The laws remained, nevertheless, in general operation, and under their protection, British shipping became lethargic and unenterprising. An obsolete system of tonnage measurement further hampered progress by penalizing breadth, and encouraging the building of deep, flat-sided, full-bottomed ships.

American owners and builders were more progressive. The high profits and big risks of the neutral trade during the Napoleonic wars had stimulated them to the construction of fast-sailing and handy vessels, and after the war they were quick to realize that speed was an asset in the carriage of mails and passengers, with the result that the Atlantic packet trade fell entirely into their hands. Everywhere they were restlessly intent on improving on earlier designs, and in 1843 the "Rainbow," the first extreme clipper ship, was turned out by a New York yard.

By that year, however, the hard driven Yankee packets had a new competitor to face in the Atlantic. So late as 1835 a cross-Atlantic steamer service had been declared a physical impossibility; but only three years later the "Great Western" and three other British ships made the passage to America under steam, and, in 1840, the British and North American Royal Mail Steam Packet Company (now the Cunard S.S. Co.), having secured a mail contract, began a regular fortnightly service, with four paddle steamers of about 1,150 tons.

From this date the sailing vessel was doomed, but few, at the time, could read the warning aright. The early steamers were too extravagant in their fuel consumption to be used for general trade or on very long voyages, and even in the mail services they required to be lavishly subsidized. The competition of steam in the ocean trades was so restricted that it had little or no influence on the last great development of the sailing vessel, due to the great gold discoveries of the mid-19th century. In their haste to be first at the diggings during the great Californian gold rush of 1849–56, people were ready to pay high for a quick passage. A demand arose for fast ships with large passenger accommodation, and the American builders responded to it by producing the finest sailing ships that had yet been seen. These Californian clippers, like "Flying Cloud" and "Andrew Jackson," were big ships for their day, with fine lines and a great spread of canvas, and there was nothing afloat that could live with them in strong winds. When the discovery of gold in Australia caused a rush of emigrants to Melbourne in 1851–56, it was from the American shipyards that British owners procured the big Australian clippers such as "Marco Polo" and "Lightning."

Navigation Laws Repealed.—Meanwhile Great Britain was moving towards free trade, and the final repeal of the navigation laws, in 1849, exposed British shipping, for the first time, to unrestricted competition in every sea. The arrival of the American clipper "Oriental," with the season's first teas from China, stung British ship-owners into an acknowledgment of the palpable inferiority of their own vessels, and a stern determination to take up the challenge.

This new-born zeal for efficiency found an echo in parliament, and the repeal of the navigation laws was closely followed by the passing of the Mercantile Marine Act in 1850 and the first Merchant Shipping Act in 1854. These laws, the parents of much subsequent legislation, were the first serious attempts to provide for the safety of life and goods at sea, and gave power to the Board of Trade to enforce reasonable standards of construction and equipment in the ships, and of competence and discipline in masters, officers and crews. Incidentally, the obsolete tonnage laws were superseded by a rational method of measurement.

Thus encouraged, and spurred on by competition, British shipowners rapidly renewed their fleets. In particular, they put into the China trade a series of beautiful little clippers, specially constructed to take advantage of every puff of wind in the light and baffling airs of the tropics. Probably no voyages have ever excited so much sporting interest as the annual race home with the new season's teas, especially that of 1866, when "Ariel," "Taeping" and "Serica" left Foochow on the same day and docked in London within a few hours of each other, 99 days out.

The California and China clippers represent the apogee of the sailing vessel; but every year the menace of steam became more insistent. The "Great Britain" (1843) was the first screw steamer to cross the Atlantic. In 1858 Brunel's monster, the "Great Eastern," was launched. Measuring 18,914 tons gross, she was a failure commercially, but as an indication of possible development she was a portent. While she was still on the stocks, the compound engine was invented, which permitted great economy of fuel, and made long voyages under steam a commercial possibility. It was first applied to long distance steamers in 1865, by the original Holt liners, which astonished the world by a nonstop run of 8,500 miles from Liverpool to Mauritius. The real death-blow to the sailing-vessel, however, was the opening of the Suez canal in 1869, which not only shortened the steamer's passage to India and the Far East, but lowered her costs, by giving her a route studded with bunker depôts at comparatively short intervals. Against such competition the sailing vessel could not live, at least in trades where speed was a greater object than cost, and the later tea clippers, such as the famous "Cutty Sark" and "Thermopylae," passed into the Australian wool trade, where the steamer derived less advantage from the Suez route.

Iron for Wood.—The transition from sail to steam was accompanied by the transition from wood to iron. Iron canal barges had been in use since the first quarter of the 19th century, and in 1825 an iron steamer began running on the Shannon; but it was not until the year 1837 that the first iron vessel was actually classed by Lloyd's Register. The later tea clippers were mostly of composite construction, with iron frames and wooden planking; but during the '60s, iron gained ground both for steamers and sailing vessels. In 1870 over five-sixths of the tonnage under construction in British yards was iron; three-quarters of the tonnage consisted of steamships.

This double transition again placed Great Britain far ahead of all rivals. The clipper ship era in the United States had been succeeded, first by a great financial depression, and then by the

Civil War, which led to the transfer of 715 American ships to British register. After the war, the energies of the American people were directed mainly to the development of their own great internal resources, and American ship-owners clung, with a strange conservatism, to wood and sail. British owners were greatly assisted by the fact that the coalfields, and the great centres of iron and steel production and engineering, were mostly within easy access to the ports, and they were quicker than any of their rivals to invest in iron and steam. In 1870 there were already 1,202,134 tons of steam shipping on British register; the United States had only 192,544 tons registered for foreign trade; France had 154,415 tons. No other country had so much as 100,000 tons.

From this point the decline of the sailing vessel was rapid, and was accentuated by the further change over, in the '80s, from iron to steel as the material for shipbuilding. In 1870 about 16% of the world's tonnage consisted of steamers. By 1890 the proportion had risen to 46%, and by 1900 to 62%, and it must be remembered that each ton of steam was equal in annual carrying capacity to three or four tons of sail. The iron wool clippers continued to struggle against the competition of steam in the Australian trade until the early '90s; but by the beginning of the 20th century sailing tonnage counted for little on ocean routes.

The Steamship and Civilization.—This tremendous revolution in maritime transport has been a prime factor in the development of modern industrial civilization. The size, the speed, and above all, the reliability of the steamer have transformed oversea commerce. There were definite limits to the possible growth both of sailing and of wooden vessels, and the 16th century Portuguese carracks of 1,500 or 2,000 tons would have been regarded as big ships in 1850. The growth of the steel steamer is limited only by the capacity of the ports. The 50,000-ton passenger liners of the north Atlantic trade are still exceptional; but the true successors of the clipper ships, ranging from 800 to 2,400 tons, are liners and freighters ranging from 5,000 to 20,000 tons.

As regards speed, the record Atlantic passage by a sailing vessel was 12 days 6 hrs. in 1854, by the "James Baines," Boston to Liverpool. The steamer record is the "Mauretania's" 4 days 10 hrs. 41 min., Queenstown to New York; but the supreme quality of the steamer is her certainty. The American clipper "Lightning" is said to have run 436 miles in 24 hours, an average of 18 knots; many cargo liners to-day are content with 12 knots. The sailing vessel, however, was at the mercy of the winds. To make her best speed she must sail at certain periods of the year, and even then her passage depended on her luck. In 1866 "Serica," a crack racing ship, was home from Foochow in 99 days; in the following year she took 120. A whole fleet of homeward bound vessels might be detained for a fortnight or three weeks off the Scillies by contrary winds. The main advantage of the steamer is not a greater maximum speed, but the fact that, on the day she puts out from port, the date of her arrival can be fixed almost with the precision of a railway time-table. So great is the superiority of the steamer over a series of voyages that, while the tonnage on British register increased 150% in the half century between 1850 and 1900, its annual carrying-power was probably multiplied by seven.

This vast increase in carrying power, coupled with certainty as to the arrival of cargoes, has had momentous consequences. In the first place it has helped to build up the populations of the newer countries by permitting a huge expansion in emigration. In the ten years 1825–34 the average annual number of immigrants received by the United States was 32,000. In the last decade before the World War it was 1,012,000. In the second place it has permitted the growth in the older industrial countries of massed populations dependent for their daily bread, and for the materials of the craft whereby they earn it, not merely on the arrival of millions of tons of imports in the course of a year, but on their arrival with absolute certainty in a steady daily stream. Finally it has raised the standard of living and broadened the outlook of people in all countries by permitting the exchange of goods on a vastly increased scale, and by facilitating travel and communication. For good or ill, our present civilization is the child of the steamship.

With the evolution of the steamer there came also a change in the organization of the shipping industry itself. In the 16th and 17th centuries the biggest ships were owned by the great chartered companies, who alone could provide the strong armaments, oversea factories and quasi-diplomatic service required in the long distance trades. In the 18th century the owners were mostly individuals or small partnerships, who might or might not be merchants, lading as well as owning the ships. At the time when steam was coming in, there were many regular lines of sailing ships, owned by wealthy firms and employed in particular trades; but a large proportion of the ships were owned on the sixty-fourth principle, by a number of persons each having an interest of so many sixty-fourths, and choosing from among themselves someone with shipping experience to act as managing owner. This system, owing to the greater cost of steamships, gradually gave way to the joint stock company, especially in the liner trades.

Liners and Tramps.—The characteristic of the liner is that she trades regularly between the same ports, running on a scheduled time-table which governs also any intermediate stoppages. In order to maintain the regularity of her sailings, an extensive and costly organization is required, with branches or agencies at all ports of call, to arrange for the collection and shipment, or discharge of cargo, and for booking passengers, if carried. Hence the liner companies have tended more and more to become large concerns, with a big publicly subscribed capital, requiring financial ability as well as technical knowledge in their management.

The "tramp," "seeker" or "general trader" has no fixed itinerary, but can be chartered, either for a definite period or for a single voyage, to carry whatever her charterer requires, usually a whole cargo of some bulky commodity, such as grain, ore or timber, between ports of his choosing. No costly organization is required; each voyage is a separate venture; each ship is a self-contained competitive unit. She may belong to a big fleet, owned by a big company; she may belong to a single-ship company, a firm, or an individual. Several small companies will often entrust actual management to an experienced managing owner.

In the early days of steam, wild speculation, especially on the sixty-fourth system, led to grave scandals in connection with overloading and the over-insurance of unseaworthy ships. The adoption of a compulsory loadline, as the result of an agitation carried on during the seventies by Samuel Plimsoll, put an end to these evils, and later legislation, together with the immense and most beneficial influence of Lloyd's and Lloyd's Register, has brought about a very high standard of safety afloat. The evils of speculation in shipping have latterly been most felt by the ship-owners themselves, through the results of a tendency to over-build in times of prosperity, which has led to every boom in shipping being followed by a long-continued slump.

The liner companies, with regular services to maintain high overhead charges, have always been particularly sensitive to rate-cutting competition. Their efforts to avoid this took two forms during the last years of the 19th century and the first years of the 20th. In the first place there was a strong tendency to amalgamation and to the pooling of financial interests by the exchange of shares between the lines. In the second place the lines in particular trades gradually organized themselves in "conferences" for the purpose of stabilizing freights at an agreed level for fixed periods. In many instances they also tied the shippers to themselves by a system of deferred rebates, which were forfeited by the shipper if he loaded goods in any vessel outside the conference lines. It was mainly as a consequence of complaints by shippers that the royal commission on shipping rings was appointed in 1906, but the lines pleaded that they could only guarantee a fast and regular service if they were assured of a steady volume of traffic at remunerative rates, and the system still persists (1929) carefully watched by the imperial shipping committee.

International Competition.—As the years went on, many of the conferences came to include lines under several flags; for shipping is an international business, and all countries are served by the ships of many nations. During the last decade of the 19th

century and the early years of the 20th, British ship-owners found their supremacy assailed by the ships of countries that were beginning to make up the leeway caused by the earlier industrial development of Great Britain. The Scandinavians, especially the Norwegians, were keen competitors in the general carrying trade. The awakening of Japan was followed by the creation of a modern mercantile marine. Dutch lines were prominent in the Far Eastern trade. France and Italy built up their fleets by a system of bounties and subsidies. Above all, German steam shipping increased from 723,000 net tons in 1890 to 3,096,000 in 1914—nearly a quarter of the tonnage on the register of the British empire. The Germans were not very successful in the tramp trade, but there were few routes on which British ship-owners did not feel the competition of the German liner companies, backed as they were by powerful financial interests.

Much of this competition was State-aided, by the reservation of the coasting and sometimes of the colonial trade to the national flag (United States, France, Russia), by shipbuilding and navigation bounties (France, Italy, Austria, Japan), and in other ways. German shipping was not directly subsidized, but British owners complained that the through rates on the German State railways were manipulated to the advantage of German shipping, and that the medical control of emigrants in transit through Germany was misused to force them to travel by German lines.

In Great Britain the early steamer companies were heavily subsidized for postal or Admiralty purposes, but from about 1875 the postal subventions were reduced to mere payment for work performed, and at no time had any State assistance been given in the construction and operation of cargo steamers. Yet British shipping still held an immense lead over its nearest rival. In the school of unrestricted competition British owners had become quick to respond to the needs of the world's commerce and to adapt the design of their vessels to the needs of particular trades. No other great maritime State placed its shipping so freely at the disposal of all countries. Many British lines ran regularly between foreign ports, and the ubiquitous tramps carried the Red Ensign wherever there was a charter to be obtained. While the freight earnings of British shipping assisted to adjust the trade balance of Great Britain, the services of the ship contributed largely to the economic development of the world, especially by distributing the products of the great agricultural countries such as Canada, Australia and Argentina, and in this way they built up new sources of foodstuffs and raw material for the British people, new markets for British manufactures, and new fields for the investment of British capital. The outstanding characteristic of British shipping at the beginning of the 20th century was the size of its contribution to that pool of fluid tonnage on which all nations draw to cope with emergency demands, or with the seasonal fluctuation in volume of traffic as between route and route.

Shipping in the World War.—The value to Great Britain of this floating reserve of tonnage was clearly seen in the war of 1914–18. From the start, the trade of the country had to be readjusted, and new sources of supply found to replace those closed by the war. About a quarter of the ocean-going tonnage on the register was taken up, in the first few months, for naval and military purposes. Soon heavy losses began to be sustained. The annual carrying-power of the remaining ships was reduced by delays arising from the frightful congestion of the ports, due to war demands, often carelessly made, on port labour and facilities. Neutral ships were frightened away from British ports by the submarine campaign. As each crisis arose it was met; first by the ship-owners alone, afterwards by directing authorities, culminating in the Ministry of Shipping, and working with and through shipping organizations such as the Chamber of Shipping, the Liverpool Steam Ship Owners' Association and the Liner Conferences. Services were readjusted to the new demands of trade; a large proportion of the ships trading between foreign ports were brought back into the trade of Great Britain to take the place of those sunk or requisitioned for war purposes.

It was the crisis caused by the submarine campaign that first really brought home to the majority of the British people, that, for about two-thirds of their annual consumption of food, and for the materials of their greatest industries, they depended on the labours of those who go down to the sea in ships, and on the enterprise and efficiency with which the ships were managed. The war brought home to them too, what manner of man the British merchant seaman is. Down to the end of the 18th century, most foreign-going ships went armed as a defence against pirates and privateers, and the British merchant seaman, by whom in those days the navy itself was manned, had proved himself a fierce and effective fighter. With the suppression of piracy, and the abolition of privateering by the Declaration of Paris in 1856, the arming of merchantmen had practically ceased, and when the German submarines broke through the accepted canons of war at sea, the seamen found themselves exposed to a deadly attack, against which they had no means of defence or retaliation. Yet there was neither panic nor holding back. Men whose ships had been torpedoed under them or blown up by mines, who had suffered hunger, thirst and cold in the long pull to land, signed on again, as a matter of course, for another voyage exposed to the same risks. When it became possible to arm them for their own defence, they used their weapons with skill and spirit, and many a mercantile skipper showed how well he could manoeuvre a ship in action.

The maintenance of supplies under war conditions was the first task of British shipping; but beyond this, it was called upon to make an immense and vital contribution to the war effort of the Allied and Associated Powers. It provided many thousands of men for the royal navy, through direct enlistment and the calling up of the naval reserves; it provided the ships and the bulk of the crews for the armed merchant cruisers that did so much of the work of patrol and convoy escort, and for the Auxiliary Patrol engaged in mine-laying, mine-sweeping, and submarine hunting in home waters. It provided the navy with indispensable auxiliaries, and carried nearly 43,000,000 tons of coal and a vast quantity of oil on Admiralty account. Without merchant shipping the battle fleets could neither have moved nor fought.

British shipping was equally indispensable to the conduct of the war on land. Practically every British soldier landed in France was carried under the British flag. British ships brought Canadian, Australian, Indian and South African troops to take their place on the western front, and carried the armies of the empire to Gallipoli, Mesopotamia, Palestine and the Balkans. When the United States came into the war, about 2,000,000 troops were transported to Europe. Of every hundred men, 49 were carried in British and 45 in American vessels.

Thus, including all movements of British and Allied troops, nurses, civilian staff, prisoners and refugees, the transport department provided tonnage from Aug. 1914, to Oct. 1918, for 23,700,000 individual passages, of which nearly one-third involved voyages of considerable length. In addition they provided tonnage for the carriage of 2,200,000 animals and nearly 50,000,000 tons of munitions and military stores, or goods, such as military fodder, which were for direct account of the British and Allied War Offices. For the Salonika expedition 26 ships, averaging over 5,000 tons, were lent to the French War Office.

British Shipping Services to Allies.—On Oct. 31, 1918, 29·5% of the total available deadweight tonnage under the British flag was in direct naval and military service. Yet this service was only a part of the contribution of British shipping to the common cause. Neither France nor Italy nor Russia had tonnage adequate to the fulfilment of their requirements for food, fuel and munitions. Again and again, at moments when the British authorities were at their wits' end to procure tonnage for military and naval requirements, without reducing British imports (largely composed of materials for the munitions industries) below the danger point, a call would come for ships to carry cereals, coal or munitions to the Allied ports, and so far as was humanly possible, every call was met. Over 15,500,000 tons of coal were carried to France and Italy in British requisitioned ships alone. Out of 5,250,000 tons of coal and munitions received by Russia during 1915 and 1916, two-thirds were carried in British ships. When France and Italy began to import meat, to supplement the rations

of their troops, they were almost destitute of insulated tonnage, and out of 1,375,000 tons purchased by them during the War, more than three-quarters were imported under the British flag. To make good the deficit of the French and Italian harvests, 2,000,000 tons of cereals in British ships were diverted during the months Aug.–Oct. 1918, over and above supplies carried by British ships already on Allied service. At the end of the War, France and Italy required 6,423,000 deadweight tons of shipping for their import services, and could provide, between them, 1,710,000 tons. The United States, all other Allies and neutrals together provided 1,611,000 tons (much of it neutral tonnage under British control). Great Britain provided 3,102,000 tons.

The bare facts are more eloquent than any rhetoric. The whole naval and military effort of the British empire and a great part of the military assistance provided by the United States, depended on British shipping. Without the assistance of British shipping the European Allies could have provided neither their armies, nor their industries, nor their people, with the supplies necessary for the continuance of the struggle. The story of the inter-Allied control of shipping is told elsewhere, but those who had most to do with it would be the first to admit how completely the execution of the whole gigantic task depended on the skilled co-operation of British ship-owners, and the daring and devotion of British seamen.

Losses and Dislocation.—The war services rendered by British shipping were rendered at a heavy cost. Apart from casualties among those who served under the White Ensign, no fewer than 14,661 officers and men of the merchant service and the fishing fleets lost their lives while engaged in trade or transport. The material losses inflicted by submarines, mines and raiders amounted to 7,759,000 tons gross, or 38% of the tonnage under the British flag in June 1914. The net reduction in ocean-going tonnage (ships of 1,600 tons gross and up), after allowing for every form of replacement, was 18%. Many of the remaining ships had suffered in efficiency through delayed repairs. The whole industry was disorganized. The tramp trade had been temporarily destroyed by the requisition of vessels for war purposes and the purchase of tramp tonnage by the liner companies to make good their depleted services. The liner services themselves had been violently dislocated in order to effect the concentration of shipping on the short Atlantic routes, which alone enabled the available tonnage to carry, in 1917–18, the essential minimum supplies. Many lucrative trades had been abandoned, for the time being, to foreign competitors.

Other nations, especially the Norwegians, whose sailors had shown extraordinary courage in maintaining the dangerous North sea trade, had suffered heavy losses, but these losses were quickly made good. The prohibition on shipbuilding for foreigners and on the sale of British ships to foreigners, imposed during the War, and maintained for some time after it, led to a great extension of shipbuilding facilities in Scandinavia and elsewhere. The huge "emergency fleet" laid down in the United States during the War came rapidly into service. Japan, whose war losses had been light, had a tonnage, in June 1920, greater by 75% than before the War. By June 1919 the world's losses of tonnage had already been made good; by June 1923 the world's total tonnage, as recorded by Lloyd's Register, was 32% greater than in 1914; but the British empire percentage (although all losses had been made good) had declined from 42·8% to 33·8%; the American (including Great Lakes tonnage) had increased from 10·9% to 26·0%.

This huge increase in tonnage was out of all proportion to actual requirements. Indeed, the volume of the world's sea-borne trade, for several years after the War, was greatly reduced as the result of that great upheaval, and the existence of a mass of surplus tonnage led, after a short post-war boom, to the worst depression the shipping industry has ever known. In Jan. 1922 it was estimated that 11,000,000 gross tons of shipping were idle for want of employment, and although the position gradually improved, as trade recovered, and as it became evident that much of the American tonnage, hastily constructed during the War, could, for all practical purposes, be written off, the supply of carrying-power was still in excess of the normal demand in 1927.

Tankers and Motor Ships.—So far as the ships are concerned, the main feature of the post-war period was the influence of oil. The tank steamer, constructed for the carriage of oil in bulk, dates back to 1885, but the increasing use of oil fuel both in industry and transport was responsible for an immense increase in the world's tanker fleets during and since the War, and one main cause of this impetus to tanker construction was the substitution of oil for coal in the bunkering of mercantile as well as naval vessels. In 1914 only 2·6% of the world's mercantile tonnage used oil under boilers, only 0·5% consisted of ships fitted with internal combustion engines. In 1927 the proportions were 28·4% and 6·6% respectively, and no less than 38% of the tonnage launched in that year consisted of motor ships.

This new revolution in motive power has its dangers for British shipping, as it diminishes the advantage derived from coal-fields within easy reach of the ports, and has combined with other factors to reduce the exports of British coal, to which tramp steamers in the trade of Great Britain look for the bulk of their outwards cargoes. It is not surprising, therefore, that British owners, while adapting many of their steamers to burn oil under boilers, and placing large orders for motor ships, have taken the lead in research and experiment directed to the discovery of a more economical employment of coal fuel, by the development of a new type of engine or the use of pulverized coal.

As regards the internal organization of the industry, the War accelerated the tendency to amalgamation and combination, especially in the liner trades. In order to maintain their depleted services, many of the big lines absorbed the fleets of other companies, or purchased tramp steamers, with the result of bringing a still larger proportion of the total tonnage under the ownership or control of a few powerful groups. The tramp trade itself has been heavily hit by the decline in British coal exports and by the slackness of demand due to a surplusage of carrying-power. The line of demarcation between tramp and cargo-liner tonnage is not always clear; for many tramp owners put their ships "on the berth" for consecutive voyages to a particular port, during the busy season, and many liner companies place some of their vessels on the open freight market, when not required for their regular services. There is no doubt, however, that the lines have gained, and the tramps lost ground since the War; but the necessity for coping with seasonal fluctuations will always provide employment for tramp shipping, and any large increase in the volume of world trade will lead to a revival of demand.

Shipping Policy.—In shipping policy two contrary tendencies are at work. The spirit of economic nationalism arising from the War has found expression, in many countries, in a tendency to foster, by subsidy or protection, the national shipping, and to discriminate against foreign flags. The other tendency springs from an increasing sense of the international character of the shipping industry, and its absolute dependence on the free movement of the world's trade. It has found expression in the slogan of British ship-owners—"freedom of the seas in the sense of equal treatment of all flags in all ports," and can be seen at work in the conventions on ports and flag discrimination concluded under the auspices of the League of Nations, and in the efforts of such bodies as the International Ship Owners' Conference and the International Maritime Law Committee to procure uniformity of law and practice in such matters as safety regulations and equipment, the conditions of employment afloat, ship-owners' liability, and shipping documents.

It is natural that British ship-owners should have taken the lead in this movement, for, while the percentage of tonnage under the British flag is smaller than before the War, the British merchant navy is still much larger than that of any other nation, and takes a much larger share in the general carrying trade of the world. That position is likely to be retained, for geographical position, an indented coastline, coal and iron in close proximity to the ports, and an accumulated capital larger than can be absorbed in the development of her internal resources, all draw Great

Britain to the sea. Shipping, however, is only the handmaid of commerce, and the future prosperity both of British and of the world's shipping depends on the demand for transport created by the peaceful development of the world's resources, and on the ability of the ship-owners to meet that demand by supplying cheap and efficient carrying power. In the past it was the glory of shipping to extend the range of civilization by the discovery and exploration of new countries, and by enabling their empty spaces to be peopled from the surplus population of the old world. The period of discovery is over; the world has been mapped and charted. The tide of emigration has slackened with the growth of the new communities oversea. It remains for shipping to continue its beneficent task of redressing the uneven distribution of the world's natural resources by a system of exchange which renders the products of all climes available in all countries to the benefit of all peoples.

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SHIPPING: MERCHANT SHIPS OF THE WORLD.

In spite of the wealth of literature dealing with the sea and ships, there is very little information about the size of the fleets of the seafaring nations of the world before the nineteenth century. Mulhall estimates the total world tonnage of shipping in 1800 at 4,026,000 tons. This is probably an under-estimate. Sir Henry Petty, writing about 1666, estimated the whole of the shipping of Europe at 2,000,000 tons distributed as follows:—

	Tons
English	500,000
Dutch	900,000
Hamburgers with the subjects of Denmark and Sweden in the town of Dantzic	250,000
Spain, Portugal and Italy	250,000

If Petty's figures are reliable, the English must have considerably improved their position relatively to the Dutch in the first half of the 17th century, for Sir Walter Raleigh writing in 1603/4 states: "We send into the East Kingdoms yearly only one hundred ships, while the Shipowners of the Low Country send thither about three thousand ships." He estimated that the Low Countries at that time possessed as many vessels of all sorts as eleven kingdoms of Christendom including England and that they built one thousand ships annually. The sailing ships in which the seaborne trade of the world was carried in the middle ages would to-day be considered of very moderate size even in purely coasting trade. Vasco de Gama rounded the Cape of Good Hope in 1497 with three vessels, the largest of which is described as of 120 tons and the first voyage round the world was accomplished by Magellan between 1519 and 1522 with five vessels, the largest of which was only 130 tons. Vessels of greater size were, however, built and King Henry VIII.'s "Harry Grace a Dieu"—the Great Harry—is listed at the head of the inventory (given after Henry VIII.'s death) as of 1,000 tons.

The average size of 152 ships in the Spanish Armada was 389 tons. The English fleet consisted of 76 of the Queen's ships averaging 121 tons each. The combined tonnage of the Spanish and English fleets was probably less than that of three or four modern transatlantic liners. More or less accurate statistics at any rate for the United Kingdom, the British colonies and the United States of America become available at the end of the 18th century, or roughly from the time of the appearance of the steam vessel. The first patent for a steam engine appears to have been taken out in 1786 and a small steamer was constructed and employed in towing on the Forth and Clyde canal in 1803.

According to a Custom House return of 1830 there were 11 steam vessels of 542 net tons belonging to the United Kingdom in 1814. Of these only one steamer of 69 net tons was registered. The 10 unregistered vessels were presumably river craft so that so far as sea-going shipping is concerned the year 1814 may be taken as the official beginning of the steamship era in British merchant shipping. In the United States records one steam vessel of 78 tons is shown for the year 1807 and 14 steam vessels of 2,917 tons for the year 1814. An accurate statistical account of the development of merchant shipping in the United Kingdom and in foreign countries since 1814 is rendered difficult by the fact that some of the relevant figures are given in net tons and some in gross. The official statistics of the United Kingdom are expressed in net tons throughout, with alternative equivalents in gross tons for later years, but when comparative figures are required for foreign countries reliance has to be placed on the records published by Lloyd's Register of Shipping, and these have in recent years been expressed in gross tons only. In the following tables gross tonnage has been converted into net. The conversion ratios vary with the period of build of the ship, and the appropriate ratios have been estimated from the data available.

Tables of British Shipping.—Mulhall gives the following totals for British and Colonial shipping up to the year 1800.

Year	British and Colonial shipping	
	Vessels	Net tons
1588	470	37,400
1610	910	83,000
1666	1,320	120,000
1688	2,620	210,000
1702	3,260	261,000
1760	5,730	487,000
1800	17,410	1,856,000

The table on p. 549 shows the tonnage of the merchant shipping on the register of the United Kingdom from 1791 to 1927, so far as the records are available for the earlier years, in some detail for the period 1860 to 1890 when the rate of replacement of sailing vessels by steam vessels was particularly rapid, and yearly from 1914 to 1927.

In 1870 the tonnage of sailing vessels was four times as great as that of steam vessels. By 1900 the position was reversed. The growth of the effective carrying power was much greater than is indicated by the mere tonnage figures as the steam vessel made three or four voyages for every voyage of the sailing vessel. The total tonnage owned in the United Kingdom was reduced by nearly $2\frac{1}{2}$ million net tons between 1914 and 1918 by reason of war building failing to keep pace with war losses. Since the war the highest total reached was at the end of 1925 when it was practically the same as at the end of 1912. The depression in shipping in the last few years has discouraged building and has accelerated the scrapping of older vessels, and tonnage on the register at the end of 1927 was more than a million tons less than at the end of 1925. Since 1923 the Board of Trade returns show motor ship tonnage on the register separately. The increase from 263,000 net tons in 1923 to 765,000 net tons in 1927 is not so great either absolutely or relatively to the total tonnage on the register as was the increase in steamship tonnage from 2,723,000 tons in 1880 to 3,973,000 tons in 1885 and to 5,043,000 in 1890.

Number and Tonnage of Registered Vessels Belonging to the United Kingdom Including Jersey, Guernsey and Isle of Man, at the End of Each Year

Year	Sail		Steam		Motor		Total	
	No.	Net tons	No.	Net tons	No.	Net tons	No.	Net tons
1791 . .	..	1,414,956	..	..	..	..	..	1,414,956
1800 . .	..	1,698,811	..	..	..	..	..	1,698,811
1810 . .	20,253	2,210,661	..	..	..	..	20,253	2,210,661
1814 . .	21,549	2,414,101	1	69	..	..	21,550	2,414,170
1819 . .	21,973	2,449,049	24	2,548	..	..	21,997	2,451,597
1829 . .	18,823	2,170,458	287	29,501	..	..	19,110	2,199,959
1841 . .	22,382	2,832,090	790	95,678	..	..	23,172	2,927,768
1850 . .	24,799	3,396,791	1,185	168,342	..	..	25,984	3,565,133
1860 . .	25,663	4,204,360	2,000	454,327	..	..	27,663	4,658,687
1865 . .	26,069	4,936,776	2,718	823,533	..	..	28,787	5,760,309
1870 . .	23,189	4,577,855	3,178	1,112,934	..	..	26,367	5,690,789
1875 . .	21,291	4,206,897	4,170	1,945,570	..	..	25,461	6,152,467
1880 . .	19,938	3,851,045	5,247	2,723,468	..	..	25,185	6,574,513
1885 . .	17,018	3,456,562	6,644	3,973,483	..	..	23,662	7,430,045
1890 . .	14,181	2,936,021	7,410	5,042,517	..	..	21,591	7,978,538
1895 . .	12,617	2,866,895	8,386	6,121,555	..	..	21,003	8,988,450
1900 . .	10,773	2,096,498	9,209	7,207,610	..	..	19,982	9,304,108
1905 . .	10,059	1,670,766	10,522	9,064,816	..	..	20,581	10,735,582
1910 . .	9,090	1,112,944	12,000	10,442,719	..	..	21,090	11,555,663
1914 . .	8,203	793,567	12,862	11,621,635	..	..	21,065	12,415,202
1915 . .	8,019	776,761	12,771	11,650,349	..	..	20,790	12,427,110
1916 . .	7,669	714,830	12,405	11,036,788	..	..	20,074	11,751,618
1917 . .	7,186	625,428	11,534	9,606,671	..	..	18,720	10,232,099
1918 . .	6,857	603,905	11,334	9,497,040	..	..	18,191	10,100,945
1919 . .	6,555	592,933	11,791	10,334,986	..	..	18,346	10,927,919
1920 . .	6,309	584,046	12,307	10,777,038	..	..	18,616	11,361,084
1921 . .	6,272	609,761	12,660	10,932,369	..	..	18,932	11,542,130
1922 . .	6,184	574,189	12,787	11,223,036	..	..	18,971	11,797,225
1923 . .	5,962	550,723	10,813	10,897,138	1,624	263,205	18,399	11,711,066
1924 . .	5,842	521,987	10,690	10,809,608	1,823	384,840	18,355	11,716,435
1925 . .	5,785	519,821	10,526	10,964,526	1,965	498,731	18,276	11,983,078
1926 . .	5,678	516,999	10,262	10,760,098	2,170	629,431	18,110	11,906,528
1927 . .	5,638	506,332	10,030	10,570,515	2,343	764,872	18,011	11,841,719

NOTE.—In 1827 the new Registry Act came into operation under which owners of ships were obliged to register anew. Many vessels that had been previously lost had been continued up to this time on the registry, no evidence of their loss having been produced.

World Shipping.—Only approximate world figures are available for the earlier years of the 19th century. In the following table the figures for the years 1886 to 1927 have been prepared from returns published by *Lloyd's Register* and the Bureau Veritas. The earlier figures are estimates collected by Mulhall. The more recent figures have been converted from gross tons to net so as to make them comparable with the earlier figures and with the preceding table applicable to the United Kingdom.

World's Mercantile Marine at Various Dates from 1800 to 1927

Year	Steam*	Motor	Sail	Total
	Net tons (000's)	Net tons (000's)	Net tons (000's)	Net tons (000's)
1800 . .	..	..	4,026	4,026
1820 . .	20	..	5,814	5,834
1840 . .	368	..	9,012	9,380
1860 . .	1,710	..	14,890	16,600
1870 . .	3,040	..	12,900	15,940
1880 . .	5,880	..	14,400	20,280
1886 . .	6,693	..	11,217	17,910
1888 . .	9,040	..	12,640	21,680
1890 . .	8,296	..	9,166	17,462
1900 . .	13,857	..	6,674	20,531
1910 . .	23,046	..	4,624	27,670
1914 . .	28,108	146	3,686	31,940
1919 . .	29,792	465	2,722	32,979
1920 . .	32,603	590	3,022	36,215
1921 . .	36,194	770	2,772	39,736
1922 . .	37,176	949	2,684	40,809
1923 . .	37,060	1,019	2,506	38,585
1924 . .	35,963	1,206	2,241	39,410
1925 . .	35,992	1,655	2,019	39,666
1926 . .	35,600	2,109	1,887	39,596
1927 . .	35,286	2,576	1,709	39,571

*Including motor ships prior to 1914.

The world's mercantile marine doubled itself between 1666 and 1800 from the 2 million tons of Sir Henry Petty's estimate to the 4 million tons of Mulhall's estimate and increased tenfold between 1800 and 1922 from 4 million to 41 million net tons. Motor ship tonnage has increased from 146,000 tons in 1914 to 2,576,000 tons in 1927 and the same comment can be made as on the United Kingdom table that this increase is not so great either absolutely or relatively as the increase in steamships between 1860 and 1870 or between 1870 and 1880. The world's merchant shipping was on the whole increasing at a rapid rate during the period. Sailing ship tonnage was increasing until 1860, roughly stationary until 1880 and has, on the whole, been steadily declining since that date.

The relative positions of the merchant fleets of the chief maritime nations for the last 40 years can be studied from the published records of Lloyd's Register of Shipping which go back to 1886.

The table on the following page shows the steam (including motor) and sailing ship tonnage for June of the years 1886, 1914, 1920 and 1927. Vessels of under 100 tons gross are omitted from Lloyd's Register figures.

In 1886 the United States occupied the second place numerically, but much of its shipping was employed on the Great Lakes and in the reserved coasting trade, and Norway came immediately after the United Kingdom among world carriers. The columns of the table headed "1914" show the position immediately before the World War. The United States had dropped to third place and more than half of the 4·3 million tons of United States steam shipping was employed exclusively on the Great Lakes.

Germany was by far the most important shipping country in the world after the United Kingdom. The figures for the year 1920 are inserted in the table as showing the position immediately after the war better than the figures for 1918 or 1919. Early in 1920 Germany surrendered all her larger vessels to the Allies under the terms of the Peace Treaty and her steam tonnage was reduced to 419,000 gross tons, or less than she had in 1886.

The United States total had increased to over 14½ million tons of steam and motor shipping, of which about 12½ million gross tons was ocean-going. This huge increase in American shipping followed the completion during 1919 and 1920 of the building programme entered upon in the last years of the war. Much of

Tonnage of the Vessels of 100 Tons and Upwards Belonging to Each of the Several Countries of the World as Recorded in Various Editions of Lloyd's Register Book

Countries where owned	1886		1914		1920		1927		
	Steam and motor ships	Sailing vessels	Steam and motor ships	Sailing vessels	Steam and motor ships	Sailing vessels	Steam and motor ships	Sailing vessels	Total
	Gross tons (000)	Net tons (000)	Gross tons (000)	Net tons (000)	Gross tons (000)	Gross tons (000)	Gross tons (000)	Gross tons (000)	Gross tons (000)
Great Britain and Ireland	6,162	3,249	18,892	365	18,111	220	19,179	130	19,309
British Dominions	378	1,377	1,632	157	2,032	220	2,699	166	2,865
Total British empire	6,540	4,625	20,524	521	20,143	440	21,878	296	22,174
United States including Gt. Lakes	496	1,587	4,330	1,038	14,574	1,475	13,690	979	14,670
Japan	78	32	1,708	..	2,996	..	4,033	..	4,033
Italy	195	705	1,430	238	2,118	124	3,396	88	3,483
France	738	319	1,922	397	2,963	282	3,362	108	3,470
Germany	604	806	5,135	325	419	253	3,320	43	3,363
Norway	140	1,352	1,957	547	1,980	240	2,803	22	2,824
Holland	190	229	1,472	25	1,773	20	2,645	9	2,654
Sweden	150	331	1,015	103	996	77	1,329	37	1,365
Spain	362	159	884	15	937	60	1,136	26	1,161
Denmark	143	128	770	50	719	84	1,032	28	1,060
Greece	54	289	821	16	497	33	1,026	3	1,029
Other countries	601	655	3,436	411	3,790	321	3,617	287	3,907
Total	10,291	11,217	45,404	3,686	53,905	3,409	63,267	1,926	65,193

this tonnage was of doubtful value, nearly 2 million tons consisting of wooden vessels. During the last seven years, American tonnage has been steadily reduced while Germany has been slowly rebuilding her merchant fleet, and she is well on the way to regain her prewar position.

Japan, Italy, France and Norway have all considerably improved their relative positions since 1914.

The British Empire owned 63·6% of the mechanically propelled shipping in the world in 1886, 35·2% in 1914, 37·4% in 1920 and 34·6% in 1927. (L. I.)

THE UNITED STATES

In the 19th century United States shipping passed through stages of brilliance (*see* SHIPPING, HISTORY OF), gradually fading and declining into an inconsequential factor in the world's carrying trade, to be revived again since the World War in a new effort to provide United States cargoes with ships of the same nationality suitable to convey them to their respective destinations.

Early in the history of American independence the shipping industry was pre-eminent among the industries developed on the western side of the Atlantic. At that time the United States was primarily a seacoast country, and overland transport had not been sufficiently developed to make exploitation of the interior convenient, while the size of the population did not make it urgent. Inter-state transport was chiefly by water, as was, of course, transportation between the states and the European sources of articles whose manufacture was not yet developed in America. Materials for wooden ship construction were to be had cheaply and at locations convenient to the coast. Therefore a large shipbuilding industry was set up and flourished along the North Atlantic seaboard.

Soon after the United States became independent, its government established a policy of industrial protection. This policy was extended to shipping and resulted almost immediately in a rapid increase of the volume of seagoing tonnage under the American flag. This is indicated in the table at the bottom of the page, authority for these figures being the bureau of research of the United States Shipping Board.

United States Flag Ships Employed in Foreign Trade 1830 to 1926
(Number of vessels not recorded prior to 1868)

Year	Number	Gross tons
1830	..	537,563
1840	..	762,838
1850	..	1,439,694
1860	..	2,379,396
1870	2,643	1,448,846
1880	2,204	1,314,402
1890	1,451	928,062
1900	1,288	816,795
1910	1,490	782,517
1920	5,932	9,924,694
1924	4,973	8,793,667
1925	4,695	8,151,426
1926	4,616	7,719,139

Steam, Motor and Sailing Vessels of the American Merchant Marine, 1830 to 1926
(Number of vessels not recorded prior to 1868)

Year	Steam		Motor		Sail		Total	
	Number	Gross tons	Number	Gross tons	Number	Gross tons	Number	Gross tons
1830	..	64,472	..	..	..	*1,127,304	..	1,191,776
1840	..	202,339	..	..	..	*1,978,425	..	2,180,764
1850	..	525,947	..	..	..	*3,009,507	..	3,535,454
1860	..	867,937	..	..	..	*4,485,931	..	5,353,868
1870	3,524	1,075,095	..	..	17,534	2,363,086	21,058	3,438,181
1880	4,717	1,211,558	..	..	16,830	2,366,258	21,547	3,577,816
1890	5,965	1,859,088	..	..	15,164	2,109,413	21,129	3,968,501
1900	6,818	2,653,533	235	4,264	13,271	1,884,842	20,324	4,542,639
1910	6,965	4,817,118	5,487	83,243	8,947	1,655,473	21,399	6,555,834
1920	8,103	13,466,400	10,711	357,049	4,030	1,272,159	22,844	15,095,608
1924	7,736	14,870,103	11,014	445,240	2,748	1,184,867	21,498	16,500,210
1925	7,454	14,495,294	11,183	481,099	2,533	1,125,403	21,170	16,101,796
1926	7,273	14,317,777	11,416	530,443	2,362	1,091,543	21,051	15,939,763

*Includes canal boats and barges.

The table in col. 2 of the preceding page shows United States shipping reached a peak at the time when sailing vessels were at the height of their development. In this type of shipping, United States shipowners and shipbuilders enjoyed advantages in the cost of construction of vessels which did not continue with the incoming of the steam ship. Almost simultaneously with this latter development, came the development of the railroad, large increases in the population, and a natural instinct, fostered by the government, to explore and settle the interior regions of the United States; all of which combined to divert national interest away from the sea. In the table below is shown the percentage of United States cargoes carried in United States vessels over a period of about one hundred years.

Year	Percentage of U.S. cargoes carried in U.S. ships	Year	Percentage of U.S. cargoes carried in U.S. ships
1830 . .	89·9	1900 . .	9·3
1840 . .	82·9	1910 . .	8·7
1850 . .	72·5	1920 . .	42·7
1860 . .	66·5	1924 . .	36·3
1870 . .	35·6	1925 . .	34·1
1880 . .	17·4	1926 . .	32·2
1890 . .	12·9		

The outbreak of war in 1914 indirectly resulted in a severe dislocation of ocean traffic through American ports due to the diversion of European vessels regularly operated in the United States trades to military usage. This situation gave rise to Congressional consideration of the shipping problem which resulted in the passage of the Shipping Act of 1916. This act was designed to create a board which would regulate shipping passing through American ports and make researches which would lead the way for further development of a national shipping programme. With the entrance of the United States into the World War and following the call on its government for ships to assist the Allies in conveying troops and supplies across the Atlantic, the shipping board was utilized by the president of the United States as an agency for carrying out the largest shipbuilding programme of history.

In the course of this programme covering a period of four years, a total of 2,314 ships, aggregating 13,636,967 deadweight tons, was built. In addition to the construction of vessels, much tonnage was secured from other sources. The entire programme is indicated in the following table:

	Number of vessels	Aggregate deadweight tons
Constructed . . .	2,314	13,636,967
Seized from enemy alien owners	105	675,441
Purchased	103	368,305
Transferred to shipping board from other government departments . .	21	25,504
Total	2,543	14,706,217

Hostilities ceased prior to the time construction on the majority of the new tonnage was completed, but most of it was well on the way before the signing of the armistice and contracts for its completion have been made.

To solve the problem presented by this fleet's existence the Merchant Marine Act of 1920 was passed. This act undertook a plan to transfer the fleet to the ownership of citizens of the United States who would operate it privately, and devised means of aiding them in their operation so that they might compete on an equal footing with ships of other flags operated under conditions more favourable to their owners. The act likewise directed the shipping board to operate vessels over trade routes essential to American commerce when it was not possible to effect transfer to private ownership to the end that all trade routes necessary to the maintenance of United States foreign trade should be served by United States ships. In many cases, this move was necessary, and in all, the shipping board established 35 shipping lines, 16 of which had been sold to citizens of the United States by the end of 1928.

In the practical operation of the Merchant Marine Act of 1920 it was found that the aids provided to assist private operators in meeting foreign competition in many trade routes were not adequate. Thereupon Congress considered the matter anew and passed the Merchant Marine Act of 1928 wherein it increased the construction loan fund, provided for in the previous act, to $250,000,000, and made it possible for shipowners to borrow up to 75% of the cost of the construction of vessels at the rate of interest which the government pays on current borrowings. It also extended the period for which mail contracts may be made from one year to ten years and increased the amount of compensation to be paid for the carriage of mail in United States ships.

(T. V. O'C.)

See W. S. Lindsay, *History of Merchant Shipping and Ancient Commerce* (1874–76); Lloyd's *Register* of Shipping (annual); Bureau Veritas (Annual); House of Commons Papers; Annual *Statement* of the Navigation and Shipping of the United Kingdom; *Statistical Abstract* of the United Kingdom; Annual *Report* of the Commissioner of Navigation, Washington.

SHIPPING, MINISTRY OF, one of the temporary British departments of State brought into existence when Lloyd George became prime minister in Dec. 1916. Shipping had long been recognized within a limited circle as a vital factor in the prosecution of the World War, but it was only about this time that the intensification of the submarine campaign, coupled with the ever-growing military demands upon sea transport, gave grounds for real anxiety in regard to the shipping resources of the Allies.

The object in view was thus to bring all the shipping available under the control of one authority to ensure its most economical employment under war conditions and for war purposes.

The Development of the Shipping Problem.—At the outbreak of war Great Britain stood easily first among mercantile nations, Germany, whose ships were compelled from the beginning of the conflict to seek safety in port, being her only competitor. The possibility that the available tonnage might prove insufficient did not therefore at first enter into the calculations of the Government, though there was ground for anxiety lest ships be prevented from putting to sea and a successful scheme of insurance against war risks had been carefully worked out beforehand. No ship was prevented from going to sea by lack of crew, though at one period on certain routes the loss of one ship in three was almost certain. Once the continued employment of the ships had been assured there seemed at the outset to be no cause for anxiety as to the sufficiency of the 18,000,000 tons of ocean-going ships with which Great Britain entered the war. Ships were taken up for service with the fleet and as transports as occasion arose, the vast majority remaining free to fulfil their normal functions, subject only to restrictions imposed in the interests of safety. It was not until the war had been in progress for more than a year that the conservation of shipping by eliminating unnecessary demands began; in 1916 the restriction of imports as a means of relieving the pressure upon tonnage was first embarked upon. (*See* War Control of Shipping.)

The possibility that shipping might prove a governing factor when once realized was not allowed to escape from view, and the facts were not less patent to the enemy. Intensified activity followed on both sides. The submarine campaign became a definite challenge upon the issue of which all Germany's hopes were centred. The establishment of the Shipping Control Committee (*q.v.*), marked the beginning of the new phase, and the constant occurrence of new demands handled by different governmental authorities tended to throw the economic system of the country out of gear and led to a risk that necessary services might be starved while surplus tonnage was seeking profitable but nationally disadvantageous employment elsewhere.

The Pre-existing Organization.—Prior to the creation of the Ministry the two authorities directly concerned with merchant shipping were the Transport Department of the Admiralty and the Board of Trade. The primary function of the former was to select, if necessary equip for service, and direct the movements of, the ships required by the Navy, and during the war its responsibilities expanded rapidly. Its activities however did not extend to matters coming within the purview of the Board of Trade, the

pre-war responsibility of which, so far as shipping was concerned, was limited to regulating in the interests of passengers and crew the conditions under which ships were employed. This responsibility was extended during the war to include such measures of control as became necessary in connection with other activities of the Board, which, *inter alia,* is responsible for watching the general economic condition of the country, and in that capacity it had to devise measures for checking developments which appeared to threaten British economic welfare. Two Committees were set up by the Board in November 1915 with that object. The first—the Ship Licensing Committee—could debar any British ship from undertaking a voyage which for any reason was not approved. The second—the Requisitioning (Carriage of Foodstuffs) Committee—directed British shipping into channels which would assist the importation of food or other necessities. The Board of Trade also from the outbreak of war undertook direct responsibility for, and transport of, all imports of frozen meat. It also saw that the interests of the Mercantile Marine were not overlooked in the competition for materials and for vacant slips in the ship-yards.

The Trade Division of the Admiralty, primarily concerned with the regulation of the movements of British ships from the standpoint of safety, developed during the first two years of war important functions in relation to neutral shipping by means of a system of control of British bunker coal; and at the end of 1915 the Port and Transit Executive Committee was set up to expedite the flow of traffic through the ports.

The Internal Organization of the Ministry.—The Ministry was organized upon the usual model of a Department of State. The Controller, Sir Joseph Paton Maclay (afterwards Lord Maclay), was a member of the Cabinet, though not of the War Cabinet. He was not a member of the House of Commons and declined to seek election, questions in the House being answered by the parliamentary secretary, while on occasions of exceptional importance a member of the War Cabinet was available to state its case.

The staff of the Ministry was drawn from a variety of sources. The Transport Department of the Admiralty was transferred to it en bloc, also certain small sections of the Board of Trade; and as the work grew, the necessary personnel was obtained by the temporary transfer of trained civil servants and by volunteers from shipping firms.

At the outset the Admiralty was inclined to regret the loss of control necessitated by the creation of a separate Ministry of Shipping, but the difficulty was solved by a compromise, the Director of Transport (the Chief Executive Officer of the Department) becoming directly responsible to the Board of Admiralty for all shipping employed on naval service, the Admiralty retaining the right to order the movements of the shipping on which they depended for their supplies.

The Shipping Control Committee became in effect the Council, or supreme deliberative body, in the Ministry and was constantly consulted by the Controller, who addressed himself from the first to the question of increasing the available supply of shipping. At home the scarcity of material and labour and the competing demands of the Navy had brought the output of the yards to far below their normal capacity. It was decided to concentrate on the production of standardized cargo vessels of the simplest design; and the co-operation of the shipbuilders was secured. Simultaneously steps were taken to place contracts with shipbuilding yards abroad—in Japan, the United States of America and Canada, and the resources of every firm at home or abroad which had berths available were utilized to the utmost.

After a few months the responsibility for all shipbuilding was transferred to the Controller of the Navy, but the Minister of Shipping continued to keep in close touch and the marked improvement in the output of new merchant tonnage which helped to relieve the situation later in the war was largely due to the programme which he had drawn up.

The executive work of the Ministry was under the Director of Transport and Shipping, an officer who had previously been Director of Transport under the Admiralty; his immediate assistants were also styled directors, dealing respectively with technical matters, with the selection and allocation of ships to the various services, with the management of the various classes of transport, naval, military and commercial, and coastwise shipping under private control, and the work of the port.

To the secretariat was assigned the handling of questions concerned with general policy and the conduct of correspondence with other departments and with the public in connection therewith. It also dealt with all establishment questions and was responsible for all business not definitely assigned to one or other of the executive branches, such as negotiations for securing the control of neutral tonnage, and the work of the National Maritime Board,—a body consisting of representatives of owners and employees, set up to settle questions connected with the pay of officers and men of the Mercantile Marine.

The Tonnage Priority Committee decided between competing claims for freight and scaled down the programmes of the various import services, bringing them within the scope of the tonnage available.

The Ministry relied on the estimates of the Statistical Branch and, when it became necessary to bring under a single control the tonnage resources of all the Allies, the Allied Maritime Transport Council (*q.v.*) was set up. A small Legal Branch was set up to advise upon questions arising in day-to-day administration of the Department and to represent the Ministry in Admiralty adjudications in regard to compensation for ships lost upon Government service.

The financial work of the Ministry attained very large dimensions for with practically the whole of British shipping under requisition, enormous sums were payable in monthly hire, and heavy claims for loss and damage to ships had to be met.

(J. A.)

SHIPPING: REGISTRATION, CLASSIFICATION AND STATE REGULATION. Registration.—It is essential that every ship should have a certificate of identity, or of registry, for facility in maritime trading. The Navigation Acts of Great Britain from 1660 onwards made the registration of vessels compulsory, and this requirement is still contained in the Merchant Shipping Acts.

To obtain a certificate, an application must be made by the owners, stating their qualifications for ownership and their financial interests. A certificate from the builders must be produced giving a description of the ship, the estimated tonnage, and the time and place of build. A surveyor of the Board of Trade measures the vessel for tonnage and for registration, and prepares a certificate of particulars which include the draught marks at the bow and stern. The registrar then issues a certificate ("carving note") which gives the vessel an official number and which states the registered or net tonnage and the port of registry. The builder thus authorized cuts the official number and the registered or net tonnage in the steel structure of the ship (usually on the beam at the after end of the main hatchway, immediately before the bridge), marks the port of registry and the name of the ship on the stern, and the name only on each side of the bow, the draught marks having already been marked and checked by the surveyor. The necessary particulars are then entered in the official register, and a certificate of registry in conformity with these particulars, but to which is added the name of the master, is given to the owners. As there is often some confusion as to what is meant by "registered tonnage," it should always be remembered that this term is usually applied to the net tonnage, that is, the tonnage on which dues are assessed, and is the tonnage which is marked on the ship for purposes of identification. (For particulars of measurement *see* SHIPPING: *Tonnage Terms.*)

Lloyd's Register.—There are certain societies formed by the sea interests which have for their purpose what is termed the classification of ships. The most famous and influential as well as the oldest of these bodies is Lloyd's Register of Shipping, which was founded in 1760 and reconstituted in 1834 "for the purpose of obtaining for the use of Merchants, Shipowners and Underwriters a faithful and accurate classification of mercantile shipping, and for their government adopt from time to time a code of rules and regulations," and which may be taken as a standard to illus-

trate the important part played by classification societies in the working of the mercantile marine. The society prints annually a *Register Book* containing the names and particulars of all the ships in the world over 100 tons gross, and where the vessels are classed with the society the characters assigned with full particulars are given. It publishes, at regular intervals, certain valuable statistical summaries of the position of shipping with reference to its growth, change, and so forth, which are regarded by the shipping world as its "barometer." and which form a sensitive index of the position of the world's trade generally.

The rules fix the quality and strength of the material to be used in the construction, the thicknesses of the parts of the hull, the equipment of anchors and cables as well as the requirements for machinery. The use of the expression "A1 at Lloyd's" as a hall-mark of excellence indicates that from the design stage to the end of its existence the fitness of the ship is under control. When a new ship is contracted for, plans of the design showing details of the various parts of the structure are submitted and amended where necessary. The materials to be used in the construction are tested by the society's surveyors, and its officers supervise the actual building of the ship and its machinery. When it is completed a certificate is issued to the effect that the general regulations and practice of the society have been complied with, and the character or symbol of classification is attached to the vessel's name in the register of the society. The ship enters into service, and at regular intervals—generally every four years—is required to undergo a special survey and overhauling at the hands of the surveyors, under specific regulations.

Lloyd's Register of Shipping is voluntarily maintained by the shipping community, and is governed by a committee composed of the most representative men in the various branches of the industry—shipowners, underwriters, and ship and engine builders. It has similar committees in the United States, France, Holland, Sweden, and Japan. It thus forms a link between the sea-faring communities of the world which cannot be supplied by international political means, and forms a community of sea-faring interests whose purpose is to ensure the fitness of ships. Its highly trained technical experts are to be found in every centre of shipping activity in the world. (*See* LLOYD'S REGISTER OF SHIPPING.)

Classification Societies.—Most countries have set up their own national classification societies, in some instances partly under Government direction. These comprise the Bureau Veritas, with headquarters in France; the Norske Veritas, with headquarters in Norway; the Germanischer Lloyd, with headquarters in Germany; the American Bureau, which was resuscitated when the United States entered the World War; the Registro Italiano in Italy; and a Society in Japan of very recent origin; these societies differ somewhat in the particular symbols which they attach to the various classes. Although their printed regulations for the construction of ships and machinery do not differ greatly, there are differences of practice in regard to the administration of the various rules. The principal classification societies in 1927, and the tonnage of vessels (steam, motor and sail) classed, were:—

	Tons gross
Lloyd's Register of Shipping, with headquarters in London	29,605,303
British Corporation for the Survey and Registry of Shipping, in Glasgow	4,484,782
American Bureau of Shipping, at New York	8,580,532
Bureau Veritas, at Paris	5,870,900
Germanischer Lloyd, at Berlin	3,837,222
Norske Veritas, at Oslo	1,847,334
Registro Italiano, at Genoa	2,712,316

It will be seen that the major portion of the total tonnage owned in the world, which in 1927 was some 63 million tons gross, plies under the aegis of one or other of the principal classification societies—a clear indication that, to the world's mercantile marine, classification is an indispensable adjunct.

The Bureau Veritas was founded in Antwerp in 1828, to make known to underwriters the qualities and defects of ships frequenting Dutch and Belgian ports. In 1832 the headquarters were moved to Paris, and in due time its influence spread to countries where shipowning or shipbuilding existed. In 1851 rules were drawn up for the construction of wood ships, and about 1867 for iron. Rules for steel came later, and also rules for the construction of machinery, and as circumstances arose provision was made for special types, such as oil-tank vessels, turret vessels, and dredgers, as well as for the testing of materials. These rules have been revised from time to time, and special rules issued for ships intended for inland waters, for yachts and for motor boats.

The British Corporation was founded in 1890, and obtained its charter under the Merchant Shipping Acts for the assignment of freeboards; its first rules were issued in 1893. Its inception was due to the enterprise and influence of a number of leading shipowners, shipbuilders and engineers more particularly connected with Glasgow and the west of Scotland, the first aim of the founders being to provide an independent society thoroughly capable of dealing with the complicated questions which were likely to arise under the Load Line Act then coming into operation. The Liverpool Registry, which had once been independent, had been absorbed into Lloyd's Register some years before, and it was thought that the enormous shipbuilding interests of the country demanded the existence of a society whose friendly rivalry with the great society of Lloyd's Register would have a beneficial influence on the shipbuilding of the country. The British Corporation have a working agreement with the Registro Italiano, the American Bureau of Shipping, and the Imperial Japanese Corporation, which provides for the mutual recognition by these bodies of the classification and survey of vessels conducted by them.

The American Bureau of Shipping, established in 1867 as the Record of American and Foreign Shipping, was resuscitated as the result of the large construction of merchant ships built by the United States for their use in the World War, and is officially supported by the United States Government.

The Norske Veritas was established in 1894 by the various marine insurance clubs of Norway. Previously each club had its own separate staff of surveyors, on whose report depended the class of the vessel and the premium to be paid. As ships rose in value and reinsurance became the rule, a desire for mutual protection led to the establishment of the Norske Veritas with one uniform system of classification and valuation.

The Germanischer Lloyd was established in 1867, and reorganized as a joint-stock company in 1889. Its functions are carried out by officers at the central office in Berlin, assisted by a staff of surveyors in Germany and at the principal foreign ports—the latter under control of agents, who are mostly consuls. In all foreign parts in which the Germanischer Lloyd has no representative, the German consuls are required by order of their Government to exercise the functions of an agent of the Germanischer Lloyd.

The Registro Italiano was first founded in 1861, and has passed through many changes of late years, the first of which occurred in 1910, when it was reconstituted as the Registro Nazionale Italiano. Later it became the Registro Navale Italiano, and after the World War, was amalgamated with the other Italian institution, the Veritas Adriatico, by the wishes of the Italian Government, in order that one Italian Register of Shipping should be established, under the name Registro Italiano.

The highest class assigned by the societies upon the completion of a ship is marked as follows:—

Lloyd's Register	✠100A1 ✠LMC
Bureau Veritas	✠Ⓘ$^3/_3$L 1,1
British Corporation	B. S.* M. B. S.*
Norske Veritas	✠1A1 ✠MV, KV
Germanischer Lloyd	✠100$\underset{4}{A}$ ✠MC
Registro Italiano	✤100A1, 1, L
American Bureau	✠A1Ⓔ ✠AMS

The star or cross in each case denotes special survey during construction. In Lloyd's Register 100A refers to conformity with the rule requirements; the figure 1 to the efficiency of the equipment of anchors and cables; LMC denotes Lloyd's Machinery Certificate. In the Bureau Veritas the encircled I expresses the first division of classification (out of three), the two rings denoting that the ship is divided into a sufficient number of watertight

compartments to enable her to float in still water with any two open to the sea; $^3/_3$ expresses completeness and efficiency of hull and machinery; the letter following $^3/_3$ indicates the navigation for which the vessel is intended, L signifying unrestricted ocean trading; the first 1 shows that the wood portions of the hull are entirely satisfactory, while the second 1 has the same significance in respect to the equipment of masts, spars, rigging, anchors, cables and boats. In the British Corporation Register, B.S. signifies conformity with all requirements, these letters standing for British Standard; M.B.S. signifies that the machinery also conforms. In the Norske Veritas 1A1 denotes compliance with rule requirements as regards the hull; MV and KV signify that the vessel has a Norske Veritas certificate for engines and boilers. The third figure A denotes the efficient state of the equipment. In the Germanischer Lloyd the mark 100 $\underset{4}{\mathbf{A}}$ signifies that the ship, including equipment, fulfils the requirements of the highest class of the society. The figure 4 indicates that the class is to be regularly renewed after special surveys held in periods of four years each. MC signifies that the machinery conforms with the rules and has obtained a separate certificate. In the Registro Italiano 100A refers to conformity with the rules, the first 1 to the equipment of the hull, and the second 1 to the equipment of the propelling power (whether sails or machinery). The letter following the class indicates the navigation for which the ship is intended, L signifying unrestricted ocean trading. In the American Bureau, A1 denotes conformity with the rules, E referring to the equipment, and AMS signifies American Machinery Survey.

State Regulation.—In Great Britain the State maintains control in matters concerning the safety of life at sea, while leaving much to the sea-faring interests as far as the safety of ship and cargo is concerned. Thus, for instance, while the classification certificates of Lloyd's Register are accepted as sufficient evidence that the vessel, her machinery and equipment are in a proper seaworthy condition, yet when it comes to the provisions for the safety of crew and passengers the Marine Department of the British Board of Trade sees that proper provision is made for

(a) the accommodation for crew and emigrants;
(b) boats and life-saving appliances;
(c) wireless, navigation fittings and control;
(d) the carriage of special cargoes such as wood, grain and coal;
(e) the marking of the proper load line of a cargo ship, and
(f) the subdivision of passenger vessels.

Authority is given to the Board of Trade by the Merchant Shipping Acts of 1894 to prepare and to administer regulations necessary for safety at sea, of which the principal are those relating to the marking of a load line.

Loadlines: (a) *Cargo Vessels.*—The loadline is not a modern feature, for the vessels of the Italian republics probably before A.D. 1000 had a mark printed on their sides to indicate that the ship should not be loaded beyond this point. The Sardinian mark was the centre of a painted ring—practically the same as to-day. The modern story of the loadline is less than a century old, for about 1835 the committee of Lloyd's proposed that a freeboard of 3 inches per foot depth of hold should be used as a guide for safe loading. The freeboard or free side was the vertical distance from the upper (*i.e.*, the top continuous) deck to the waterline, and Lloyd's rule approximately stated that this freeboard should be ¼ of the depth of the ship. While other rules were also tried, the first definite proposal to deal logically with the relation of freeboard to size and type of ship was sent by the Institution of Naval Architects to the Board of Trade in 1867. In 1871 a Merchant Shipping Act was passed requiring a scale of feet to be marked at the bow and stern showing the draught, and authorizing the Board of Trade to appoint persons to record the draught of water of vessels leaving port. Lloyd's Register of Shipping, in about 1873, required what were known as Awning Decked Vessels to have a maximum loadline marked. In 1874 the Royal Commission on Unseaworthy Ships dealt with the question of loadlines, and under the stimulus of Samuel Plimsoll three Merchant Shipping Acts were passed by parliament in 1874–75–76, which together brought the freeboard question to a definite position. (The sailor to-day regards the freeboard mark as the "Plimsoll" line.) These acts required the owners of foreign-going ships to mark the position of the upper deck line and to mark also a circular disc showing the maximum draught to which they claimed to load, while the distance between the deck line and the centre of the disc was recorded and inserted in the agreement with the crew.

While by the act of 1873 the Board of Trade were given power to detain overladen ships, yet without certain rules for guidance as to what constituted an overladen vessel the surveyors at the ports were in an impossible position. In order to remove these difficulties Benjamin Martell, the chief surveyor to Lloyd's Register, suggested in 1874 a series of tables of freeboard based on actual experience with British vessels. The Board of Trade in 1875 called a conference with Lloyd's Register which laid down as principles that—(i.) There should be an enclosed buoyant volume above water which should be a certain proportion of the volume of the ship below water; (ii.) There should be a certain height of the exposed deck at particular places (known as "height of platform") such as at the forecastle and bow, at the stern, and at the bridge or navigating position; (iii.) The construction of the vessel should be sufficiently strong, and all exposed openings in the main or weather deck should be properly closed.

The question of tables, based on these principles, was further examined by Lloyd's Register in 1882 and by the Board of Trade which appointed the first loadline committee in 1883. This committee drew up a set of tables which was adopted voluntarily in 1885 and made compulsory by the Merchant Shipping Acts of 1890. Authority was given by the Board of Trade to Lloyd's Register, the Bureau Veritas, and the British Corporation to fix the freeboards on behalf of the Government. The Rules and Tables drawn up in 1890 have served since that time as the basis of freeboard; they have been examined and adjusted on several occasions principally in 1898 and in 1906, in which latter year the Merchant Shipping Acts were amended to apply to all foreign vessels using British ports. In 1908 an arrangement was made with Germany to adjust the differences between the practice of the two nations. As a consequence those tables have not only remained in force but have been adopted by all the maritime countries.

In 1913 a further load line committee was appointed and reported in 1915, but the war delayed any action, and in 1927 another committee was asked to reconsider the whole problem, and in addition to examine (a) the practice of various countries which permitted vessels carrying wood cargoes to load deeper, and (b) the contention of the United States that oil tankers (vessels carrying entire cargoes of oil) could with safety be loaded deeper than ordinary ships. This committee is still sitting, and has before it a suggested departure in principle, viz.:—to allow vessels which carry whole cargoes of timber and oil to be loaded deeper than other ships.

The detailed calculations to ascertain the freeboard of a vessel are necessarily complex and can only be undertaken by an expert. In order however to give an idea of the actual amount of freeboard it may be taken roughly that for a cargo vessel having a forecastle, a bridge and a poop the freeboard will be about one quarter of the depth of the ship from the keel to the uppermost continuous deck.

(b) *Passenger Ships.*—The question of additional protection of passenger ships arose from a committee which in 1887 was considering the regulations for boats and life-saving appliances on British vessels; Thomas Gray, the official then in charge of the Marine Department of the Board of Trade, suggested that a proper arrangement of internal partitions ("bulkheads") should be provided in order that the vessel might remain afloat for a reasonable length of time to enable the life-saving appliances to be used. The Bulkhead Committee of 1890 suggested rules for the number and position of bulkheads, which permitted a reduction in the amount of life-saving appliances. The conclusions of this committee determined the practice until 1911, when the Merchant Shipping advisory committee suggested that the question of life-saving appliances needed adjustment. Following the loss of the "Titanic" in April 1912 a Bulkhead Committee was appointed to consider the whole question, but after the Court of Enquiry presided over

by Lord Mersey, the question of subdivision was separated from that of life-saving appliances. Consequently for the first time regulations were prepared for the number and position of bulkheads (subdivision). It was laid down that passenger vessels should have as efficient a scheme of subdivision as the nature of their service or their trade would allow. It was realized that regulations which destroyed the economic possibilities of trade were worse than useless.

While this committee was sitting an international conference was held in London to consider the whole question of safety of life at sea—embracing subdivision, life-saving appliances, wireless and navigation. The general lines of agreement were embodied in a convention signed by all the principal maritime nations (save Japan) in March 1914—and adopted by parliament in Great Britain and some other countries; but it was only made partially operative on account of the World War. As in certain respects the subdivision regulations were incomplete, the British Government only put into operation the minimum requirements and applied these to all passenger vessels which carried more than 12 passengers. When however during the war the provisions of the convention were examined in regard to new ships, it was rapidly found that such drastic alterations were required to vessels carrying a relatively small number of passengers as to render them economically impossible.

The whole question has been re-examined both by Governments and by the International Chamber of Shipping, and as a result the question of revising the whole convention was under consideration in 1928. It has been generally recognized that while the regulations laid down in 1913–14 might be deemed to apply to vessels almost wholly devoted to passengers, such as the large liners on the North Atlantic, yet considerable alterations are necessary to apply them to all other passenger ships.

Any system of subdivision must take into account—

(a) the spring of (*i.e.,* distance between) bulkheads—the more passengers carried the closer is the spacing;

(b) the height of the bulkheads above water—the greater the height, the wider is the spacing;

(c) the strength of the bulkheads in relation to the height of water which may be behind them when an adjacent space is full of water;

(d) the probable contents of the various parts of the vessel—some spaces requiring more water to fill them than others, and

(e) the nature of the damage to the side and underwater portion of the ship; it should be observed that it is of little use providing bulkheads unless the ship can remain afloat with the space between them open to the sea, and that where any greater protection is necessary endeavour should be made to arrange that the vessel will float with an intermediate bulkhead damaged and the space open to the sea.

Lloyd's Register of Shipping and the other classification societies have rules for the number of bulkheads in cargo vessels. A bulkhead is required near the bow called the collision bulkhead, one has to be fitted at each end of the machinery space, and another near the stern. In general, while all ships have 4 bulkheads, yet when the length exceeds 285 ft., more bulkheads are required on the scale of one bulkhead for about every 65 ft. increase in length; thus a vessel 285 ft. long should have 5 bulkheads, and one 610 ft. long 10 bulkheads. The result of the suggested amendments to the convention would be that with a small number of passengers there would be the same number of bulkheads as required by Lloyd's rules, but these bulkheads would have to be spaced in accordance with the principles given above. (W. S. A.)

SHIPPING: TONNAGE TERMS. The term "Tonnage" has a variety of meanings. According to the British Merchant Shipping acts and the Suez and Panama Canal regulations it is a measurement of the capacity or volume of a ship expressed in units of 100 cubic feet—one unit of such volume being termed a ton measurement. The purpose of measuring a ship is two-fold—primarily to form a basis for the payment of the various charges which are levied by Port and Harbour authorities, by Lighthouse Boards and for pilotage services; secondly for use in the registration or identification of the ship itself. (*See* SHIPPING: *Registration, Classification and State Regulation.*)

Tonnage legislation dates from very early times, not only in the Mediterranean but also in the Far East, where in China some form of measurement has existed since before the Christian era. The earliest known record in Great Britain occurs in A.D. 1422, which provides that "keels (barges) that carry coals at Newcastle shall be measured and marked." In 1694 the actual weight carried was recorded and was ascertained by placing known iron or lead weights on board, 20cwt. avoirdupois being taken as a ton. In France in 1681 the volume was measured approximately and expressed in tons of 42 cubic feet, on the assumption that 4 wine tuns—which average that particular volume—weighed 1 ton avoirdupois. There is thus from early times a considerable confusion of thought as to what is the real meaning of the word "ton," it being apparently connected both with the ton avoirdupois and with the tun of wine.

Methods of Measurement.—Besides the methods prescribed by the Merchant Shipping acts, which are generally followed by the principal maritime nations of the world, there are other methods used for various purposes. The principal methods may be summarised as follows:—

(1) *Measurement or Capacity Tonnage* (British Merchant Shipping Acts). (a) Under-deck tonnage, which is the total internal capacity of a ship below the tonnage deck. (b) Gross tonnage, which is the sum of the under-deck tonnage and of all enclosed spaces above the tonnage deck—there being, however, certain portions above the tonnage deck which may be exempted from measurement. (c) Register or net tonnage, which is derived from the gross tonnage by deducting the volumes of certain "non-earning" spaces—spaces which cannot, broadly speaking, be utilized for the carriage of cargo or passengers.

(2) *Displacement Tonnage.* This system is invariably used for warships, and represents the weight expressed in tons avoirdupois of the vessel when fully loaded. It is called displacement because it is generally ascertained by calculating the weight of the water displaced by the form of the vessel when immersed to the loadline.

(3) *Deadweight Tonnage.* Deadweight tonnage is the weight in tons avoirdupois of cargo, passengers, fuel and stores which can be carried by a vessel when fully loaded. It is the difference between the weight of a vessel (including machinery)—or what is termed the light ship—and the weight of the vessel and the contents when fully loaded.

(4) *Freight Tonnage.* Freight tonnage is a measure of the total cubic capacity of a vessel which is available for the carriage of cargo, and is usually expressed in tons of 40 cu.ft. measurement, it being assumed that 40 cu.ft. weigh 1 ton avoirdupois. Under the British system of tonnage measurement, the tonnage deck is the upper deck in vessels which have one or two decks, and in all other vessels it is the second continuous deck from below. The upper deck is the uppermost complete deck the openings of which are closed in such a way that any space below the deck is regarded as a closed-in space by the Board of Trade. The tonnage dimensions, *i.e.,* length, breadth and depth, differ from the *registered dimensions* (*see* SHIPPING: *Registration, Classification and State Regulation*)—although these are both ascertained at the same time by the surveyor who is measuring the tonnage.

For purposes of tonnage, the length is measured along the centre line of the upper surface of the tonnage deck from a point forward where the inner surface of the frames or lining crosses the deck at the bow to a similar point aft. The tonnage breadth is taken horizontally from face to face of the inside of the frames, or of the inside of the lining on the frames provided the lining is not more than 3 in. thick. The depth for tonnage in vessels with double bottoms is measured from the upper surface of the inner bottom plating at the centre line to the under side of the tonnage deck, from which is deducted one-third of the curvature or "round" of the deck beam, while a further deduction is made if a lining is fitted on the inner bottom.

For purposes of registration, the length is taken from the fore part of the bow, on the line of the forecastle deck, to the after side of the head of the sternpost (or the centre of the rudder stock where no sternpost exists). The breadth is the maximum breadth

measured to the outside of the plating of a steel ship, or to the outside of the planking of a wooden ship. The depth is measured from the top of the tonnage deck beam at the centre line amidships to the top of the inner bottom plating. In the measurement of tonnage, the area of cross section in the space under the tonnage deck is determined at a number of places—depending on the size of the ship, and from these areas—which are obtained by actual measurement at the ship—the volume of the under-deck tonnage is ascertained. The result in cubic feet divided by 100 gives the under-deck tonnage. The spaces above the tonnage deck are now measured, such spaces being either those which extend through a complete 'tween deck or those which are situated above the upper deck. All spaces which are deemed to be properly enclosed are required to be measured and included in the gross tonnage. Such spaces as hatchways have to be measured and their volume ascertained, and any excess over a certain amount is added to the tonnage. There are, however, certain spaces (such as shelter decks, forecastles, bridges or poops) which may be closed in certain defined ways, and which so long as they have the accepted methods of closing are not measured for tonnage nor included in the gross tonnage.

"Gross" and "Net."—From the gross tonnage—which is the sum of the under-deck tonnage and of the tonnage above the tonnage deck—the register or net tonnage is obtained by making certain deductions on account of the space in which the machinery or engines and boilers are situated, on account of crew spaces, and on account of certain small spaces necessary for the general working of the ship. The most important of these is the allowance for the machinery space; the other two items, although of importance, amounting to only some 10% of the total deductions permitted. The allowance for machinery spaces appears to be designed to include not only the volume actually occupied by the machinery itself, but also an allowance on account of the fuel necessary to propel the ship. The present allowance is based on the use of coal as a fuel and on the use of steam machinery. It is quite evident that the fuel space allowance must be the subject of compromise, since for the same ship the length of voyage may be very variable. It is usual to provide in all ships a certain amount of permanent bunker space, which may, for the average sea-going ship, be roughly described as that necessary for a month's voyage. The spaces occupied by the main machinery (including the necessary light and air spaces and shaft tunnels) are measured. The total deduction permitted is either $1\frac{3}{4}$ times the propelling space, or 32% of the gross tonnage where the actual measurement of the propelling space lies between 13% and 20% (both inclusive) of the gross tonnage. It will therefore appear that the difference between the volume of the machinery space and the volume allowed to be deducted represents the allowance made for the space deemed to be occupied by fuel. In order to take full advantage of this deduction, all low-powered steamships have the volume of machinery space so arranged that it is never less than 13% of the gross tonnage. The Merchant Shipping Act of 1907, however, limits the deduction which may be permitted for propelling power to a maximum of 55% of the gross tonnage. It must be recognized that with the improvement in marine engines and the adaption of the oil motor for propelling purposes, the tendency is for the machinery spaces to be less in volume than the 13% necessary for the ordinary marine steam machinery, and in this respect it will probably be necessary in the future to reconsider the allowance which may properly be made. The register or net tonnage is now determinable (being the gross tonnage less the deductions permitted as described above), and is the tonnage which appears on the register of the vessel and on which dues are assessed. The British system of measurement has been generally adopted by all the maritime nations, the principal differences in those which do not identically comply being on account of the method of estimating the propelling power deduction. It may be said that generally the tonnage as measured by any maritime country will not differ more than about 2% from that obtained by the British measurement.

Suez and Panama "Tons."—This satisfactory state of affairs does not, however, obtain with the Suez and Panama canal authorities, whose regulations differ from the British in giving less allowance for deductions, and in requiring more of the superstructures to be taken into the gross tonnage. Approximately it may be stated that the gross tonnage for the Suez Canal is 5% higher than the British, and that for the Panama Canal 10% higher, while the net tonnage for the Suez Canal is nearly 30% higher, and for the Panama Canal about 25% higher, than the British measurement.

It is difficult to express briefly the relation between tonnage and size of ship. As an example, an ordinary cargo steamer which can carry a nominal deadweight of about 8,000 tons avoirdupois of cargo, fuel and stores will have a displacement of about 11,500 tons, a gross tonnage of about 5,200, and a registered or net tonnage of about 3,200. The net tonnage is relatively highest in this type of steamer, where it may be as much as 65% of the gross tonnage. This figure is reduced to 50% for coasting cargo vessels of small size. In fast steamers, where a large proportion of the space is taken up by machinery, the net tonnage may be as low as 50% of the gross tonnage, and for such extreme types as the cross-channel boat the ratio may be as low as 40%.

Bibliography.—*Board of Trade Instructions as to the Tonnage Measurement of Ships* (H. M. Stationery Office); E. R. Johnson, *Measurement of Vessels for the Panama Canal*, Washington Government Printing Office (1913) includes references to tonnage measurement systems adopted by various nationalities; A. Van Driel, *Tonnage Measurement*, The Hague Government Printing Office (1925).

(W. S. A.)

SHIPPING, WAR CONTROL OF: *see* War Control of Shipping.

SHIPPING: WAR LOSSES OF. The outstanding features of the attack upon merchant shipping in the World War were (1) the enormous preponderance of the British losses, (2) a neutral nation—Norway—suffered the second largest losses, (3) two allied nations, the United States and Japan, owned more shipping at the end of the war than at the beginning, every other nation possessing less, (4) submarines accounted for 87% of the losses, (5) nearly one-half of the losses occurred in the 12 months Nov. 1916 to Oct. 1917, (6) marine losses of British ships were nearly 50% greater in 1918 than in 1913, (7) one commerce raider, "Möwe" accounted for more than double the number of ships sunk by any other individual surface craft, (8) on an average approximately 1,000,000 tons of shipping was continuously under repair, (9) the current losses were greater than the output of new shipping until the last nine months of the war.

The enemy conducted his campaign by submarine, by surface craft and by mine, five vessels only being sunk by aircraft. To losses directly due to enemy action must be added the losses due to marine risks which were greatly increased by strandings and collisions, resulting from the unlighted coasts, concentrated shipping, etc. There was also a diminution of effective tonnage on account of damage to vessels which ultimately reached port. The campaign falls into three periods, the first extending until Aug. 1916, when the enemy began an intensified effort. This continued until the "sink-at-sight" campaign began in Feb. 1917. For this last period, much more detailed information was obtained regarding the circumstances of each attack, and this part of the campaign can be studied from every possible standpoint. Comparison cannot be made, however, with the earlier periods owing to the lack of the earlier statistics, particularly in regard to foreign tonnage. In the case of British tonnage, the losses do not include merchant ships which were fitted out as armed escorts or as merchant cruisers for the protection of shipping routes, etc.

World's Losses.—Excluding tonnage owned by the then enemy countries, the world's losses by enemy action were 6,604 vessels aggregating 12,850,814 tons, or approximately one-third of the pre-war tonnage of the world. To this figure must be added the losses due to marine risks, approximately 2,102,000 tons, making a grand total of nearly 15,000,000 tons. The table at the top of the next page shows the losses suffered by each of the principal allies and by neutrals as the result of enemy action.

Excluding fishing vessels, the total war losses of the allies and neutrals were in part made good by new construction (10,849,000 tons) and by 2,411,000 tons captured from the enemy, the total

Number and Tonnage of Merchant and Fishing Vessels Sunk by Enemy Action, 1914–18

Country	Number				Tonnage			
	Periods			Total (51 months)	Periods			Total (51 months)
	24 months from 1. 8. 14	6 months from 1. 8. 16	21 months from 1. 2. 17		24 months from 1. 8. 14	6 months from 1. 8. 16	21 months from 1. 2. 17	
					Thousand tons			Tons
United Kingdom:								
Merchant	517	270	1,692	2,479	1,659	829	5,271	7,759,090
Fishing	297	97	281	675	35	12	25	71,765
France	91	171	435	697	184	144	571	899,358
Italy	88	119	414	621	136	182	528	846,388
United States	..	..	134	134	..	..	341	341,394
Other Allies	59	51	262	372*	101	74	438	612,781*
Neutrals	297	374	955	1,626†	419	541	1,360	2,320,038†
Totals (all countries other than enemy countries)	1,349	1,082	4,173	6,604	2,534	1,782	8,534	12,850,814

*Excludes and † includes 118 ships of 298,393 tons which when sunk belonged to countries which were neutral but subsequently became allies.

pre-war tonnage of 34,825,000 being reduced to 33,041,000 tons. There were net gains to the United States of 4,196,000 tons (128% over 1914) and to Japan of 677,000 tons (67%), while the largest net losses were to United Kingdom 3,084,000 tons (17%) and to Norway 1,260,000 tons (48%).

British Losses.—2,479 merchant vessels (7,759,090 tons) belonging to the United Kingdom and Colonies were sunk by the enemy, and of British fishing vessels 675 (71,765 tons). Submarines accounted for 2,099, the figures for the three periods being 342, 211 and 1,546, mines for 259 (102, 42, 115), surface craft for 117 (72, 18, 27) and aircraft 4 (three at the beginning of the "sink-at-sight" period).

Submarine Attacks During the Unrestricted Campaign.—During the 21 months, 3,672 vessels were reported attacked, of which 2,930 were by torpedo and 742 by gun-fire. Of those attacked, 2,262 were sunk, 345 damaged and 1,065 escaped. Of the 2,930 attacked by torpedo, 1,949 were British (28% escaped) and 981 foreign (18% escaped). Of the 742 attacked by gun-fire 368 were British (71% escaped) and 374 foreign (21% escaped).

A comparison between the 9 months Feb.–Oct. 1917 with the same period in 1918 gives the following interesting figures:—

Method of attack	British				Foreign			
	Attacked	Escaped	Sunk	Damaged	Attacked	Escaped	Sunk	Damaged
By torpedo,								
1917	958	253	615	90	533	80	419	34
1918	723	226	387	110	295	71	200	24
By gun-fire,								
1917	301	209	87	5	276	44	218	14
1918	48	35	12	1	72	28	39	5

Losses by Surface Craft.—Of the 191 vessels (562,900 tons) lost throughout the war, cruisers accounted for 48, raiders 61, armed merchant cruisers 27, and torpedo boats, etc. 55; 117 were British (averaging 3,800 tons) 43 allies (1,900 tons) and 31 neutrals (1,200 tons). The most successful enemy vessel was the raider "Möwe," which in the 15 months from Jan. 1916 sank 38 vessels (33 British). The cruisers Emden and Karlsruhe in the first four months of the war had 17 and 16 to their credit, all except one being British vessels averaging 4,000 tons. Two other raiders "Seeadler" and "Wolf" operating 2 and 6 months in 1917 accounted for 12 and 10, each sinking 6 British vessels. The armed merchantmen Kronprinz Wilhelm sank 9 British and 5 others and the Prinz Eitel Friedrich 5 British and 6 others, before being interned in March and Feb. 1915 respectively. The 16 British vessels sunk by torpedo boats and by unidentified vessels averaged 1,275 tons and the 39 others were about the same size.

Losses by Mine.—The chief centres in which mines were laid by the enemy were the East Coast and the English Channel. During the 21 months of unrestricted campaign, 119 vessels over 500 tons (of all countries) were lost, of which 88 were in home waters. There was a steady fall in losses after the first quarter, when 22 were lost in home waters and 8 in other areas. Nearly 10,000 mines were swept up in home waters. Usually the half-yearly yield by sweeping was between 1,000 and 1,350, but in 1917 the yields were 2,452 and 1,835. The improvement in dealing with new minefields is best indicated by the fact that the number of mines swept up was about 9 times the number of vessels struck in each of the half years up to June 1916, after which the proportion went up to 14, 16 and 23 times in the subsequent half years until it was 35 times in Jan. 1918.

Marine Losses.—The British tonnage lost during the war owing to marine risk was 1,100,000 tons, or rather more than half the world's losses from this cause. The next largest losses were those of the United States—302,000—and Norway 132,000 tons. During 1918 the British losses totalled 256,000 tons exclusive of 3,784,000 tons damaged. For allies and neutrals during the same period the figures were 330,000 sunk and 2,262,000 tons damaged. Detailed information relating to all tonnage lost by marine risks during the last 6 months of the war shows that of 191 vessels (368,000 tons) sunk, 54 were lost by collisions, 22 by fire or explosion, and 60 ran ashore. The remaining 55 foundered, capsized or were lost from unknown causes. Taking British vessels only, the pre-war monthly loss from marine risks was 18,000 tons, but during the war years it showed a continuous increase, namely, 21,000, 22,000, 24,000 and 26,000.

Damaged Tonnage.—It has been estimated that the quantity of shipping continuously out of service undergoing or waiting repair averaged 1,000,000 tons, half of which was damaged by enemy action and half by marine risk. The British and foreign tonnage damaged by enemy action during the 6 quarterly periods from Feb. 1917 varied between 253,000 tons and 378,000 tons; 80% of the total was British (1,550,000 tons), the rate of damage showing a marked decline during the later months of the war. The average time that this tonnage was out of service was 5 months. As regards shipping damaged by marine risks, the average monthly tonnage during the 10 months of 1918 was 378,000 tons of British and 226,000 of foreign vessels, but these figures include quite minor damage. Nearly 40% was due to collision and nearly 24% to machinery breakdown. About one-third of the casualties occurred in the English Channel and the East Coast.

The total tonnage of the monthly sailings of British vessels for overseas destinations other than near continental ports increased from about 5 million tons in 1917 to 6 million in 1918, while the percentage of losses fell from about 4½ in the first two quarters of the unrestricted campaign to 3 in the October quarter, 1½ in Jan. 1918, and to 1⅞, 1½ and 1% in April, July and Oct. 1918. Taking British and foreign vessels leaving U.K. ports for overseas destinations the tonnage of the sailings increased from 6½ million in April to nearly 8 million in Oct. 1918, and the percentage losses during 1918 were highest in the April quarter at

$1\frac{3}{4}\%$ and lowest in October at just over 1%.

Losses Under the Convoy System.—During the spring of 1917, the system of special routes for independent sailings was gradually superseded by that of convoy. In the French coal trade, which occupied nearly 38,000 sailings during the war with an average loss of only 0·14%, the losses during the heaviest period of the "sink-at-sight" campaign were 0·16%, while during 1918 they were reduced to 0·07%. The success of the convoys to Scandinavia was marred by two costly surface attacks, the percentage of losses being 1·16%, which was afterwards reduced to 0·39%. Overseas shipping that was convoyed increased from 2,700 vessels in April–Oct. 1917 to 7,700 for the same period in 1918, while the losses—including those by marine risks arising out of convoy conditions—fell from 1·01% to 0·66%. The grand total of vessels convoyed during the war under the British organization was nearly 90,000, the losses being 436 or approximately $\frac{1}{2}\%$.

Area of Operations.—During the unrestricted campaign, the area of the enemy operations may be divided into four main groups (1) the English coast, (2) the western approaches north and south of Ireland, (3) the South Atlantic from Land's End to the neighbourhood of the straits of Gibraltar, and (4) the Mediterranean. Round the English coast, the losses from enemy submarines showed little variation from the beginning of the campaign in Feb. 1917 until the blocking of Zeebrugge and Ostend in April 1918, when the losses fell from an average of 56 vessels per month to 28. The east coast section suffered heavily in June 1918 mainly in the north-east convoy when 21 vessels were lost as compared with an average otherwise of seven. The English Channel section was subjected to a burst of activity by the enemy in Dec. 1917 when the previous average of 22 vessels lost per month went up to 37, after which it fell to 23 and later to six. In the Irish Sea section, Feb. to April 1918 were bad months, the losses averaging 16 monthly compared with 5 and 4 per month respectively for the periods before and after that quarter. In the second group (western approaches), the fall in the monthly losses from 41 in the 6 months Feb. to July 1917 to 4 in the subsequent 6 months was attributable to the convoy system, as was also that in the third area (South Atlantic) from 26 to 16 per month. In the Mediterranean, the losses in the 6 months Feb. to July 1917 averaged 30 per month and in subsequent similar periods were 27, 21 and 11 vessels per month. The improvement was greater in the western Mediterranean than in the eastern.

Protective Measures.—Devices for the protection of individual ships included "paravane" and "otter" gear for use against mines, smoke apparatus for spreading a screen against the enemy and dazzle-painting, a colour scheme to create a confusional effect as to the vessel's course and speed. But the greatest protection lay always in the watchfulness and resource of the officers and men of the merchant service, undismayed by the fact that 62% of the vessels struck sank within 15 minutes. (H. W. G.)

SHIPPING: WRECK STATISTICS. About 1870, Samuel Plimsoll, a Member of Parliament, commenced an agitation against the overloading of ships and the sending to sea of unseaworthy ships. This agitation led to the appointment of a royal commission on unseaworthy ships. Important load-line legislation followed and the freeboard mark on British vessels is still known as the Plimsoll mark.

The 19th century was a period during which the British merchant marine was rapidly growing numerically and in which at the same time sail was being replaced at first gradually and then more rapidly by steam. The royal commission on unseaworthy ships, in the introductory paragraph of their preliminary report in Sept. 1873, drew attention to the danger of statistical comparisons of wrecks "because with the employment of steamers a greater number of voyages may be made with fewer vessels." In spite of considerable improvement in the quality and quantity of official statistics since Farrer's day, it is not yet possible to relate the number of wrecks to the number of voyages or the number of lives lost to the number of persons employed on such voyages and thus exposed to risk.

On the 31st Dec. 1829, there were 18,823 sailing vessels on the United Kingdom register aggregating 2,170,458 net tons. During that year, according to a parliamentary return, 1,305 sailing vessels of 98,894 net tons were wrecked. This is 6·9% of the number and 4·6% of the tonnage. Sailing vessels employed in the long distance trades made only one or two voyages a year, and the smaller vessels employed in the shorter trades were frequently laid up for the winter months. During the four years 1826 to 1829, 4,720 sailing vessels were totally lost or an average of 1,180 per year.

Safety through Steam.—Although 287 steam vessels of 29,501 net tons were already on the register in 1829 no record of losses of steam vessels appears to be given in the parliamentary papers of that year. The following table gives an imperfect indication of the increasing safety to the ship resulting from the substitution of sail by steam. It is of course an understatement as it makes no allowance for the fact that the distance travelled by the steam vessel in a year was three or four times greater than that travelled by the sailing vessel.

Period	Average number of vessels on the register		Average number of vessels totally lost or missing	
	Sail	Steam	Sail	Steam
1841–50	23,500	1,000	518	7
1851–60	25,200	1,600	570	17
1861–70	24,400	2,600	640	38
1871–80	21,600	4,200	640	80
1881–90	17,000	6,600	500	140
1891–1900	12,500	9,200	340	130
1901–10	9,900	10,500	230	110
1911–20*	7,600	12,200	110	120
1921†	6,300	12,700	49	142
1922	6,200	12,800	41	129
1923**	6,000	12,400	62	146
1924**	5,800	12,500	47	133
1925**	5,800	12,500	41	106
1926**	5,700	12,500	29	102

*Excluding losses of vessels by enemy action and losses of vessels due to mines. †Excluding losses due to mines. **Excluding vessels belonging to the Irish Free State.

The substitution of the intrinsically safer steam vessel for the sailing vessel has not only lowered the risk of loss to shipping as a whole but the loss among sailing vessels, as such few sailing vessels as remain are only very occasionally employed on the longer and more dangerous routes or at the more dangerous seasons.

The Hazards That Remain.—It remains true, however, that the occupation of the seaman is hazardous. That part of the Registrar General's decennial supplement for England and Wales 1921, dealing with occupational mortality, after pointing out the difficulty of preparing figures by which the mortality of seamen from all causes may be compared with the mortality of all occupied males, comes to the conclusion that the seaman's mortality from disease exceeds the average by 48.8% and his mortality from violence by 430%.

The loss of life among seamen and among passengers caused by wreck of or casualty to the vessel has, however, notably diminished in recent years.

The following table shows in five yearly periods the loss of life among passengers and members of the crew from these causes from 1871 to 1925.

*Lives Lost by Wrecks and Casualties at Sea to Vessels Belonging to the United Kingdom**

Averages for five year periods

Period	Passengers lost	Seamen lost
1871–5	406	1,943
1876–80	154	1,593
1881–85	136	2,053
1886–90	288	1,259
1891–95	429	1,356
1896–1900	157	966
1901–05	179	709
1906–10	102	636
1911–15	380	825
1916–20	187	385
1921–25	10	287

*From the Board of Trade *Reports of Shipping Casualties.*

During 1926 only two passengers lost their lives from casualties to vessels in which they were travelling. The corresponding numbers for 1925 and 1924 were four and five respectively. These figures are much smaller than those relating to the pre-war periods.

REFERENCES: Parliamentary papers; Statistical Abstracts of the United Kingdom; Returns of Shipping Casualties and Deaths; Report of Royal Commission on Unseaworthy Ships (1873); *Sea casualties and loss of life,* Sir Westcott Abell, Journal of North East Coast Institutions of Engineers and Shipbuilders (1921); *The Interpretation of Statistics relating to Shipping Casualties, and Loss of Life at sea,* J. W. Verdier, Journal Royal Statistical Society (1922). (L. I.)

WRECK STATISTICS, UNITED STATES

The statistics of wrecks and casualties at sea occurring to vessels of the United States are useful for comparative purposes only since 1915. Before that time the figures reported by the United States Coast Guard regularly included disasters for foreign vessels on and near the American Coast.

Date year ended June 30	Number of vessels	Casualties involving partial and unknown damage	Vessels totally lost	Wrecks involving total loss	Vessels damaged
			Tons		Tons
1911–15	6,237	4,759	631,510	1,478	7,480,757
1916–20	5,000	3,391	958,571	1,609	7,433,821
1921–25	4,589	3,325	563,222	1,264	9,041,591

Date year ended June 30	Losses to vessels	Losses to cargoes	Passengers	Crews	Lives lost
	Dollars	Dollars			
1911–15	47,755,195	11,707,413	86,947	111,474	1,438
1916–20	197,202,420	69,017,135	49,445	98,667	3,255
1921–25	93,971,722	21,872,325	51,033	99,294	947

During 1926 there were 236 lives lost; number of vessels lost 982; wrecks involving total loss 254; casualties involving partial and unknown damage 728; vessels totally lost 93,539 tons; vessels damaged 2,015,068 tons; losses to vessels $15,596,857; losses to cargoes $4,324,475; 12,331 passengers and 21,970 crew. *See* reports of the United States Coast Guard, Treasury Department.

SHIPPING BOARD: *see* UNITED STATES SHIPPING BOARD.

SHIPPING CONTROL COMMITTEE. A co-ordinating body appointed by the British Government on Jan. 27, 1916, to decide on the allocation of British ships to essential requirements of Britain and the Allies, and to make representations to the Cabinet regarding ships required for naval and military purposes. (*See* WAR CONTROL OF SHIPPING.)

SHIPPING LINES AND GROUPS. The tendency for a large number of comparatively small shipowning firms to spring up during a period of prosperity and to collect into groups in the ensuing depression has long been one of the regular cycles of the shipping business. Since the latter part of the 19th century there has also been a general and increasing practice of combining big successful lines into huge groups.

British Empire.—Under the British flag the principal groups are the Kylsant, Inchcape, Furness Withy, Cunard and Ellerman amalgamations.

The group which takes its name from Lord Kylsant (Sir Owen Philipps) centres round the Royal Mail Steam Packet Co., which maintains services to South America, the West Indies and north Pacific. Numerous well known lines are associated with it. The Aberdeen Line runs to Australia and in 1928 absorbed the Australian State shipping service (Australian Commonwealth Line). The Shaw Savill and Albion Co. covers New Zealand, Elder Dempster and Co. (African S.S. Co., British and African S.N. Co., Elder Line and Imperial Direct Line) are principally concerned in the west African trade. On the various South American trades, in addition to the parent R.M.S.P., are the Lamport and Holt, Nelson and Pacific S.N. Lines, while the group is also interested in the Mihanovitch fleet of river steamers on the Plate. The King Line covers the general cargo trade; MacAndrews (including John Hall Jr. and Company) the Iberian business; the Glen and Shire Lines the Far East; the Moss S.S. Company the Mediterranean; the Union Castle Line East and South Africa; and Bullard King and Co. S. Africa and India. The White Star Line, purchased from the International Mercantile Marine in 1927 and bringing with it the Aberdeen and Shaw Savill businesses, is engaged on the American, Canadian and Australian trades. Numerous coastal, Irish Sea and Continental services are maintained by the Coast Lines (several small companies merged) and J. and P. Hutchinson. Among the group's interests outside shipping are Harland and Wolff and A. McMillan and Son the shipbuilders, and the London Maritime Investment Company.

The second big group is the Inchcape, at the head of which in 1928 was Lord Inchcape. The Peninsular and Oriental and British India Lines are the predominant partners, their interests being joined in 1914. Both are interested in the Indian, Eastern and Australian trades, the British India maintaining East African services in addition. The other companies connected with it include the P. and O. Branch Line (formerly Lund's Blue Anchor) and the Orient Line, both to Australia. The New Zealand Shipping Company, Federal Line, James Nourse, Hain Line, Union S.S. Company of New Zealand, Australasian United Line, General Steam Navigation Company, Khedivial Mail Line, Burns Philp and Company, the Eastern and Australian Line and Euphrates and Tigris S.N. Company are all closely connected. Nearly all these companies confine themselves to regular services but the General S.N. Company is largely employed on the coasting and continental trades and the Hain Line steamers are chartered all over the world. The group is also interested in shipbuilding on the Thames and Clyde and also in the English Channel.

The Furness Withy group was in 1928 under the control of Sir Frederick W. Lewis. It includes a large number of minor companies for agency purposes and otherwise, but also a number of important regular lines. In addition to Furness Withy and Company itself, running principally to Canada and the United States, there is the British and Argentine S.N. Company, the British Empire Steam Navigation Company, the British Transoceanic Line, the Furness-Houlder-Argentine Line, the Gulf Line, the Prince Line, the Johnston Line, the Neptune Line, the Rio Cape Line, the Warren Line, Manchester Liners, Messrs. Harris and Dixon, Houlder Bros. and Company, Norfolk and North American Steam Shipping Company, Bermuda and West Indies Steamship Company and the Danube S.N. Company. The group also controls the management of the Cairn Line to Canada. The organisation of the group is extremely complicated and units are constantly being transferred from one section to another. From being originally interested almost entirely in the North Atlantic trade, Furness Withy's activities extend nearly all over the globe and the firm possesses some of the finest cargo tonnage afloat. In addition to these shipowning concerns it has an interest in the British Maritime Trust, the Economic Insurance Company, the Queenstown Dry Dock Company, and the Blythswood Shipbuilding Company.

The Cunard group, under the chairmanship of Sir Thomas Royden, includes the various North Atlantic and Mediterranean services of the Cunard Line itself, the American-Levant Line (under the management of Messrs. S. and J. Thompson) the Anchor Line which runs on the North Atlantic and Indian services and which includes the old Donaldson Canadian service, the Brocklebank and Well Lines, and the Commonwealth and Dominion Line of big cargo liners which is interested in the Australian, New Zealand and South African trades as well as the American.

The Ellerman group, controlled by Sir John Ellerman, includes the Ellerman Line itself and the Bucknall, City, Papayanni, Hall and Wilson Lines, and Messrs. Westcott & Laurance. Its activities extend all over the globe, either by itself or in conjunction with other concerns and like the Furness Withy group has a very complicated organisation which constantly changes.

The Canadian Pacific Company has absorbed important concerns, such as the Elder Dempster company's Beaver service and

the Allan Line, but they have completely lost their identity. In addition to numerous services on the rivers, lakes and coasts of Canada it has both Transatlantic and Transpacific interests. Together with the Union Steamship Company of New Zealand (Inchcape group) it maintains the Canadian-Australian Line between Vancouver and Australia, alternative to the Suez route.

The Alfred Holt group, almost invariably known as the "Blue Funnel" from the characteristic appearance of its ships, consists principally of the Ocean and China Mutual Companies, with close connections with certain local companies in the East and shipbuilding concerns at home. Its ships are most familiar in the Oriental, East Indian, North Pacific, South African and Australian ports. The firm was one of the pioneers in fast cargo tonnage and still makes it one of the principal features of its policy.

The International Mercantile Marine has of recent years become more and more United States in character, although many of its ships still fly European flags. It was a combine formed by the late J. Pierpont Morgan in 1902 and its sale to the Kylsant group of the White Star Line did not break up the combine, although it took away the Shaw Savill and Albion and Aberdeen interests. There still remain the Leyland Line under the British flag, the Atlantic Transport Line, partly British and partly American, the Holland America Line and the Red Star Line on the North Atlantic and the Panama-Pacific Line and the International Mercantile Marine Corporation on the intercoastal trade. (F. C. Bo.)

The United States.—United States shipping may be divided into two broad groups: (1) domestic, including coastwise, intercoastal and Great Lakes shipping, and (2) foreign trade shipping. In the two groups there is a total of about 13,000,000 tons, and this is divided about equally.

In the domestic group some of the important companies engaged in shipping are the Panama Pacific Line, an International Mercantile Marine Company subsidiary; the Luckenbach Line; the Williams Line; the Munson-McCormick Line; and the Argonaut and Calmar Lines. The Atlantic, Gulf and West Indies Lines, commonly called the AGWI group, composed of the Clyde, Mallory, Ward and a few smaller concerns, is engaged partially in the domestic trade along the Atlantic Coast and partially in the foreign trade through its services to the West Indies and Central America.

In the foreign trade group, distinction may be made between privately owned lines and government owned lines. Through the Merchant Marine Act of 1920 the United States Shipping Board established 35 lines, five of which were passenger services, from American ports to the various ports of the world having commerce with the United States. There are no United States flag lines operated between two ports foreign to the United States. Sixteen of the lines established have been sold and are now operated privately by United States firms.

Among the larger American shipping concerns is the Dollar Steamship Line which operates passenger and cargo ships across the Pacific and also operates a fleet of seven passenger-cargo vessels in a round-the-world service. The bulk of the Dollar ships were purchased from the government. The Munson Steamship Line is the principal United States concern operating vessels from New York to the east coast of South America, while the Grace Line operates lines from both Atlantic and Pacific coasts of the United States to the west coast of South America. These two services carry both passengers and cargoes.

Of the strictly cargo services, the largest private line is the American Export Lines which runs from North Atlantic ports of the United States to ports of the Mediterranean and Black Sea. Others are: The American West African Line, the American South African Line, the Pacific Argentine Brazil Line operated out of San Francisco to the east coast of South America, the Oregon Oriental Mail which runs from Portland, Oregon, to the Orient, and the Tacoma Oriental Line which runs from Tacoma, Washington, to the Orient.

A large group which also has interests in the domestic trade is formed by the American Hawaiian Line and Matson Navigation Company. This group maintains passenger and cargo services from Pacific coast ports to the Hawaiian islands and cargo services from these American ports to Australia, Philippine Islands and the Orient.

The shipping board cargo lines are operated for the government's account through private shipping agencies, known as managing operators. These companies act as agents in the securing of cargoes and general management of the ships.

The one remaining government passenger line, the United States Lines, is operated direct by the United States Shipping Board Merchant Fleet Corporation which is the shipping board's business corporation. This line is operated in the North Atlantic between New York, Southampton, Cherbourg and Bremen.

In United States shipping it should also be noted that there is a large volume of tonnage coming under the class of so-called industrial carriers. The Standard Oil Company, the United States Steel Corporation, the United Fruit Company and the Ford Motor Company all maintain substantial fleets primarily for the transportation of their own traffic. (T. V. O'C.)

Other Countries.—There are also several groups on the Continent, particularly in Germany and France. In the latter country the Compagnie Générale Transatlantique, is intimately associated with the Fabre Line, the Chargeurs Réunis, the Compagnie Sud Atlantique, the Transports Maritimes Line and the Fraissinet Company. This group shows every indication of further extensions. In 1928 the Compagnie Générale Transatlantique, the Sud Atlantique, and the Chargeurs Réunis formed a company known as the Union Française d'Armement, to deal with matters concerning the interests of the three lines, fuel, victualling, agencies, and the like.

In Germany the policy of amalgamation has produced the keenest rivalry between the two big concerns, the Hamburg American Line and the Norddeutscher Lloyd, who between them own the greater part of the tonnage under the national flag. The latter includes the Argo Line, the Roland Line, the Horn Line, the Hamburg-Bremen-Afrika Line, the Seefahrt Co., the Hanseatic Co., and the Hansa Line, in addition to smaller concerns. The group also owns shipbuilding interests and in partnership with the Hamburg American Line has interests in the Deutsche Levante Line, the Deutsche Ost Afrika Line and the Woermann Line.

In addition to these concerns in which they share an interest with the Norddeutscher Lloyd, the Hamburg American group has the Deutsche-Australische, Kosmos and Hugo Stinnes Companies, also the Hamburg South American Line.

The big Italian group is headed by the Cosulich Line and includes the Lloyd Triestino, which before the war was the Austrian Lloyd, the Adria Line, the Marittima Italiana, the San Marco and the Puglia Lines, with other less important connections and considerable shipbuilding interests. There is also very close working between the various companies under State guidance quite apart from actual amalgamation. In northern Europe the principal groups are the Dan Brostrom group in Sweden, and the Forenede group in Denmark.

The Japanese companies have followed the policy of total absorption more than amalgamation, the two principal concerns being the Nippon Yusen Kaisha and the Osaka Shosen Kaisha. Both maintain a network of services all over the globe.

The tendency towards amalgamation in shipping appears to increase rather than decrease, particularly in periods of shipping depression. Compared with the huge groups mentioned, the independent shipping firms appear small, although there are many important ones still in service. Under the British flag the most important are the Clan Line of cargo ships, Messrs. T. and J. Harrison, Andrew Weir's Bank Line, the Bibby Line, Runciman's and Reardon Smith's, while some of the tanker companies also aggregate a big tonnage.

In France there is the Messageries Maritimes, in Italy the Navigazione Generale Italiana, in Spain the Compania Transatlantica, in the United States such concerns as the Dollar and Matson Lines, in Holland the Rotterdam Lloyd and Nederland companies, and in Denmark the East Asiatic Co., although the last-named has Swedish connections. (F. C. Bo.)

SHIPPING ROUTES. Regular shipping routes have existed as long as regular shipping, originally as measures of safety but afterward as part of the intricate organisation of trade. For this reason they are constantly changing with changed trade and political conditions.

Early History.—In the older history of shipping routes several factors must be especially considered. One of these concerns the relatively small size of the vessels used; it often made coastwise routes advisable and it permitted far more river navigation than can be accomplished by the deep-sea ships of to-day. Another factor was the discovery or introduction of the compass, probably in the 13th century. By means of it methodical charting was made possible, supplanting the accident-and-report system of the earliest times. It must be said, however, that such early route-maps as the *Periplus maris erythraei,* of the 1st century, show an attentive study and systematic record of what had been discovered by the use of the old method.

There were two other factors of the highest importance for the history of sea routes to the Orient. One was the discovery of the Indian ocean trade wind, which occurred, so far as Europe is concerned, at a time not far distant from the composition of the *Periplus.* As the story has come down to us, a marine tax collector in the Roman service was carried out into the Indian ocean by a high wind which maintained its direction steadily for many days. At the end of this adventure he was able to drop anchor in a port which proved to be in Ceylon. There he was made to understand that the wind set in alternate directions every six months and that he would be able to return to the Red sea after a certain interval and by the same means that had brought him out. This he did, with the result that the direct overseas route to India was often followed thereafter instead of the coastal one. However, as late as the 14th century, the Persian mariners still used the old route; they feared the long course because of the frail construction of their vessels.

In still earlier times there existed a navigable channel from the Nile to the Red sea—one which was silted up long before the end of the ancient period. Early shipping routes were thus strikingly influenced by accident as well as by discovery, and in no other field of endeavour has progress been more uneven.

Although the coastal and island navigation of the remotest times was never discontinued in the Mediterranean, the Roman empire developed several important long routes. A notable one was that followed by the grain ships from Egypt, which, generally setting out from Alexandria, rounded Crete and the southern coast of Greece and thence made a run due westerly to the straits of Messina, after which the course was northwesterly to Ostia, where the grain was unloaded for Rome. The most dangerous part of this route, incidentally, seems to have been at the entrance to the harbour of Ostia. Another route was almost due south from Ostia, between Corsica and Sardinia, then north of the Balearic islands and then southwesterly along the Spanish coast to the Strait of Gibraltar.

In the middle ages the main shipping routes substituted Venice and Genoa for Rome as their Italian termini, while Alexandria maintained much of its ancient importance. This was lessened, however, by the use of Constantinople as the gate to Asia Minor and the Far East and by the centralization of the eastern Mediterranean trade, for a considerable period, in Famagosta, on the island of Cyprus.

As was only natural before the science of navigation was developed, the first regular trade routes were coasting, giving some element of safety both from weather and enemy. The Mediterranean was crossed and recrossed by regular lanes at a very early date, then the Baltic and Atlantic coast of Europe, while they existed from the East African coast, Red sea and Persian gulf to India from time immemorial. The Portuguese found this trade fully organised and flourishing when they entered the Indian Ocean in 1498. Even later than that, the overland route developed by the Italian republics prospered, the sea portion being generally from Constantinople to Western Europe. Antwerp was one of the principal *entrepôts* for this trade.

One of the first long sea routes to be developed by European shipping was the "Guinea trade" to the west coast of Africa, which followed the ships of the fifteenth century explorers who were attempting to find a sea route to India. With the establishment of the regular slave trade this grew into a triangular route such as ship-owners frequently have to adopt in order to get the return cargoes which are an economic necessity. The regular run for British ships for nearly two centuries was out to the west coast of Africa with a general cargo of "notions," across to the West Indies with slaves, and home with sugar and rum. With certain changes due to the fluctuating slave market this triangle continued until the abolition of slavery.

The Portuguese were able to keep their secrets of the Indian trade for nearly a hundred years, but when it was opened to the English in the early 17th century, first to the islands and then to the mainland, this route was rapidly developed with a very necessary victualling station at the Cape of Good Hope. It was afterwards continued to China and when the East India Company lost its Indian monopoly in 1814 an alternative was found and it sent many of its ships to Australia with settlers and their stores, then on to China in ballast to load tea for Great Britain.

This tea trade attracted the attention of the American shipowners who, employing very much faster ships than the East Indiamen, worked up a big trade from the United States to China by way of the Cape with general cargo, collecting for the American and European markets. Their ships entered the British trade from China on the repeal of the Navigation Act, and for a time obtained the cream of the business but almost immediately afterwards the discovery of gold in California gave them such opportunity on a route that was protected from foreign competition that the Oriental trade was speedily abandoned.

This superior speed was characteristic of American ships. In colonial days their shipping was very severely handicapped by legislation, but as soon as the United States attained full independence they established a lucrative trade along a regular lane from the New England States to the West Indian islands, particularly with the Spanish possessions from which they were debarred. It was to avoid the Spanish warships that the American shipbuilders first turned their attention to speed, and it had a very considerable influence on their trading operations.

The direct route across the Atlantic from Britain to the United States was comparatively neglected until the end of the Napoleonic Wars, when the first of the fast sailing vessels which were to become famous as the Western Ocean Packets were started by enterprising Americans and soon included some of the finest ships afloat. Even when regular steamers were running the sailing packets maintained a large measure of their position, particularly in the emigrant traffic. The short distance and the big volume of passenger trade on the North Atlantic permitted fast and luxurious tonnage then just as it does to-day.

In the earlier days of Atlantic steam navigation the coal difficulty necessitated a call at Halifax, which was abandoned when more economical machinery was evolved. Although the direct service is more than ever important, the post-war tendency is to revive such intermediate calls with the less expensive tonnage, while the biggest ships tap the Continental as well as the British trade by making use of the various Channel ports instead of the Western.

The "Suez" Changes.—On the Eastern routes, the experiment of sending steam ships out to India by way of the Cape having proved too expensive to be practical, a new "overland route" was established in which a proportion of the tonnage was kept in the Indian Ocean, running from Suez, while other steamers carried the passengers and cargo to Alexandria, the connection across the Isthmus of Suez being made by caravan. The expense, trouble and discomfort of this route gave to the sailing ships which succeeded the East Indiamen, particularly the "Blackwall frigates," the greater part of the cargo and a proportion of the passenger business to India, Australia and the East until the Suez canal was completed in 1869.

This waterway changed all the principal trade lanes to the East. It was not suitable for sailing vessels but favoured the steamship in every respect, so that sailing ship freights fell and it became

necessary to build tonnage for large capacity rather than for small cargoes at high charges. This sounded the death knell of the clipper. Within comparatively few years the sailing ship as a first class passenger carrier was doomed, although it still had good chances of profit from emigrants and special passengers.

In the last quarter of the 19th century the west-about route to the Orient, New Zealand and Australia came into favour, the lines running across the Pacific from the Canadian and American ports in conjunction with the regular Atlantic services and trans-Continental railways. These routes are becoming more and more popular as an alternative to Suez and the trying passage of the Red sea, while their establishment has done much to encourage the regular trans-Pacific services which are now numerous.

When the business of sailing vessels on the Australian trade became more or less confined to the less expensive cargoes a new triangle was evolved in addition to the regular out-and-home run of the wool ships. This was from Europe to Australia by way of the Cape with general cargo, on to the West coast of South America with coal, and home with nitrates. Another triangle which existed for some years was out to the Cape with general cargo, railway materials or machinery, on to India in ballast and home with jute. Direct trades during the last years of sail were numerous, one of the most important being the grain trade from California which was finally covered almost entirely by subsidised Continental sailing ships able to do the outward voyage in ballast and still show a profit.

Meanwhile the tramp steamship route in the Mediterranean also tended to form a triangle—out to Italy with coal, then to the Black sea in ballast and back with grain. This route has been checked by the Russian revolution. Direct routes which absorbed and absorb much tramp tonnage are with coal out to the River Plate and home with grain and to the St. Lawrence, generally in ballast, for wheat. A certain number of sailing ships, nearly all owned on the Continent, still contrive to secure charters for Australian grain from the steamers.

The West African trade is now almost entirely direct, but in the case of South Africa the direct mail services are supplemented by intermediate services which reach the various East African ports by way of the Mediterranean and Suez, then proceed to the Cape and return direct to Europe by way of the West Coast.

As regards the Continental trades, the opening of the Suez canal permitted a rapid development of the routes from the Mediterranean to the East. The French, backed by the maritime interest of Napoleon III., and the Austrians took immediate advantage of it: the Spaniards and the Italians followed later. Of these the French and Austrians tended to keep their steam tonnage on the regular routes, leaving the tramp business to the sailing ships under their flags and to the steamers of their rivals.

The development of German shipping was slower. Despite the maritime heritage of the Hanseatic League it suffered from initial discouragement, largely on account of the fear held by the authorities that passenger communications would drain the country of conscripts. In spite of this discouragement steamship companies were formed both in Hamburg and Bremen in the mid-19th century, principally for the transatlantic trade. The policy was reversed by Bismarck in 1885, when he offered a heavy subsidy for German mail services, particularly to Africa, Australia and the East. German owners had always kept the greater part of their tonnage on regular routes, never favouring the tramping business.

Although the Italians were slow in starting on a large scale on the regular services, they have made great strides of recent years. Before the war they did a very extensive North Atlantic steerage business, but that was ruined by the restriction of U.S. immigration and many of the North and South American services have been combined to make the most of the seasonal trades. At the same time the Italians have adopted a very strongly protective policy to preserve for Italian ships their emigration, both across the Atlantic and to Australia.

In the West, until the latter part of the 19th century, it was quite usual for travellers from the United States to South America to travel by way of Europe, to the detriment of American trade, but there are a number of passenger companies now maintaining a direct service and a very big trade is done in addition to the passenger business.

Panama Changes.—The latest great influence on the trade lanes is the cutting of the Panama canal. It has provided very much shorter alternative routes from Europe to the whole of the Pacific seaboard, the saving in time in almost every case more than compensating for the canal charges and the sometimes vexatious regulations. It has also permitted the establishment of a new intercoastal trade between the Eastern and the Western States in opposition to the railways, reviving the old clipper route to California round the Horn. Being technically a coasting service, this is reserved for American ships and is attaining very large proportions.

The canal has also permitted the recent development of round-the-world cargo services, from the North Pacific ports to the Orient, through the East Indies to India, to New York via Suez and then back to the North Pacific ports along the usual intercoastal route. (F. C. Bo.)

SHIPS' FIGUREHEADS. The primitive ship was double-ended, with both stems, that is the stem and stern-post, rising above the planking of the hull; and nearly all types occurring from the earliest times till late in the middle ages are recognizable as variants of this original. The high stems were commonly so conspicuous as to be naturally the first parts chosen for decoration; and if only one of the two was decorated, that one was in most cases the stem. These stem-head carvings represent the earliest figureheads. When, as in the oared war-galleys of ancient Greece and Rome, the stem-head ceased to be conspicuous, a wood carving or bronze casting was fixed as near to the traditional position as was convenient, so resembling the modern figureheads in northern Europe. The few Roman figureheads which have survived from the period of the early empire are, save for their greater artistic merit, curiously similar to those which were applied to English men-of-war in the Napoleonic era.

Figureheads might be religious emblems, they might indicate the nationality of the ship, or might symbolize her name. Also as, with few exceptions, they represented living creatures, and as they are rarely if ever, in early times, found in conjunction with the oculus, it would seem that the mariner must have held, if only as a secondary consideration, that they helped the ship to find her way. The Phoenicians placed a horse's head on the fore stem, just as the English and the Dutch of the 17th and 18th centuries employed their national lions as figureheads; the Egyptians used various religious emblems, which probably served also to designate individual ships, as did the figures of the holy family and of saints in the Spanish navy in the 18th century; the Romans of the empire would seem to have named at least some of their ships after distinguished warriors, whose busts were employed as figureheads, in this anticipating the practice which began in England in the 17th century and became increasingly common from the middle of the 18th century onwards.

When, about the 13th century, the temporary fighting stages developed into integral parts of the hull, figureheads almost vanished for a long period; for the forecastle overlapped the stem-head, and left no very obvious position in which a figure could be carried. A very small carving on the foremost part of the rail of the forecastle itself, or a device placed under it across the stem, were the available alternatives, but both were quite ineffective. They served, however, to keep the tradition of the figurehead alive while this old type of forecastle, often nowadays spoken of as the "carrack forecastle," was universal in great ships. But in Henry VIII.'s reign the important change began which substituted the galleon type of ship for the carrack type. The galleon, as one of her most conspicuous differences from the old type, had the forecastle cut back so that it ended abaft the stem. The figure might therefore have resumed its old place on the stem-head, had not the introduction of the beak-head afforded a still better position for it. By the end of the 16th century the galleon type was universal, and the foremost end of the beak-head bore the figure. The beak-head altered its shape continually, but as the "head" it outlived the galleon and is found in the sailing man-of-war right

down to the days of steam; it always bore the figure at its fore end in men-of-war and in all merchantmen of similar build, the figure varying in size and general form to match with the changes of the head itself.

It will be enough to indicate what were the fashions in the figure itself in England from Elizabeth's reign onwards, for in no other country was the figure developed to a greater extent. At first a simple "beast" sufficed, being most commonly the lion or the dragon, the supporters of the royal arms. When the dragon was discontinued as a supporter, he ceased also to be used as a figure, and the lion during the 17th century was by far the most common figure. For great ships more elaborate figures were used, small groups, especially St. George and the dragon, which, though given always to ships bearing the name of St. George, was considered also as a national emblem. So too was a figure of Neptune. From Charles I.'s time also equestrian figures began to be used in the largest ships, and these in the 18th century developed to a portentous extent into the so-called "double" heads. From 1703 to 1727 the lion was established by order as the universal figure for men-of-war, but a dispensing order was nearly always forthcoming for the greatest ships. After 1727 any figure was allowed to be used which did not exceed the lion in cost; but in 1796 an attempt was made to abolish figureheads as an unnecessary extravagance. This order at once became a dead letter, and instead of it another was issued which cut down the cost to so low a figure that no more than "devices" could be given to the great ships, and busts to the smaller. One of these "devices" survives as the existing figurehead of the Victory. After 1815 busts continued, but grew greatly in size and about 1840 developed into half length figures of vast dimensions.

When, with the coming of steam, the old form of head fell out of use, the figure also became obsolete; but an attempt was made for several years to provide some sort of a substitute which usually took the form of a badge or scutcheon on each side of the stem. The last ships in the Navy to have figureheads were the sloops of the Odin class, which, indeed, served with them in the World War of 1914.

See L. G. Carr Laughton, *Old Ship Figureheads and Sterns*, illustrated by Cecil King, R.I. (L. G. C. L.)

SHIPTON, MOTHER, a reputed witch and prophetess who is supposed to have lived in early Tudor times. There is no really trustworthy evidence of her existence, but tradition has it that her maiden-name was Ursula Southill, Sowthiel or Southiel, and her parents were peasants, living near the Dropping Well, Knaresborough, Yorkshire, and that she was born about 1486–1488. Her mother, Agatha Southill, was a reputed witch, and Ursula, who was phenomenally ugly, was regarded by the neighbours as "the Devil's child." When about twenty-four she married a builder of York, Tobias Shipton. Her most sensational prophecies had to do with Cardinal Wolsey, the duke of Suffolk, Lord Percy and other men prominent at the court of Henry VIII. She is said to have died at Clifton, Yorkshire, in 1561, and was buried there or at Shipton. Her whole history rests on the flimsiest authority, but her alleged prophecies had an extraordinary hold on the popular imagination. The suggestion that Mother Shipton had foretold the end of the world in 1881 caused most poignant alarm in rural England in that year, the people deserting their houses, and spending the night in prayer in the fields, churches and chapels. This latter alleged prophecy was one of a series of forgeries to which Charles Hindley, who reprinted in 1862 a garbled version of Richard Head's *Life*, confessed in 1873.

See Richard Head, *Life and Death of Mother Shipton* (London, 1684); *Life, Death and the whole of the Wonderful Prophecies of Mother Shipton, the Northern Prophetess* (Leeds, 1869); W. H. Harrison, *Mother Shipton investigated* (1881); *Journ. of Brit. Archaeo. Assoc.* xix. 308. *Mother Shipton's and Nixon's Prophecies*, with an introduction by S. Baker (1797).

SHIR: *see* Bari.

SHIRAZ, the capital of the province of Fars in Persia, in 29° 38′ N., 52° 40′ E., 530 m. by road from Tehran and 180 m. N.E., by E. of Bushire (112 m. crowfly). The city stands 5,200 ft. above sea level on the right bank of a small stream, in a well watered plain about 7 m. wide, surrounded by mountains which on the west attain 11,000 ft. It is approached on the north through chains of hills which separate the plain of Mervdasht, where are the ruins of Persepolis; and on the south from the Persian gulf through difficult mountain passes, the highest of which attain 7,400 ft. The city is irregularly circular in plan and has a mud wall flanked by semi-circular towers, about 4 m. in circuit, but the suburbs have extended far beyond the enceinte. There are six gates and the town within the walls is divided into eleven quarters, one of which, the Mehalleh Yahudi, is inhabited exclusively by Jews numbering 2,200. The population has been very variously estimated: at 53,600 in 1884, 38,000 in 1900, and at 60,000 in 1904; no exact figures of more recent date are available.

Shiraz can make no claim to eminence by reason of its great antiquity. The general location is certainly ancient, as evidenced by the Achaemenian and Sasanian ruins in the vicinity—at Persepolis (some 45 m. N.E.) and elsewhere; but according to Mohammedan authors the town arose only after the Mohammedan conquest. Shiraz owes most of its architectural distinction to Karim Khan Zand (1751–79) who governed it as regent under the Safavid dynasty and made it his capital; but much of his work was destroyed by the eunuch ruler Agha Mohammed Khan, who razed to the ground the stone ramparts and replaced them by the existing mud wall.

Of its fifty considerable mosques, the Jami Atiq is amongst the most noted and ancient. The largest mosque, not only in Shiraz but in all Persia, is the Masjid i Nau, or New Mosque, built by Atabeg Sa'd bin Zangi, *c.* 1200, a building reconstructed out of his own palace; while perhaps the most beautiful is the Jami i Vakil of Kerim Khan built about A.D. 1766.

The gardens (*bagh*) and rose-bowers of Shiraz and its outskirts are famous and some of these pleasure-grounds, despite neglect, retain much of their original beauty. Close to the Bagh i Dilgushi, one of the most conspicuous of these gardens, north of the city, is the Sa'diyyeh, an enclosure planted with cyprus and orange trees which holds the tomb of the celebrated mystic poet Sa'di; and in a cemetery nearby is the Hafiziyyeh with the tomb of the poet Hafiz, a sarcophagus of Yezd marble on which two of the poet's odes are chiselled in relief. The true renown of Shiraz rests largely on the fame of these her two great sons and on other distinguished men she has given to Iran. It was also the birthplace of the religious reformer called the Bab.

Shiraz is an important trade centre and point of departure of passable motor roads: north, via Isfahan and Qum, to Tehran; north-east to Yezd; east to Kerman; and south-west to Bushire. The most noted product is wine of the Khullar vineyards, 30 m. N.W. of which, however, only a small quantity is exported, religious scruples preventing its production on a large scale. The town is noted for its silver-work, and it manufactures mosaics called *Khatam-Kari*, cloths, brocades and silk-floss, and is the centre of a rug industry. The climate though healthy is subject to extremes; the absolute maximum observed over a number of years was 113° Fahr. and the absolute minimum 21°. The town was laid in ruins by the earthquakes of 1813, 1824 and 1853, which also caused great loss of life.

See G. N. Curzon, *Persia and the Persian Question* (1892); E. G. Browne, *A year among the Persians* (1893 and 1926); A. V. Williams Jackson, *Persia past and present* (1906). (P. Z. C.)

SHIRÉ, a river of East Central Africa, the only tributary of the Zambezi navigable from the sea. The Shiré (length about 370 m.) issues from the southernmost point of Lake Nyasa and almost immediately enters a shallow sheet of water called Malombe or Pa-Malombe, 18 m. broad, and 12 or 13 m. long. A shifting bar of sand obstructs the end of Malombe nearest Nyasa, but does not prevent navigation. Below Malombe the bed of the Shiré deepens. The river flows through a mountainous country, and in its descent to the Zambezi valley forms rapids and cataracts, rendering its middle course for a distance of 60 m. unnavigable. The most southern and the finest of these cataracts is called the Murchison Cataract or Falls, after Sir Roderick Murchison, the geologist, who identified himself during the mid-Victorian epoch with geographical exploration in Africa. In

passing the cataracts the Shiré falls 1,200 ft. From the station called Katunga, a short distance below the cataracts, shallow-draught steamers can navigate the river when in flood (January-March) to its junction with the Zambezi, and thence proceed to the Chinde mouth of the main stream. The scenery of the lower Shiré is very picturesque, the spurs of the plateau forming bold, rocky crags overhanging the water. The river is studded with small islands usually covered by thick grass. A little before the Zambezi is reached the country becomes flat. The Shiré joins the main river in about 35° 25′ E., 17° 50′ S., at a point where the Zambezi is of great width and presents in the dry season many narrow winding channels, not more than 3 ft. deep, with intervening sandbanks.

The lower part of the Shiré is in Portuguese territory; the upper part is in the British Nyasaland Protectorate, to which it is the natural highway. Below Port Herald the Shiré is navigable all the year round.

(*See* Zambezi and British Central Africa.)

SHIRE, one of the larger administrative divisions in Great Britain, now generally synonymous with "county" (*q.v.*), but the word is still used of smaller districts. The Anglo-Saxon shire was an administrative division next above the hundred and was presided over by the ealdorman and the sheriff (*q.v.*).

SHIRE MOOT, an assembly of the free men of a shire for judicial, fiscal, and other administrative business. It is first mentioned in the reign of Edgar (958–975), and then probably consisted of all the free landholders of the shire. In course of time the burden of suit to this court became attached to particular estates, and by the 13th century the number of persons present at a shire court was small. Each shire moot met at a specified place, and in the 10th century twice a year only, though more frequent sessions were held in later centuries. The shire court received fresh importance in the 12th century from the occasional presence of royal justices itinerant, and at a later time it came to play an important part in the machinery by which members were elected to parliament from the counties.

SHIRLEY or **SHERLEY, SIR ANTHONY** (1565–*c.* 1635), English traveller, was the second son of Sir Thomas Shirley (1542–1612), of Wiston, Sussex. Educated at Oxford, he gained some military experience with the English troops in the Netherlands and also during an expedition to Normandy in 1591 under Robert Devereux, earl of Essex; about this time he was knighted by Henry IV. of France, which brought upon him Elizabeth's displeasure and a short imprisonment. In 1596 he conducted a predatory expedition along the western coast of Africa and across to Central America, but owing to a mutiny he returned to London in 1597. In 1598 he led a few English volunteers to Italy to take part in a dispute over the possession of Ferrara; this, however, had been accommodated when he reached Venice, and he decided to journey to Persia to promote trade between England and Persia and to stir up the Persians against the Turks. He was well received by the shah, Abbas the Great, who made him a *mirza,* or prince, and granted certain rights to all Christian merchants. Then, as the shah's representative, he visited Moscow, Prague, Rome and other cities, but the English Government would not allow him to return to his own country. For some time he was in prison in Venice, and in 1605 he went to Prague and was sent by the emperor Rudolph II. on a mission to Morocco; afterwards he went to Lisbon and to Madrid. The king of Spain appointed him to command an expedition in the Levant, which failed. After this he was deprived of his command. Shirley, who was a count of the Holy Roman empire, died at Madrid some time after 1635. His brothers Thomas (1564–*c.* 1620) and Robert (*c.* 1581–1628) were also great travellers.

Sir Anthony Shirley wrote: *Sir Anthony Sherley: his Relation of his Travels into Persia* (1613), the original manuscript of which is in the Bodleian library at Oxford. There are in existence five or more accounts of Shirley's adventures in Persia, and the account of his expedition in 1596 is published in R. Hakluyt's *Voyages and Discoveries* (1809–12). *See* also *The Three Brothers; Travels and Adventures of Sir Anthony, Sir Robert and Sir Thomas Sherley in Persia, Russia, Turkey and Spain* (1825); E. P. Shirley, *The Sherley Brothers* (1848), and the same writer's *Stemmata Shirleiana* (1841, again 1873).

SHIRLEY or **SHERLEY, JAMES** (1596–1666), English dramatist, was born in London in September 1596. His career of playwriting extended from 1625 to the suppression of stage plays by parliament in 1642. He was educated at Merchant Taylors' school, St. John's College, Oxford, and Catherine Hall, Cambridge, where he took his B.A. degree in or before 1618. His first poem, *Echo, or the Unfortunate Lovers* (of which no copy is known, but which is probably the same as *Narcissus* of 1646), was published in 1618. He took orders and held a living near St. Albans, which he left on his conversion to Catholicism. He was then (1623–25) master of St. Albans grammar school. Shirley settled at Gray's Inn, London, in 1625, and for eighteen years was a prolific writer for the stage, producing more than thirty regular plays, tragedies and comedies, and showing no sign of exhaustion when a stop was put to his occupation by the Puritan edict of 1642. Between 1636 and 1640 Shirley went to Ireland, under the patronage apparently of earl of Kildare, and three or four of his plays were produced in Dublin. On the outbreak of war he seems to have served with the earl of Newcastle, but soon returned to London. He supported himself chiefly by teaching, publishing some educational works under the Commonwealth. Besides these he published during the period of dramatic eclipse four small volumes of poems and plays, in 1646, 1653, 1655 and 1659. Wood says that he and his second wife died of fright and exposure after the great fire, and were buried at St. Giles's-in-the-Fields on Oct. 29, 1666.

Shirley constructed his own plots out of the abundance of materials that had been accumulated during thirty years of unexampled dramatic activity. He worked with confident ease and buoyant copiousness on the familiar lines, contriving situations and exhibiting characters after types whose effectiveness on the stage had been proved by ample experience. His scenes are ingeniously conceived, his characters boldly and clearly drawn; and he never falls beneath a high level of stage effect.

Shirley's tragedies are: *The Maides Revenge* (acted, 1626; printed, 1639); *The Traytor* (licensed, 1631; printed, 1635), which Dyce reckoned as Shirley's best tragedy; *Love's Crueltie* (1631; printed, 1640); *The Duke's Mistris* (acted, 1636; printed, 1638); *The Polititian* (acted, 1639; printed, 1655); *The Cardinal* (acted, 1641; printed, 1652), a good example of Shirley's later style, and characterized by Edmund Gosse as perhaps the last great play produced by the giants of the Elizabethan age. His comedies are: *Love Tricks, or the School of Complement* (licensed, 1625; printed under the latter title, 1631); *The Wedding* (licensed, 1626; printed, 1629); *The Brothers* (acted, 1626; printed, 1652); *The Wittie Faire One* (acted, 1628; printed, 1633); *The Gratefull Servant* (licensed in 1629 as *The Faithful Servant;* printed, 1630); *Changes: Or Love in a Maze* (acted and printed, 1632); *Hide Parke* (acted, 1632; printed, 1637); *The Ball* (acted, 1632; printed, 1639); *The Bird in a Cage* (acted and printed, 1633), ironically dedicated to William Prynne; *The Young Admirall* (licensed, 1633; printed, 1637); *The Gamester* (played at court, 1634; printed, 1637), written at the command of Charles I., who is said to have invented or proposed the plot; *The Example* (acted, 1634; printed, 1637); *The Opportunity* (licensed, 1634; printed, 1640); *The Coronation* (licensed, 1635, as his, but printed, 1640, as by Fletcher); *The Lady of Pleasure* (licensed, 1635; printed, 1637); *The Constant Maid, or Love will find out the Way,* printed in 1640 under the former title with *St. Patrick for Ireland; The Royall Master* (acted and printed, 1638, ed. with critical essay in C. M. Gayley's Representative English Comedies, New York, 1914), an excellent comedy of intrigue, with an epilogue addressed to Strafford; *The Doubtfull Heir* (printed, 1652), licensed as *Rosania, or Love's Victory* in 1640; *The Gentleman of Venice* (licensed, 1639; printed, 1655); *The Imposture* (acted, 1640; printed, 1652); *The Sisters* (licensed, 1642; printed, 1653); *The Humorous Courtier* (perhaps identical with *The Duke,* licensed, 1631), printed, 1640; *The Court Secret* (printed, 1653). *Poems* (1646), by James Shirley, contained "Narcissus," and a masque dealing with the Judgment of Paris, entitled *The Triumph of Beautie. A Contention for Honour and Riches* (1633) appeared in an altered and enlarged form in 1659 as *Honoria and Mammon.* In 1653 a selection of his pieces was published as *Six New Playes.* He wrote the magnificent entertainment presented by the members of the Inns of Court to the king and queen in 1633, entitled *The Triumph of Peace,* the scenery being devised by Inigo Jones and the music by W. Lawes and Simon Ives. In this kind of composition he had no rival but Ben Jonson. His *Contention of Ajax and Ulysses* (printed, 1659) closes with the well-known lyric, "The Glories of our Blood and State."

The standard edition of Shirley's works is *The Dramatic Works and Poems of James Shirley, with Notes by William Gifford, and Additional Notes, and some Account of Shirley and his Writings,* by Alexander Dyce (6 vols., 1833). A selection of his plays was edited

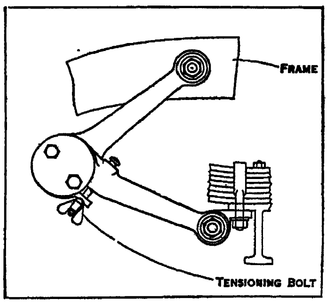
(1888) for the "Mermaid" series, with an introduction by Edmund Gosse. *See* R. S. Forsythe, *The relations of Shirley's plays to the Elizabethan drama* (1914).

SHIRLEY, WILLIAM (1694–1771), colonial governor of Massachusetts, was born at Preston in Sussex, England, on Dec. 2, 1694. He studied law, entered the Middle Temple, emigrated to Massachusetts in 1731, was appointed "the King's only advocate-general in America" (*i.e.*, of all New England except Connecticut) in 1734, and in 1741, while representing Massachusetts in a boundary dispute with Rhode Island, was appointed governor. The most important event of his administration was the conquest of Louisburg in 1745. The expedition was undertaken on his suggestion and its success was largely due to his energy and enthusiasm. In Sept. 1749, £183,650 (English) in coin was brought to Boston to cover the outlay of Massachusetts, and largely through Shirley's influence this was used for the redemption of outstanding paper money, thus re-establishing the finances of the province, a subject to which Shirley had given much attention.

Both in the colonies and in England, whither he returned in 1749 on leave of absence, Shirley kept up an active agitation for the expulsion of the French from the whole of Canada. He went back to Massachusetts as governor in 1753; led an unsuccessful expedition against Ft. Niagara in 1755, and after the death of Gen. Edward Braddock (1755) until June 1756 was commander-in-chief of all the British forces in America. In Sept. 1756 he was recalled to England and was succeeded as governor by Spencer Phips. He was governor of the Bahamas until 1770, then again returned to Massachusetts, and died at Roxbury, March 24, 1771. He published a *Journal of the Siege of Louisbourg* (1745), and *The Conduct of General William Shirley Briefly Stated* (1758).

SHOA, the southern of the four former principal provinces of the Abyssinian empire. Shoa from about the middle of the 10th century till nearly the close of the 13th century was the residence of the Abyssinian sovereigns, who had been driven out of Axum, their former capital. About 1528 Shoa was overrun by Mohammedan invaders and was for over a century afterwards a prey to Galla raiders. It remained independent of northern Abyssinia until 1855 when the emperor Theodore reduced it to submission. In 1889 Menelek II., king of Shoa, on the death of the emperor John, made himself master of the whole of Abyssinia. The principal town, Addis Ababa (*q.v.*), is now the capital of the empire (*see* ABYSSINIA).

SHOCK ABSORBER is an elastic medium which absorbs the heavier shocks given to road vehicles. One type consists of two arms pivoted together, with their ends connected to the frame and axle. Tension is imparted to the pivot joint by flat friction discs, or by a band brake with friction lining, as in the absorber made by Frank Smith and Co. Ltd., of Elland, and shown here. As the axle rises the arms move towards one another, which movement acts on the tension spring so allowing the band to slide freely round the brake drum. On the rebound the arms separate, and the band coils round the drum, thus absorbing the excess energy stored up in the spring during the compression movement. The tensioning bolt has four indicating grooves in its head to enable uniform adjustment to be given to each absorber. Grease is supplied to the friction surfaces by a special lubricant packed inside the drum, and automatically feeding through two slots to the friction surfaces. To assist lubrication under all climatic conditions a paddle is fitted, with a hexagon head, to be oscillated with a spanner at about every 1,500 miles. There are many types of shock absorbers in use in the United States on motor vehicles.



BY COURTESY OF FRANK SMITH (ELLAND)
FRICTION ARRANGEMENT WHICH DAMPS OUT BOUNCING OR ROLLING OF A CAR ON ITS SPRINGS

The term shock absorber is also applied to spring fittings in large power chain drives for factory and other installations. Instead of making the sprocket-wheel solid, it has a separate rim which presses against a set of peripheral coiled springs, and so starting and variable impulses are absorbed quickly by the springs without stressing the chain.

SHOCK and **COLLAPSE.** A severe injury which is not sufficient to kill may yet so derange the mechanism of the body that even a casual observer can correctly judge how little extra hurt would be necessary to cause death. In lesser degrees of injury a trained observer is able to detect derangements which must be regarded as early stages of the more serious conditions which compel observation. The name given to this depressed condition of the body is "shock" and when consequent on injury it is known as traumatic shock.

Shock has been studied chiefly in connection with injury and many would limit use of the term to the results of trauma. It is undeniable however that conditions of the body very similar to those produced by severe external injury may follow various accidents of disease, *e.g.*, perforation of a gastric ulcer or strangulation of a coil of intestine—so that it is wise to take a broader view of the subject. This is the more necessary since Dale has shown that injection into the body of minute doses of histamine—a protein decomposition product—will produce an almost exact simulation of shock. Similar symptoms may also be produced by the entry into the circulation of poisons formed in obstructed small intestines, or of products of muscle-disintegration after injury, or of bacterial products in peritonitis. It is convenient therefore to apply the term shock to the common state and to designate the particular type by a qualifying adjective, *e.g.*, traumatic, toxic, protein or haemorrhagic shock. The word collapse is rather loosely used to indicate the same condition as shock. Various contradictory and unsatisfactory efforts have been made to distinguish between shock and collapse. There is no doubt that collapse suggests something rapid and a close approximation to the common significance of the term would be "the rapid onset or aggravation of the symptoms of shock."

The symptoms of severe shock are very characteristic and consist chiefly of a failure of the peripheral circulation with accompanying (and partly consequent) diminution of all the metabolic processes of the body. There is in addition some increased activity of the sympathetic system as shown by the sweating and dilated pupils. The affected person is usually pale or livid, the extremities and nose cold, the pulse small and weak, and frequently more rapid than normal. The blood-pressure is as a rule lowered and tends to diminish as the condition progresses. The mental processes are commonly sluggish and the muscles relaxed. The secretions are diminished with the exception of sweat which may be poured out in great quantities. Though pain itself may produce shock yet in severe cases of shock, pain is usually not a complaint. The temperature is usually subnormal, registering 95° or 96° F. The clinical measure of the degree of shock is usually made by an estimation of the blood-pressure. In severe shock the systolic blood-pressure usually goes below 100mm. of mercury and sometimes drops to 80 or even 60mm. Recovery rarely takes place if a lower register than 50mm. is reached. Sometimes the systolic pressure does not fall so low but the pulse-pressure (difference between systolic and diastolic pressures) drops from the normal 50 down to as little as 20mm. These measurements afford a ready proof of circulatory failure.

Though in well-defined shock all the indications are present there are many occasions when one or more of the classical symptoms are wanting. Occasionally a slow pulse may accompany even severe shock whilst very obvious appearance of shock (subnormal temperature, sweating, pallor) may exist with only a slight or even no fall in blood pressure. Mental dullness is another rather variable factor for in many cases of toxaemic shock the mind may be very alert.

The pathology of shock has been the subject of much research and difference of opinion. Most of the experimental work has been concerned with traumatic shock and has been performed on animals. Clinical work has been concerned chiefly with shock following operation—a particular type of traumatic shock. It is agreed that prolonged over-stimulation of peripheral nerves will cause shock in proportion to the intensity of the stimulus and the

able weather prevents regular and sufficient burning of old heather, and so prevents the growth of young heather; it prevents heather from ripening its seed, and so lessens the food supply of grouse in winter; and it prevents the proper regulation of the size of the grouse stock on the moor. In a word, it reduces food supply, and the provision of a sufficient supply of food is the single key to successful moor management.

Partridge Shooting.—Partridge shooting, like grouse shooting, can be separated as regards methods into two categories—walking up and driving. The former is the older form of the sport and still has many adherents—probably, indeed, the majority of partridge shooters prefer walking. Certainly it is a method which has its own charm, partly of old association, partly of simplicity, partly doubtless of September weather. A single gun may go out by himself, or with a companion, or if there is plenty of ground available, there may be a line of four or five guns—any larger number is apt to be cumbrous. The general proceeding on a September morning is to walk the stubble fields so as to drive the coveys into roots or other cover, and then to walk each piece of cover in turn so as to flush the coveys and to send them in the direction of other cover which can be walked in the same way. Working the different fields of a farm in this way needs careful planning and a certain knowledge of the natural habits of partridges, which is one of the chief claims to consideration that the sport of walking up must have for the country sportsman.

In driving partridges, the purpose of the shooters is to collect a number of coveys into a field or strip of roots lying alongside a fence, on the other side of which are posted the guns. If possible, these guns should stand in a grass field or on stubble, in order that the partridges killed in the drive may be collected easily and quickly. A drive begins with a line of beaters, with flankers working on the right and left of the line, advancing over a chosen number of fields and driving the partridges before them towards the selected strips of roots. The beaters and flankers carry flags, the latter being charged with the duty of waving their flags so as to keep the birds from breaking out at the sides. Throughout, the head keeper (or possibly the host) is in charge of the drive, and it requires a considerable knowledge of the country and of wind and weather to ensure success. The beaters on reaching the strip of roots into which the coveys have been driven advance slowly and the partridges are flushed so as to fly over the fence behind which stand the guns. As they top the fence and catch sight of the guns the birds swerve and swing in every direction, with a disconcerting suddenness that tests the quickest eye and hand. Indeed, there could be no higher criterion of the all-round skill of a game shot than to describe him as first rate with driven partridges.

Pheasant Shooting.—Pheasant shooting, compared with grouse and partridge shooting, is an artificial business; or it is true, at all events, to say that only under more or less artificial conditions can pheasants supply the sporting chances of shooting which modern sportsmen prefer. Wild pheasants, to speak generally, make dull work for the gun. It is a pheasant's natural instinct to run rather than to fly, and if forced to fly, to regain shelter as soon and as near as possible. Therefore when a covert containing wild pheasants is beaten out, few of them will be found to fly high or far, or to go straight in any particular direction; the birds will fly out anyhow and anywhere, possibly back over the beaters' heads. Only a small proportion can be put over a line of guns, and the shots offered will be poor and uninteresting.

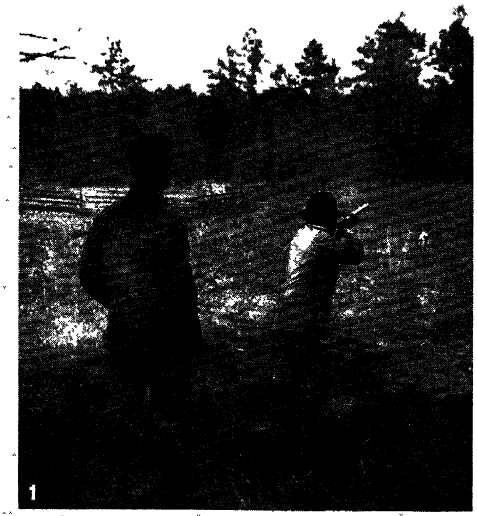
With hand-reared pheasants the case is different. A line of beaters enters the wood in which the pheasants are fed, and pushes them out by advancing slowly and tapping the trees quietly; the birds run before the advancing line and can be pushed in this way, either running or flying low from one wood to another, until they have been manoeuvred into a covert previously chosen, at the far side of which is placed a line of stops, that is, men or boys tapping trees, fences, etc.—beyond which the pheasants will not go. When the birds are collected into this covert the guns will take up their position in a line between the covert and the birds' home; the keeper and one or two chosen assistants then enter the covert, and flush the birds a few at a time. The pheasants thus put on the wing rise into the air with the object of regaining their "home," and as a rule will attempt to do so in a single flight. It is upon this home-flying habit of pheasants that the whole principle of modern covert-shooting is founded, and there can be no question that pheasants flying in this way, high in the air and at a great pace, and often swerving or curling in a high wind, provide as exacting a test of skilled shooting as is possible.

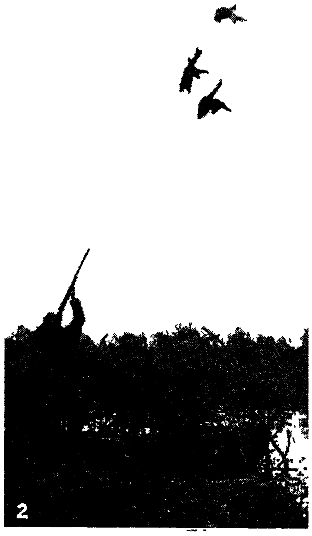
Black Game, Ptarmigan and Capercailzie.—Most of the shooting of other game in Great Britain is corollary to the sport to be had with grouse, partridges and pheasants. Black game, for example, are to be found in most places where there are grouse, and the methods of shooting the two species are identical. Ptarmigan, on the other hand, belong only to the higher ranges of grouse country, or perhaps, rather, deer forests, and if walked up provide uninteresting shooting owing to their tameness. Capercailzie may occasionally be found on the open moor, but only in the neighbourhood of trees; the name is "cabhar coille," or cock of the wood, and it is in the heart of pine and fir woods that the capercailzie makes its home. The birds are driven in winter, and afford remarkable shooting, for they sail out from the trees over the glen at a great pace, and may easily be out of shot.

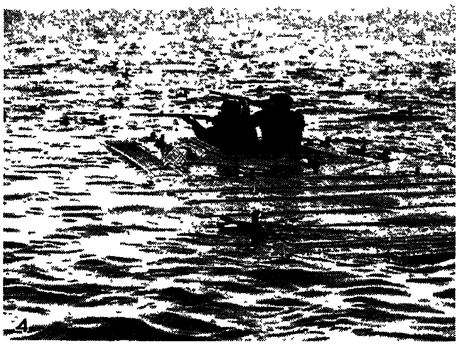
Snipe Shooting.—Two or three other forms of shooting may be pursued for their own sake. Snipe are to be found on most grouse moors, but snipe shooting is a sport by itself, to be enjoyed wherever there is bogland adapted to the snipe's feeding habits. The bird rises from the ground like a flash, twisting this way and that, and to hit so elusive a mark needs a quick eye and hand. Snipe-shooting is a sport of the winter months, for the home-bred birds are joined by the migrations from the Continent in November. The largest bags of snipe have been made in the Hebrides, but Ireland and Wales, especially the former, provide some of the best snipe ground, and in England there are possibilities of good shooting in Norfolk.

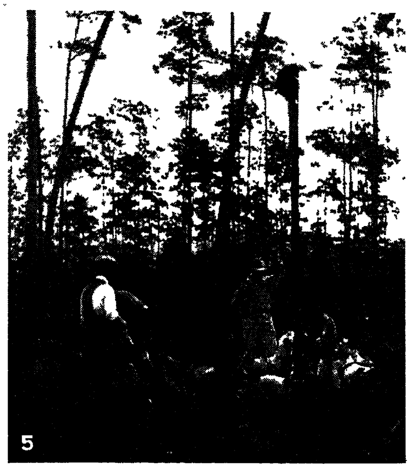
Woodcock.—Woodcock shooting, as a sport by itself, belongs principally to certain localities on the line of the birds' migration. As is the case with snipe, large numbers of woodcock arrive every autumn from the Continent, and pass through the British Isles in a general direction from north-east to south-west. The furthest limit of this migration is the west and south-west of Ireland, and the shooting at Ballykine and its neighbourhood on the shores of Lough Mask is possibly the best in the world. But large bags are obtained in Cornwall, which is the limit of the line of flight in England, and in the west of Scotland, particularly the isle of Islay, which is a stage of the birds' migration both on the outward and homeward journey. The supposed difficulty of the shooting arises from the erratic movement of the bird, whose sight is adapted for night conditions rather than day, when flying among trees. A woodcock in the open is a comparatively simple mark.

Hares and Rabbits.—Ground game provide shooting which is variously regarded as sport according to the standards of the shooter. Hares, which are destructive to crops, have to be shot down but hare-driving produces few opportunities for interesting work with a gun. But rabbit-shooting may afford considerable tests of hand, eye and brain, for a rabbit gets to its top speed in an amazingly small space of ground, and takes every advantage of cover and obstacle. The main methods of shooting rabbits are two—ferreting and laying out. In the former, ferrets are put to ground in the rabbits' burrows, or "buries," and the little animals are shot as they bolt from the holes. The sport varies with the condition of the weather; if it has been fine at night, and the rabbits have fed well, they are sluggish and disinclined to move; if they have been kept in by rain—for rabbits dislike a wet jacket—they will bolt quickly, or dodge from one hole into another, offering only the chance of snap shooting. If the second method, that of laying out, is adopted, the procedure is different. A day or two before the shoot, the gamekeeper goes the round of the buries with some sort of evil-smelling mixture, such as paraffin and tar, which he sprinkles into each hole. The rabbits leave their holes at night to feed, but do not return to them, objecting to the smell. The keeper the next morning fills in every hole, and on the day of the shoot the rabbits are found lying out in the undergrowth, from which they are dislodged by beaters with sticks,









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SMALL GAME SHOOTING

1. Quail shooting in the South, U.S. The dog in the centre of the picture will retrieve the fallen bird
2. Shooting ducks from a blind. The sportsman in the photograph has killed three birds with one shot
3. Waiting for the approach of the ducks. Wooden ducks are used as decoys to attract the wild birds
4. Duck shooting on Long Island sound. The two hunters are waiting in a tiny boat of the "sneak-box" type
5. End of a coon hunt in Florida. With the coon treed by the dogs and the hunters preparing to fire
6. Duck hunter, with his retriever "Spike," shooting on Grass lake, Illinois
7. Winter winds and zero weather are no bar to this Long Island sound duck hunter. He lies on his back in the boat covered with branches until the flying ducks come within range
8. Mrs. Lindsay Stewart's "Haylers Rufus" retrieving a bird from dense undergrowth
9. V. Routledge's "Partridge" retrieving a dead partridge during the Retriever Trials near Hatfield, England

or by spaniels. In the south of England a pack of beagles is sometimes used for this purpose.

Wildfowl.—Sport with wildfowl must always be of an uncertain nature, since it depends largely on the weather. The harder the weather the better, so far as the wildfowler is concerned, since gales bring the fowl in from the sea to shelter and frost confines the spaces of water where they can feed by night and rest by day. Sport with wildfowl may be enjoyed by following two methods. One is that of the shore shooter, who waits at dawn and dusk at certain points over which he knows the duck will pass when flighting to and from their day and night quarters. He will need both for use and for friendly company a well-trained retriever, or he will not be able to pick his birds in the dark or from the water into which they may have fallen. The other method is that of the punt-gunner, who sets up to his fowl in a flat-bottomed boat carrying a heavy swivel-gun, firing anything from 1 lb. to 2 lb. of large size shot, with which he shoots at duck on the water or as they rise. This is a form of sport which is followed by probably a decreasing number of persons, but is one which requires a strong constitution, patience and endurance, and is perhaps more exciting and also more dangerous than any other shooting of its kind.

The art of shooting is not to be taught in words; it is a matter of practice. But practice should be begun on right lines; this is an easier proceeding to-day than it used to be, for one of the modern developments of the gun trade is the shooting school which the best firms place at the disposal of their clients, where the use of the gun can be learned together with the elements of the etiquette of the shooting field. The beginner should always be fitted with a gun, and the fitting again, is part of the gunmaker's business. For different purposes different types of weapon are necessary, but for all round work a 12 bore hammerless ejector, weighing say $6\frac{3}{4}$ lb. and firing cartridges loaded with $1\frac{1}{16}$ oz. of shot with 42 grains of Schultze or 34 grains of E.C. may be recommended.

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GAME SHOOTING WITH DOGS IN THE UNITED STATES

Development of gun dogs in the United States has covered a range of breeds and fields for their respective hunting activities ranging from fox, deer and bear hounds, through the rank and file of Chesapeake bay, Irish water spaniel and springer spaniel water retrievers, on into the ranks of pointers and setters (*see* DOG: *Setters and Pointers*). The last-named breeds constitute the main stem of upland game workers as differentiated from marsh dogs. It might be well, in order definitely to establish his entitled place in the record, to recall with full credit a type of gun dog now practically extinct along the vanishing frontiers. This was the sturdy, upstanding settler's dog, a combination strike dog and trailer, capable of helping to provide meat for wagon train, camp or home, and also of acting as watch dog and cattle herder.

"Hounding" game with dogs, save in the pursuit of predatory bears, wolves, lynx and coyotes—and then only by permit—is a practice now more or less barred by most State game codes and falling more and more into disuse, as being against the sounder principles of conservation. When game abounded, and the country, particularly in the south, was a thickly wooded and almost impenetrable barrier of windfall and swamp, "hounding" was the recognized and thorough-going arm of a royal sport and race of men. Plantation owners and ranchmen bred and trained magnificent packs capable of imparting an almost exalting contagion to the spirit of good hunting and the hardihood of its followers. To-day, hounding is confined almost wholly to fox-hunting, coon and rabbit hunting. As a gun dog, the hound attained a rating of high efficiency when broken to follow only given scents. Slow running, cold-nosed strike dogs, sticking with their trailing mates to specific quarry and deserting it for none crossing, were the dogs before which much of the country's game supply fell to waiting sportsmen. That the American hound could be trained to run dangerous foreign game was demonstrated when the late Paul J. Rainey selected well-broken stock from several of the country's best big game packs and sent them to Africa with Shelley. Shelley, a master-hand at such work, remained in Africa off and on for 13 years, making record kills of lion hunted by his American hounds. Hunting lion, leopard, cheetah, etc., with hounds, is not now permitted in the Kenya Colony of British East Africa.

Half-bred American hounds and airedale terriers also have been used to hunt mountain lion, panther and other of the large Carnivorae in North and South America. A good hunting rather than a game or plucky hound or dog is the better for following the powerful and more savage wild animals against which the aggressive dog has no chance, the rifle, *not* the dog, being the implement used for destruction.

A pack of rough-haired Welsh foxhounds—a breed celebrated for its great scenting powers—imported by Erastus Tefft, of Brewster, N.Y., in 1928 ran and killed 14 out of 20 foxes they found in Putnam County, N.Y. This probably constituted a record in the annals of American foxhunting with hounds that not only kill but eat their foxes.

A conception of gun dogs in the United States, however, rests in the main upon those breeds best adapted to finding, pointing and retrieving game from marsh and upland. Setters and pointers unquestionably occupy the more prominent station with reference to the gun. They are of several strains, foundation stocks of which were imported from England. Llewellin, Gordon, Lavarack and Irish constitute the main stems in setter blood. In many instances these strains have been inter-bred, which doubtless accounts for the enormous number of so-called cold-nosed or unregistered bird dogs of all breeds. In addition, pointers and setters have, at times, been knowingly or unknowingly cross-bred. Such progeny are classed in bird dog parlance as droppers. In a few cases droppers have turned out splendid gun dogs, seeming to possess, in addition to sound bird dog instincts, the ability to trail and tree squirrels and wild turkey. In the main, however, little if any attention need be paid to such mistakes in canine offspring. Long and short hair, setter and pointer conformation are sometimes found together in the same litter of droppers.

The Best Gun Dogs.—Three types of gun dog aristocracy are found in the blooded lineage of the United States: bench-show individuals, shooting dogs and field-trial dogs. The true shooting dog is usually pedigreed, thoroughly broken to the gun and possessing the brain and stamina, nose and bird-sense which constitute the acme of class and reflect pride of ownership to a true bird-hunter. The field-trial dog is bred for and trained to the rigours of competitive bird-finding, the acid test of great speed, heart, ability to locate and, what is of paramount importance, ability to handle game and be handled. By handling is meant (in addition to all other demands of the competition,—bird sense, finding, steadiness to shot and wing, etc.) the dog's acute perception and intelligent execution of its trainer's direction on the field-trial course.

Types of upland gun dogs vary with the game sought and terrain to be covered both by dog and hunter. In heavily bushed and wooded grouse and partridge coverts the dog required is a strong, keen-nosed individual of somewhat restricted range as compared to the needs for freer upland casting. Handling such birds is a distinct phase of gunnery both for dog and master, the supreme importance of stance and signal in thick cover being obvious in sizing up limited space and opportunity for enforced quick-pointing and snap-shooting. Good individuals on grouse or quail would doubtless find their respective abilities badly at sea were they to

are extremely simple in their decoration. The more recent Dutch store design has completely emancipated itself from the domestic store policy and has broken every restriction either of form or of use of material. These façades are interesting experiments though it is more than likely that another generation will choose certain elements of strength from which to evolve a simpler and less bizarre form of building.

On the whole, the variation between the store preceding the 19th century and our own type is essentially that of a change in business policy; the larger store developing from a bazaar into a great organization has required monumental buildings. At the same time, a parallel development of the specialized store has resulted in the construction of special settings for the display and sale of merchandise requiring environment, as, for example, small shops, candy stores and the particularly American development of the drug store which is quite in sharp contrast to the dignity of the apothecary of Europe. With the development of the modern store and the distinctly modern use of large sheets of glass, the frame of the store, in many instances, has become the band enclosing the expanse of display within. The only reasonable explanation of this boldness is the demand for sudden changes of display—hardware in the morning to clothes or food in the afternoon. Under such circumstances the less striking the setting the simpler the problem of the window designer. (E. J. K.)

Technique.—The great development in recent years in the design of shop fronts has been caused by the growing expanse of display space, the use of new materials and the intensification of sales technique. The modern shop front is designed as a picture frame for the contents of the window and also as a means of attracting customers at long range. Intelligent merchants have discovered that mere expanse of plate glass is not enough. In other words, the picture needs a frame, but at the same time, the frame must not be so important that it overpowers the picture. The attraction of customers from a distance offers a more difficult problem—the reconciliation of the desire of the shopkeeper to have his shop as conspicuous as possible with the desire to preserve the beauty of the street as a whole. It is obtained by richness of material, interesting form, prominent signs, bright colours, strong lighting.

The extent of display space has been increased by new types of glass joints, metal mouldings and deep vestibules with elaborate convolutions of plan, so that even on a short frontage a large display is possible—more powerful lights and greater control by colour screens and spotlights, together with a great advance in the art of window dressing have added to the effectiveness of the display itself. Show window interiors should be designed as a background for the display, not so dark as to absorb light or so light as to make prominent shadows, or of a colour or treatment so strong as to overpower the display. The display itself is treated as a composition of sculpture or painting, arranged in mass with stands and drapery and accented by lighting. (R. H. S.)

Modern Tendencies.—In the modern store, wood and plaster have practically disappeared and the use of marble, stone, bronze and the less expensive materials, such as cast iron, copper and quite recently polished rustless steel, is usual.

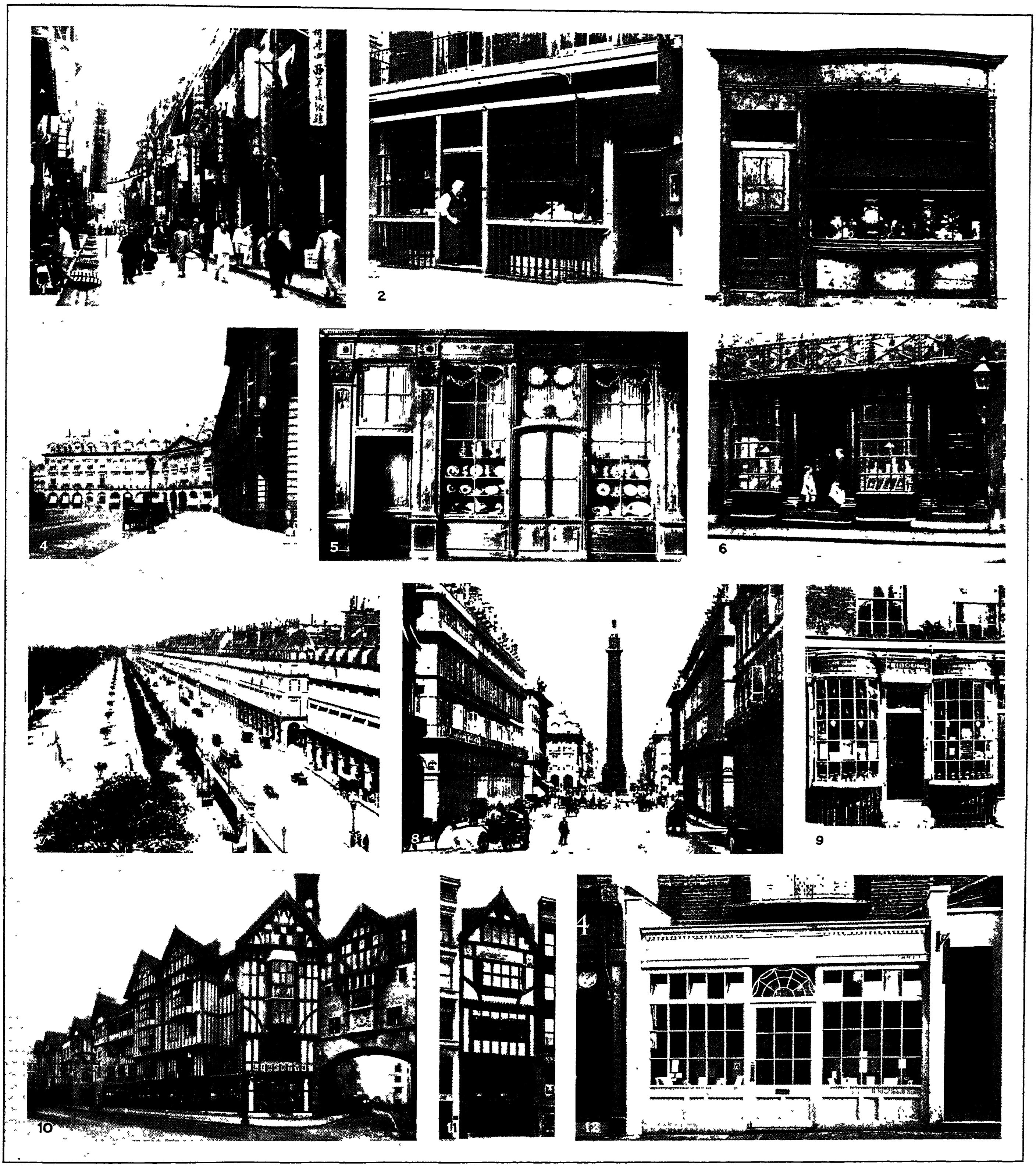
As a matter of solution of design, the stores in America have not shown great brilliancy in spite of the tremendous opportunities that have been presented. This, in large measure, is due to extreme conservatism. Two influences appear in recent years: one, an attempt to introduce into store design the principles of the Colonial or English Georgian architecture, and many excellent examples of store fronts are now in evidence throughout New England. The very close derivation of detail from historic sources has produced charm of design and intimate scale that is in thorough sympathy with the buildings surrounding the shop. The other tendency has been to copy the specialty store, as was particularly developed in Paris during the 19th century, and up to this particular day, the theory being largely that of creating a striking frame for a very special display of goods. In quite a number of these stores, however, where the designer has proceeded with a free hand in the solution of a problem, unusually excellent results have been obtained, and on a number of the streets in Paris examples of these stores may be seen. The Rue St. Honoré, the Rue de la Paix, Avenue de L'Opéra and the Rue Royale, in Paris, as well as Unter den Linden and the Kurfürstendam, in Berlin, are especially to be noticed and there the variety of design is almost as extensive as the quality of merchandise which the stores contain. In these various stores the proportion and size of the show window are in direct relation to the scale of the merchandise in the store. The back of the window is very often made an interesting part of the composition, but it is not clear that this element of design is of sufficient importance to warrant comparison with the well developed façade and the illumination within.

Fifth avenue, in New York, has a character thoroughly at variance with the streets noted. Although the original theory of the shopkeeper had quite simply been a willingness to adapt European forms, the rapid development of the Avenue has forced serious changes in style in so breathless a form that the description is difficult. At one period, particularly at the beginning of the 20th century, the classic revival produced excellent varieties of Italian palaces transformed into stores that are slowly feeling the pressure of business changes. The uneven sky-line which the daily rebuilding further exaggerates tends to complicate the problem by presenting difficult questions of scale. The struggle seems to lie between the policy of the large show window of the Altman, Bonwit Teller and Franklin Simon store type as against the smaller window and larger wall surface as exemplified in the Cammeyer, Dobbs and Bergdorf-Goodman stores. The tendency on Fifth avenue has been thoroughly conservative and its appearance, in spite of the restraint, is dignified and well worthy of the most important shopping district in the country.

In Germany, the illumination of the exterior and the interior of the window has been greatly exploited by the use of tubular lamps which, on occasion, frame the store opening, or where the same lamps are used to develop a store name and appear during the day as letters against a proper background, at night presenting a brilliant design against the dark surface of the building. These tubular lamps do not throw a large amount of illumination but show themselves as brilliant units of glowing colour. In Germany, likewise, the use of sheets of glass is to be noted, wherein varying possibilities of effect are produced. In some cases a white glass is used to form surface patterns through which, at night, light is thrown, thereby presenting a very brilliant impression to the street. This is particularly noticeable in restaurants or stores where the major requirement is a sensational effect. Another use of the glass is in the application of sheets of opaque material; blue, black and white glass acting as a veneer, either framed in metal or bolted to the wall as purely decorative material. Throughout France and Germany, mosaic has been extensively used, and the possibilities of colour effect which this material permits appear to be unlimited.

In Paris, the large stores, as contrasted with the specialty shops of the streets before mentioned, have developed a design extremely characteristic of Paris. The Printemps, Bon Marché and the Galleries Lafayette have, during the past few years, redesigned their façades, not only to keep abreast of the modern note in design, but to maintain the public's interest, apparently in their own evolution. It is quite likely that Paris, being a cosmopolitan city, requires more active development than similar cities in the United States or England might find advisable, and it is likewise obvious that according to American and English standards French stores are somewhat over-elaborate. There must be a nice balance between the interesting frame and the merchandise within, quite in the same proportion that a painting or a piece of sculpture requires careful handling to be enhanced by its background. In spite of this criticism, however, the French stores unquestionably are of great interest and apparently hold the popular enthusiasm through their present policies.

The German stores, in particular the Wertheim building, designed by A. Messel in 1905, and which is still the prototype for big store design in Germany, resemble the French stores in their elaboration, with profuseness of carving and decoration, explaining a period when money was available for such use. It would seem to be a happy misfortune that the requirement for economy



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EXAMPLES OF SHOP FRONT DESIGN

1. Jewellery Street in Hongkong, China. Most of the shops are small and narrow
2. An 18th century hatter's shop in London
3. A late 18th century shop front from Petty France, Westminster
4. Place Vendôme, Paris, France. Noted for its beautiful shops
5. An 18th century Louis Seize shop front, similar to English examples of the same century
6. Early Georgian shop front
7. Rue de Rivoli, Paris. Famed for its exclusive shops
8. Rue Castiglione and Place Vendôme, Paris. Many smart shops are found here
9. The Old Snuff House of Fribourg and Treyer. Business probably established there about 1720. Front preserves its original state
10. Liberty's Tudor Building, London. Quaintness of Tudor architectural style attracts attention
11. Todhunter, Inc., 119 E. 57th Street, New York city, N.Y.
12. Favil Press shop front designed by the late H. J. Birnstingl, London


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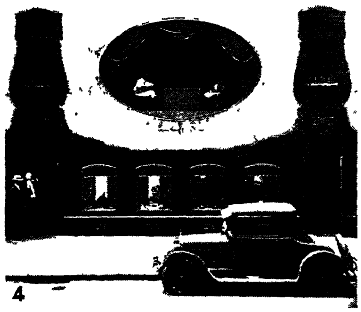
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BY COURTESY OF (1) JOHN WARD SHOES, INC., (2) GALERIES LAFAYETTE, (3) THOM MCAN, (4) DELMAN, (6) ALLAN CHRISTENSEN AND COMPANY, PHOTOGRAPHS, (5, 7) THE VAN ANDA STUDIOS. CAPTIONS BY R. H. SMYTHE

MODERN TREND IN SHOP FRONT DESIGN

1. The John Ward shop, 555 Fifth Avenue, New York, designed to provide large display space for small frontage. Floor of round windows may be lowered to basement for arranging
2. Galéries Lafayette, Paris. Glass faceted marquise attracts the eye from a distance and gives light and shelter to those wishing to inspect the display more closely
3. Thom McAn shop. Beveled windows allow distant vision. Reflections kept from display by sloping glass
4. Delman, Madison Avenue and 54th street, New York. Large oval window with figures in motion attracts attention. Small windows below make for intimate effect
5. Lucky Strike, Broadway and 45th street, New York. Odd shaped corner window with moving figures and machinery used to attract attention of passers-by
6. Extensive amount of glass is used in the Peter Sorensen shop in Copenhagen, Denmark, one of the greatest shops for the sale of shoes in that city
7. Delletrez, Fifth Avenue near 57th street, New York. Effect obtained by use of rich materials, original forms and delicacy of treatment

in Germany to-day is causing the designers to simplify the forms to a point where effects are obtained with a great reduction in decoration and more emphasis on proportion, colour and purity of form.

Among American examples might be noted the work of Louis Sullivan, in New York and Chicago, in particular the Carson Pirie Scott and Co. store which, although most exuberant in detail, shows an interesting variance in pattern from the work of its day. The former Alexander shoe store on Fifth avenue was a very interesting example of a specialty store design to frame a very particular business, and although it has changed its occupancy it still remains one of the fine examples of design on the most important street in America. The Gattle jewellery store on Fifth avenue likewise shows a type of store that had considerable influence on other store designs, through the shape of its windows, arrangement of display and more particularly the unusual placing of marble and glass. The Bergdorf-Goodman store at 58th Street and Fifth Avenue is characteristic of the new store in the most exclusive district of the city, where restraint and dignity would seem to be dominant.

(*See* Architecture; Industrial Architecture; Lighting and Artificial Illumination.) (E. J. K.)

Bibliography.—*Architectural Forum* (July, 1928); *Encyclopédie de l'architecture, Constructions modernes; Nouvelles devantures et agencements de magasins; Devantures, vitrines, installations de magasins* (1925); *Het Stadswoonhuis in Nederland gedurende de laatste 25 jaren* (1924); K. Matthes, *Moderne Ziegelbauten* (1927); *Moderne Ladenbauten* (Berlin); *Cafes, Bars and Restaurants*, published by Librairie de la Construction Moderne, Paris; W. C. Behrendt, *Der Sieg des Neuen Baustils* (Stuttgart, 1927); *Wasmuths Monatshefte für Baukunst* (Berlin, 1927).

SHOP STEWARDS. Prior to 1914, shop stewards in Great Britain were confined to certain of the skilled trade unions. The duties of the shop steward were to inspect trade union contribution cards at regular intervals, to recruit new members for the union, to keep a watch on possible encroachments in the trade of other sections of labour, and to report regularly to the trade union branch or district organisation which he represented on matters arising in the workshop demanding official attention. In some cases he was also responsible for representing grievances of members of his union in the workshop to the management. His powers were, therefore restricted. The conditions of wartime led to the assumption of new functions by shop stewards. The official trade union organisations were parties to the industrial truce agreed upon at the beginning of the war, and in any event, their machinery was too cumbrous to deal with the questions which arose from day to day in almost every munitions factory.

During the war, therefore, shop stewards became negotiators and superseded in a large degree in factories and workshops engaged on war production, the ordinary official machinery of trade union negotiation. At the end of the war, the restoration of more normal conditions broke the power of the shop stewards. They have, however, in many unions now become a normal part of Trade Union organisation. Shop stewards have been appointed in factories and workshops in a variety of industries where they did not exist prior to the war. In addition to carrying out their well established duties, they are in some industries empowered to negotiate on minor matters, but their negotiating powers are derived from the unions and are not exercised independently of the unions as was so frequently the case during the war. (*See* Trade Unions.)

SHORE, JANE (d. 1527), mistress of the English king Edward IV., is said to have been the daughter of Thomas Wainstead, a prosperous London mercer. She was well brought up, and married young to William Shore, a goldsmith. She attracted the notice of Edward IV., and soon after 1470, leaving her husband, she became the king's mistress. Edward called her the merriest of his concubines, and she exercised great influence; but, says More, "never abused it to any man's hurt, but to many a man's comfort and relief." After Edward's death she was mistress to Thomas Grey, marquess of Dorset. She also had relations with William Hastings, and may perhaps have been the intermediary between him and the Woodvilles. At all events she had political importance enough to incur the hostility of Richard of Gloucester, afterwards King Richard III., who accused her of having practised sorcery against him in collusion with the queen and Hastings. Richard had her put to public penance, but the people pitied her for her loveliness and womanly patience; her husband was dead, and now in poverty and disgrace she became a prisoner in London. Thomas Lynom, the king's solicitor wished to marry her, but was apparently dissuaded. Jane Shore survived till 1527; in her last days she had to "beg a living of many that had begged if she had not been." She figured much in 16th-century literature, notably in the *Mirrour for Magistrates*, and in Thomas Heywood's *Edward IV.* The legend which connected Jane Shore with Shoreditch is quite baseless; the place-name is very much older.

Bibliography.—Most of our information as to Jane Shore comes from Sir Thomas More's *Life of Richard III.*, edited by J. R. Lumby (Cambridge, 1883), supplemented a little by Edward Hall (*Chronicle*, pp. 363–364). *See* also H. B. Wheatley's edition of Percy's *Reliques*, ii. 264 (1876–77), and J. Gairdner's *Life and Reign of Richard III.* (Cambridge, 1898).

SHOREDITCH, an eastern metropolitan borough of London, England, bounded north-west by Islington, north-east by Hackney, east by Bethnal Green and Stepney, south by the City of London, and west by Finsbury. Pop. (1931) 97,038; area 658 acres. It is a crowded district extending east and west of Kingsland Road. An old form of the name is *Soersditch.* The metropolitan borough of Shoreditch returns one member to Parliament.

SHOREHAM, a seaport in Sussex, England, near the mouth of the River Adur, 6 m. W. of Brighton. Pop. of New Shoreham (1931) 8,757. The town is sometimes known as New Shoreham, in distinction from the village of Old Shoreham, a mile distant, which was the former port. Shoreham owed its early importance to the natural harbour formed by the River Adur. It became an important port in the 13th and 14th centuries, but was later much reduced, doubtless owing to the encroachment of the sea. The port revived during the reign of George III., when acts were passed for securing and improving the harbour which was continually becoming silted up by the tides and tending to move eastward. Shoreham was called a borough in 1236. Weekly markets and an annual fair dating from the time of Edward I., were held for some centuries, but have now been discontinued. Shipbuilding has always been the chief industry, and was largely carried on in the 13th and 14th centuries. There is also trade in coal, grain, timber and cement. The public boys' school of St. Nicholas, Lancing, is near Shoreham.

SHOREY, PAUL (1857–), American classical scholar, was born at Davenport (Ia.), on Aug. 3, 1857. He graduated at Harvard university in 1878, and was admitted to the Chicago bar in 1880. He then continued his studies at the universities of Leipzig (1881–82) and Bonn (1882) and the American School of Classical Studies, Athens (1882–83), proceeding thence to the University of Munich (Ph.D., 1884). He was professor of Greek at Bryn Mawr college 1885–92, resigning to fill a similar chair at the University of Chicago. He became head of the classical department at Chicago in 1896, and was Roosevelt professor in the University of Berlin (1913–14). Dr. Shorey wrote: *De Platonis Idearum Doctrina* (1884); *The Idea of Good in Plato's Republic* (1895); *The Odes and Epodes of Horace* (1898); *The Unity of Plato's Thought* (1903); and *The Assault on Humanism* (1917), the last named a brilliant but bitter polemic directed chiefly against those who minimized the value of humane studies in the educational system. He became managing editor of *Classical Philology* in 1908, and was a constant contributor to its columns.

SHORING is the scientific placing of supports to parts of a building which are liable to distortion or collapse either because the fabric of the building is unsound—which may be evidenced by failure or settlement—or to guard against the disturbance of adjacent parts of a structure and adjoining premises where alterations to the fabric are being made. The word "shore" means a prop or support and is applied to the work under description because every member employed is virtually a prop or a strut, opposing movement by its own resistance to compression. The craft of shoring lies in so placing the shoring members and forming the joints and connections, that the shores as a whole may

function perfectly; this condition requires that all parts shall fit closely and squarely at their ends and to be brought into close contact without "shock" to the structure which is being operated upon. Wedging requires the use of the hammer, causes shocks and vibration and should be used as little as possible; though it cannot be dispensed with entirely. Where wedges are adopted they should be placed at the ends of members distant from the defective portions of the structure and great care must be exercised in using the wedges, which should be slowly and cautiously driven by gentle blows.

In all shoring it is imperative to *maintain* the condition of the structure to which it is applied, not to *disturb* it, or to attempt to restore it to an original position. There are several different forms of shoring, each adapted to suit particular circumstances. Much ordinary shoring is done with heavy, roughly sawn timbers strongly braced together, but for heavy work steel members may be introduced with advantage. Generally, steel is only employed for short heavy beams called "needles" (*see* below *Dead Shoring*), but in some special cases, as in the restoration of the piers supporting the dome of St. Paul's cathedral, shoring and scaffolding must necessarily be of steel to support the immense loads during repair operations.

The form of shore in most general use is that known as the *raking shore.* It consists of one or more timbers sloping from the face of the structure to be supported and bedded upon the ground. When the ground is of a yielding nature, a stout timber plate termed a sole-piece, is placed to receive the base of the raking timber or timbers. A wall-plate, to increase the area of support, is fixed to the face of the wall by hooks driven into the joints. Where space is available, a slope of 60° is found convenient for the main shore, the auxiliary members ranging in their slope from 45° to 75°. In many cases, especially in towns, the angle of slope is governed by outside influences such as the width of the footway or by local regulations. Raking shores are erected singly or in "systems" in planes at right angles to the face of the wall. The members rise fanwise from the sole-plate to support the wall at different points. The spacing between systems depends on the condition of the building to be supported, and also upon the spacing of its window and other openings. The usual spacing is 10 ft. to 15 ft. apart, but depends upon the openings in the wall. The application of the shores needs care, support being given only where there is a corresponding thrust from a floor or roof. A clear idea of the construction of a system of raking shores can be obtained from a study of the illustration (fig. 1). The names and functions of the different timbers are indicated here.

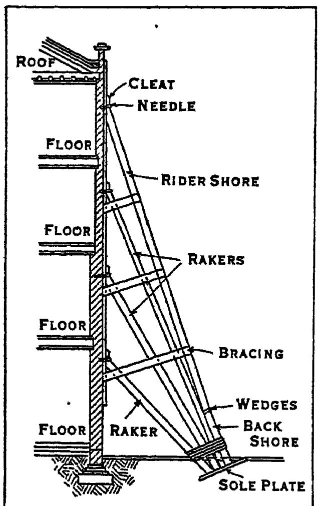


FIG. 1.—SYSTEM OF RAKING SHORES

Raking Shore or Raker.—A piece of timber sloping up from the sole-plate to the wall-piece and joined as in fig. 2. The top and longest shore may necessarily be formed in two pieces. The upper one is the *riding shore* or *rider,* and the lower, which supports it, is the *back shore.* At their junction folding wedges are introduced to give the head of the rider a firm bearing against the needle and wall-plate above. The *sole-piece* (fig. 2) usually consists of a piece of 11 by 3 plank, but may have to be bedded on a platform of timber to spread the weight over a large area. The sole should be placed at an angle (say 80°) with the inside of the shore to enable the latter to be gradually levered to a firm bearing with the aid of a crowbar. Wedging should not be resorted to or the building may sustain injury through vibration. When in position the foot of the shore is fixed by dog-irons to the sole-piece, and for additional security against slip, a cleat is spiked very firmly on the sole plate.

Braces.—Compound shores are stiffened and braced either by rough boarding nailed across them or bound with bands of hoop-iron (figs. 1 and 2). For further strength braces of 1-in. boards, 6 to 9 in. wide, are used to bind the shores and plate together. The *wall-plate* is usually a "deal" 9 in. wide by 2 in. thick, secured against the wall with wrought-iron wall hooks, forming a good abutment and serving to spread the pressure from the shores over a large area of the wall supported by them. Holes are cut through this plate to receive the *needles,* which are pieces of wood about 1 ft. long and 4 in. square in section, cut with a shoulder to butt against the wall-plate. A portion of a brick or stone is removed from the wall and the end of the needle is passed through the hole in the wall-plate into the recess in the wall. The head of the needle projects about $4\frac{1}{2}$ in. beyond the face of the wall-plate and forms an abutment for the notched head of the shore; the notching prevents side movement. A *cleat* is housed and spiked above the needle to obtain a firm bearing.

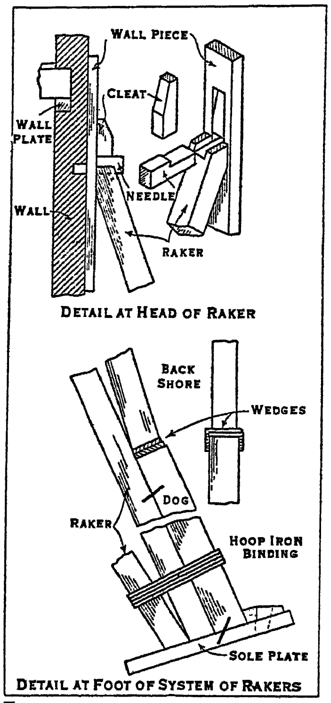


FIG. 2.—DETAILS OF JOINTS USED IN ASSEMBLING FIG. 1

Horizontal shores, or flying shores, may be employed for spans up to about 35 ft. They are used to support the party walls of buildings which adjoin premises being rebuilt. They are erected in stages during the pulling down operations and removed as the new building is raised. A system of flying shores consists of one or more horizontal timbers, sometimes known as dog shores, cut in tightly between wall-plates similar to those employed in raking shores (fig. 3). These horizontal members are supported at each end by cleats and needles fixed in the wall-plate and the shores are supported in their length by inclined struts springing from needles fixed near the lower ends of the wall-plates and serving to strut the shore at a point about a third of its length from the wall. Corresponding braces are carried from the upper surface of the shore and abut against needles at the upper ends of the plates. Straining pieces are secured to the upper and lower faces of the horizontal member to serve as abutments for the ends of the struts. The best angle for these struts is about 45°, but a smaller inclination has frequently to be adopted. Wedges are inserted, usually at the end of the *flyer* and sometimes between the struts and the straining piece, and gently driven to cause each timber to find a close bearing. If the adjoining premises are of considerable height and especially if it is proposed to undertake extensive excavations, the systems of flying shores may be complicated, each consisting of several horizontal members spaced from 10 to 13 ft. apart, placed opposite floors or other solid masses and well strutted one to another and to the wall-plate (fig. 4). The members should be securely dogged and spiked together to form a rigid framework able to resist the attacks of a strong wind.

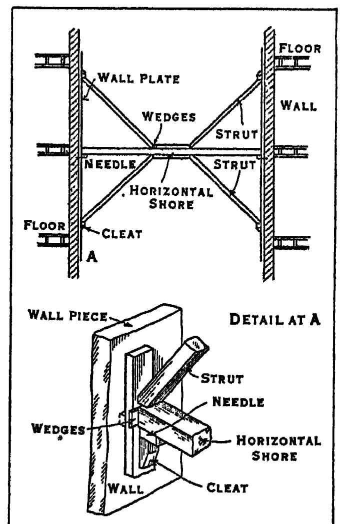


FIG. 3.—HORIZONTAL OR FLYING SHORE

Horizontal shores are preferable to raking shores. Besides being more economical, they are more convenient and more efficient than rakers springing from the ground, especially if the height of the building is considerable and the span not much over 30 ft. They present a direct resistance to the thrust and are well out of the way of building operations that may be carried on below them, so that there is little risk of their being accidentally disturbed; raking shores may be disturbed by accident or loosened by digging and other operations.

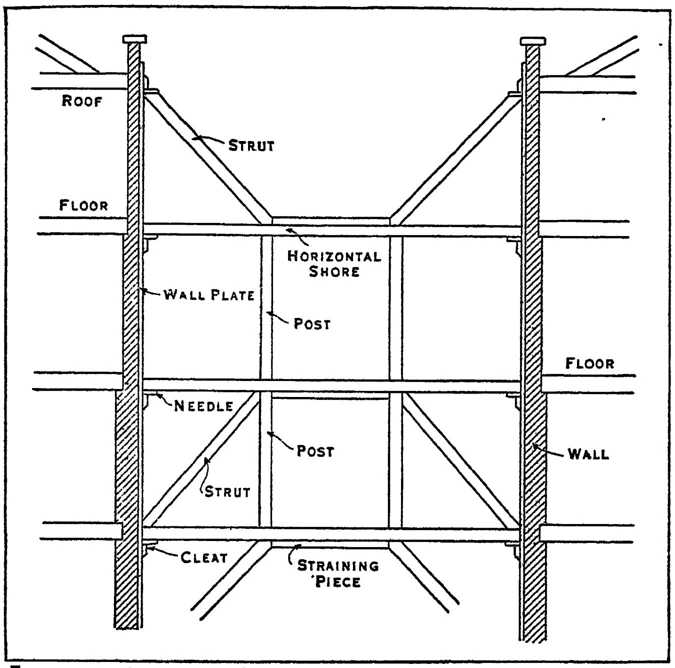


FIG. 4.—SYSTEM OF FLYING SHORES USED IN CONSTRUCTING A HIGH BUILDING

Dead shoring is also known as *vertical shoring* or *needle shoring*, and is adopted to support the upper portion of a building when necessary to reconstruct foundations or to make large openings in the lower parts of the wall, as, for example, when putting a shop front in an existing building. This form of shoring consists of horizontal members of balk timber or steel I-sections termed *needles* (very different from the needles used in raking and flying shoring), which are passed through holes in the wall to be supported, at a sufficient height to allow of the insertion of any arch or lintels that may be necessary above the proposed opening. The needles are supported at each end by an upright timber or *dead shore*, one on each side of the wall to each needle. These should not be allowed to rest upon any floor or vault but be carried down to a solid foundation and set upon and securely dogged to a timber sleeper running parallel to the wall. If it is not practicable to take the inner dead shore through intervening floors down to the solid ground in one piece, and it is necessary for its base to rest upon the floor or upon sleepers placed on the floor, the shores must be continued in a direct line below it until a firm foundation is obtained. Between the needle and the head (or base) of the dead shores folding wedges are inserted to force the horizontal supporting balk firmly up to the underside of the masonry. Fixings between dead shores, needles and sleepers are made with wrought iron dogs. The spacing of dead shores depends upon the material of the wall; for brickwork the intervals should not be greater than 6 ft. With this form of shoring it is often necessary to adopt supports auxiliary to the main shoring.

All openings in the wall above should be well strutted between their reveals to prevent any alteration of shape taking place. Inside the building, for support of the floors, vertical shores or strutting must be carried up independently from a firm foundation, in a direct line between the floors with head and sole plates at floor and ceiling to relieve the wall of weight from the floors and roof. To obviate settlement as much as possible, work done in underpinning should be built slowly with rich Portland cement mortar. Before the shoring is removed, at least a week should elapse to allow the work to set hard and firm. Then the needles should be carefully loosened and removed and the holes from which they were withdrawn made good. The remainder of the props can then be "struck," leaving the raking or flying shores until the last.

Rules and Sizes for Raking Shores.—Walls 15 ft. to 30 ft. high should have 2 shores to each system; if more than 30 ft. in height an additional shore is required for each increase of 10 ft. Shoring is rarely seen more than 5 shores high. The angle of the main shores is usually about 60° (but may be governed by local regulations concerning the use of the roadway), and none of the timbers should exceed an angle of 75° to the horizontal. Some of the lower shores will slope at angles between 40° and 60°. The systems should not be placed at a greater distance apart than 15 ft. and they should always be applied at the piers between window openings. The approximate section of a shore for any height of building may be determined by dividing the height of the building (at point of application) in feet, by five; then the result equals the side of the square section in inches.

For Horizontal or Flying Shores.—For spans not exceeding 15 ft. the principal strut may be 6 in. by 4 in., with raking struts 4 in. by 4 in.; for spans exceeding 15 ft. but not exceeding 35 ft. the size of the principal strut should be from 6 in. to 9 in. square, and the raking struts from 6 in. by 4 in. to 9 in. by 6 in.

The restoration of some important and ancient buildings in England by the British Office of Works has provided the opportunity for the design and application of new methods of shoring where great loads have had to be supported upon arcade arches while the original piers or columns were removed and restored.

The system adopted was to build very large brick piers under each arched opening and to construct brick rampant arches springing from each side of the pier and terminating against the soffits of the original arches thus providing pairs of side supports to each spandrel portion. As the arcade supported a high and thick wall, this latter was also shored by raking shores—with which was combined scaffolding for use in restoring the wall faces. The columns were provided with a steel core of special section, round which the original column facing was rebuilt.

The whole system was applied at Tintern abbey and at Furness abbey and met its purpose admirably. It is an excellent example of structural engineering applied to restoration work.

The principal works of reference on this subject are: C. H. Stock, *Shoring and Underpinning* (3rd ed., 1902); G. H. Blagrove, *Shoring and its Application* (1887); G. Ellis, *Modern Practical Carpentry* (1915).

SHORNCLIFFE, a military station in Kent, England, on high ground north of Sandgate and 3 m. W. of Folkestone.

SHORT, SIR FRANCIS JOB (1857–), knighted 1911, English engraver and water-colour painter, was born at Stourbridge, Worcestershire, on June 19, 1857. He was educated to be a civil engineer, and came to London in 1881 as assistant to Baldwin Latham in connection with the parliamentary inquiry into the pollution of the river Thames. He was elected an associate member of the Institute of Civil Engineers in 1883 and the same year joined the National Art training school, South Kensington, and worked at the Westminster school of art, and at the Schools of the Royal Institute of Painters in Water-colours. His real life-work now became that of an original and translator engraver. He was a keen student of the works of J. M. W. Turner; and his etchings and mezzotints from Turner's *Liber Studiorum* (1885 *seq.*), wonderful examples of devotion and skill, were among his earliest successes. Short also reproduced in fine mezzotints several of the pictures of G. F. Watts, and engravings of the landscapes of David Cox and Peter de Wint. His subtle drawing of the receding lines of the low banks and shallows of river estuaries and flat shores is seen to perfection in many of his original etchings, mezzotints, and aquatints.

Short was elected A.R.A. in 1906 when the rank of associate-engraver was revived. As head of the Engraving school at the Royal college of art, South Kensington, he had great influence on younger engravers. He was elected to the Royal Society of

Painter-Etchers and Engravers in 1885. In 1910 he succeeded Sir Seymour Haden as president.

See *The Etched and Engraved Work of Frank Short,* by Edward F. Strange (1908), which describes 285 plates by the artist.

SHORTER, CLEMENT KING (1857–1926), English journalist and author, was born in London on July 19, 1857. After working as a clerk at Somerset House, he became a journalist on the staff of the *Penny Illustrated* in 1890. He was editor of the *Illustrated London News* from 1891 to 1900, and founded and edited the weekly *Sketch* (1893), the *Sphere* (1900) and the *Tatler* (1903). He helped to found the Omar Khayyam Club, and was at one time president of the Johnson Club. He was a considerable critic and literary historian, and was interested particularly in Borrow, Dr. Johnson and the Brontës. He died on Nov. 19, 1926, leaving a valuable collection of books and manuscripts. Shorter's first wife, Dora Sigerson, is separately noticed.

In 1896 he published *Charlotte Brontë and her Circle,* and later edited the Haworth edition of the Brontës with Mrs. Humphrey Ward. In 1924 he issued a private edition of Patrick Branwell Brontë's *And the Weary are at Rest.* He edited Boswell's *Life of Dr. Johnson* (1922) and Mrs. Gaskell's *Life of Charlotte Brontë.* Through various connections of the Brontë family, a number of unpublished documents came into his possession, and he privately printed over 30 brochures on the Brontës and other subjects, including Mrs. Gaskell's *My Diary; the early years of my Daughter Marianne.*

SHORTHAND is the art of writing legibly, by means of brief signs, at a rate sufficiently rapid to record speech. It has been variously known as stenography (close, little or narrow writing), tachygraphy (swift writing), brachygraphy (short writing). But the term "shorthand" is now almost universally applied to it. Shorthand is now employed widely in reporting the proceedings of parliament and legislative bodies, the trial of cases in courts of law and especially for taking dictated business correspondence, reports and other business communications.

The Shorthand of the Ancients.—The earliest record we have of an organized system of shorthand dates from the year 63 B.C., the age of eloquence in Rome. At that time a freedman and friend of Cicero, Marcus Tullius Tiro, invented a system of *notae* that was used in recording the speeches of Cicero, Seneca and others of the Roman senate. The system invented by Tiro was taught in the Roman schools, was learned by emperors, and remained in use for several centuries. We are informed by Plutarch, in his life of Cato the younger, that the speeches of Caesar and Cato in connection with the conspiracy of Catiline were taken down verbatim by *notarii* who had been placed by Cicero in various parts of the Senate.

An inscription on a marble slab from the Acropolis at Athens, attributed to the 4th century B.C., indicates that a system of brief writing was practiced among the Greeks. Tiro's system was based on the orthographical principle; it abounded in the use of initials, following in this respect the abbreviating formulae in common use with the Romans; and, principal distinction of all, it was marked by this peculiar excellence which renders it superior to every other system known till to-day—namely, that by it, one and the same consonant letter, without the addition of points or any other signs whatsoever, expressed, by the inclination of such letter in three different directions, the exact vowel, *a*, *e*, or *i*, which followed. In the case of some of the consonants the whole five vowels, and even the diphthongs, were capable of like indication.

Example of Tironian Notae:

Nemo fideliter diligit quem fastidit nam et calamitas querula

Shorthand in the Middle Ages.—After the fall of the Roman empire, the use of the Tironian system survived for several centuries. In A.D. 625 Tironian notes were used in the royal diploma of the Merovingian King Clotaire II. In subsequent years we find on public documents brief notations as to the composition of deeds, names of officials concerned, etc. It is the opinion of some authorities that such notations were a protection against forgery. Examples of Greek shorthand are confined to a few fragmentary papyri and waxen tablets ranging from the 4th to the 8th century, chiefly among the Rainer collection at Vienna to which Prof. Wessely has devoted much labour. A manuscript (Add. ms. 18231) in the British Museum contains marginal notes in shorthand of the date A.D. 972 (Wattenb., *Script. Graec. specim.*, tab. 19). Dating from the 10th century, we find the Paris ms. of Hermogenes, with some tachygraphic writing of that period which Bernard de Montfaucon deciphered with incredible labour (*Pal. Gr.*, p. 351). But the largest amount of material is found in the Vatican ms. 1809, a volume in which as many as 47 pages are covered with tachygraphic writing of the 11th century. Cardinal Angelo Mai first published a specimen of it in his *Scriptorum veterum nova collectio* (1832); and in his *Novae patrum bibliothecae tom. secundus* (1844) he gave a second, which, in the form of a marginal note, contained a fragment of the book of Enoch.

Shorthand and the Early Christian Church.—With the rise of the Christian Church and a demand for the exact utterances of the religious leaders of the day, the teaching and practice of the Tironian *Notae* received a new impetus. Many of the trials of the early Christians were reported by shorthand writers who were employed by the church for that purpose.

Revival of Shorthand in England.—England was the birthplace of modern shorthand. The publication by Dr. Timothy Bright in 1588 of his *Charac erie: an Arte of Shorte, Swifte, and Secrete Writing by Character* marked the beginning of this development in England. Bright's system was invented during the reign of Queen Elizabeth and dedicated to her. It provided that each sign could be given four different slopes, and that the base of each could be modified by 12 varying terminations.

With the publication of the *Arte of Stenographie* in 1602 by John Willis began the introduction of the systems based on the alphabet. These systems are sometimes referred to as orthographic, because they followed the spelling of the words, omitting silent letters and in many cases the vowels in a word. One of the best known of these orthographic systems is that of Thomas Shelton, published about 1630, in which the famous diary of Samuel Pepys was kept. In 1767, Dr. John Byrom published his *Universal English Shorthand.* His principal contribution to the art was greater lineality in writing, and representation of the five vowels by writing a dot in five different positions with respect to the consonant outline. His system was popularized by Thomas Molyneux, who published seven cheap editions between 1793 and 1825. In 1786, Samuel Taylor published in London an *Essay Intended to Establish a Standard for a Universal System of Stenography.* He simplified his system considerably by limiting each letter to one sign, except *w*, and by the elimination of a great many of the arbitrary signs that had characterized previous systems. His system was eventually adapted for use in France, Italy, Holland, Sweden, Germany and other Continental countries.

Development of Phonetic Shorthand.—Most of the early systems of shorthand in England were orthographic or alphabetic, but the idea of writing according to sound continued to gain in favour. The first published system using a phonetic base was that of William Tiffin (1750). Others were Lyle (1762), Holdsworth and Aldridge (1766), Roe (1802), Phineas Bailey (1819), Towndrow (1831) and De Stains (1839).

PITMAN SYSTEM

The publication by Isaac Pitman, in 1837, of *Stenographic Sound Hand* marked a new era in the development of phonetic systems. Not only did he classify the sounds of the language scientifically and arrange his material for writing accordingly, but he introduced simple expedients of abbreviation that made for rapidity. A short summary of the principles underlying the system is given.

Since the system is phonetic, all words are written according

to their sounds. The words *lain, deal, may, knife* would therefore be written as if they were spelled *lān, dēl, mā, nīf*.

PITMAN'S SHORTHAND ALPHABET

CONSONANTS

Names		Sign	Names		Sign	Names		Sign	Names		Sign
pee	P		*chay*	CH		*ef*	F		*es*	S	
bee	B		*jay*	J		*vee*	V		*zee*	Z	
tee	T		*kay*	K		*ith*	*TH*		*ish*	SH	
dee	D		*gay*	G		*thee*	TH		*zhee*	ZH	

em M *en* N *ing* NG *el* L *ar* R

way W *yay* Y *hay* (aspirate) H

VOWELS

LONG		SHORT	
1. AH	1. AW	ă	ŏ
2. EH	2. OH	ĕ	ŭ
3. EE	3. OO	ĭ	ŏŏ

DIPHTHONGS

I OI OW U

Consonants.—The consonants in the system are drawn from simple geometrical forms, straight lines and shallow curves. It is a curious fact that, while the tendency in longhand writing, beginning about A.D. 600 with the development of the Uncial letters, was away from the Roman capital letters and toward a cursive style, this tendency did not affect shorthand writing, although several systems appearing before Pitman's were cursive in form. In Pitman's system there are 26 signs for 24 consonant sounds in the language, two of the signs being provided with duplicates for convenience in joining with other signs. The first 16 signs occur in pairs, a light sign for a light sound, and a heavier sign for a heavy sound.

Vowels.—The 12 vowels in the language, *ah, a, e, aw, o, oo,* as heard in the words, "Pa, may we all go too?" and their corresponding light sounds, *a, e, i, o, u, oo,* as in the words, "That pen is not much good," are represented by a dot and a dash, disjoined. A heavy dot placed opposite the beginning of a consonant represents the long vowel *ah;* opposite the middle of the stroke it represents *ā;* and opposite the end of a stroke it represents *ē.* A short, heavy dash placed similarly represents the sounds *aw, ō, ōō.* The dot or the dash is made very light to represent the corresponding light or short vowel sounds. To illustrate: pa bay tea sigh ode bug

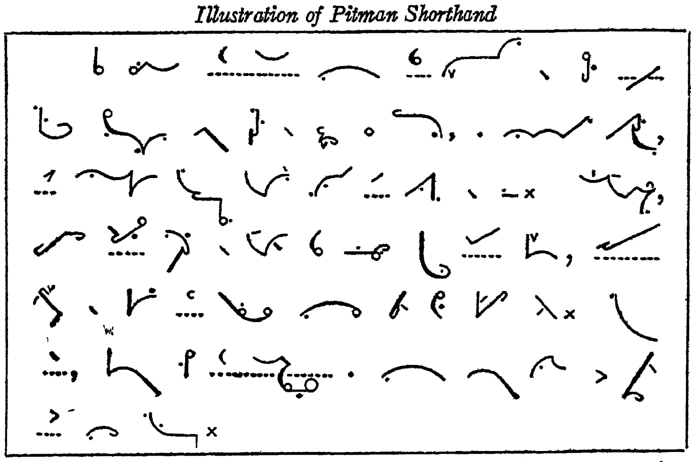
The sound *s* when preceding or following another consonant is expressed by a small circle: pays tease spy spouse. When the sound *ses* occurs other than at the beginning of a word, it is represented by a large circle: paces teases spices excessive. When the large circle is the beginning of a consonant it represents *sw:* swoop Swede swim. The small circle for *s* is turned into a small loop to represent *st,* and into a larger loop to represent *str:* past pastor boast boaster must muster state steam.

Use of Hooks.—The hooks used as abbreviating devices are obtained from segments of the circle *s,* or of the large circle for *ses.* A small hook written at the beginning of a consonant on the left of straight downstrokes and under horizontal strokes adds *r;* a small hook written at the end of a consonant under the same conditions represents *n:* pray brain tray train grow grown. A small initial hook written on the right side of downstrokes or above horizontals represents *l;* at the end of these strokes, it expresses *f* or *v:* play pave brave blow bluff glow glove. The common sound of *shun,* no matter how it is spelled, is expressed by a large hook: passion petition occasion. When used with curved letters, the hooks are always written inside the curve. The small hook represents *r* at the beginning of a stroke and *n* at the end of a stroke: frayed fan fans loan. A large hook at the beginning of a curve adds *l* and at the end of a curve it adds *shun:* flow flung evil notion motion. The halving of a stroke indicates the addition of *t* or *d.* This principle is of great value in writing the past-tense forms of verbs: float floated plate plated pain pained or paint grade graded label labelled. Doubling the length of a consonant adds *ter, der* or *ther:* track tractor laugh laughter bill builder mole moulder pore porter.

Vowel Indication.—In rapid writing it is not possible to insert all vowels, nor is it necessary. Three methods are employed to indicate the presence or absence of a vowel. Letters having alternate forms are used for this purpose; the downward *r* usually indicates that a vowel precedes it, whereas the upward form is usually used when a vowel follows. By writing a word in position with relation to the line, it is possible to indicate a vowel. Words may be written above the line to indicate a first-place vowel, on the line for a second-place vowel, and through the line for a third-place vowel. The first up or down stroke in the word generally takes the position, and the rest of the outline follows in regular order. The position of the word is determined by the first vowel. The third method of vowel indication is by the use of some of the consonant outlines instead of their abbreviated form, as the use of the *s* stroke in place of the circle at the beginning of a word, or the writing of the *n* stroke in place of the *n* hook in such a word as *funny.*

Grammalogues.—A large number of the most commonly occurring words have been condensed in outline form so that they can be written with one stroke of the pen without vocalization. These words are memorized and learned thoroughly so that they can be written with great facility. Illustrations: that is as, has are our it should cannot you this. Just as the early authors discovered that joining words increased the speed of writing, so Pitman's system affords an extensive use of this principle of phrasing: you cannot you cannot be. Besides the list of grammalogues, there is a list of contractions which it is necessary for the writer

Illustration of Pitman Shorthand



It is certain that any matter that is likely to strain our attention severely should be attended to when the mind is clear, the memory retentive, and the mental faculties fully alert and ready to act. Unfortunately, we cannot always arrange to follow this excellent division of our time, and we are obliged to deal with business matters just as they turn up. After all, it may be said that in all these cases the matter may be left to the judgment of the man affected.

to memorize before he can develop much speed. These contractions are usually long or awkward outlines that have been reduced in form by dropping parts of the word but at the same time keeping them significant enough to establish their identity.

Examples of these are: indispensable dangerous indefatigable

The Pitman system was introduced into America a few years after its publication. Alfred Baker tells us in the *Life of Sir Isaac Pitman* that the first instruction book in Pitman shorthand was brought out by Mr. Stephen Pearl Andrews (Boston, 1844). In 1852, Mr. Benn Pitman, brother of the author of the system, came to America to continue the work he had been doing for several years. After the publication of the 10th ed., in which the vowel scale was changed, Benn Pitman refused to adopt the change and adhered to the old forms. Many others who had learned and practised the system began to modify it and publish it in altered form. Among these were A. J. Graham, J. E. Munson, E. Longley and Eliza B. Burns.

Script Systems.—Just as Pitman and his predecessors rejected the orthographic principle in shorthand and adopted the phonetic basis, so another group of authors discarded the use of geometrical signs. As early as 1787, S. G. Bordley had presented his cursive shorthand. This was followed by R. Roe (1802), T. Oxley (1816), J. and J. Aitchison (1832) and D. Cadman (1835). In France and Germany script systems had been introduced successfully and are in wide use to-day. Fayet's French system and Gabelsberger's German system are illustrations.

GREGG SYSTEM

In 1888, John Robert Gregg published his Light-Line Phonography, in which he incorporated what he considered this fundamental idea of employing shorthand characters that were in harmony with the slant and movement of longhand as well as many other principles, the lack of which had given rise to many criticisms of existing systems. Gregg adopted the phonetic principle and added a scientific analysis of *handwriting*. The title of the first book of his system was *The Phonetic Handwriting*. Gregg brought his system to America and offered it to the public soon after its publication in England. At present it is taught in more schools in the United States, and practised by more stenographers, than any other. A summary of the system is presented. The basic principles given below are taken from a copy of the original Light-Line Phonography, published in 1888: (1) Total absence of shading or thickening. (2) The characters being based on the elements of the ordinary longhand, the strokes are familiar and the motion uniform. (3) The insertion of the vowels in their natural order without lifting the pen. (4) The absence of positions, or the placing of words on, above, or through the line of writing to imply the omission of certain vowels or consonants. (5) The preponderance of curve motion.

Although some changes have been made in the system since 1888, these principles have remained the same.

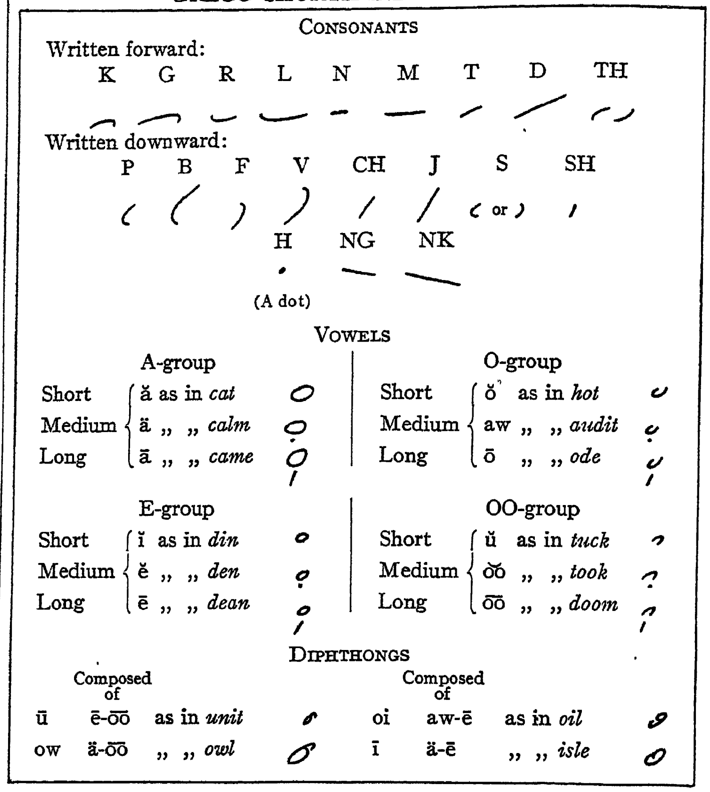
Consonants.—The consonants generally are paired according to affinity of sound and are distinguished by length. Consonant signs were selected which would permit the joining of many frequently recurring consonantal combinations without modifying the primitive form and to make possible the writing of these forms with but one movement of the pen, thus: pr br

pl bl kr kl gr gl

The Signs for S and Th.—To facilitate joining in various combinations alternative signs are provided for the frequently recurring sound of *s*, written downward, and for *th*, written upward. In the use of these forms two principles serve as guides: uniformity of rotation and forward movement when joined to curves; sharp angles when joined to straight strokes.

Vowel Signs.—The vowels are expressed by circles, small and

GREGG SHORTHAND ALPHABET



large, and by hooks. A small circle expresses the E-group of vowels, *ĭ, ĕ, ē;* a large circle, the A-group, *ă, ä, ā.* The circle is written on the inside of curves and on the outside of angles; before and after straight strokes, or between straight strokes in the same direction the circle is written clockwise; between reverse curves the circle is turned back on the first curve. A system of diacritics is provided for showing the exact shade of sound, as for example *ă, ä, ā,* but since the large circle expresses an *a*-sound in any case, the need for these diacritics arises rarely. To illustrate the application of the rules for joining circles: key air meet gain make aim me mean wreck lake The hook vowels are derived from a small elliptical figure, thus: the lower part expressing the O-group of vowels, *ŏ, aw, ō;* the upper part expressing the OO-group, *ŭ, ŏŏ, ōō.* These hooks join naturally in most combinations but they are modified in two instances to avoid unnecessary angles, thus: the O-hook is turned on its side before *n, m, r, l;* the OO-hook is turned on its side after *n, m,* and after *k, g,* if followed by *r* or *l.* Illustrations: ought wrote know shop obey to foot mode mood cull coal on nor

Signs for W and Y.—*W* has the sound of *ōō,* as *ōō-ā-t* in *wait,* and is expressed by the sign for *ōō. W* within a word is expressed by a short dash struck under the vowel sign. The sound for *y* is equivalent to long *e,* as *ē-ōō-th* in *youth,* and is so expressed, except *ye* is expressed by a small loop, and *ya* by a large loop. Illustrations: wait weave youth yacht yellow Yale queen

Diphthongs.—The signs for the four pure diphthongs, *ū, ow, oi,*

i, are written by simply joining the signs for the sounds composing them. Concurrent vowels are written in the same way. Illustrations: feud now toil try price science enjoy radio

Blended Consonants.—When two straight lines form an obtuse or blunt angle the natural tendency of the hand is to slur the angle and allow the lines to form a curve, thus

This principle is applied in securing a number of frequently recurring syllable signs:

TEN, DEN	*as in* tenor		denote	
TEM, DEM	*as in* temper		demolish	
ENT, END	*as in* paint		bond	
EMT, EMD	*as in* prompt		deemed	
DEF-V, TIVE	*as in* defeat		native	
JENT-D, PENT-D	*as in* gentle		happened	
MEN, MEM	*as in* mention		memory	
TED, DED, DET	*as in* heated		seated	
SES	*as in* passes		faces	
XES	*as in* boxes		mixes	

Expressing R.—By writing the circle with a reverse movement before or after straight lines; between a horizontal and an upward character; between a downward character and *t*, *d*, *n*, *m*, the sound *r* following the circle is expressed. Illustrations:

art share yard tardy
barn chart earn cart

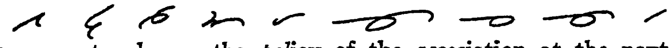
Wordsigns and Phrases.—The Gregg system includes a list of forms, called wordsigns, for the commonest words of the language which are reduced to the simplest outlines. Examples: the of and a-an in-not that at-it is-his I

These words, through repetition, comprise more than one-quarter of all written and spoken English.

Phrasing.—Phrasing forms a very important function in the Gregg system. Since the words do not depend on position for vowel indication, phrasing is limited only by whether or not outlines can be joined easily. The following phrases will show how the principle is applied to wordsigns: of the that the it is in the in that and in

General Abbreviating Principle.—The rule for abbreviation given in the first edition of *Light-Line Phonography* remains the same to-day. It reads, "Drop the termination of words, *i.e.*, write so much of the outline as will, with the aid of the subject matter and vocalized context, suggest the whole word, as *unan* for *unanimous*, etc." This principle is already familiar in longhand, as *Rev.* for *Reverend*, *Ans.* for *answer*, *Jan.* for *January*, *Phila.* for *Philadelphia*, etc. Illustration:

It is *pos*sible that the *suc*cess of the *mag*azine may make it



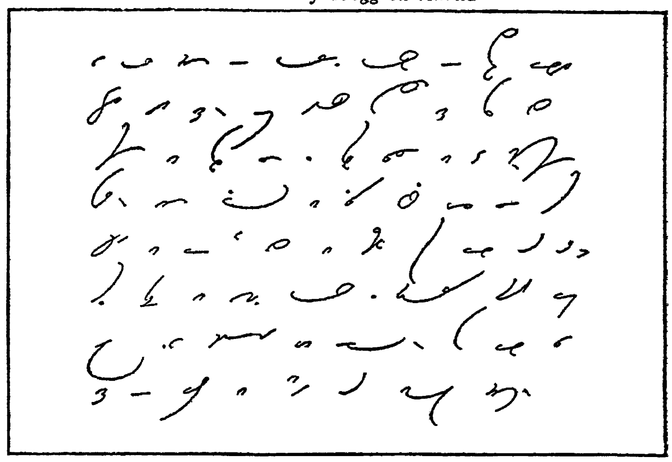
*neces*sary to change the *pol*icy of the *asso*ciation at the next

meeting at *Phila*delphia.

The principle is applied generally to long words not taking regular suffix endings. Its application gives brief and legible word-forms for a large number of words.

Prefixes and Suffixes.—The system is provided with joined and disjoined prefixes and suffixes, built up on the principle of analogy, for the most part, thus: forgive submit parallel overthrow going fairly nation common envy impress express proper

Illustration of Gregg Shorthand



The real success in learning lies in absolute honesty particularly to yourself. Never try to make yourself believe that you have done your best when a voice within you says you should have done better. You can hold your head high only when you have satisfied your own self that your efforts have been honest and thorough. Having chosen your calling, lay a solid foundation on which to build the structure of your knowledge. Be honest with yourself in whatever you undertake, and you will be successful.

Conclusion.—Expert writing of shorthand has been recognized in some States as a profession; the Department of Education of the State of New York conducts an annual examination and awards to those successful in passing the test the degree of C. S. R. (certified shorthand reporter). From 1909 to 1927, the National Shorthand Reporters' Association conducted an annual speed contest consisting of three five-minute dictations on different classes of matter. Records have been established of 280.4 words a minute on court testimony (Charles L. Swem); 259.6 words a minute on judge's charge to the jury (Martin J. Dupraw); and 220 words a minute on straight literary matter (Martin J. Dupraw, Nathan Behrin, Solomon Powsner), the degree of accuracy attained in all cases being greater than 99%.

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(E. J. McN.)

SHORTHOUSE, JOSEPH HENRY (1834–1903), English novelist, was born in Great Charles Street, Birmingham, on Sept. 9, 1834, of Quaker parents. Shorthouse wrote his famous story, *John Inglesant*, when he was forty; he finished it in 1876, and after keeping it for three years in ms. printed 100 copies (1880), one of which came into the hands of Mrs. Humphry Ward, who recommended it to Messrs. Macmillan, but Gladstone

was at once struck by its quality, and made its reputation by his praise. It became the most discussed book of the day, and its author was suddenly famous. Besides *John Inglesant* (1881), Shorthouse published other novels, none of which had the same success. In 1861 he joined the Church of England. Something of his own stress of religious transition appears in the character of his hero. Shorthouse died at Edgbaston on March 4, 1903.

See *The Life, Letters and Literary Remains of J. Henry Shorthouse,* edited by his wife (2 vols., 1905); E. Gosse, *Portraits and Sketches* (1912).

SHORT STORY, THE. It is possible to distinguish between three forms of fiction—the novel (*roman*), the novelette (*nouvelle*) and the short story (*conte*). The difference between the first and second form is a matter of quantity rather than quality: as may be deduced from a comparison of, say, *Kim,* which is a novel, and *The Light That Failed,* which is a novelette. The modern tendency among writers of fiction is to shorten the novel to a novelette, and a stricter sense of art is here at work; a more intensive method of narration, not a less extensive view of men and matters being the compelling motive. The necessity for condensation and the exclusion of passages which have no direct bearing on the plot and characterization, if the attention of a modern reader is to be gripped, has been emphasized by writers as different, nay divergent, in their matter and manner as Merimée, Turgeniev, Stevenson and Kipling, the last-named of whom declared that "the three volume novel is extinct," in the motto prefixed to the literary requiem entitled "The Three-Decker." But the tendency has not proceeded so far that the novelette must be considered a different species from the novel. Moreover there are signs of a reaction in favour of the long, discursive novel in the popularity of William de Morgan's leisurely rambling stories, in the success of Dorothy Richardson's long, analytical studies of motive, and James Joyce's *Ulysses,* which might be described as a three-decker with the Freudian philosophy for ballast.

Totality.—The short story, however, differs from the novel and the novelette, not only in length and size of canvas, but also in its aim and nature. In his famous review of Nathaniel Hawthorne's *Tales* (1842) Poe, the first great master of the modern short story, outlined his theory of the tale that has the force of "totality," which a long novel, not to be read at one sitting, cannot possibly possess:—"In the whole composition there should be no word written, of which the tendency, direct or indirect, is not to the one pre-established design. . . . The idea of the tale has been presented unblemished, because undisturbed; and this is an end unattainable by the novel. Undue brevity is just as exceptionable here as in the poem; but undue length is yet more to be avoided."

The influence of Poe's short stories was immense, particularly in France, but his critical theory was not generally received until 40 years later when Brander Matthews published his well-known essay on "The Philosophy of the Short-Story." In the second part of his essay he summarizes his argument as follows:—"A true short-story is something other and something more than a mere story which is short. A true short-story differs from the novel chiefly in its essential unity of impression. In a far more exact and precise use of the word, a short-story has unity as a novel cannot have it. Often, it may be noted by the way, the short-story fulfils the three unities of the French classic drama; it shows one action, in one place, on one day. A short-story deals with a single character, a single event, a single emotion, or the series of emotions called forth by a single situation."

It may be added that, to achieve "totality" or unity of impression in the highest degree, the short story must be an organic whole. This point is emphasized in a letter written by Stevenson to Sir Sidney Colvin, who had suggested that he should change the end of one of his tales:—"Make another end to it? Ah, yes, but that's not the way I write; the tale is implied; I never use an effect when I can help it, unless it proposes the effects that are to follow; that's what a story consists in. To make another end, that is to make the beginning all wrong. The *dénouement* of a long story is nothing, it is just a 'full close,' which you may approach and accomplish as you please—it is a coda, not an essential member in the rhythm; but the body and end of a short story is bone of the bone and blood of the blood of the beginning."

Brevity.—Brevity, which comes of the artistic desire for the greatest possible economy of means, is not an essential characteristic of the short story. There are many long short stories, of which the most famous are *The Turn of the Screw,* by Henry James (which runs to something like 40,000 words). Stevenson's *Dr. Jekyll and Mr. Hyde,* and *The Man Without a Country* by Edward Everett Hale. One of Dorothy Richardson's full-length novels was once added to the list of long short stories by a facetious critic on the score that it was "about a quarter of an hour!" On the other hand a very brief tale may not possess that organic unity which would justify us in calling it a true short story.

Conscious Unity.—The short story has always existed, though it was not until the 19th century that the art of writing it was consciously practised. As Sophocles said of Aeschylus, these early authors of short stories did the right thing without knowing why. It was only on rare occasions, however, that these happy accidents occurred. Thus Professor Baldwin, after an exhaustive and rather exhausting examination of the hundred tales in Boccaccio's *Decameron,* decided that only two of them—the second story of the second day, and the sixth of the ninth day—are short stories in the modern critical sense, while three others approach the "totality" of impression which is the result of conscious unity in expression. We must go back to the New Testament for a short story which is a structural masterpiece. There can be no denying that the parable of the Prodigal Son, which is only 500 words long in the noble prose of the Authorised Version, satisfies the modern definition, securing the greatest emphasis possible with a surprising economy of means. Setting aside the religious implications of the story and treating it as a single narrative effort, we have to admit that its theme is profoundly interesting, that its three characters are perfectly portrayed, and that it is informed with a complete knowledge of human nature. The reiteration of the beautiful words of compassion and reconciliation: "For this thy brother was dead and is alive again; and was lost and is found" is a stroke of divine artistic genius which completes the whole prearranged design. The parable suggests a gold coin or medal which has been created by a single impact of the die, and it rings true because it is of noble metal nobly wrought. It owes much, no doubt, to the grave simplicity of its style (less than half-a-dozen words in the narrative are of more than two syllables) and this fact should serve to remind us that nearly all fine great short stories in the English language have a distinction of style which measures and maintains the emotional significance of the theme.

The same author has seldom, if ever, been able to write great short stories as well as great novels. Scott's *Wandering Willie's Tale* and Dickens' *A Child's Dream of a Star* are notable exceptions to this rule. Poe, Maupassant, Bret Harte, G. W. Cable, O. Henry, to name a few of the masters of the short story, could not have written great novels—perhaps because the minute exactness and restriction of structure required for success in the short story create a mentality which cannot give us cross-sections through the vast body of human life or trace its bewildering intricacies. The painter of miniatures, if we may risk a comparison from another art, cannot hope to be successful in work on a large canvas.

Poe and Maupassant.—Poe, whose mathematical mind could give a lucid explanation of the how and why of his artistic achievements, was really the ruling influence with Maupassant and other much-imitated French masters of the *conte,* which in their hands so often became a psychological epigram—with a sting, or perhaps a pang, in its conclusion. Nearly all these French story-writers were pessimists, as many of the French masters of aphorisms were, in their view of human nature, and they set their small self-contained dramas against a gloomy background of man's moral turpitude. *Boule de Suif* is perhaps the most powerful example of this cruel criticism of life, and it does grave injustice to the French character which is so kindly and considerate, even

among the *bourgeoisie*, to the courtesan. Anatole France's *Crainquebille* is one of the last large achievements in this mode, which has gone out of fashion since victory in the World War cured the French nation of its inferiority complex. Maupassant, however, will always remain a model of technique, especially for the young writer who suffers from the melancholy which is the shadow of youth's hopefulness.

Kipling.—Kipling, however, has had a more far-reaching influence in the development of the short story, and even those who have come to dislike his philosophy of life, largely as a result of post-war disillusionment, have adopted and adopt his technique, as a rule without admitting their indebtedness, even to themselves. Nine-tenths of the huge output of American short stories to-day might be described as acts of faith in the literary creed: "There is only one Kipling and O. Henry is his prophet." O. Henry, who is faithfully imitated by at least nine in every ten contributors to the American magazines, copied most of Kipling's mannerisms and has made a feature of the expository opening, which is so often used in *Plain Tales from The Hills* and the volumes that followed it in the next few years. It is a popular, but inartistic expedient, which may be compared with the informative soliloquy of the old family servitor in pre-Ibsenite comedies. The younger school of writers reject it, knowing that it is much more effective to convey such information implicitly, through the words and works of the characters, which has the added advantage of not subverting the narrative form. In his later short stories, such as the admirable *They* and *The Brushwood Boy,* the English master has avoided it, nor has he committed the technical blunder (it occurs more than once in the "Plain Tales") of adding superfluous matter when his story is logically complete—a blunder perpetrated by O. Henry in *The Gift of the Magi,* perhaps the most famous of all his stories.

The Russians.—To-day the Russians, especially Chekov and Kuprin, whose *Captain Ribnekov* is one of the best short stories in any language, are the dominating influence with the youngest writers. Since the Slav genius, with its abiding sense of *prostor,* or illimitable horizons, has no liking for such limitations, some of them are in rebellion against the doctrine of unity.

Post-War Stories.—Since the World War ended—to be transferred to the spiritual sphere as a campaign against all manner of conventions—the output of short stories has greatly increased. They appeal strongly to minds too restless and preoccupied to read the old go-as-you-please novels or even the artistically composed and concentrated novelettes. At a rough estimate 100,000 short stories, good, bad and indifferent, have appeared in the last ten years, and it is manifestly impossible to make a critical survey of this vast mass of printed matter. Every type of periodical likes to publish short stories—especially the kind that "lies under the edge of the news"—and it is surprising how high the standard of craftsmanship is in these ephemeral productions. Since, however, they must take the orthodox view of life, including the happy ending, hardly one in a score awakens a second thought. The best of them may be compared with those local French soups, never seen on a hotel menu, of which the cook says: *Ça aide à faire passer le pain.* They help to carry off the news, which is so apt to be more indigestible than fiction.

The Regional Short Story.—The "regional" short story has never been as popular in England as in America and France, and the English public seems to be interested only in the dialect and local life of certain favoured areas, such as "Wessex," Cornwall and Yorkshire, though now and again a specialist in the short story, which is often a personality sketch, goes further afield and yet finds readers—S. L. Bensusan in East Anglia is a case in point. The best writers of the short story in England are generalists, so to speak, who find their themes in the town and countryside. There is a marked tendency among the younger authors to ignore the doctrine of concentration which insists that only one of the three threads—setting, plot and characterization—should be made prominent. Others, again, reject the dogma of unity since they find it does not exist in real life, and their stories are often presentations of a corner of the chaos of luxury, as viewed through a temperament. It is too soon to say whether a new form or forms will come into being and be established as a result of this rebellion against tradition.

Modern Writers.—Katherine Mansfield, who sought truth and found beauty by the way, is one of the inspiring influences which is revitalizing the short story to-day. Her noble supplication "May I be found worthy to do it! Lord, model me crystal clear for Thy light to shine through" was granted to such an extent that her best stories, such as *Ma Parker* and *The Doll's House* are illuminated throughout by a serene glow of comprehension. She, like most of the writers she has influenced by her notable achievement and still more noble promise, holds that form was made for the artist, not the artist for form. Other sincere artists, whose work will survive, are C. E. Montague (his *Fiery Particles* is a triumph), Miss Tennyson Jesse, Stacy Aumônier, Neil Lyons, Aldous Huxley and Princess Bibesco. But A. E. Coppard is perhaps the finest of all these young and sincere artists, who refuse to sacrifice truth to a beautiful epigram or to fall over the slippery verge of sentimentality. His style, beguiling and yet bewildering, is a new wine that creates its own new bottles, and he—and perhaps the same may be said of Princess Bibesco, whose lucidity is that of diamonds, which are not meant to be seen through—is the most original and provocative English writer of short stories at the present moment. (E. B. O.)

THE UNITED STATES

The short story, as it is now defined,—brief prose fiction with limitations and laws that make of it a distinct literary form—had its beginning in America in the *Sketch Book* of Washington Irving. Before 1819 there had been short fiction,—an abundance of it: the tale in prose and verse is in all languages one of the most abundant varieties of literature, but Irving was the first to recognize that it could be moulded into a prose literary form that would have laws and an individuality of its own.

The causes that led Irving as a pioneer into this field were three. (1) He had been stranded in England without funds, and he knew of no source of income for himself save through some variety of literary creation; (2) temperamentally he was fitted only for short dashes at literature; a novel, as he later abundantly proved, was not within his powers; (3) he realized that to succeed he must offer something distinctly his own. The popular literary form of the time was the romantic tale, told in verse after the Scott-Byron patterns or else in prose after the fashion of the German *märchen,*—tales of terror, ultra-romantic and often ultra-sentimental. Irving, intent upon originality, evolved the "sketch" as he called it. First of all, it was to be a thing for entertainment only, with no touch in it of the Addison-Steele-Goldsmith moralizing. Then, too, it was to descend from the general to the particular. He was not to deal with types but with individuals and individual localities. With no attempt at plot or dramatic action, he would induce in the reader a mood, an emotion: he would create an atmosphere. The short story was to be the frame on which he was to hang his materials; the materials were the all-important things. The difficulties attendant upon the creation of this variety of narrative as compared with the ease of writing the looser form of the novel he made clear in a letter to Brevort: he was the first to recognize, therefore, the short story as a distinct form. That he had evolved such a form he never once doubted. "I choose to take a line of writing peculiar to myself rather than to fall into the manner or school of any other writer," he wrote to a friend. "It is true other writers have crowded into the same branch of literature, and I now begin to find myself elbowed by men who have followed my footsteps; but at any rate I have had the merit of adopting a line for myself, instead of following others."

THE FORCE OF IRVING'S EXAMPLE

The influence of Irving was immediate and wide-spread. His great European success stimulated the group of young writers that, as we see it now, was to become the most distinctive in American literary history. A veritable epidemic of sketch-writing was the result. But there was no outlet for these sketches. The magazines were few and they paid nothing. At this critical moment, however, there came what must be denominated the second step in the evolu-

tion of the American short story: in 1826 was issued in Philadelphia the first number of an annual, or gift-book, *The Atlantic Souvenir*, soon to be followed in Boston by *The Token*, and then by others in all directions, literally by the hundreds. These annuals prided themselves on their American contents; they were illustrated with American-made steel engravings and filled with American poetry and prose. They sold large editions, and as a result they were able to pay contributors and thus become the source of nourishment for the first group of writers—Catherine Sedgwick, Paulding, Simms, Hawthorne, Poe and others. To *The Token* Hawthorne was able to sell no less than 24 of his "Twice-Told Tales," as he later called them.

A direct result of the great success of the annuals came in 1830 with *Godey's Lady's Book* which may be described as a monthly gift book. It specialized in short fiction, ruling from its columns all continued stories. Its phenomenal success, especially after it had called as its editor Sarah Josepha Hale, brought a host of imitators. Soon the age of magazines had opened in America—*Burton's, Peterson's, The Gentleman's, Graham's, Sartain's* and the like, all of them eager for original and well-written single-number pieces of fiction. It was Poe's contention that the short story was the child of the American magazine.

Another element helped in the evolution of the shortened form: the lack of international copyright laws. So long as it was possible for American publishers to secure for nothing their pick from the current fiction of England, they were in no haste to pay obscure American writers for their questionable products. In the mid-century Willis complained bitterly that he was forced to write short pieces instead of novels: "We must either write books to give away, or take some vein of literature where the competition is more equal—an alternative that makes almost all American authors mere contributors of short papers to periodicals."

Nathaniel Hawthorne.—After Irving the second important figure in the history of the short story was Nathaniel Hawthorne, who made of the form the study of a single intense situation often allegorical in its setting. He deepened the current of the short story and made it respected as a serious art form—he gave it beauty of style; and he perfected for it an artistry that called forth the praise of Poe. It was while reviewing the 1842 edition of *Twice-Told Tales* that Poe awoke to the conception of the "prose tale" as a distinct literary form, and he proceeded to formulate the laws governing it—a remarkable piece of criticism, the first codification ever attempted of short-story laws. The tale, he ruled, should be what one could read at a sitting. It must have singleness of aim, unity of tone from the first sentence, originality, compression, picturing power and "truth."

Poe.—Poe doubtless was thinking as much of his own artistry as he was of Hawthorne's. The review with scarcely a change could serve as an introduction to his *Tales of the Grotesque and Arabesque*. He had begun as a prose-writer by making travesties of the conventional short fiction of the time, but soon he awoke to the realization that in the "prose tale" he had a literary form that could express all that his imagination might body forth. From the time of his assumption of the editorship of the *Southern Literary Messenger*, until near the time of his death, he was by profession a magazine editor, and more and more his product was stamped with magazine requirements. "The whole tendency of the age," he wrote in 1840, "is magazineward." And the magazine demanded originality, variety, piquancy, movement. "We now demand," he wrote, "the light artillery of the intellect; we need the curt, the condensed, the pointed, the readily diffused—in place of the verbose, the detached, the voluminous, the inaccessible." And Poe gave in his tales what the age demanded: originality, sensation, shortness, variety. His total product is remarkably varied. It hardly seems as if "The Fall of the House of Usher" could have come from the same pen as "The Murders in the Rue Morgue" which is the parent of the modern detective story. He was of the school of Coleridge in all his work: unlike Hawthorne, he stood for art for mere entertainment, art without moral basis or message, "art for art's sake."

During the decade after Poe's death in 1849, the decade of the Bohemian group of writers in New York, the short story languished. With the entry of a veritable swarm of "female writers" into the field of fiction the "tale" became a sentimental thing, delighting in the romantic and the marvellous, and the mawkishly pathetic. The influence of Dickens was everywhere apparent. It was the decade of Fitz-James O'Brien, the brilliant leader of the Bohemians and the creator of a few remarkable tales like "The Diamond Lens" and "What was It?" But O'Brien was too headlong, too impatient, too intense. He finished nothing.

Just before the Civil War a revivifying breath came to American fiction through the new *Atlantic Monthly* (1857) under the editorship of James Russell Lowell. Lowell himself wrote no fiction but he had positive convictions as to the nature and demands of this literary form. He believed in the short story as a dignified piece of art; during his editorship of the magazine there was an average of three stories in every number. And he demanded actuality,—he preferred tales of humble life with characters from the Hosea Biglow area of society. As a result his leading contributor was Rose Terry Cooke, who put into short fiction (eight stories in the first year of the magazine) the first actually realistic studies of New England rural life. Other contributors were Rebecca Harding, whose "Life in the Iron Mills" was as grim a piece of realism as may be found in American literature, and Edward Everett Hale, who added a whimsical lightness of touch to his tales that gave them a distinction of their own. His tale, *The Man Without a Country*, has become an American classic.

POST CIVIL WAR PERIOD

The Civil War was followed by an expansion period. Railroads were pushed in all directions and by the end of the decade of the '60s the first line had been completed across the continent into California. The telegraph had annihilated distance, and provincialism was everywhere breaking down. The result was a new discovery of America—by Americans themselves. Bret Harte was the pioneer in the new period. From the California which had become to the world almost a fabulous area, came in 1868 a new and startling type of short story, highly picturesque, wrought with dramatic art, furnished with characters after the Dickens model, and though really romantic, so told as to suggest the barest realism. The "Luck of Roaring Camp" stories mark the beginning of a new period in the history of the short story. The fame of such exquisite pieces of art as "Tennessee's Partner" and "The Outcasts of Poker Flat" swept over America and then over England like a prairie fire. They advertised the short-story form enormously. Soon "local colour" tales were coming in from every picturesque area in America. Mark Twain came in from Nevada and the Comstock Lode with "The Jumping Frog" extravaganza, from New Orleans George W. Cable sent his "Old Creole Days" tales, from the Lake country Constance Fenimore Woolson contributed her "Castle Nowhere" tales. Then from New England came Sarah Orne Jewett's and later Mary Wilkins Freeman's stories, from Tennessee Mary N. Murfree's studies of the Great Smoky mountains signed with the pen name "Charles Egbert Craddock," from Georgia came the inimitable Uncle Remus folk-lore stories by Joel Chandler Harris. "Local colour" swept into the magazines in a veritable flood. The high tide came in the mid '80s, when Thomas Nelson Page's "Marse Chan," written wholly in negro dialect, appeared in the *Century Magazine*.

Henry James.—Not all of the short stories of the period were in "local colour." Henry James was evolving his psychological studies into a short story form of his own devising—the story of character analysis developed scientifically by the aid of a multitude of minute touches. He needed room for this variety of tale, always two and three magazine numbers, yet it is impossible to classify these pieces other than as short stories. As compared with the novel he considered the short story form inferior, yet he never abandoned it, and first and last he expressed in it some of his strongest contributions. His gruesome tale "The Turn of the Screw" is a masterpiece.

Lightness and humour and finesse were brought to the short story by Frank Stockton, whose extravaganzas, like "The Transferred Ghost" and "Negative Gravity," done with verisimilitude—outrageous impossibilities rendered seemingly possible and even

probable—are unique. His story *The Lady or the Tiger?* with its ingenious ending, became, perhaps, the most famous story of its period. Its influence was surprising and far-reaching. It impelled Brander Matthews to write his suggestive article *The Philosophy of the Short-Story,* in which he suggested that since the French term *conte* was not available for the new form the term Short-Story should be written with a capital and hyphenated to distinguish it from the story that was merely short. It also awakened Henry Cuyler Bunner, editor of *Puck,* who wrote his *Short Sixes* series of tales with a mastery of art that showed the larger possibilities of the short-story form.

Then with the '90s came the era of the handbooks, a veritable outpouring of text-books formulating short-story art, collections of specimens, and outlines for correspondence courses. A study of the art of short-story writing was soon introduced everywhere into the courses of high schools and colleges. Then had come the O'Brien annual with specimens of the best product of the year, to be followed by the O. Henry Society annual. With the '90s came also an increasing output of stories of every variety. Magazines were cheapened and multiplied and their prosperity rendered them able to pay high prices for short-story contributions. The decade saw the beginnings of the short-story work of Hamlin Garland, whose *Main Travelled Roads* volume is distinctive, the first works of James Lane Allen, Richard Harding Davis, Mary E. Wilkins Freeman, Alice Brown, Ambrose Bierce and a host of others.

Jack London.—With the opening of the new century came two creators who were able to deflect the current of the short story into new channels, Jack London and Sydney Porter. London, a native of California, an adventurer, a sailor with the sealing fleet, a tramp, a miner in Alaska in the first days of the gold rush, an explorer in his own yacht of the South Seas, gave first of all Alaska tales, *The Call of the Wild,* episodes in the life of a super-dog of the North, and when that gold lode was exhausted, wild adventure tales of the cannibal seas. He wrote with colour, exaggeration, poetic abandon, with movement always and romantic atmosphere, and he gave always the sense of actuality, the impression that he himself had been present and that this was a part of his own life.

O. Henry.—Sydney Porter, who wrote under the pen-name "O. Henry," was also an adventurer,—a ranchman in Texas, a fugitive in South America, an inmate of the Ohio State prison, a reporter on a New York newspaper. He was a humorist, an entertainer, a man with a bag of literary tricks which he handled most dexterously, and withal he was gifted with a style which at times is exquisite, and with a vocabulary that is worth one's study. His tales are padded with slang, with surprises within surprises, with outrageous comparisons, and antitheses—everywhere the unexpected. Enormous was their popularity. Sets of his books were sold by the hundreds of thousands. His influence was such that for a time it swung the short story almost wholly to manner rather than to matter.

The waning of the O. Henry influence was followed by a reign of short-story lawlessness—deliberate revolt. The younger group which in 1929 was in the fullness of its creative powers, seems to be striving for originality, for strangeness, for a breaking away from the conventions so long in force. With the new century had come realism and disillusion in increasing power until they have become a ruling force. We can only say that short-story making and teaching have become veritable national industries and the output seems to be increasing. (F. L. Pa.)

SHOSHONE. This loose group of western American Indian bands gave name to the much larger Shoshonean family, or Shoshonean branch of the Uto-Aztecan family. The Shoshone proper occupied a continuous territory from central Wyoming to eastern California, and an offshoot, only dialectically different, are the Comanche of Texas. The culture varied, according to locality, from Great Basin (Plateau) to Plains type. Politically, the Shoshone have always been disunited.

SHOSHONG, a town in the British protectorate of Bechuanaland, formerly the chief settlement of the eastern Bamangwato. It is about 200 m. N.N.E. of Mafeking and 30 m. N. of Shoshong Road station on the Cape Town-Bulawayo railway. At the time of the declaration of a British protectorate in 1885 Shoshong had 20,000 to 30,000 inhabitants, including about twenty Europeans. Being the meeting place of trade routes from south and north it was of considerable importance to early explorers and traders in South-Central Africa. The population is now about 800. (*See* BECHUANALAND.)

SHOT TOWER, a tower generally about 200 feet high in which gun shot is made by dropping melted lead through a sieve, or drop pan, at the top to a tank of water at the bottom, the falling liquid assuming the round form of raindrops. The largest shot made this way, .20 inches in diameter, is dropped through about 150 feet; the smallest, dust shot, through 40 feet. The shot is polished by rotating it in a barrel with graphite. There are several shot towers in operation in England; in the United States there are shot towers at New Haven and Bridgeport, Connecticut; East Alton, Illinois; Kings Mills, Ohio; and San Francisco.

SHOTTS, mining and manufacturing parish of Lanarkshire, Scotland. It comprises eight villages, parts of two others, and the town of Cleland and is served by the L.N.E. and L.M.S. railways. Pop. (1931) 20,537. The parish contains large ironworks, collieries and quarries. Matthew Baillie (1761–1823), and Janet Hamilton (1795–1873), the poetess, were born in the parish of Shotts.

SHOVEL, SIR CLOUDESLEY or CLOWDISLEY SHOVELL as he seems to have spelt the name himself (*c.* 1650–1707), English admiral, was baptised at Cockthorpe in Norfolk on Nov. 25, 1650, and went to sea under the care of his kinsman Sir Christopher Mynns. He was present as captain of the "Edgar" (70) at the first fight at Bantry Bay, and shortly afterwards was knighted. In 1690 he convoyed William III. across St. George's Channel to Ireland; the same year he was made rear-admiral of the blue, and was present at the battle of Beachy Head on July 10. In 1692 he was appointed rear-admiral of the red, and joined Admiral Russell, under whom he greatly distinguished himself at La Hogue, by being the first to break through the enemy's line. When Russell was superseded, Shovel was put in joint command of the fleet with Admiral Killigrew and Sir Ralph Delaval. In 1702 he brought home the spoils of the French and Spanish fleets from Vigo, after their capture by Sir George Rooke, and in 1704 he served under Rooke in the Mediterranean and co-operated in the taking of Gibraltar. As commander-in-chief of the British fleets he co-operated with Peterborough in the capture of Barcelona in 1705, and commanded the naval part of the unsuccessful attempt on Toulon in October 1707. When returning with the fleet to England his ship, the "Association," struck on the rocks near Scilly (Oct. 22), and was seen by those on board the "St. George" to go down in three or four minutes' time, not a soul being saved of 800 men that were on board. The body of Sir Cloudesley Shovel was cast ashore next day, and was buried in Westminster Abbey.

See *Life and Glorious Actions of Sir Cloudesley Shovel* (1707); Burnet's *Own Times;* various discussions in *Notes and Queries,* 5th series, vols. x. and xi.; and T. H. Cooke, *Shipwreck of Sir Cloudesley Shovel* (1883).

SHOVELLER, a word originally applied to the bird now termed spoonbill (*q.v.*), but now used of *Spatula clypeata,* a duck characterized by its broad flat beak, the edges of which are beset with long lamellae by means of which food particles are filtered off from the water just as is done by the baleen in whalebone whales. The shoveller is a surface-feeding duck, and the male, with his contrasted plumage of white, brown and bay, dark green head and speculum, and orange feet, is a handsome bird. The female resembles in plumage the ordinary wild duck. The shoveller breeds locally over the greater part of Europe (including Great Britain), Asia and North America, wintering farther south, where it reaches India, Abyssinia, Central America and even Australia. Other species inhabit South America, South Africa, Australia, and New Zealand.

SHRAPNEL: *see* AMMUNITION.

SHREVEPORT, a city of north-western Louisiana, U.S.A., at the head of navigation on the Red river; the capital of Caddo parish. It has a municipal airport; is on Federal highways 71, 171 and 80; and is served by the Illinois Central, the Kansas

City Southern, the Louisiana and Arkansas, the Louisiana Railway and Navigation company, the St. Louis South-western, the Southern Pacific and the Texas and Pacific railways, and by numerous motor-bus and motor-truck lines. Pop. 43,874 in 1920 (57% native white and 40% negroes); 67,641 in 1927, according to a special enumeration under the supervision of the Federal Census Bureau; and, after annexations of territory, was 76,655 in 1930 by Federal census.

The city has an area of 27 sq.m., an assessed valuation for 1927 of $121,111,580, and a commission form of government. The Caddo parish court-house (completed in 1928, at a cost of $1,250,000) is a structure of unusual beauty and many interesting features, including a gaol on the seventh and eighth floors, the highest in the building. The city has 56 schools, 98 churches representing 12 denominations, nine hospitals with a total of 1,000 beds, 22 hotels with a total of 1,500 guest-rooms, a municipal auditorium seating 5,000, and seven theatres, including a charming playhouse for the "little theatre." It is the seat of Centenary college (Methodist; founded at Jackson in 1825 and moved to Shreveport in 1908) and the Dodd Junior college (1927), and the home of the Louisiana State fair. There are 12 lakes in the vicinity, providing good fishing and duck-hunting. Shreveport is the largest city within a radius of 175 m., and therefore an important commercial and financial centre. Its trade territory covers a rich agricultural region, vast forests of hard and soft woods, and one of the greatest oil and gas areas of the Mid-Continent field. The Caddo oil-field, north-west of the city, which field includes the Caddo Lake in its area, produced 4,067,000 bbl. in 1925. The city is headquarters for 230 oil-operating firms or individuals, and has seven large refineries. Petroleum products constitute about half (measured by value) of its total factory output, which in 1927 was valued at $20,707,409 and included 90 different products. Lumber and lumber products, on which the earlier development of the city was based, rank second in importance, and fertilizer to the amount of 75,000 tons is manufactured annually. Bank debits for 1926 aggregated $483,902,000.

Shreveport is in the Caddo Grant, a tract ceded to the United States by the Caddo Indians in 1837. In 1835 Captain Henry Miller Shreve (who had charge of improvements on the western rivers from 1826 to 1841) came up the river in his snag boat and founded a settlement here. In 1839 Shreve's Landing was incorporated as a town, and the city was chartered in 1871. In 1862, after the capture of Baton Rouge and New Orleans by the Unionists, Shreveport was occupied by the Confederate officials of the State. In the spring of 1864 it was the objective of combined land and naval expeditions of Union forces, in the course of which the Federals were worsted at Mansfield on April 8, and the Confederates at Pleasant Hill on April 9. Development of the oil and gas resources of the region began in 1906.

SHREW, a term applied to the members of the family *Soricidae* of the mammalian order Insectivora (*q.v.*).

Sorex araneus, the common shrew, or shrew-mouse (though it does not resemble the mouse in structure or in habits) is a small animal about the size of a mouse, but distinguished externally by its long slender muzzle, which projects far beyond the lower lip. The small eyes are almost concealed by fur; the ears are short, wide and provided internally with a pair of deep folds capable of closing the entrance; the tail is slightly shorter than the body, quadrangular in section, and hairy, with a short tuft at the tip. The body fur is soft and dense, brown above, grey below. Between the elbow and the knee is a gland secreting a fluid with an unpleasant cheesy odour.

The lesser or pigmy shrew (*S. minutus*) is smaller and differs slightly in its dentition. Like the last, it extends across the whole of Europe and Asia. Both live in the neighbourhood of woods, feeding by night on insects, worms, and slugs. They are pugnacious and very voracious and produce five to seven naked, blind, and toothless young in a litter.

The alpine shrew (*S. alpinus*) is restricted to the Alps of Central Europe. It is slightly larger than the common shrew and the fur is uniformly dark.

The largest American shrew is *S. bendiri.* Numerous other species, many belonging to the allied genus *Blarina,* characterized by a short tail, occur on this continent. They resemble the Old World shrews in habits.

The water-shrew (*Neomys fodiens*) is larger than the common shrew and aquatic in habits. It has much the same range as *S. araneus.* In America, two species of *Sorex* are aquatic, *S. palustris* being the commonest.

SHREWSBURY (shrōz'brĭ), **EARLS OF.** This, one of the most ancient Earldoms in the English peerage, dates from the time of William the Conqueror. Roger de Montgomery (*c.* 1030–1094), son of another Roger de Montgomery, known as "the Great," was a councillor of William, duke of Normandy, before his invasion of England, and was probably entrusted by William with the government of Normandy during the expedition of 1066. Roger received territory in Sussex, including the city of Chichester and the castle of Arundel, he became earl of Arundel, or probably and more correctly earl of Sussex. In 1071 the greater part of the country of Shropshire was granted to him, carrying with it the title of earl of Shropshire, though, from his principal residence at the castle of Shrewsbury, he like his successors was generally styled earl of Shrewsbury. He probably exercised palatine authority. He was the founder of Shrewsbury Abbey in 1083. His first wife was Mabel, daughter of the seigneur of Belesme and Alençon; hence his son Robert, who, after the death of another son, Hugh, succeeded to the earldoms of Shrewsbury and Arundel, was generally known as Robert de Belesme (*q.v.*), one of the most celebrated of the feudal nobles in the time of Henry I. Robert having been deprived of all his English estates and honours in 1102, the earldom of Shrewsbury was next conferred in 1442 on John, 5th baron Talbot, whose descendants have borne the title to the present day. (*See* TALBOT; and SHREWSBURY, 1ST EARL OF.)

SHREWSBURY, CHARLES TALBOT, DUKE OF (1660–1718), only son by his second wife of Francis Talbot, 11th earl of Shrewsbury, was born on July 24, 1660. His mother was a daughter of Robert Brudenell, 2nd earl of Cardigan, and the notorious mistress of the 2nd duke of Buckingham, by whom his father was killed in a duel in 1668. Charles was a godson of Charles II., and he was brought up as a Roman Catholic, but in 1679 under the influence of Tillotson he became a member of the Church of England. On his father's death in 1668 he succeeded to the earldom of Shrewsbury; he received an appointment in the household of Charles II., and served in the army under James II. But in 1687 he was in correspondence with the Prince of Orange, and he was one of the seven signatories of the letter of invitation to William in the following year. He crossed to Holland to join William, and landed with him in England in November 1688. Shrewsbury became a secretary of state in the first administration of William and Mary, but he resigned office in 1690 when the Tories gained the upper hand in parliament. While in opposition he brought forward the triennial bill, to which the king refused assent. In 1694 he again became secretary of state; but there is some evidence that as early as 1690, when he resigned, he had gone over to the Jacobites and was in correspondence with James at St. Germains. It has been stated that William connived at the correspondence. However this may be, William seems not to have suspected Shrewsbury's loyalty, for he was created marquess of Alton and duke of Shrewsbury, and acted as one of the regents during the king's absence from England. In 1696 definite accusations of treason were brought against him by Sir John Fenwick, which William himself communicated to Shrewsbury. The latter asked to resign on ground of health, and in 1700 the king accepted his resignation reluctantly.

For the next seven years Shrewsbury lived abroad, chiefly at Rome, whence in 1701 he wrote a letter to Lord Somers declaring that if he had a son he "would sooner bind him to a cobbler than a courtier, and a hangman than a statesman." When he returned to England in 1707 he gradually became alienated from his old Whig associates, and in 1710 became lord chamberlain in the Tory administration, to which the queen appointed him without the knowledge of Godolphin and Marlborough, while his wife

was at the same time made a lady of the bedchamber. Shrewsbury became lord lieutenant of Ireland in 1713; but he was in London in July 1714 during the crisis occasioned by the impending death of Queen Anne. On July 27, when the queen was dying, Oxford was dismissed, and Anne appointed Shrewsbury to the vacant treasurership. When the queen died on Aug. 1, Shrewsbury was able to influence the succession to the crown. He threw his influence into the scale in favour of the elector of Hanover, and powerfully promoted the peaceful accession of George I. He exchanged his onerous office for that of lord chamberlain. This also he resigned in 1715. He died on Feb. 1, 1718.

In 1705 Shrewsbury married Adelaide, daughter of the Marquis Paleotti of Bologna. On the accession of George I. the duchess became a lady of the bedchamber to the princess of Wales. Shrewsbury left no children, and at his death the dukedom became extinct, the earldom of Shrewsbury passing to his cousin Gilbert Talbot. (*See* TALBOT.)

See *Correspondence of Charles Talbot, Duke of Shrewsbury, with King William, the Leaders of the Whig Party, &c.*, edited by W. Coxe (London, 1821); Gilbert Burnet, *History of his own Time* (6 vols., 2nd ed., Oxford, 1833); F. W. Wyon, *History of Great Britain during the Reign of Anne* (2 vols., London, 1876); Earl Stanhope, *History of England comprising the Reign of Anne until the Peace of Utrecht* (London, 1870), and *History of England from the Peace of Utrecht*, vol. i. (7 vols., London, 1836–54); *The Wentworth Papers*, edited by J. J. Cartwright (London, 1883); W. E. H. Lecky, *History of England in the Eighteenth Century*, vol. i. (new edition, 7 vols., London, 1892); and G. E. C., *Complete Peerage*, vol. vii. (London, 1896).

SHREWSBURY, ELIZABETH TALBOT, COUNTESS OF (1518–1608), better known as "Bess of Hardwicke," was the daughter and co-heiress of John Hardwicke of Hardwicke, Derbyshire. She was four times married—to John Barlow, Sir William Cavendish, Sir William St. Lo (or St. Loe), and finally, in 1568, to George Talbot, 6th earl of Shrewsbury. With each marriage she made a good settlement, and before she married Shrewsbury was accounted the wealthiest woman in England. She now arranged a marriage between her daughter Elizabeth and Charles Stuart, brother of Lord Darnley, without consulting her husband. Since the Lennox family were of royal blood, Elizabeth thought the countess over-ambitious, and sent her to the Tower for a short time. The child of the Stuart marriage was the unfortunate Arabella, a claimant to the throne.

By this time the earl of Shrewsbury and his wife were on very bad terms with one another, and the former tried to obtain a divorce. The countess revenged herself by accusing him of a love intrigue with the queen of Scots, a charge which she was forced to retract before the council. In the meantime she repeated scandal about Elizabeth to Queen Mary, who made use of it in the extraordinary letter she wrote some time in 1584. In 1583 the countess of Shrewsbury went to live apart from her husband, with whom she was afterwards reconciled formally by the queen. After his death, in 1590, she lived mostly at Hardwicke, where she built the noble mansion which still stands. She was, indeed, one of the greatest builders of her time at Hardwicke, Chatsworth and Oldcoates. It is said that she believed she would not die so long as she was building. Her death came on Feb. 13, 1608, during a frost which put a stop to her building operations. She was buried in All Saints' church, Derby, under a fine monument with a laudatory inscription which she took care to put up in her lifetime.

See White Kennett, *Memoirs of the Cavendish Family* (London, 1708); and Mrs. Murray Smith (Miss E. T. Bradley), *Life of Arabella Stuart* (London, 1889); Mrs. Stepney Rawson, *Bess of Hardwicke* (1910).

SHREWSBURY, JOHN TALBOT, 1ST EARL OF (d. 1453), was second son of Richard, 5th baron Talbot, by Ankaret, heiress of the last Lord Strange of Blackmere. He was married before 1404 to Maud Neville, heiress of the barons Furnivall, and in her right summoned to parliament from 1409. In 1421 by the death of his niece he acquired the baronies of Talbot and Strange. He served in the Welsh wars (1404–13), was lord lieutenant (1414–19) of Ireland, where he saw more fighting, had a command in France (1420–24), and, after a brief stay at home on the Welsh marches, he was back at the French war in 1427. He fought at the siege of Orleans. Talbot's stubborn rashness was chiefly to blame for the English defeat at Patay in June 1429. After Patay Talbot was four years a prisoner. On his release he became one of the foremost of the English captains. In 1434 he recovered the county of Clermont, next year took part in the siege of St. Denys, and in 1436 by reducing and harrying the revolted Pays de Caux saved Normandy. He was rewarded with the offices of captain of Rouen and marshal of France. During five years as a dashing fighter he was the mainstay of the English cause. His chief exploits were the defeat of the Burgundians before Crotoy in 1437 and the recovery of Harfleur in 1440. In 1442 during a visit to England he was created earl of Shrewsbury. In November he was back in France besieging Dieppe; but "fared so foul with his men that they would no longer abide with him" and was forced to break the siege (*Chronicles of London*, p. 150). In March 1445 he was once more sent to Ireland, where he used his old methods, so that the Irish said "there came not from the time of Herod any one so wicked in evil deeds." In 1449 he served for a short time in Normandy.

When in 1452 the Gascons appealed for English help, Shrewsbury was the natural leader of the expedition. He landed in Aquitaine on Oct. 17. Bordeaux and the surrounding district returned quickly to their old allegiance, and in the following summer Shrewsbury captured Fronsac. In July the French besieged Castillon. Shrewsbury hurried to its relief, and with foolhardy valour attacked the enemy in their entrenched camp without waiting for his artillery. The English and Gascon footmen charged in vain in face of the French cannon, until Shrewsbury and the flower of his troops had fallen. This happened in July 1453, and was the end of the English rule in Gascony. Shrewsbury's fighting qualities made him something of a popular hero, and in the doggerel of the day he was "Talbot our good dog," whose valour was brought to nought by the treason of Suffolk. But in truth though a brave soldier he was no general. He was twice married, his second wife being Margaret, eldest daughter of Richard Beauchamp, earl of Warwick.

BIBLIOGRAPHY.—For Shrewsbury's French campaigns see especially the *Chronique* of E. de Monstrelet, Jehan de Waurin and Matthieu d'Escouchy (all these are published by the *Société de l'Histoire de France*), and the *Chronicles of London* (ed. C. L. Kingsford, London, 1905). Also H. Ribadieu, *Conquête de Guyenne* (1866); J. T. Gilbert, *Viceroys of Ireland* (1865); and J. H. Wylie's *Henry the Fourth* (1884–1898) for his early career.

SHREWSBURY (Salop; Welsh Amwythig), an ancient market centre and the county town of Shropshire, England. Pop. (1931) 32,370. Its position in relation to the routes leading into Wales and along the border has made it a town of great importance. The old part of the town, including churches, old houses and market hall, lies almost entirely within the remarkable southward loop here described by the Severn.

History.—The picturesque red-sandstone castle, built originally by Roger de Montgomery (1070), crowns the narrow bluff which forms the neck of the peninsula. Under the castle clusters the town, with its half-timbered houses and narrow, quaintly-named streets, leaving the public park or Quarry, outside the old walls but still within the loop of the river. Over its two ancient bridges, the English and the Welsh, the town early spread east and west into Abbey Foregate, around the abbey church and into Frankwell on the Welsh side. The strategic position of the peninsula rising above the Severn floodlands was recognized from the time of the princes of Powys, who made it their seat, called Pengwern, in the 5th and 6th centuries. At the end of the 8th century it was engulfed in the province of Mercia and given its Saxon name Scrobesbyrig, with alternative Sloppesbury, from which came the modern titles, Shrewsbury and Salop, respectively.

As a Saxon and Norman town it became the base of operations, alike of war and peace, extending up the lowland ways westward into the upper Severn valley. Being one of the chief border towns it was besieged and plundered by the Welsh on numerous occasions, and was never without fear of sudden raids. The first extant charter, dated 1199, is a grant by Richard I. to the burgesses of the town at a fee farm of 40 marks, but Henry II. is known

to have granted an earlier charter which was confirmed by King John in 1200. Henry II. in 1227 granted a gild merchant with a house. Besides these charters there are numerous confirmations before the incorporation charter of Elizabeth of 1586. Charles I. in 1638 altered the corporation to a mayor, 24 aldermen and 48 assistants. In 1684 the burgesses surrendered their charter to the king and received a new one in the following year which, however, did not change the form of government. In 1403, at Battlefield on the north side of the town, Henry Percy was defeated by Henry IV. During the late Middle Ages and again in Tudor and Elizabethan times the town profited greatly from trade with the Welsh in wool and flax. The Severn was navigable for about 40 m. above Shrewsbury, and this enabled a vast amount of commerce to be carried on with Gloucester and Bristol.

With the establishment of law and order in the Marches in Tudor times, Shrewsbury and the border saw a period of great prosperity which had as one of its expressions the spread of the custom of building half-timbered houses. Ireland's mansion (*c.* 1580), Owen's mansion (*c.* 1592), the Drapers' hall and the stone Market hall are examples of the art which culminated at this time. Another feature of border or "fall line" towns in general is exemplified by growth of the industry of printing, *e.g.*, of many Welsh books in the 17th century. The importance of the town houses of the country gentry in the 18th century consolidated the position of the town as a regional centre; while as a market and route town it has continued to flourish. The remarkable concentration of road and rail routes can be best seen from a map. Since 1918 important steam-waggon works and other industries have grown on flat lands to the north of the old settlement; and additions to the town are extending along all the main roads so that the effective urban population is much larger than the census figure given, being probably 35,000 or 40,000. Old established industries include brewing, melting and tanning. The general station, a joint station of the G.W.R. and L.M.S.R., deals with a vast amount of traffic, and the labour attracted is one important feature of the town's development.

Buildings, etc.—Shrewsbury castle, now the property of the mayor and corporation, was restored by Telford, but retains the walls of the inner court and two round Edwardian towers. Opposite the castle entrance are the old grammar school buildings, in front of which is a bronze statue of Darwin, who was born at the Mount, in Frankwell. The schools now occupy a site south of the river, in Kingsland, formerly the scene of the Shrewsbury show, a pageant held during the Festival of Trinity. St. Mary's church, in a commanding position on high ground south of the castle, is a noble building with a lofty tower and spire, displaying examples of various styles of architecture from early Norman to Perpendicular. It has some interesting painted glass brought from the abbey of Altenburg and a large 14th century Jesse window at the east end, taken from Old St. Chad's. St. Alkmond's and St. Giles's are old foundations, much altered subsequently. Old St. Chad's church was destroyed by the fall of the tower in 1788, the new church being built shortly afterwards, on a new site, with a round auditorium. The restored Abbey church (Holy Cross), retains its massive Norman nave, built of deep red sandstone, and there also remain two Early English arches and an imposing decorated western tower. Of the monastic buildings little is left, save a remarkable roofed outdoor pulpit of ornate Decorated work.

In the centre of the old town is the Market square with the old market house, an Elizabethan building of 1596. Butcher row, up a narrow "shut" from the square, contains some noteworthy 15th century houses.

Shrewsbury is the seat of a Roman Catholic bishop. For purposes of parliamentary representation the borough is included in the Shrewsbury division, together with the rural districts of Atcham and Chirbury.

SHRIKE or **BUTCHER-BIRD,** the common names of birds of the family *Laniidae. Lanius excubitor,* the greater butcher-bird, or great grey shrike—a bird which visits the British Islands in autumn or winter and occasionally in the summer; breeds from the north of France to within the Arctic Circle. Exceeding a song-thrush in length, it is more slender; pearly grey above with a black band on the head, beneath it is nearly white, or in Eastern varieties with dusky bars. The wings and tail are black and white. The smaller red-backed shrike, *L. collurio* is a well-known summer visitor to Great Britain. The cock has a grey head and neck, black cheek-band, chestnut back and pale rosy breast, while the hen is duller. The nest, in a clump of brambles, thicket or hedge, contains five or six eggs, very variable in colour but usually spotted with brown or red-brown. The alarm note is harsh. The woodchat, *L. senator,* is a third European species. All these birds have the remarkable habit of catching insects, frogs, lizards or small birds and mammals, and of spitting them on thorns in a "larder" near their nest, to eat them later.

The *Laniidae* occur both in the Old and New World. The shrikes are active and powerful birds, with stout bills often strongly hooked. Their diet is chiefly insects and small frogs, lizards, birds and mammals, but they also take seeds and fruits.

SHRIMP, a name applied in general to the smaller Crustacea of the sub-order *Natantia* of the order *Decapoda.* The shrimps and their allies are distinguished from the larger macrurous Decapoda such as the lobsters and crayfishes, by greater development of the paddle-like limbs of the abdomen or tail, which are used in swimming. The abdomen is usually sharply bent between the third and fourth segments and has a characteristically humped appearance when straightened out.

The common shrimp (*Crangon vulgaris*) of northern Europe is found abundantly in shallow water wherever the bottom is sandy. It is 2 or 3in. long, slightly flattened, and with the rostrum or beak, in front of the carapace, very short. It is of a translucent greyisn colour, speckled with brown and closely resembles the sand in which it lives. On many parts of the coast the shrimp fishery is of considerable importance.

The larger shrimp-like Crustacea are generally known as "prawns," the name being especially applied in Britain to *Leander serratus,* which is highly esteemed for the table. In warmer seas many other kinds of prawns are caught for food. These are generally species of *Penaeus,* which are distinguished from all those already mentioned by having pincers on the first three, instead of only on the first two, pairs of legs. The large river-prawns of the genus *Palaemon* (closely allied to *Leander*) found in most tropical countries are also often used as food. In the West Indies *Palaemon jamaicensis,* and in the East Indies *Pal. carcinus,* attain almost the dimensions of full-grown lobsters. (W. T. C.)

The annual catch of shrimps in the United States is about 70,000,000 lb. Most of this is taken along the southern coast from North Carolina to Texas. Louisiana, Florida, Georgia and Mississippi lead in the order named. The shrimp canners in this region pack about 14,000,000 lb. annually. The shrimps are put up in two forms, the "dry" pack and the "wet" pack.

In Japan, the annual catch ranges between 35,000,000 and 50,000,000 lb. The fishery is carried on chiefly in the southern half of the empire, in the inland sea and bays. Hand trawls and Japanese trawls are used. The Gulf of California, Mexico, has at times been the centre of a considerable shrimp fishery, particularly along the coasts of Sinaloa.

SHROPSHIRE (Salop), a county of England on the Welsh border, bounded north by Cheshire and a detached portion of Flint, east by Staffordshire, south-east by Worcestershire, south by Herefordshire, south-west by Radnorshire, west by Montgomeryshire and north-west by Denbighshire. The name Salop, in common use, comes from an early name of the county town of Shrewsbury (*q.v.*).

Towards the west Shropshire is hilly, while nearly all the county south of the Severn is upland. This comprises the Long Mountain and a small part of the conspicuous Breidden group in the west, the Shelve hill lines, Longmynd (1,696 ft.), the Caradoc range, and Wenlock Edge (1,000 ft. to 1,200 ft.), with Clun Forest in the south-west, the Clee hills in the south-east, and the Wrekin (1,335 ft.). The Wrekin is an isolated hill north of the Severn. The pre-Cambrian series of rocks are represented here and in the adjoining Ercall hill (granitoid and gneissic rocks) and again in the line of "hog-backs" including Lawley and Caradoc

running south-west. These consist of volcanic lavas and tuffs, and are, with the Wrekin, among the oldest hills in the British Isles. Next in point of age come the conglomerates, grits and shales of the Longmynd. The mass of these well consolidated rocks makes a flat-topped plateau of 4 or 5 sq.m., which faces the Caradoc hills across the Church Stretton valley. Cambrian rocks succeed hard quartzites and sandstones, with soft shales (Shineton Shale) which have been eaten out to form the hollow west of Longmynd. The Ordovician system is represented by the resistant quartzites of the Stiperstones, the volcanic ashes of Shelve Hill, the grits of Snailbeach, the sandstones of Hoaredge and a few intrusions of volcanic rocks.

Silurian rocks outcrop in the shape of a horseshoe around the mountain mass from Stiperstones to Caer Caradoc, being represented by mudstones in the smoothly contoured Long Mountain, whose slopes, nevertheless, have deep hidden dingles, by sandstones and shales in the Clun Forest and by the mudstones of Wenlock and Ludlow, with the interstratified limestones of Wenlock and Aymestry which form an unbroken scarp for 17 m. in the remarkable Wenlock Edge. This is in reality a double ridge made of two "edges," the higher and eastern of which is sometimes called View Edge. The steep scarps of both "edges" look to the north-west, and are densely clothed with woods of beech, oak, elm and hazel, while the gentler "dip-slopes" are arable and pasture.

Old Red Sandstone outcrops in the Clee hills (Titterstone Clee 1,749 ft. and Brown Clee 1,792 ft.) which stand so high because they are covered by layers of the next division of rocks, the Carboniferous, here protected in turn by a capping of hard igneous intrusive dolerite known locally as "Dhu-Stone." The Old Red Sandstone group also has extensive out-liers at Clun and Bettws-y-Crwyn among the Silurian rocks of the south-west of the county.

The Carboniferous Limestone and Millstone Grit of the Denbighshire coalfield enter the county near Oswestry in the north-west lobe, and end in the conspicuous cliff of Llanymynech hill, overlooking the Vyrnwy and Severn flats. They also appear at Lilleshall and Coalbrookdale on the west border of the eastern coalfield, and include the little coalfield of Titterstone Clee.

Elsewhere in the Hanwood, Coalbrookdale and Forest of Wyre coalfields these lower rocks are absent, and the Coal-Measures rest directly on Silurian, Ordovician and Cambrian rocks. The Coal-Measures, with their coal seams and bands of ironstone, are of great economic importance. Triassic deposits, laid down in a lake whose south shore was not far from the present border of "the Upland," cover most of north Shropshire. An island of Longmyndian rock (Haughmond Hill) and a peninsula of coal-measures (from Coalbrookdale to Lilleshall) outcrop from these sandstones, marls and conglomerates. Around Wem and Prees is a capping of Liassic clays, while outcropping conglomerates or breccias form the hills of Nesscliff, Pim Hill, Grinshill and Hawkstone. Over much of the plain, glacial deposits—boulder-clay, gravel and sand—are spread. Some peat bogs in the drift-covered region towards the Cheshire border appear to occupy the sites of lakes, of the type of the meres of the Ellesmere district, in the irregular morainic material.

The north and east of the county lie almost entirely in the basin of the Severn, which enters from Montgomeryshire and flows eastward to Shrewsbury, after which it turns south-eastward to Ironbridge, and then continues in a more southerly direction past Bridgnorth, entering Worcester near Bewdley. The scenery is striking at some places, as near the finely situated town of Bridgnorth, but it is spoilt near Coalbrookdale by factories. Its principal tributaries within Shropshire are: the Rea, Cound, Borle, Vyrnwy (a well-known trout-stream forming part of the boundary with Montgomeryshire), Perry, Tern, which receives the Roden, and the Worf. The Dee and its tributary the Ceiriog touch the north-western boundary of the county with Denbighshire.

In the south the Teme, which receives the Clun, the Onny and the Corve, flows near the Herefordshire border, which it intersects. Salmon are taken in the Severn and trout and grayling from the Teme. There are small lakes near the Denbighshire border, of which the largest is Ellesmere.

Early History.—Evidence of prehistoric occupation comes chiefly from the open hills of the south. A few stone circles and menhirs occur, like the Bronze Age tumuli, chiefly on the Longmynd, Clun Forest and other parts of the Upland. Shropshire is rich in earth encampments, possibly Early Iron Age, in some cases used if not made in Romano-British and even Saxon times. Examples crown the Wrekin, Gaer Caradoc and the two Clees. In the north are Bury Walls (on Hawkstone) and Old Oswestry (*see* OSWESTRY) with its six-fold embankment, but in prehistoric times swamp marsh and woodland must have seriously affected any attempt at permanent settlement. The "islands" of Haughmond and Grinshill may have been used as stepping-stones in a trade route of the early metal age which followed the watershed between the Perry and the Tern.

The Romans built a city, Viroconium or Uriconium (*q.v.*) (modern Wroxeter) at the junction of roads from north, south, west and east (Watling Street). It is situated some five m. below Shrewsbury, whose functions as a route centre and border town it so remarkably recalls. The city wall, which has been traced, encloses 170 ac., excavated portions of which include the forum, basilica, baths and numerous houses. Hill camps were fortified by the Romans at Chesterton Walls, Nordy Bank and Norton. Villas have been partially excavated at the Lea near Pontesbury, Acton Scott and Linley Hall, while traces of square camps occur at Leintwardine (?Bravonium) towards Caerleon and at Oakengates (?Uxacona). The discovery of pigs of lead stamped with the name of the Emperor Hadrian (A.D. 117–138) proves that mining and smelting were carried on by the Romans in the Shelve district. The mines of Grit and Roman Gravels have considerable traces of ancient workings.

The district which is now Shropshire was annexed to the kingdom of Mercia by Offa, who in 765 constructed Wat's Dyke to defend his territory against the Welsh, and in 779 drove the king of Powys from Shrewsbury and secured his conquests by a second defensive earthwork known as Offa's Dyke, which, entering Shropshire at Knighton, traverses moor and mountain by Llanymynech and Oswestry, in many places forming the boundary line of the county, and finally leaves it at Bron y Garth and enters Denbighshire. (*See* Dr. Cyril Fox, "Archaeologia Cambrensis," June 1926, etc.) Anglo-Saxon village settlements occupy most of the county except the hills of the north-west and south-west. They are easily recognizable by the terminations "bury," "ton," and "ley," etc. The numerous Celtic place names in the hilly country of the north-west and south-west (*e.g.*, frequently recurring elements like "bettws," "pentre," "llan," and "tre") are an interesting feature.

The Danes in 874 destroyed the famous priory of Wenlock, said to have been founded by St. Milburg. In 912 Aethelflead, the lady of Mercia, erected a fortress at Bridgnorth against the Danish invaders, and in the next year at Chirbury. Mercia was mapped out into shires in the 10th century after its recovery from the Danes by Edward the Elder, and Shropshire is the sole Mercian shire which did not derive its name from its chief town. The Saxon Chronicle says that the king crossed the Thames in 1006 and wintered in Shropshire. In 1016 Edmund Aetheling plundered Shrewsbury and the neighbourhood.

After the Conquest Shropshire was bestowed on Norman proprietors, pre-eminent among whom is Roger de Montgomery, the 1st earl of Shrewsbury. At this period a large part of Shropshire was covered by its vast "forests," the largest of which, Worf Forest, at its origin, was at least 8 m. by 6 m., and became a favourite hunting-ground of the English kings. The forest of Wrekin, or Mount Gilbert as it was then called, covered that hill and extended eastward as far as Sheriff Hales. Other forests were Stiperstones, the jurisdiction of which was from time immemorial annexed to the barony of Caus, Wyre, Shirlot, Clee, Long Forest and Brewood.

The constant necessity of defending their territories against the Welsh prompted the Norman lords of Shropshire to such activity in castle-building that out of 186 castles in England no fewer

than 32 are in this county. Of these the most famous are Ludlow, founded by Roger de Montgomery; Bishop's Castle; Clun Castle; Cleobury Castle; Caus Castle; Rowton Castle and Red Castle. Other castles were Bridgnorth, Corfham, Holgate, Pulverbatch, Quatford, Shrewsbury and Wem.

One of the finest examples of moated manor houses is the 13th century Stokesay Castle near Craven Arms. It has a notable 14th century half-timbered gatehouse.

Among the Norman religious foundations were the Cluniac Priory at Wenlock, re-established on the Saxon foundation by Roger Montgomery in 1080; the Augustinian abbey of Haughmond founded by William Fitz-Alan; the Cistercian abbey of Buildwas, now a magnificent ruin, founded in 1135 by Roger, bishop of Chester; Shrewsbury Abbey, founded in 1083 by Roger de Montgomery; the Augustinian abbey of Lilleshall, founded in the reign of Stephen; the Augustinian priory of Wombridge, founded before the reign of Henry I.; the Benedictine priory of Alberbury founded by Fulk Fitz-Warin in the 13th century; and Chirbury Priory founded in the 13th century.

In post-Roman times the history of Shropshire is largely concerned with the constant incursions of the Welsh from beyond Offa's Dyke. The Norman castles already enumerated, guarding the approaches to Wales (*see* Montgomeryshire), formed an inner and outer line of defence; but the western half of the county, down to the time of Elizabeth, probably had little permanent population outside the castle towns and moated farms. For centuries whole areas were waste land. When peace came in the 16th century it was chiefly Welshmen who began to occupy the rich plains. This infiltration has persisted down to modern times. Oswestry, Clun and Shrewsbury were more than once plundered and burnt, *e.g.*, by Llewellyn the Great in the 13th century. It was then that Edward I. determined to remove the Welsh menace and in 1282 his "conquest" of Wales and his restoration of the border castles brought a measure of peace to the county.

Meanwhile the Shropshire lords were actively concerned in the more national struggles. At Acton Burnell in 1283 was held the parliament which passed the famous Acton Burnell statute. During the Percy rebellion a battle at Shrewsbury (1403) saw the defeat and death of Hotspur. About 1473 a "Council of the Marches" was established to administer the Welsh borderland. It lasted for two centuries, with its headquarters at Ludlow, and did much good in suppressing border riots. During its term the Union of England and Wales was effected by parliament, and the boundaries of the Shire of Salop were fixed. On the outbreak of the Civil War in the 17th century the majority of the Shropshire gentry declared for the king. A mint and printing press were set up in Shrewsbury. The town was forced to surrender in 1644, and the royalist strongholds of Ludlow and Bridgnorth were captured two years later.

One of the first acts of William and Mary was to abolish the Council of the Marches. About a century later came the agricultural and industrial revolutions which so greatly affected the occupations and distribution of the population. The county is mainly indebted to geographical and geological causes for its industrial life both in the past and in the present, proximity to Wales having largely influenced the ancient cloth trade, while the richness of its mineral resources has resulted in the coal and iron industry of to-day.

The history of the cloth trade in Shropshire centres in Shrewsbury (*q.v.*), where the drapers occupied a singular position in drawing their revenue not from their own manufacture, but from the distant markets of Oswestry, Welshpool and Montgomery, though the goods were dressed by the middlemen of Shrewsbury. The beginnings of the wool trade go back to the 13th century, when the interests were of municipal importance, Shrewsbury, Ludlow, Oswestry and Bridgnorth being the leading Shropshire centres. By the 16th century Shrewsbury drapers had many privileges and with geographical advantages the town became the chief market for an area including Merionethshire, Montgomeryshire and parts of Denbighshire.

It is to this period of prosperity in the border, when the Council of the Marches had established order and commerce and population increased, that we trace the spread of the custom of constructing houses with timber frames, many of which are to-day world-famed for their beauty and elegance. Such "black and white" houses, large and small, give a peculiar charm to the border counties from Cheshire to Gloucestershire. In Shropshire the best examples are in those towns mentioned above; while country houses include Pitchford Hall near Acton Burnell (cir. 1570) and Park Hall near Oswestry (1560) which was, however, nearly destroyed by fire in 1918. While some houses of this type date from the 15th century, most are of 16th century date, when much building in stone and brick was also carried on, Benthall Hall (1580), Shipton (1589) and Condover (1590) being fine Elizabethan country houses. By the end of the 18th century the Shropshire cloth trade had declined, new markets having been established in Wales with better means of communication, the improvement of roads and the construction of canals.

Within the county the River Severn had long been a source of food and a highway of industry. The salmon and eel fisheries of the river are famous, and Shrewsbury fishermen retain the primitive "coracle." In mediaeval times the religious houses were conveniently placed near the river (*e.g.*, Buildwas, Shrewsbury and the White [Alberbury] Abbeys), both for fishing and for water communication. Thus Buildwas Abbey exported wool to Italian markets in the 13th and 14th centuries.

At this time the Severn was navigable nearly up to Welshpool, and Shrewsbury, Bridgnorth, Gloucester and Bristol were connected by brisk traffic, which persisted and at times flourished down to about 1850. Goods carried included coal, iron, lead ores, groceries, wool and timber. Nearly 400 barges were in use in 1758, Broseley alone having 87 vessels employed in the export of coal and pig and bar iron. But the river was not navigable for three or four months of the year, and as the ancient rules for maintaining the waterway, etc., fell into disuse the barge traffic decayed until, by 1900, it had practically disappeared.

In 1792 the Shropshire canal was completed, in which the inclined plane system invented by Mr. William Reynolds of Ketley was first successfully used instead of locks. Local transport of coal and iron was greatly assisted by this and other canals in the industrial districts. The Shropshire Union canal was designed by Telford. By means of this system, now defunct, it was possible to pass from the Severn to the Dee, Mersey and Stour. With the building of railways the canals gradually fell into disuse, though they were still used for heavy goods up to the World War.

The railway systems show a remarkable concentration on Shrewsbury, whose position as a route centre they have greatly enhanced. The principal line is that of the G.W.R. from Albrighton to Shrewsbury, Chirk and Birkenhead. Other main railways run from Shrewsbury to Welshpool, to Whitchurch, to Bridgnorth and Bewdley and to Ludlow. The L.M.S. line from Stafford skirts the north-west border of the coalfield to Wellington. From Craven Arms a railway line (L.M.S.) runs to Knighton and Builth Road. There are numerous local lines.

The chief industries are coal-mining, iron founding and the making of china, tiles and bricks. They are concentrated in the "Coalfield Peninsula" from Broseley to Lilleshall. Other coalfields are those of Chirk, the Forest of Wyre, Hanwood and the Clee hills. Iron smelting is an old industry at Coalbrookdale, charcoal having been used long before the beds of coal, found interbedded with the ironstone, were utilized. Abraham Darby of Coalbrookdale first applied pitcoal to the reducing of ironstone. Under the Darbys and Reynolds the Shropshire works gained a reputation both for their large size castings and for their delicate "hollow" work. The first cast-iron bridge ever erected (1779), designed by Abraham Darby, spans the Severn near Coalbrookdale and gives its name to the town of Ironbridge. The manufacture of cast and wrought iron still continues on a smaller scale.

Very important industries early developed from the exploitation of the coal-measure clays. Bricks, white, red and blue, are largely made, and roof tiles, fire bricks and encaustic tiles. Coarse pottery, earthenware and drain pipes are also made from local clays, while the Coalport china works and the once famous Broseley clay

pipes are typical of other aspects of the industry, though Kaolin clay is imported for these old industries. Other clays used for brick-making include the marls of the Upper Trias, boulder clay and river alluvium. The chief building stone is the upper Triassic sandstone, the most famous quarries being at Grinshill, whence came the stone of Buildwas Abbey (*e.g.*) in the 12th century. Many other rocks, including limestone, igneous rocks and conglomerates, are locally used as building material. The dolerite or "dhu-stone" which caps the Clee hills is a well-known road metal.

For the most part, however, Shropshire remains an agricultural county. More than four-fifths of its area is under cultivation. On the sandy soils and loams of the north barley and oats are the chief crops, and sugar beet is increasingly grown. Wheat is grown especially on the west and south sides. There are considerable tracts of hill-pasture in the south, where Shropshire and Kerry Hill Sheep (the latter related to the old Clun Forest breed) are reared. "Cheshire" cheese is made on the northern plain from Market Drayton to Ellesmere. The cattle are chiefly Shorthorns, but Herefords are preferred for fattening. The prosperous market towns of Shrewsbury, Oswestry, Wellington, Ellesmere and Ludlow (*q.v.*) serve as centres for the agricultural regions. The county contains considerable areas of coppice and woodland, modern plantings of conifers occurring chiefly in the south, while the northern plains have much hedgerow timber and beautiful clusters of typical Scots pine. Part of the ancient Forest of Wyre extends into the Cleobury Mortimer area in the south-east.

The area of the ancient county is 859,516 ac., with a population of 244,162 in 1931. The area of the administrative county is 861,800 ac. or 1,343 sq.m. The dioceses of Lichfield and Hereford divide the county between them, but a few parishes in the west are in the diocese of St. Asaph. The municipal boroughs are Bishop's Castle, Bridgnorth, Ludlow, Oswestry, Shrewsbury and Wenlock.

There are 14 hundreds, 267 civil parishes and 284 ecclesiastical parishes or districts. The county is in the Oxford circuit and assizes are held at Shrewsbury. It has one court of quarter sessions and is divided into 18 petty sessional divisions. For purposes of parliamentary representation there are four divisions, those of Ludlow, Oswestry, Shrewsbury and the Wrekin, each returning one member.

See *Victoria County History, Shropshire;* W. Pearson, *Antiquities of Shropshire* (1807); R. W. Eyton, *Antiquities of Shropshire* (12 vols., 1853–60); C. H. Hartshorne, *Salopia Antiqua* (London, 1841); Fletcher, *Religious Census of Shropshire in 1676* (1891); W. W. Watts, *Shropshire, The Geography of the County* (Shrewsbury, 1919); Shropshire Archaeological and Natural History Society (1877, etc.).

SHROVE TUESDAY, the day before Ash Wednesday, the first day of Lent, so called as the day on which "shrift" or confession was made in preparation for the great fast. Shrove Tuesday is called in French *Mardi gras,* "Fat Tuesday," in allusion to the fat ox which is ceremoniously paraded through the streets. The Germans know it as *Fastendienstag.* It is celebrated in Catholic countries, as the last day of the carnival, with feasting and merrymaking, of which, in England, the eating of pancakes alone survives as a social custom, the day having been called at one time "Pancake Tuesday."

In the United States the festival season preceding Lent, particularly associated with New Orleans, La., is known as the Mardi Gras. Properly speaking, the season begins with the New Year and terminates with parades, pageantry and a ball on Shrove Tuesday. This carnival season, of ancient and somewhat obscure origin, was introduced into America by the French colonists. Celebrations, accompanied by masking, are recorded as among the activities of the soldiers at Ft. Louis de la Louisiane (1702–10), on the first site of Mobile, Ala. Similar festivities were observed by the residents of New Orleans from its foundation, and were continued during the Spanish control of Louisiana. The custom was retained after the United States purchased that territory, but it was not until 1857 that a group of former residents of Mobile, Ala., where masked parades had long been a prominent feature of the celebration, organized "The Mystick Krewe of Comus," and produced the first spectacular parade with floats at New Orleans. Since that date "King Rex" has yearly ruled over the city on Shrove Tuesday or Mardi Gras, and appeared in the streets accompanied by his "Mystick Krewe of Comus." In the evening the frolic season terminates with brilliantly illuminated pageantry, depicting scenes from literature or history, followed by a ball.

See P. J. Hamilton, *Colonial Mobile* (1910); L. De V. Chaudron, *Mobile Mystics and the Story of the Mardi Gras* (Mobile, 1910); J. S. Kendall, *History of New Orleans* (1922).

SHUFFLE-BOARD or **SHOVEL-BOARD** (originally "shove-board"), the game in which wood or metal discs are "shoved" by the hand or with an implement so that they shall come to a stop on or within certain lines or compartments marked on the "board"—a table or a floor. It was formerly very popular in England, especially with the aristocracy, under the names *shove-groat, slide-groat* and *shovel-penny,* being mentioned as early as the 15th century. It was a favourite pastime at the great country houses, some of the boards having been of exquisite workmanship. That at Chartley hall, in Staffordshire, was over 30ft. long and was made up of 260 pieces. Shuffle-board enjoys considerable vogue in the United States. The board is from 28 to 30ft. long and from 18 to 20in. wide, of pine, poplar or white wood, with a gutter 4½in. wide extending entirely round the board. The surface is slightly sanded and sometimes oiled. About 5in. from each end of the board is drawn a line called the *deuce line.* Each side, whether composed of two or four persons, uses four discs of polished brass or iron, generally about 2in. in diameter and ½in. thick. When two persons play they shove first from one end of the board and then from the other; but when four play one of each side remains permanently at each end. The discs, four of which are marked A and four B, are shoved alternately by each side. A disc resting between the deuce line and the end of the board is *in* and scores two. One protruding over the end sufficiently to be lifted by the finger is called a *ship* and counts three. A disc resting on the board but not crossing the line counts one. In scoring only the best of the eight discs counts, unless one side has two that are better than any of their opponents', in which case both count. The side first scoring 21 points wins.

A variety of shuffle-board is very popular as a deck game on board steamers and yachts. It is played by pushing wooden discs by means of crutch-shaped cues, or *shovels,* into which the discs fit, so that they come to a stop within the lines of a large rectangle drawn with chalk on the deck and divided into squares numbered from 1 to 10 with an extra square nearest the player, numbered –10. The game is usually 21 points.

SHUKRIA: *see* ARABS.

SHUMEN, incorrectly SHUMLA, a town of Bulgaria, 50 m. W. of Varna, on the Sofia-Varna railway. Pop. (1926) 25,315, about one-third being Muslims. The town is built within a cluster of hills, northern outliers of the eastern Balkans, which curve round it on the west and north in the shape of a horse-shoe. As a centre of communications in the southern Danube valley, Shumen has great strategical importance. In the picturesque upper quarter is the magnificent mausoleum of Jezairli Hassan Pasha. The principal mosque is the largest in Bulgaria. The town has an important trade in grain and wine, besides manufactures of silk, red and yellow slippers, ready-made clothes, richly embroidered dresses for women, and copper and tin wares.

In 811 Shumen was burned by the emperor Nicephorus, and in 1087 besieged by Alexius I. In 1387 it was taken by the Turks. In the 18th century it was enlarged and fortified. Three times, in 1774, 1810 and 1828, it was unsuccessfully attacked by Russian armies. The Turks consequently gave it the name of Gazi ("Victorious"). In 1854 it was the headquarters of Omar Pasha and the point at which the Turkish army concentrated (*see* CRIMEAN WAR). On June 22, 1878, it capitulated to the Russians.

SHUMLA: *see* SHUMEN.

SHURUPPAK (modern Fara), an ancient city of Mesopotamia situated on the old course of the Euphrates 50 m. N.W. of Lagash in 31° 30′ N., 45° 30′ E. The city is of special importance in the prehistoric period. It was famous as the home of Zuisudu, the hero of the flood story, and the Semitic version actually places the construction of the ark and all the details of the story at Shuruppak, which with Sippar, Larak and Eridu are mentioned as the only cities before the flood. The town entirely

disappears from ancient records after the last dynasty of Ur, somewhere before 2300 B.C. Excavations have thrown considerable light on the earliest period. Burials have been found with the bodies folded in the so-called embryonic position and wrapped in a reed mat. Clay coffins have also been found with the mat burials. The goddess of the city was Ninlil, the earth mother of Nippur, and the chronology of the town was kept by calling the year after the annual magistrate. A few tablets have been found before the time of Urnina. The town probably belonged to the southern kingdom of Lagash, and Langdon believes that it is not included in the dynastic list because there was the contemporary kingdom of Unzi of Akshak. He suggests that there was an extensive Sumerian kingdom at Lagash for a short period before Urnina, and cites the evidence of the similarity of legal terms in the business documents of Shuruppak, Lagash and Akkad.

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SHUSHTAR, a town in the province of Khuzistan, Persia, about 32° N. and 49° E., in the angle formed by the bifurcation of the Karun River into the Ab i Gargar and Ab i Shatait, some 40 m. below the point where the Karun debouches into the plains from the Bakhtiari mountains. The town covers a larger area than its estimated population of 20,000 warrants, being in large part in a ruinous and deserted condition; it has indeed been described as one of the most tumble-down places in all Persia. Many of the houses, of stone and brick, have cellars, called *shewadan,* in which the inhabitants shelter in the excessive heat of summer, which on occasion reaches 128° F. The sanitary conditions are very bad. The bazaar is a poor one and the few permanent shops are to be found in the street leading through the centre of the town to the Pul i Bulaiti (bridge). Even the mosques are devoid of special architectural features except perhaps the oldest one built under the Abbasids. On the other hand, the citadel, or Qal'ah Salasib, is a most imposing though ruinous mass, crowning the cliff, covering an area 350 by 150 yd., and described by Sykes as "the finest fort he had ever seen in Persia." The town has three exits: (a) westward over the bridge to Dizful, now interrupted owing to the bridge being broken down in the middle, its place being taken by a ferry; (b) southward by the Pul i Lashkar road to the Miyanab (the name of the fertile tract between the Gargar and Shatait branches); and (c) over the great dam to the suburb of Bulaiti.

Water Works.—Shushtar is most famed for the great works constructed in ancient times for the disposal of the voluminous water of the Karun river. These comprise (a) the Ab i Gargar Canal (the Masruqan of the middle ages). (b) The great barrage called the Band i Qaisar which is thrown across the Ab i Shatait (the principal arm of the river) west of the town. It is about 440 yd. long and supports a bridge, the Pul i Dizful (previously referred to). (c) The canal called Minau, which takes off above the barrage by a tunnel cut out of the rock on the western side of the town below the citadel, the purpose of which was to irrigate the Miyanab. Tradition says that the Minau Canal was built by Dara the Great and that it was Ardashir I. (the Sasanid) who began to construct the barrage after the canal mouth had dried up. The barrage was only completed under Shapur II. by the Roman prisoners with Valerian II. The Ab i Gargar was first dug simply to divert the volume of the water of the main river; the Band i Qaisar was then constructed, and the bed of the river above the barrage was paved with huge stone slabs bound with iron, to prevent further erosion. This paving was called *Shadurwan,* a term also applied to the barrage itself. Ultimately, a new barrage is said to have been built across the Gargar.

Population and Industries.—The population is a mixture of Arab and Iranian or proto-Iranian elements, known locally as Shushtaris, speaking a patois of their own and all Shia Mohammedans. A few Bakhtiaris are the only other element. Travellers speak of the disagreeable and fanatical character of the inhabitants; but among the Persians their devoutness has earned for the town the honorific title of *Dar al Muminin.* Its position gives the town a considerable commercial as well as strategic importance. It stands on a trunk road from Mohammerah via Ahwaz, Dizful, Khurramabad and Qum to Tehran, in large part fit for motor traffic. The industries are carpet weaving called *gilim,* the making of woollen cloths for *abas,* coarse cotton canvas and turbans, glazed earthenware, pack and riding saddles; copper, brass and silver-work; tanning and dyeing. A project was under consideration in 1928 for hydro-electric development by utilizing the water of the Karun near Shushtar.

History.—In the Umayyad period Shushtar became a stronghold of the Kharijites, one of the earliest religious sects of Islam. Under the Caliphs it was the capital of one of the seven provinces into which Khuzistan was then divided. When Baghdad became the centre of the empire, Shushtar, by its proximity was advantageously affected. The town was conquered by Timur and remained in the hands of the Timurids until 1514, when it fell to a Shia dynasty of Sayyids under the suzerainty of the Safavids and became a centre of Shia propaganda. In the beginning of the 19th century it was governed by a son of Fath Ali Shah who restored the barrage and the bridge; and at this time it was said to have a population of 45,000.

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SHUTTLE: *see* WEAVING and WEAVING MACHINERY.

SHUVALOV (shōōv'ạ-lŏv) or SCHOUVALOFF, **PETER ANDREIVICH,** COUNT (1827–1889), Russian diplomatist, was born in 1827. In 1864 Court influence secured for him the appointment of governor-general of the Baltic Provinces, and in 1866 he was made head of the political police in Russia. In 1873 he was sent on a mission to London, ostensibly to arrange matters in dispute between England and Russia in Central Asia, but also to arrange the marriage of the grand duchess Marie Alexandrovna with the duke of Edinburgh, which took place in January of the following year. The success of this mission led to the appointment of Shuválov as ambassador to London; and he justified his selection by the extraordinary diplomatic ability he displayed during the Russo-Turkish War of 1877–78 and the subsequent negotiations, when the relations between Russia and Great Britain were strained almost to the point of rupture. After the publication of the treaty of San Stefano, which seemed to render a conflict inevitable, he concluded with Lord Salisbury a secret convention which enabled the two powers to meet in congress and find a pacific solution for all the questions at issue. When it became known that the San Stefano arrangements were profoundly modified by the treaty of Berlin, public opinion in Russia condemned him as too conciliatory, and in the autumn of 1879, when Bismarck assumed an attitude of hostility towards Russia, Count Shuválov, who had been long regarded as too amenable to Bismarckian influence, was recalled. He died at St. Petersburg in 1889. (D. M. W.)

SHWEBO, town and district in the Sagaing division of Burma. The town is situated in the midst of a rice plain, 53 m. N.E. from Mandalay by rail. Pop. (1921) 10,605. It is of historic interest as the birthplace and capital of Alompra, the founder of the last Burmese dynasty. After British annexation it became an important military cantonment; but there is no longer any garrison. The area of the district is 5,714 sq.m.; pop. (1921) 391,284, showing an increase of 34,921 in the decade. It lies between the Katha, Upper and Lower Chindwin and Mandalay districts. The Irrawaddy forms the dividing line on the east. The physical features of the district vary considerably. The Minwun range runs down the whole eastern side, skirting the Irrawaddy. In the north it is a defined range, but at Sheinmaga, in the south, it sinks to an undulation. West of the Mu river, in the centre of the district, there is a gradual ascent to the hills which divide Shwebo from the Upper Chindwin. Between these ranges and on both sides of the Mu is a plain, unbroken except for some isolated hills in the north and north-east and the low Sadaung-gyi range in the south-east. The greater part of this plain is a rice-growing tract, but on the sloping ground maize,

millets, sesamum, cotton and peas are raised. A good deal of sugar is also produced from groves of the *tari* palm. The Mu river is navigable for three months in the year, from June to August, but in the dry season it can be forded almost anywhere.

Extensive irrigation works existed in Shwebo district, but they fell into disrepair in King Thibaw's time. Chief of these was the Mahananda lake. The old works have been restored and extended, and in 1906 the main canal was formally opened. The district is on the northern borders of the dry belt; the southern tracts have between 25 and 40 in. of rain, the northern tracts rather more. The Sagaing-Myitkyina railway runs through the heart of the district, and a railway was recently opened connecting Yè-u (pop. 2,742 in 1921) with the Chindwin river port of Mônywa.

SHYOK, a large tributary of the upper Indus, which rises near the southern foot of the great pass of the Karakoram range, on the route from Leh to Yarkand. Two important streams, with affluents, flow south from the Karakoram until they reach one of the great longitudinal troughs north of and parallel to the Himalaya system and the Indus-Brahmaputra line, and north of the latter. They both join the stream along this trough which, flowing north-westwards, makes a very sharp bend, and thus joins the Indus in Baltistan. Below a station called Yapchan, situated some 35 m. S. of the Karakoram pass, at a junction of valleys, the river bed begins to encase itself in a deep, narrow gorge, in which, normally, it receives the drainage of the Little Khumdan glacier. In 1926 this glacier pushed its way into and across the gorge, and thus built an ice-dam 480 ft. high. The ice-dammed lake above had grown to a length of 9 m., an average breadth of 1,000 yd. and a depth of 25 ft. by July 1928. At the beginning of August the level of the lake rose steadily, and on Aug. 4, 1928, a crack in the dam had developed. This caused widespread anxiety, and elaborate beacon-signalling arrangements were improvised and some villages below were evacuated. The alarm was intensified as a beacon fire was seen, but it proved to be a fire kindled by a Yarkandi caravan. Subsequent reports showed that the lake was leaking slowly through the crack in the ice-dam, and the danger of flood passed away.

SIALKOT or **SEALKOTE,** a town and district of British India, in the Punjab. The town, which has a station on the North-Western railway, is 72 m. N.E. of Lahore. Pop. (1921) 70,619. It is a military cantonment, being the headquarters of a brigade. There are remains of a fort dating from about the 10th century; but the mound on which they stand is traditionally supposed to mark the site of a much earlier stronghold, and some authorities identify it with the ancient Sakala or Sagal. The town has an extensive trade, and manufactures of sporting implements, boots, paper, cotton, cloth and shawl-edging.

The District of Sialkot has an area of 1,796 sq.m. It is an oblong tract of country occupying the submontane portion of the Rechna (Ravi-Chenab) Doab. Sialkot is above the average of the Punjab in fertility. The upper portion is very productive; and the southern portion, though less fertile, now receives irrigation from the Upper Chenab Canal. Sialkot is reputed to be healthy; it is free from excessive heat, judged by the common standard of the Punjab; and its average annual rainfall varies from 35 in. near the hills to 22 in. in the parts farthest from them. The population in 1921 was 937,823. The principal crops are wheat, barley, maize, millets and sugar-cane.

The early history of Sialkot is closely interwoven with that of the rest of the Punjab. It was annexed by the British after the second Sikh war in 1849; since then its area has been considerably reduced, assuming its present proportions in 1867.

SIAM (Muang Thai), an independent kingdom, in the Indo-Chinese or Further India Peninsula, with an area of about 220,000 sq.m. (For map, *see* Indo-China.) The country contains four natural regions:

(1) *North.* About 60,000 sq.m. in area, a series of parallel ranges, lying north and south, and rising from mere gently sloping acclivities in the south, to precipitous masses in the north. Between these ranges of limestone and red sandstone flow four streams, turbulent and shallow in their upper reaches, but slow-moving and deep where they near the points of junction. Of these the Menam is the largest, deepest and most sluggish. The districts watered by the lower reaches of the four rivers are fertile and contain a considerable population of Siamese. Farther north live the Laos, scattered in villages along all the river banks, and numerous communities of Shan, Karen, Kamoo and other tribes in the uplands and on the hill tops.

(2) *East.* About 70,000 sq.m. practically a huge basin, the bottom of which is a plain lying from 200 to 300 feet above sea-level, and the sides hill ranges rising to between 1,000 and 2,000 feet. The plain is mostly sandy and almost barren, subject to heavy floods in the rainy season and to severe drought in the dry. The hills, composed of limestone, red sandstone, etc., are clothed with a thin shadeless growth of stunted forest which only here and there assumes the characteristics of ordinary jungle. Nearly 2,000,000 people, mixed Siamese, Lao, and Cambodian, probably amongst the poorest peasantry in the world, occupy this inhospitable region.

(3) *Central.* Estimated area, 50,000 sq.m. This is the heart of the kingdom, the home of the greater part of its population and the source of nine-tenths of its wealth. It is a great alluvial plain flanked by high mountains on the west, inclining gently to the sea in the south and round the inner Gulf of Siam and with a long strip of mountainous seaboard stretching out to the south-east. The western range, whose highest peak is Mogadok (5,000 ft.) forms the boundary between central Siam and Burma. The eastern and south-eastern ranges also have peaks of from 3,000 to 5,000 feet. The rivers, with the exception of the Menam Chao Phaya, the principal river of Siam, are short and of little value except for traffic by small native boats. The Menam Chao Phaya flows from the point where it is formed by the junction of the rivers of northern Siam almost due south for 154 m., when it empties itself into the inner gulf. In the neighbourhood of Chainat, 40 m. below Paknam Poh, it throws off three branches, Menam Noi and the Lopburi, which rejoin the parent stream much lower down, and the Suphan which has its own outlet to the sea. About the centre of its course, the main river is joined by its only tributary, the Nam Sak, which drains the most easterly part (the Pechabun valley) of north-east Siam. The Menam Chao Phaya is a deep, fairly rapid river, subject to a regular rise and flood every autumn and is affected by the tide 50 m. inland. It is navigable for 20 m. by vessels of over 1,500 tons and, if it were not for the enormous sand bar at the mouth, ships of almost any size could reach Bangkok. (*See* Bangkok.) Vessels up to 300 tons and 12 ft. draught can ascend the river 50 m. and more, and beyond that point large river boats and deep-draught launches can navigate for many miles. The river is loaded with silt which, during the flood season, is deposited on the plain. With the exception of the forest growth on the slopes of the bounding hills the whole of central Siam is open rice-land, alternating with great stretches of grass, reed jungle and bamboo scrub, much of which is under water for quite 3 months each year.

(4) *Southern.* Area about 20,000 sq.m. This comprises that part of the Malay Peninsula belonging to Siam. It is a narrow strip at the north but widens out to the south where the habitable section consists of the lower slopes of the range with the valleys and small alluvial plains which lie between its spurs. The remainder is mostly covered with dense forest containing several kinds of valuable timber. The coast, both east and west, is much indented and studded with islands. The rivers are small and shallow. The highest mountain is Kao Luang, an almost isolated projection over 5,000 feet high, round the base of which lie the most fertile lands of this section, and near which are situated a few small towns, such as Bandon, and many villages.

Climate.—Siam has a monsoon climate—the wet season, May to October, corresponding with the prevalence of the S.W. monsoon in the Bay of Bengal. The full force of the monsoon is broken by the western frontier hills so that the average rainfall of Bangkok is about 50 inches and of Chieng Mai about 42 in. The temperature during the wet season averages 65–75° F at night and 75–85° F by day; but breaks in the rains occur which are hot and steamy. The cool season begins with the commencement of the N.E. monsoon in November. Siam then enjoys cool

nights (40–50° F) and day temperatures rarely as high as 90° F in the shade; but the east coast of the Malay Peninsula receives the full force of the north easterly gales. In February the northerly current begins to lose strength and the gradual heating of the land produces local sea breezes along the coast. Inland, temperature rises to over 100° F, but the extreme continental heats of India are unknown. The comparative humidity of the atmosphere makes the climate trying for Europeans.

Flora.—In its flora and fauna Siam combines the forms of Burma and the Shan States with those of Malaya and Cambodia. The coast region is characterised by mangroves, *Pandanus*, rattans and similar palms; the central region by rice fields, coco-nut and areca palms, and tropical economic plants; the temperate uplands of the interior are forested and contain some Himalayan and Japanese species—oaks, pines, chestnuts, peach and apple trees, raspberries, honeysuckle, vines, saxifrages, Cichoraceae, anemones and Violaceae; there are many valuable timber trees—teak sappan, eagle-wood, wood-oil (Hopea), and other Dipterocarpaceae, Cedrelaceae, Pterocarpaceae, Xylia, ironwood and other dye-woods and resinous trees, these last forming in many districts a large proportion of the more open forests with an undergrowth of bamboo. The chief products of the plains are rice (the staple export), pepper, sirib, sago, sugar cane, coco-nut, betel, palmyra or sugar and attap palms; banana, durian, pommelo, guava, bread fruit, mango, pineapple, custard apple, mangosteen and other fruits.

Fauna.—Among the big game animals are the elephant, tiger, leopard, fishing-cat, leopard-cat and other species of wild cat, honey-bear, large sloth-bear, and one- and two-horned rhinoceros. Wild cattle include the gaur, banting and water buffalo. The goat antelope, several varieties of deer, wild pig, rats, bats and monkeys also exist. There are 56 varieties of snakes, of which only 12 are poisonous. Crocodiles haunt the rivers and estuaries. Fresh and salt water fish are numerous and, after rice, form the main food of the population. The country is rich in birds many of which are common to Burma and Cambodia.

Inhabitants.—The estimated population for 1925–26 was 9,831,000. Of this about 3,800,000 are Siamese, about 3,650,000 Laos, about 500,000 Chinese, 400,000 Malays, and the rest Cambodians, Burmese Indian, Mon, Karen, Annamite, Kache, Lawa and others. There are about 1,800 Europeans and Americans mostly resident in Bangkok. The Siamese inhabit central Siam principally, but extend into the nearer districts of the other sections. Laos predominate in northern and eastern Siam; Malays mingle with Siamese in southern Siam; Chinese are everywhere but mostly in the towns. Bangkok, the capital, with some 350,000 inhabitants, is about one-third Chinese; in the suburbs are settlements of Mons, Burmese, Annamites and Cambodians, descendants of ancient prisoners of war. The Eurasian population is very small compared with that of other large Eastern cities. Of the tribes in the mountains some are remnants of very ancient inhabitants, probably of the Mon-Khmer family, who were supplanted by a later influx of more civilised Khmers from the southeast, the fore-runners and part ancestors of the Siamese, and were still farther thrust into the remoter hills when the Lao-Tai descended from the north. Of these the principal are the Lawa, Lamet, Ka Hok, Ka Yuen and Kamoo; the last four collectively are known to the Siamese as Ka. Other immigrant tribes include the Karens (about 60,000) of the western frontier range, offshoots from the main tribes on the Burma side of the range and possibly of Burma-Tibetan origin; the Lu, Yao, Yao Yin, Meo and Mussur, who have Yunnanese characteristics, and possibly entered northern Siam since the beginning of the 19th century; a small tribe called Chong, behind Chantabun; and the Sakei and Semang in the higher ranges of southern Siam. The last three have Negrito characteristics and may represent a race far older even than the ancient Ka.

Racial Characteristics and Dress.—The typical Siamese is of medium height, well formed, with olive complexion, darker than the Chinese, fairer than the Malays; eyes well shaped but slightly inclined to the oblique; broad flat nose; prominent lips; face wide across the cheek bones; chin short. A thin moustache is common; any beard is plucked out. Hair is black, coarse and cut short. Lips usually deep-red and teeth black as a result of chewing betel. The children are pretty but early lose their charm. The position of women is good. Polygamy is common only among the upper classes but the first wife is the head of the household. The Siamese are gentle, patient, law-abiding, kindly and hospitable to strangers, light hearted, sympathetic, and little given to quarelling or violent crimes. They are able, intelligent farmers but as they do not care for any other than agricultural labour, most of the industries and trades are in the hands of the Chinese. The national costume is the *panung*, a piece of cloth 1 yd. wide and 3 yd. long. The middle of it is passed round the body, covering it from the waist to the knees, and is hitched in front so that two ends of equal length hang down; these being twisted together are passed back between the legs, drawn up and tucked into the waist at the middle of the back. The *panung* is worn by both sexes but the women supplement it with a scarf worn round the body under the arms. Among the better classes both sexes wear also a jacket buttoned to the throat, stockings and shoes, and all the men, except servants, wear hats.

The staple food is rice and fish. Meat is eaten, but as the slaughter of animals is against Buddhist tenets, is not often obtainable, with the exception of pork, killed by Chinese. Men but not women smoke. Everybody chews betel. The principal pastimes are gambling, boat-racing, cock- and fish-fighting and kite-flying, and a kind of football.

Slavery has been gradually abolished by a series of laws. No such thing as caste exists and low birth is no insuperable bar to the attainment of the highest dignities. There are no hereditary titles, those in use being conferred for life only and being attached to some particular office.

Towns.—Siam has very few towns with a population of over 10,000, the majority being scattered townships and villages; the capitals of provinces are often only a few houses gathered round the market place, the offices and the governor's residence. The more important places of northern Siam include Chieng Mai (*q.v.*) the terminus of the Northern railway; Raheng, a timber station and the starting point of a Burmese trade route; Pitsanulok of historical interest and a centre of agricultural activity. In Eastern Siam the only towns of importance are Korat, the centre of a silk weaving industry; Ubon, the future terminus of the Eastern railway, and Nong Kai, an ancient place on the Mekong river. In Central Siam after Bangkok and Ayuthia are Pak Nam, with naval fortifications at the entrance to the Menam river; Paklat, a town of Mons, descendants of refugees from Pegu; Nontaburi, a big market centre; Lopburi, the last capital before Ayuthia and the residence of kings during the Ayuthian period, a city of ruins but now re-awakening as a railway centre. To the west of the Menam Chao Phraya are Suphanburi and Ratburi, ancient cities; Pechaburi (the Piply of early travellers); and Nakon Patom (Phrapatum) with its huge pagoda on the site of the capital of Sri Wichaiya, a kingdom of 2,000 years ago, and now a place of military, agricultural and other schools. To the east in the Bang Pakong basin and on the eastern shore of the Gulf are Petriou; Bang Plasoi, a fishing centre; Rayong, Chantabun (*q.v.*) and Krat, which produce gems and pepper. In Southern Siam the chief towns are Puket, the centre of the tin mining of the country; Nakon Sri Tammarat and Patani with a good roadstead which attracted European traders in the 16th and 17th centuries.

Communications.—Central Siam is well supplied with water communications: east to west canals link the three main river systems and bring the farthest parts of the kingdom within touch with Bangkok. In 1903 a department of government was formed to control the canals, the traffic on which is so great that the collection of a small toll more than pays for all maintenance expenses. The low level of the land, the soft soil, the absence of suitable road building material prohibits road construction but a bureau of roads and highways, organized by the railway department hopes to develop a policy of road construction whereby highways will serve as feeders to the railways at the main trading centres. In the mountainous country of northern and southern

Siam, road building is again difficult, and travelling in the remoter parts is still a matter of much discomfort.

In 1892 the construction of the first State Railway from Bangkok to Korat was undertaken. In 1926, 1,631 miles of State railways were in operation and 281 under construction. There were also 66 miles of private lines. Bangkok is the terminus of all main lines. The main line to the north terminates at Chieng Mai; the southern line threads the Malay Peninsula to Padang Besor where it joins the Federated Malay States Railway from Penang and Singapore. A branch line from Haad Yai passes along the east coast to Sungei Golok to join the Federated Malay States Railway. The north-eastern line to Korat is being extended to Khonkaen. The Korat-Ubon line is open as far as Buriram. The Eastern line runs to Aranya Pradesa on the Cambodian frontier.

Siam joined the Postal Union in 1885 since when there has been a steady and consistent improvement in postal, telegraphic and telephonic communication throughout the kingdom. Foreign telegraph lines communicate with Saigon, the Straits Settlements and Moulmein. Aviation has been adapted to postal communication and gives the remote provincial places a regular postal service. Dorn Muang, 22 km. north of Bangkok, is the chief aerodrome and has been used as a port of call by foreign aviators on long distance flights. Other towns have prepared landing places. Wireless installations under the control of the navy are found at Bangkok and Singora; another, under the control of the Post and Telegraph Department, is at Koh-Khan.

Agriculture.—Rice cultivation occupies almost all the inhabitants of Siam outside the capital. The sowing and planting season is from June to August and the reaping season from December to February; 40 or 50 varieties of paddy are grown and Siam rice is of the best in the world. Irrigation, until recently, was rudimentary and water supply depended chiefly on local rainfall. Under the advice, however, of an expert lent by the Government of India, the Siamese began work, in 1916, on the Prasak South Canal System. This, completed in 1924 at cost of £1,200,000, will eventually irrigate 240,000 acres. Work is now in progress on the Saphan programme. Other products of the plain include tobacco, pepper, coco-nuts (annual export of copra, 10,000 tons), sugar cane and many fruits. Live stock in 1926 included 8,389 elephants, 247,158 horses and ponies, 4,013,882 bullocks, and 4,216,127 buffaloes.

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SIAMESE ACTORS IN THE ELABORATE APPAREL COMMON IN PLAYS

Mining.—The minerals of Siam include tin, tungsten, wolfram, coal, iron, zinc, manganese, antimony, gold, silver, rubies, sapphires. Tin mining is carried on in the island of Puket, in the north of the Puket province and other parts of the Malay Peninsula where wolfram is also now being extracted in considerable quantities. Tin production in 1926–27 amounted to 10,140 tons. The Mining Department is well organised and employs several highly qualified English experts.

Timber.—Teak grows all over the hill district north of 15° N. but attains its best development in the west. The extraction of teak, almost entirely in British hands, employs a large number of people. The dry logs are floated down to Bangkok while large quantities are also exported via Burma. In 1926–27 the export of teak amounted to 59,339 tons, valued at £747,144. Other forest products include thingan wood (*Hopea odoratus*) used for boat building; damar oil from the *Dipterocarpus,* agilla wood, sapan, rosewood, iron wood, ebony and rattan. The forests are under the control of a Siamese conservator aided by British officials.

Commerce.—Commerce with India, China and Japan dates from the beginning of the Christian era and may be even earlier. European trade began in the 16th century. Over 85% of the foreign trade passes through Bangkok. Imports (1926–27) £15,935,121; exports £17,963,042. Siam is essentially an agricultural country and her exports comprise two main products—rice, £14,795,041; teak £747,144 (1926–27). Imports included cotton goods £2,292,638, gunny bags, £777,829, foodstuffs, £2,292,203, metal manufactures, £967,224, and machinery £326,219.

Government.—The government is an absolute monarchy. The executive power is exercised by the King advised by the Supreme Council of State and a Cabinet of 10 ministers. The Supreme Council of State is an advisory body, created by the present King Prajadhipok at the beginning of his reign, and consists of five princes of wide experience who possess the confidence of the country. It meets once a week, is presided over by the King, and considers extremely confidential matters and matters which affect the King personally and the royal family. By a Royal Decree of Jan. 10, 1895, a Legislative Council was established, but its functions have now been taken over by the Supreme Council of State, the Cabinet Council and the Department of Legislative Redaction of the Ministry of Justice. The Legislative Council seldom met but the Supreme Council and the Cabinet Council meet regularly.

For administrative purposes the country is divided, as from April 1, 1926, into 14 *montons* (or divisions), 13 of which are under a Lord-Lieutenant who derives his authority direct from the King, and exercises control over a number of subordinate governors in different parts of the monton; the Bangkok division (which includes the capital) is under the control of a Lord Prefect. The montons are subdivided into 79 provinces (Changwats) which are again subdivided into 413 districts (Ampurs) and 5,109 communes (Tambons). The policing of the montons is provided for by a gendarmerie of over 8,000 men and officers, a well-equipped and well-disciplined force. That of the suburban provinces is effected by branches of the Bangkok civil police.

Finance.—The revenue of Siam for 1908 was 58 million ticals or £4,300,000. In 1926–27 the revenue was £7,827,618 and the expenditure £7,808,362. The principal sources of revenue were

Land Tax	£ 911,459
Capitation Tax	863,636
Opium	1,433,671
Customs	930,118
Excise	901,197
Railways	645,800
Mines and Forests	641,818

Up to March 31, 1925, the amount spent on works of development was: construction of railways, £14,054,821; irrigation, £1,804,921; Bangkok waterworks, £394,344.

The unit of Siamese currency is the tical, a silver coin of fixed value of 1s.8d or 12 ticals to the £. Currency in use is mainly in the form of notes of which the first issue was made in 1902. In 1925 there was £10,735,305 worth of currency notes in circulation.

Weights and Measures.—The coinage furnishes the standard weight. 1 tical=15 grams; 4 ticals=1 Tamlung; 20 Tamlungs=1 Chang; 1 Picul or Hâp=60·48 kilograms=100 Catties of $1\frac{1}{3}$ lb., which is the catty usually employed in commerce.

The unit of length is the Wah. 1 Niew=·83 in.; 12 Niu=1 Keub (10 in.); 2 Keup=1 Sawk (20 in.); 4 Sawk=1 Wah (80 in.); 20 Wah=1 Sen (133 feet); 400 Sen=1 Yote (10 miles roughly). For square measure the unit is the Rai, ·39 acre, and for capacity, the Kanahan=$\frac{19}{20}$ litre.

In 1924 a law was passed for the introduction of the metric system which is to be compulsory in 1930.

Army and Navy.—All able bodied men are liable by the Military Service Act of 1917, to two years' service with the colours and for varying periods in the reserves. The army is divided into ten divisions. Aviation schools are in existence and a flying corps has been formed which is chiefly employed in development of civil aviation. The navy is small and consists of 5 gunboats, 3 destroyers, 4 torpedo boats and various small craft. One thousand men are available for service afloat and there are 1,000 marines besides a reserve of 20,000 men.

Justice.—Since the institution of the Ministry of Justice in

1892 very great improvements have been effected. The old tribunals, where customary law was administered by ignorant satellites of the great, amid corruption, have all been replaced by organised courts with qualified judges appointed from the Bangkok law school and under the direct control of the ministry, except in the most outlying parts. A provincial judicial scheme now in force provides a Court at the headquarters of each province (Changwat) and a Central Court at the chief town of each Circle (Monton) and a Supreme Court at Bangkok. Extra-territorial power was secured by treaty for all subjects of a foreign power. A commission for the codification of laws is in existence which is to cover Penal Code, Criminal Procedure Code, Commercial Code, Law of Judicial Organisation. When the codification has been completed the recognition of Siamese laws by all the powers may be expected and an end of extra-territoriality.

Religion.—Buddhism is the prevailing religion of the Siamese and Laos but the Malays of the Peninsula are Mohammedans. Buddhism in Siam is tinged by Burmese and Sinhalese influences and in the remote country districts by spirit-worship characteristic of the Ka and hill peoples of Indo-China. In Bangkok Brahmanical influence is still noticeable and Brahman priests assist at all acts of public importance. The Siamese, as Southern Buddhists, pride themselves on their orthodoxy and since Burma and Ceylon have ceased to be independent, the King of Siam is regarded as the sole surviving defender of the faith. A close connection exists between the laity and priesthood for the Buddhist rule prescribing that every man should enter the priesthood for at least two months is almost universally observed. The accounts given as to the profligacy and immorality in the monasteries are exaggerated. Many of the temples are under the direct supervision of the King and in these a stricter rule of life is observed. Some of the priests are learned in the Buddhist scriptures and most of the Pali scholarship in Siam is to be found in the monasteries. There is little public worship. On the day set apart for worship (*Wan Phra*, or "Day of the Lord") the attendance at the temple is small and consists mostly of women. Religious and semi-religious ceremonies play a large part in Siamese life. Few weeks pass without some function or procession. The cremations of great people, often lasting several days, are the occasion of public festivities and are celebrated with processions, theatrical shows, illuminations and fireworks. The English, French and American missionaries in Siam have done much to help on the general work of civilisation while the progress of education has been largely due to their efforts.

Education.—The Buddhist monasteries throughout the country carry on almost the whole of the elementary education in rural districts. A provincial training college was established in 1903 for the instruction of priests and laymen in the work of teaching and by this means and with regular government supervision and control the monastic schools are being brought into line with the government educational organization. The Minister of Education is responsible for education throughout the country with the exception of such Departmental schools as the Military, Naval, Law and Police schools and a few others. There are 343 Government schools with 47,268 pupils and 1,958 teachers; 65 technical departments in Government schools with 1,100 pupils, principally in training for teachers; 4,707 local schools run by the local authorities under departmental inspection, with 527,603 pupils and 9,872 teachers; 573 private schools with 27,435 pupils and 1,446 teachers. Many of the special schools use the English language for conveying instruction and in three the whole curriculum is conducted in English by English masters. In 1917 the Chulalongkorn University was founded at Bangkok. In it are incorporated special schools of Administration, Engineering, Medicine, Literature and Science. There are also Military and Naval schools. Many of the special schools award scholarships to enable the best of their pupils to complete their studies abroad.

(E. Y.)

HISTORY

The town of Lampun (Labong or Haribunchai), the first Lao capital in Siam, was founded about A.D. 575. The fusion of races may be said to have begun then, and the Siamese language, written character and other racial peculiarities were in course of formation. But the finishing touches to the new race were supplied by the great expulsion of Lao-Tai from south-west China by Kublai Khan in A.D. 1250. Thereafter the north, the west and the south-west of Siam, comprising the kingdom of Swankalok-Sukhotai, and the states of Suphan and Nakhon Sri Tammarat (Ligore), with their sub-feudatories, were reduced by the Siamese (Thai), who, during their southern progress, moved their capital from Sukhotai to Nakhon Sawan, thence to Kampeng Pet, and thence again to Suvarnabhumi near the present Kanburi. A Sukhotai inscription of about 1284 states that the dominions of King Rama Kamheng extended across the country from the Mekong to Pechaburi, and thence down the Gulf of Siam to Ligore; and the Malay annals say that the Siamese had penetrated to the extremity of the peninsula before the first Malay colony from Menangkabu founded Singapore, *i.e.*, about 1160.

Sano also was attacked, and its fall completed the ascendancy of the Siamese (Thai) throughout the country. The city of Ayuthia which rose in A.D. 1350 upon the ruins of Sano was the capital of the first true Siamese king of all Siam. This king's sway extended to Moulmein, Tavoy, Tenasserim and the whole Malacca peninsula. About this time Siam attacked Cambodia, seized Angkor and carried off some 90,000 prisoners. This was the beginning of a series of wars lasting some 400 years, until Cambodia fell entirely under Siamese rule and influence. Vigorous attacks were also made during this period on the Lao states to the north-west and north-east, and Siamese supremacy was pretty firmly established in Chiengmai and its dependencies by the end of the 18th century, and over the great eastern capitals, Luang Prabang and Vien-chang, about 1828.

Phra Naret.—During the 15th and 16th centuries Siam was frequently invaded by the Burmese and Peguans, who, attracted probably by the great wealth of Ayuthia, besieged it more than once without success, the defenders being aided by Portuguese mercenaries, till about 1555, when the city was taken and Siam reduced to dependence. From this condition, however, it was raised a few years later by the great conqueror and national hero Phra Naret, who after subduing Laos and Cambodia invaded Pegu, which was utterly overthrown in the next century by his successors. But after the civil wars of the 18th century the Burmese, having previously taken Chieng-mai, which appealed to Siam for help, entered Tenasserim and took Mergui and Tavoy in 1764, and then advancing simultaneously from the north and the west destroyed Ayuthia after a two years' siege (1767).

The intercourse between France and Siam began about 1680 under Phra Narain, who, by the advice of his minister, the Cephalonian adventurer Constantine Phaulcon, sent an embassy to Louis XIV. An interesting episode was the active intercourse, chiefly commercial, between the Siamese and Japanese governments from 1592 to 1632. Japan was, in 1636, closed to foreigners; but trade was carried on at all events down to 1745 through Dutch and Chinese and occasional English traders. In 1752 an embassy came from Ceylon, desiring to renew the ancient friendship and to discuss religious matters. After the fall of Ayuthia a great general, Phaya Takh Sin, collected the remains of the army and restored the fortunes of the kingdom, establishing his capital at Bangkok; but, becoming insane, he was put to death, and was succeeded by another successful general, Phaya Chakkri, who founded the present dynasty. Under him Tenasserim was invaded and Tavoy held for the last time by the Siamese in 1792, though in 1825, taking advantage of the Burmese difficulty with England, they bombarded some of the towns on that coast. The supremacy of China is indicated by occasional missions sent, as on the founding of a new dynasty, to Peking, to bring back a seal and a calendar.

European Contacts.—Of European nations the Portuguese first established intercourse with Siam (1511). They were supplanted gradually in the 17th century by the Dutch. English traders were in Siam very early in the 17th century; there was a friendly interchange of letters between James I. and the king of Siam, who had some Englishmen in his service, and, when the ships

visited "Sia" (which was "as great a city as London") or the queen of Patani, they were hospitably received and accorded privileges. The important items of export were, as now, tin, varnish, deerskins and "precious drugs." Later on, the East India Company's servants, jealous at the employment of Englishmen not in their service, attacked the Siamese, which led to a massacre of the English at Mergui in 1687, and the factory at Ayuthia was abandoned in 1688. A similar attack is said to have been made in 1719 by the governor of Madras. After this the trade was neglected. Pulo Penang, an island belonging to the Siamese dependency of Kedah, was granted on a permanent lease to the East India Company in 1786, and treaties were entered into by the sultan of Kedah with the company. In 1822 John Crawfurd was sent to Bangkok to negotiate a treaty with the suzerain power, but the mission was unsuccessful. In 1824, by treaty with the Dutch, British interests became paramount in the Malay Peninsula and in Siam, and, two years later, Captain Burney signed the first treaty of friendship and commerce between England and Siam. A similar treaty was effected with America in 1833. Subsequently trade with British possessions revived, and in time a more elaborate treaty with England became desirable. Sir J. Brooke opened negotiations in 1850 which came to nothing, but in 1855 Sir J. Bowring signed a new treaty whereby Siam agreed to the appointment of a British consul in Bangkok, and to the exercise by that official of full extra-territorial powers. Siam entered into treaties with Japan in 1898 and Russia in 1899. A further convention afterwards provided for a second British consular district in northern Siam, while England and France have both appointed vice-consuls in different parts of the country.

France and England.—For centuries Siam had been distracted by wars with Cambodians, Peguans and Burmans, but the incorporation of Lower Cochin China, Annam and Tongking by the French, and the annexation of Lower and Upper Burma successively by the British, freed her from all further danger on the part of her old rivals. But later, disputes with frontier tribes led to complications with France, who asserted that the Siamese were occupying territory that rightfully belonged to Annam, which was now under French protection. France, while assuring the British Government that she laid no claim to the province of Luang Prabang, which was situated on both banks of the upper Mekong, roughly between the 18th and 20th parallels, claimed that farther south the Mekong formed the true boundary between Siam and Annam, and demanded the evacuation of certain Siamese posts east of the river. The Siamese refused to yield, and early in 1893 encounters took place in the disputed area, in which a French officer was captured and French soldiers were killed. The French then despatched gunboats from Saigon to enforce their demands at Bangkok, and these made their way up to the capital in spite of an attempt on the part of the Siamese naval forces to bar their way. In consequence of the resistance with which they had met, the French now greatly increased their demands, insisting on the Siamese giving up all territory east of the Mekong, including about half of Luang Prabang, on the payment of an indemnity and on the permanent withdrawal of all troops and police to a distance of 25 kilometres from the right bank of the Mekong. Ten days' blockade of the port caused the Siamese government to accede to these demands, and a treaty was made, the French sending troops to occupy Chantabun until the provisions of this treaty should have been carried out.

In 1895 lengthy negotiations took place between France and England concerning their respective eastern and western frontiers in Farther India. These negotiations bore important fruit in the Anglo-French convention of 1896. By this convention Siam's independence was guaranteed by the two European powers who alone have interests in Indo-China. Encouraged by the assurance of the Anglo-French convention, Siam now turned her whole attention to internal reform, and to such good purpose that, in a few years, improved government and expansion of trade aroused a general interest in her welfare, and gave her a stability which had before been lacking. With the growth of confidence negotiations with France were reopened, and, after long discussion, the treaty of 1893 was set aside and Chantabun evacuated in return for the cession of the provinces of Bassac, Melupré, and the remainder of Luang Prabang, all on the right bank of the Mekong, and of the maritime district of Krat. These results were embodied in a new treaty signed and ratified in 1904.

Meanwhile, in 1899, negotiations with the British government led to agreements defining the status of British subjects in Siam, and fixing the frontier between southern Siam and the British Malay States, while in 1900 the provisions of Sir J. Bowring's treaty of 1855, fixing the rates of land revenue, were abrogated in order to facilitate Siamese financial reform.

In 1907 a further convention was made with France, Siam returning to the French protectorate of Cambodia the province of Battambang conquered in 1811, and in compensation receiving back from France the maritime province of Krat and the district of Dansai, which had been ceded in 1904. This convention also modified the extra-territorial rights enjoyed by France in Siam, and disclosed an inclination to recognize the material improvements of the preceding years. In 1907 also negotiations were opened with Great Britain, the objects of which were to modify the extra-territorial rights conceded to that power by the treaty of 1855, and to remove various restrictions regarding taxation and general administration, which, though diminished from time to time by agreement, still continued to hamper the government. These negotiations resulted in a treaty, signed and ratified in 1909, by which Siam ceded to Great Britain her suzerain rights over the dependencies of Kedah, Kelantan, Trengganu and Perlis, Malay states situated in southern Siam just north of British Malaya, containing in all about a million inhabitants and for the most part flourishing and wealthy, and obtained the practical abolition of British jurisdiction in Siam proper.

In 1917 Siam declared war on Germany and Austria-Hungary. All enemy subjects were interned and a quantity of German shipping taken as prize. The most important modern treaties are those made with the United States (1920); Japan (1924); Denmark, France, Holland, Portugal and Spain (1925); and in the same year a provisional economic arrangement was entered into with Germany. In 1925, also, two new treaties (a new general and a new commercial treaty), were signed between Great Britain and Siam: they were ratified in May 1926. The present king is Prajadhipok of Sukhodaya, born Nov. 8, 1893. He succeeded his brother Rama VI. in Nov. 1925 and he is the seventh monarch of the present reigning dynasty.

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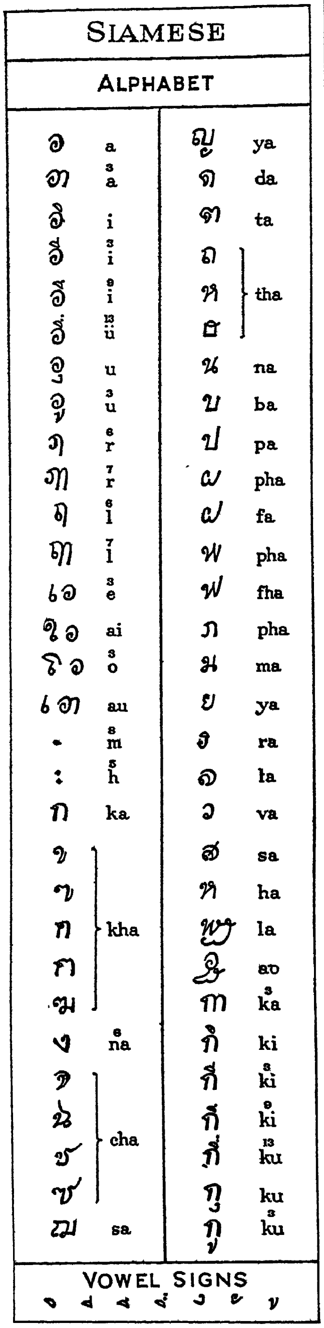
SIAMESE LANGUAGE AND LITERATURE. Siamese belongs to the Tai group of the Siamese-Chinese family of languages. Its connection with Chinese is distant but with other languages of the Tai group very close. It is spoken throughout central Siam, in all of southern Siam except Patani Monton, in northern Siam along the river-banks as far up as Utaradit and Raheng, and in eastern Siam as far as the Korat Monton. Siamese was purely monosyllabic, each true word consisting of a single vowel sound preceded by, or followed by, a consonant. Of such monosyllables there are less than 2,000, and therefore many syllables have to do duty for the expression of more than one idea, confusion being avoided by the tone in which they are spoken.



The current Siamese characters are derived from the Cambodian alphabet, which owes its origin to the alphabet of the inscriptions, an offshoot of the character found on the stone monuments of southern India in the 6th and 8th centuries.

The Siamese alphabet consists of 44 consonants, in each of which the vowel sound "aw" is inherent, and of 32 vowels all marked not by individual letters, but by signs written above, below, before, or after the consonant in connection with which they are to be pronounced. Several of the 44 consonants express each a slightly different intonation of what is practically the same consonant, the sound of "kh," for instance, being represented by six different letters and the sound of "t" by eight. Other letters are present only for use in certain words imported from Pali. The vowel signs have no sound by themselves, but act upon the vowel sound "aw" inherent in the consonants, converting it into "a," "i," "o," "ee," "ow," etc. Each of the signs has a name, and some of them produce modulations so closely resembling those made by another that at the present day they are scarcely to be distinguished apart. Only vowel or diphthong sounds, or the letters "m," "n," "ng," "k," "t," and "p" are permissible at the end of words. Hence the final letter of all words ending in anything else is simply suppressed or is pronounced as though it were a letter naturally producing one or other of those sounds. Thus many of the words procured from foreign sources are more or less mutilated in pronunciation, though the entirely suppressed or altered letter is still retained in writing.

Siamese is written from left to right. In manuscript there is usually no space between words, but punctuation is expressed by intervals isolating phrases and sentences.

The Tonal System.—Of the simple tones there are five—the even, the circumflex, the descending, the grave, and the high—any one of which when applied to a word may give it a quite distinct meaning. Four of the simple tones are marked in the written character by signs placed over the consonant affected, and the absence of a mark implies that the one remaining tone is to be used. The consonants are grouped into three classes, to each of which a special tone applies, and consequently the application of a tonal sign to a letter has a different effect, according to the class to which such letter belongs. Though many syllables have to do duty for the expression of more than one idea, the majority have only one or at most two meanings, but some are used with quite a number of different inflections, each of which gives the word a new meaning. Thus, for example, the syllable *khao* may mean "they," "badly," "rice," "white," "old," or "news," simply according to the tone in which the word is spoken. Words are unchangeable and incapable of inflection. There is no article, and no distinction of gender, number, or case. These, when necessary, are expressed by explanatory words after the respective nouns; only the dative and ablative are denoted by subsidiary words, which precede the nouns, the nominative being marked by its position before, the objective by its position after, the verb, and the genitive (and also the adjective) by its place after the noun it qualifies. Occasionally, however, auxiliary nouns serve that purpose. Words like "mother," "son," "water" are often employed in forming compounds to express ideas for which the Siamese have no single words, *e.g. lûk cân,* "the son of hire," a labourer; *mê mü,* "the mother of the hand," the thumb. The use of class words with numerals obtains also. In Siamese the personal pronouns are mostly represented by nouns expressive of the various shades of superior or lower rank according to etiquette. The verb is, like the noun, perfectly colourless—person, number, tense, and mood being indicated by auxiliary words only when they cannot be inferred from the context. Such auxiliary words are *yû,* "to be," "to dwell," (present); *dai,* "to have"; *leao,* "end" (past); *cā,* "also" (future); the first and third follow, the second and fourth precede, the verb. *Hài,* "to give" (prefixed), often indicates the subjunctive. There are compound verbs; thus, *e.g., pai,* "to go," is joined to a transitive verb to convert it into an intransitive or neuter; and *thûk,* "to touch," and *tòng* "to be compelled," serve to form a sort of passive voice. The number of adverbs, single and compound, is very large. The prepositions mostly consist of nouns.

In Siamese the subject of the sentence precedes the verb and the object follows it. The possessive pronoun follows the object. The adverb usually follows the verb. In compound sentences the verbs are placed together as in English, not separated by the object as in German. When an action is expressed in the past the word which forms, with the verb, the past tense is divided from the verb itself by the object.

In addition to the ordinary language of the people there is a completely different set of words ordained for the use of royalty, to avoid the employment of downright expressions of vulgarity or of words which might be capable of conveying an unpleasant or indelicate idea other than the meaning intended. Words of Sanskrit origin have been freely adopted and many Cambodian words are also used. The language is so complete that the dog, pig, crow, and other common or unclean animals are all expressed by special words, while the actions of royalty, such as eating, sleeping, walking, speaking, bathing, dying, are spoken of in words quite distinct from those used to describe similar actions of ordinary people.

See O. Frankfurter, *Elements of Siamese Grammar* (1900); *Linguistic Survey of India,* vol. ii. (1904).

LITERATURE

The genius of the Siamese finds its best literary expression in verse which contains a great variety of metre, but the three commonest metres are called *Klon, Kap* and *Klong.* The tones of the language play a very important part in Siamese poetry—indeed they may be said to take the place of rhymes; the *Kap,* however, has rhymes in addition. Every subject is material for the Siamese poet and the verses are comparable with those of almost any land. *Klong* and *Kap* forms are combined in the style known as *Nirat* poetry, or extended narrative love-verse, and the *Klon'pet ton* or thumb-nail love-songs are numbered by hundreds. They are unrivalled for elegance of diction and sweet sound, perfectly balanced little pieces of eight lines divided into two stanzas; each line having eight syllables. This form of verse

is confined to the treatment of love and passion. The other metres are of interest only to the academician.

Siamese is rich in quasi-historical and mythological literature. The purely native material is informed by an imagination far less vivid than that of the Indian *Ramayana*, (*Ramakien*), but is decidedly interesting as an index of the Siamese mind. It is sometimes very difficult to decide whether a story is purely native, as Siam drew upon the mighty sources of India, Cambodia and China; where the material was not too definitely alien, the Siamese pressed it very closely into their own mould, producing a very different piece of literary effort from the original. *Wet ya Sun yin* and *Wo ra loongs* are examples of stories originally borrowed from India. Semi-magical stories are numerous and nature-stories abound. A study of the mythological literature sheds a flood of light on the origin and development of Indo-Chinese superstition. *Phum hon,* a very popular tale, tells of a young woman loved by an elephant, and *Prang tong* is a story of a princess who was prenatally betrothed to a giant. Siamese cosmogony is enshrined in the *Nok khum,* and these mythological works may be considered the earliest examples of native literature.

There exists much religious material in Siamese—almost the whole of the Buddhist Canon having appeared, some parts of it existing in many different versions: *Pattama Sompothiyan* is the standard Siamese life of Buddha. There is often great difficulty in distinguishing between Buddhist literature proper and *Niti* or traditional literature. Much of this is from the Bali language and from Javanese, which in their turn were inspired from India. The outstanding work in this division is called the *Maxims of Phra Ruang*. Phra Ruang was the national hero-king and he is held up to Siamese youth as the mighty ideal of manhood.

It is in law that Siamese literature shows its best early prose. Five ancient canons, some of them founded on the *Law of Manu,* exist and present the earliest form of Siamese law and a very early style of Siamese literary composition. A large collection of early royal edicts has come down to our day although a modern code of laws has long since superseded the old statutes. A penal code based on foreign procedures was issued in 1908 and additions are made periodically. Never has Siam published so lavishly; every month new legal codes, translations of religious texts, new versions of foreign classics or translations of alien literature roll from unwearied presses. More especially versions from the Pali scriptures of Buddhism abound and there is nowadays a movement on foot to supply the lacunae in historical literature.

The wars of the middle ages and early modern times in Siam have robbed us of much literary material which must have existed centuries ago. There is as yet no reliable, connected history of Siam in the native tongue, although we have a fairly complete history of the Aguthia dynasty and of the modern line of kings. The cause for dissatisfaction with these histories is almost entirely concerned with the earlier parts which have drawn largely upon the quasi-historical and legendary literature. Modern works on general history are of almost daily publication now, however, and histories of Siam, based on material drawn from foreign contemporary sources are in course of preparation. The educational department of the Siamese Government is indeed the modern fairy godmother of the people in matters of dissemination of general knowledge. (See *Catalogue of the India Office Library,* London.)

(A. N. J. W.)

SI-AN (Hsi Gnan Fu; Si Gnan Fu; Si-gan Fu; Sian Fu), the capital of the province of Shensi, in north-west China, in 34° 17′ N., 108° 58′ E. The city is said to have one million inhabitants, of whom 50,000 are Mohammedans. The site is on a broad loess terrace the surface of which is of recent accumulation. Si-an lies where the road over the Tsin-ling shan meets the road down the Wei valley. Eastward of Si-an the valley narrows remarkably to the fortress of Tung-kwan. The city is in a fertile spot commanding routes up and down the Wei-ho, to Kansu and Central Asia, as well as to Szechwan and Tibet. Its strategical position at the entry into China from the west has helped it to play an important part in the history and administration of China. Shi Hwang-ti (246–210 B.C.), the first universal emperor, established his capital at Kwan-chung, on the site of the modern Si-an. Under the succeeding Han dynasty (206 B.C.–A.D. 14), this city was called Wei-nan and Nui-shi; under the eastern Han (A.D. 25–221) it was known as Yung Chow; under the T'ang (618–907) as Kwannui; under the Sung (960–1127) as Yung-hing; under the Yuan and Ming (1260–1644) as Gan-si. During the Ts'in, Han and T'ang dynasties the city was usually the capital of the empire, and in size, population and wealth it is still among the most important cities of China. It was visited by Marco Polo in the 13th century, and he refers to it as Kenjanfu. During the Mohammedan rebellion it was unsuccessfully besieged by the rebels during 1868–70. The city is square in plan, and includes within its limits the two district-cities of Ch'ang-gan and Hei-ning. There are extensive walls and fortifications around the city. Several of the temples and public buildings are very fine, and many historical monuments are found within and about the walls. Many of these are now housed in the Pei Lin, or "forest of tablets," a museum containing tablets, coins, bronzes, etc., appertaining to the history of the city. One of the most notable is the Nestorian tablet, accidentally discovered in 1625 in the Ch'ang-gan suburb. The stone slab is 9 ft. high by 3 ft. wide.

The contents of the inscription, which consists of 1,780 characters, may be described as follows: (1) An abstract of Christian doctrine of a vague and figurative kind. (2) An account of the arrival of the missionary, Olopan (probably a Chinese form of Rabban=Monk) from Tats'in in the year 635, bringing sacred books and images; of the translation of the said books; of the imperial approval of the doctrine and permission to teach it publicly. Then follows a decree of the emperor (T'ai-tsung, a very famous prince), issued in 638, in favour of the new doctrine, and ordering a church to be built in the square of justice and peace (*Ining fang*) in the capital. The emperor's portrait was to be placed in this church. After this comes a description of Tats'in, and then some account of the fortunes of the church in China. Kaotsung (650–683, the devout patron also of the Buddhist traveller and doctor, Hsüan Ts'ang) it is added, continued to favour the new faith. In the end of the century Buddhism got the upper hand, but under Yuen-tsung (713–755) the church recovered its prestige, and Kiho, a new missionary, arrived. Under Tih-Tsung (780–783) the monument was erected, and this part of the inscription ends with a eulogy of I-sze, a statesman and benefactor of the church. (3) Then follows a recapitulation of the above in octosyllabic verse. The Chinese inscription, which concludes with the date of erection, viz., 781, is followed by a series of short inscriptions in Syriac, and the *Estrangelo* character, containing the date of the erection, the name of the reigning Nestorian patriarch, Mar Hanan Ishua, that of Adam, bishop and pope of China, and those of the clerical staff of the capital. Then follow 67 names of persons in Syriac characters, most of whom are characterized as priests, and 61 names of persons in Chinese, all priests but one.

The stone remained in the enclosure of a dilapidated temple until 1907, when it was housed in the Pei Lin and a replica deposited, in 1908, in the Metropolitan Museum of Art, New York, moved later to the Lateran, in Rome, under pontifical charge. Replicas have been given by Prince Frits Holm to 14 countries.

The importance of Si-an as a trade centre was noticed by Marco Polo, who mentions it as a place "of great trade and industry. They have great abundance of silk, from which they weave cloths of silk, and gold of divers kinds, and they also manufacture all sorts of equipments for an army. They have every necessary of man's life very cheap." The trade, before the recent period of disorder, was also extensive. To the northward were sent cotton, tea, tobacco and cereals, and from the north, coal, iron and salt were imported. To Kansu were sent cotton and cereals, while horses, wool, sheep, fur and tobacco were imported. Silk and tea, porcelain, sugar and paper were sent to Kuku Nor and thence to Central Asia, while from the west Si-an received rhubarb and medicinal herbs, the products of stock breeding, jade from the Tarim basin (Khotan), and a quantity of cloth from Russia. Cotton, wool, skins and fur were sent to Szechwan, while sugar, silk and cheap opium were imported. Medicinal plants were received from South China. From the south-east, through

Hang-chow, came tea, paper, porcelain, pepper and European materials, while most of the silk also came this way.

See H. Yule, *Marco Polo* (1903 ed.); A. Williamson, *Journeys in North China* (London, 1870); F. von Richthofen, *China*, vol. ii. (1882); S. Wells Williams, *The Middle Kingdom* (London, 1883); Père Havret, *La Stèle de Si'ngan Fou* (Shanghai, 1895–1902); William E. Geil, *Eighteen Capitals of China* (1911); Prince Frits v. Holm, *My Nestorian Adventure in China* (1924).

SIBELIUS, JOHAN JULIUS (1865–), Finnish composer, known as Jean Sibelius, was born at Tavastehus on Dec. 8, 1865. He studied music under Wegelius at Helsingfors 1885–89, under Becker 1889–90 in Berlin, and under Fuchs and Goldmark in Vienna 1890–91. He showed imagination and power of expression, a masculine sentiment and a respect for his art which never allowed him to abuse his profound technical powers for the display of mere virtuosity. Among his compositions are: 10 symphonic poems, six symphonies, a violin concerto, a string quartet, *Voces Intimae, Valse Triste,* several works for choir and orchestra, incidental music to *Pelléas et Mélisande, As You Like It, The Tempest,* the pantomime, *Scaramouche,* numerous songs and miscellaneous pieces.

ŠIBENIK, a port of Dalmatia, Yugoslavia, on the Adriatic Sea (Ital. *Sebenico*). Pop. (1910) 12,588, over 98% being Croatians. Šibenik, full of Venetian Gothic and Renaissance architecture, is built on a steep hill, and is partly walled. On the seaward side are two forts, now dismantled, and the castle of St. Anna. There are both Orthodox and Roman Catholic bishops, the see of the latter having been founded in 1298. Most of the inhabitants are of the Roman faith and have a beautiful cruciform church built entirely of stone, even the waggon vaults over the nave, choir and transepts being unprotected by lead or tiles. Probably no other church in Europe, of equal size, is similarly constructed. The older part (1430–41) is Italian Gothic.

Šibenik is a naval base, has a wireless station and a steamship station, and has a considerable export trade in bauxite. It is lighted by electricity, the power being supplied by the celebrated falls of Kerka. There are several schools including a secondary one, and also a Forest School. The town is a weaving centre, and here the national costumes are made. Other industries include an insecticide powder mill, a calcium carbide factory, woollen mills, oil refining, the preparation of the *Rhus Cotenus* for dyeing purposes, wine and honey, while fishing and sponge and coral fishing are also carried on. Many of the inhabitants are fishermen.

Šibenik is said to have been founded by the Uskoks (*see* Bosnia) fleeing from Turkish oppression, who then took to piracy. Later the town became famous as a favourite residence of the Croatian kings. In 1117 it was captured by Venice, but held by Hungary from 1351 to 1412, when it again became Venetian. In 1647 it was unsuccessfully besieged by the Turks, and after the fall of Venice in 1797 it became French. From 1815 to 1918 it was Austrian, and in the latter year, before Dalmatia was incorporated in Yugoslavia, it was occupied by the Italians.

SIBERIA, the name in Russian Sibir, of the chief settlement of the Tatar khan Kuchum, Isker on the Irtysh, which was captured by the Cossack *Yermak* in 1581. Subsequently the term was used to denote the dominions of Russia in northern Asia, which were the first to be absorbed by Russia, the more densely peopled south retaining its independence longer. The term had considerable elasticity as regards its southern boundary, being used sometimes as if it included the steppes of the south and at other times as if the steppes of Akmolinsk, Semipalatinsk and the Turgai were not included. Administratively it is now divided into the Uralsk Area, which also includes part of European Russia, the Siberian Area, the Yakutsk Republic, The Buriat Mongol Republic and the Far Eastern Area, while the steppe region above referred to is incorporated in the Kazak republic (*qq.v.*). The geography of Siberia is included in the article Russia (*q.v.*). (X.)

History.—According to Radlov, the earliest inhabitants were the Yeniseians who were followed by the Ugro-Samoyedes, who also came originally from the high plateau and were compelled, in the 3rd century B.C., to cross the Altai and Sayan ranges and to enter Siberia. To them must be assigned the remains dating from the Bronze period which are scattered all over southern Siberia. Iron was unknown to them; but they excelled in bronze, silver and gold work. Their ornaments and implements, often polished, evince artistic taste; and their irrigated fields covered wide areas. On the whole, their civilization stood much higher than that of their more recent successors. Eight centuries later the Turkish stocks of "Tukiu" (the Chinese spelling for "Turks"), Khagases and Uigurs—also compelled to migrate north-westwards from their former seats—subdued the Ugro-Samoyed. They likewise left numerous traces of their sojourn, and two different periods may be distinguished in their remains. They were acquainted with iron, and learned from their subjects the art of bronze-casting, which they used for decorative purposes only, and to which they gave a still higher artistic stamp. Their pottery is much more perfect and more artistic than that of the Bronze period, and their ornaments are accounted among the finest of the collections at the St. Petersburg museum of the Hermitage. This Turkish empire of the Khagases must have lasted until the 13th century, when the Mongols destroyed their civilization. A decline is shown by the graves which have been discovered. In the beginning of the 16th century Tatar fugitives from Turkestan subdued the loosely associated tribes inhabiting the lowlands to the east of the Urals. Agriculturists, tanners, merchants and mollahs (priests) were called from Turkestan, and small principalities sprang up on the Irtysh and the Ob. These were united by Khan Ediger, and conflicts with the Russians, who were then colonizing the Urals, brought him into collision with Moscow; his envoys came to Moscow in 1555 and consented to a yearly tribute of 1,000 sables. As early as the 11th century, the Novgorodians had occasionally penetrated into Siberia; but the fall of the republic checked the advance of the Russians. On the defeat of the rebel Stenka Razin (1667–71) many who were unwilling to submit to the iron rule of Moscow made their way to the settlements of Stroganov in Perm, and tradition has it that, in order to get rid of his guests, Stroganov suggested to their chief, Yermak, that he should cross the Urals into Siberia, promising to help him with supplies of food and arms. Yermak entered Siberia in 1580 with a band of 1,636 men, following the Tagil and Tura rivers. Next year they were on the Tobol, and 500 men successfully laid siege to Isker, the residence of Khan Kuchum, in the neighbourhood of what is now Tobolsk. Kuchum fled to the steppes, abandoning his domains to Yermak, who, according to tradition, purchased, by the present of Siberia to Ivan IV., his own restoration to favour. Yermak was drowned in the Irtysh in 1584 and the Cossacks abandoned Siberia. But new bands of hunters and adventurers poured every year into the country, and were supported by Moscow. To avoid conflicts with the denser populations of the south, they preferred to advance eastwards along higher latitudes; meanwhile Moscow erected forts and settled labourers around them to supply the garrisons with food. Within 80 years the Russians had reached the Amur and the Pacific. This rapid conquest is accounted for by the circumstance that neither Tatars nor Turks were able to offer any serious resistance. In 1607–10 the Tunguses fought for their independence, but were subdued about 1623. In 1628 the Russians reached the Lena, founded the fort of Yakutsk in 1637, and two years later reached the Sea of Okhotsk at the mouth of the Ulya river. The Buriats offered some opposition till, in 1643 Poyarkov's boats descended the Amur, returning to Yakutsk by the Sea of Okhotsk and the Aldan, and in 1649–50 Khabarov occupied the banks of the Amur. In 1852 a Russian military expedition under Muraviev explored the Amur, and by 1857, a chain of Russian Cossacks and peasants were settled along the whole course of the river. The accomplished fact was recognized by China in 1857, and 1860 by a treaty. In the same year in which Khabarov explored the Amur (1648) the Cossack Dejnev, starting from the Kolyma, sailed round the north-eastern extremity of Asia through the strait which was rediscovered and described 80 years later by Bering (1728). Cook in 1778, and after him La Pérouse, settled definitively the broad features of the northern Pacific coast. Although the Arctic ocean had been reached as early as the first half of the 17th century, exploration of its coasts was begun only in the 18th century (1735–39).

The scientific explorations of Siberia, begun in the period 1733 to 1742 by Messerschmidt, Gmelin, and De Lisle de la Croyère, was followed up by Müller, Fischer and Georgi. Pallas, Hansteen and Erman (1828–30), Humboldt, Ehrenberg and Gustav Rose also paid in the course of these years short visits to Siberia. Ritter elaborated in his *Asien* (1832–59), the foundations of a sound knowledge of the structure of Siberia. To Middendorff's journey (1844–45) to north-eastern Siberia—contemporaneous with Castrén's journeys for the special study of the Ural-Altaian languages—the expeditions of Akhte and Schwarz (1852), and later on (1854–57) of the Siberian expedition we owe so marked an advance in our knowledge of East Siberia. The Siberian branch of the Russian Geographical Society was founded at the same time at Irkutsk, and afterwards became a permanent centre for the exploration of Siberia; while the opening of the Amur and Sakhalin attracted Maack, Schmidt, Glehn, Radde and Schrenck, whose works on the flora, fauna and inhabitants of Siberia have become widely known.

Political History.—The events along the trans-Siberian track after the abdication of the tsar in March 1917, his murder in 1918, and the fall of the Provisional Government (Nov. 1917) were part of the general history of the time. Siberia had supplied the moderate Socialists with a valuable contingent of soldiery taken from the political exiles, and also, regrettably, many criminals. Conditions in Siberia were determined by the retreat thither of anti-Bolshevik politicians and the presence of English, French, Japanese and American armed forces, while Russia was in the hands of Lenin, who had made a separate peace with Germany. Czecho-Slovak troops, 70,000 in number, who were opposed to the Brest-Litovsk Treaty, had no other way of exit from Russia. They held and defended the Siberian line until they had to give it up. Siberia, loosely organized, became a centre of resistance to Bolshevik rule under Admiral Kolchak, who took the title of supreme ruler. He was defeated by the Red armies after an attempted invasion of European Russia, and perished in the debacle. (*See* RUSSIA: *History*.)

Since 1920 the gradual organization of the Siberian section within the so-called federal framework of the Union of Socialist Soviet Republics has led to the establishment, under the name of republics (1922–23), of various administrative units. The major part of Siberia (pop. 8,238,000, area 4,500,000 sq. kilo.), forms a region within the U.S.S.R.; the Buriats (481,100) and the Yakuts (288,200) form republics and with the Far Eastern republic (1,721,900), are parts of the U.S.S.R.

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SIBERIAN AREA, an administrative unit of Asiatic Russia, with an area of 4,028,615 square kilometers. The Arctic ocean, from Gyda bay to Khatanga bay forms its northern, and Mongolia and the Kazakstan A.S.S.R. its southern boundary. To the west lies the Uralsk Area, and to the east the Yakutsk and Buriat-Mongol republics. It coincides roughly with the former Yeniseisk, Tomsk and Irkutsk Governments of Imperial Russia. The name Siberia (Sibir) was the Russian name given to the chief settlement, Isker on the Irtysh, of the Tatar Khan Kuchum, and was subsequently extended to include the whole of the Russian dominions in Asia. After the 1917 revolution various republics and areas, each having a good deal of local autonomy were separated off and now the name Siberia is limited to the central region which was not thus split off. Much of it consists of the basin of the Yenisei river (*q.v.*). Stretching from the Sayan alpine regions in the south (lat. 51° 45′ N.) to Cape Chelyuskin in the north (77° 38′ N.), it displays much orographical variety. The West Sayan mountains have their southern base on the plateau, and their northern at a much lower level, and reach heights of 10,000 feet. Around and north-east of Lake Baikal well-marked ridges fringe the plateau, with steep north-western slopes turned towards the valleys (*e.g.*, the beautiful and fertile valley of the Irkut river between the Tunka Alps and the Sayan). A typical feature of the north-eastern border of the high plateau is a succession of broad valleys, longitudinal in an orographical sense, but not geologically, since they are erosion valleys and not synclinal foldings of rocks. Formerly submerged by Alpine lakes, they are now sheeted by flat alluvial soil, suitable for agriculture, and drained by rivers which afterwards make their way northwards through narrow gorges pierced in the mountain walls; the valleys of the Us, the Upper Oka and Irkut are of this type.

An Alpine region, 100 to 150 m. in breadth, fringes the plateau to the north-west, and is called in east Siberia the *taiga:* it consists of separate chains of mountains (4,800 to 6,500 ft.) clothed with dense forest, except on the highest parts, and having narrow marshy valleys, thickly strewn with boulders, *e.g.*, the Altai in the west, the Kuznetskiy Ala-tau, the Us and Oya mountains in West Sayan, the Nizhne-Udinsk taiga, and several chains pierced by the Oka river. North of these alpine regions is the broad belt of fertile black-earth high plains (1,200 to 1,700 ft.) stretching from Tomsk eastwards, and from Kansk penetrating in a great arc south-eastwards to Irkutsk (*see* YENISEI RIVER for structure). North of the town of Yeniseisk, and east of the Yenisei river is a broad belt of Alpine tracts of Archaean origin reaching their greatest elevation in the Yeniseisk taiga, between the Angara (Upper Tunguska) and the Middle or Stony Tunguska. North of this region begins the slope towards the Arctic plains, interrupted by the north-west to south-east ranges of the Upper Inbatsk district and the Syverma, beyond which lie the bleak tundra plains.

The Taimyr peninsula is strictly the name of the northward projection from Taimyr bay on the west to Khatanga gulf on the east, but it is often applied to the whole district between the Yenisei gulf and the Khatanga gulf. The northern coast and the islands off it are not yet accurately known: the Russian explorer Vilkitski, in 1913–14, discovered the islands named after him, lying south of the Nordenskjöld archipelago. Recent corrections of the coast of western Siberia resulting from the explorations of Russian navigators indicate that, except for Cape Chelyuskin, the Taimyr peninsula stretches about 40 m. farther north, and that the gulfs of the Ob and Yenisei should be farther to the west than shown on older maps. East of Cape Chelyuskin good harbours are scarce, but the *Eclipse* in 1914–15 wintered safely in a bay in long. 92° E., and Vilkitski's *Taimyr* in that winter remained safely frozen in Toll bay in lat. 76° 30′ N., long. 100° E. A rolling treeless tundra plain (100 to 150 ft.) covers Taimyr except for the Byrranga mountains (2,000 to 3,000 ft.) and, though comparatively well drained, is difficult to cross except in winter: erratic blocks are widely distributed. Polar bears and seals are found in summer, and in that season Samoyede reindeer breeders migrate to Taimyr Land with their herds, avoiding the Taimyr gulf region,

which is deficient in reindeer "moss." In winter the region is deserted.

Ethnology.—The majority of the population in the Siberian Area is Russian, but there are still survivals of earlier immigrants. Of the Palaeo-Siberians, the most interesting are the Yenisei Ostyaks living along the Yenisei and its tributaries from Yeniseisk to the Lower Tunguska, and most numerous about Sumarokovo, near the confluence of the Stony Tunguska. They are probably a remnant of the primitive aborigines of Siberia, and their race and language are unrelated to any other. They are in no way connected with the Ostyaks of the Ob basin, and are not Mongolian in appearance. They are fairer than the other Yenisei races and sometimes have long, oval faces and fine hair. They call themselves Tindigyet, Kanacket or Din (people), and live in birch bark tents and use hollowed trees for boats. They are a hunting and fishing people and apparently came from the Tom basin, where some place names belong to their language.

Of the Neo-Siberians, the Samoyedes are the most widespread. They have migrated from the Altai, driven north by the Turco-Tatars in the 5th century A.D., and may be the descendants of the people whose civilization can be traced in the Upper Yenisei. They are closely related to the Finno-Ugrians and Samoyede may be a corruption of *Suomi*, the name the Finns give to their native land. The three chief branches in the Siberian Area are the Tavgi reindeer nomads of the Taimyr region, the hunting Ostyak Samoyedes between the taiga and the tundra, and the fishing and hunting Samoyedes along the banks of the Yenisei. They are meso- to brachycephalic, have straight black hair, sallow skin, narrow oblique eyes and broad flat faces and noses. They are short, stout and muscular. Related to them are the Beltirs of the Abakansk steppe, the Kaibals of the Upper Yenisei, the Kamassins of Kainsk, the Karagasses, Motors, and Soyots of the Sayan district. These southern peoples are being absorbed; they frequently speak Tatar and have become settled cultivators or herdsmen. Of the Tatars, the chief branches are those of the Baraba steppe and the Chulim river, who are gradually becoming Russianized, the Altai Tatars, including the Teleuts or Telengites of the Kuznetsk district, the Chern or Black Forest Tatars of the Biya river, and the Tatars of the Abakansk steppe. The Tatars of the Altai mountains are successful cattle and horse breeders, and have large flocks of sheep and goats. There are some Tungusic tribes between the Lower and Middle Tunguska, the best known being the Chapogir. Their original home was Manchuria and they are of the Ural-Altaic group to which the Manchus belong, and are nomad reindeer breeders. The Russian population is mainly settled in the rich agricultural belt through which the trans-Siberian railway passes.

Agriculture and Stock Raising.—Cultivation is densest round Omsk, especially to the south, and in the region to the south of the railway from Lake Chany eastwards to Tomsk. Eastward from that region there are scattered patches along the railway, and along the courses of the Upper Yenisei and its tributaries, especially in the Abakan and Tuba valleys. From Irkutsk a belt of cultivation extends along the Angara and its tributaries as far north as lat. 55° N. The chief crops are wheat, rye, barley, potatoes, flax, hemp, sunflower seed, beans and grasses. In the Minusinsk district beet is successfully grown and there are beet sugar factories; water melons also thrive. In Irkutsk rye is the predominant crop. The sandy black soils of the Kainsk and Mariinsk districts near Tomsk, and of the Altai favour wheat production, as does the black earth of the Baraba steppe, and wheat in these districts forms 50 to 75% of the harvest. The brown, less fertile soils of Tomsk are favourable to barley and spring rye. Winter rye and oats flourish east of Tomsk. The long winter and slight snowfall everywhere make spring corn a better crop than winter corn, and fruit growing is rarely successful. Makhorka tobacco is grown along the Irtysh, south of Omsk, and supplies the Omsk tobacco factory.

Of wild produce, the cones of the *Pinus Cembra* of the northern Tomsk and Mariinsk districts and of the mountain regions of Biisk and Kuznetsk find a ready market in the oil pressing factories of Tomsk; bilberries, cranberries and dried mushrooms are also exported. The introduction of agricultural machinery and of fertilizers is improving the harvest. Novo-Sibirsk and Omsk are the chief centres of distribution, and there is a machine-testing station at Novo-Sibirsk. Grain elevators are increasingly common. Most grain is exported unmilled, but Tomsk, Biisk, Barnaul and Novo-Sibirsk have extensive milling industries. Freightage costs militate against the export of Siberian grain. Dairying is the most productive occupation, though only introduced in 1893. There are technical dairy schools at Omsk, Kainsk, Barnaul and Zmyeinogorsk, in addition to a central laboratory at Tomsk and other small local laboratories. The reasons for its success are its small bulk which lessens transport difficulty, and the fact that Siberian milk contains a high proportion of fat owing to the rich pasture; the average yield is 1 lb. of butter to 20·05 lb. milk as against 1 lb. to 28 lb. in Denmark. Ice trucks for butter leave Novo-Sibirsk several times a week during the summer and collect from the various butter transit centres en route. Siberian cheese is increasingly finding its way on to the market. East of Krasnoyarsk dairy farming is of little importance; the cattle are few in number, small, and yield little milk.

Horses and working cattle are raised, especially in the west, for local use; the Kuznetsk breed is famous, but the number of horses fell during the post-1914 period and have not yet reached pre-war numbers. The stock raising districts of Minusinsk, Achinsk and Turukhansk are recovering more rapidly. Sheep-breeding, especially of the newly introduced merino sheep, is rapidly developing on the Yenisei plains, where the hay is excellent. Pig-breeding has developed with the increasing dairy industry, which provides buttermilk as pig food, and bacon and sausage factories are springing up. Reindeer are valuable in the Turukhansk district, while in the southern hill regions the *maral*, a kind of wapiti, is bred in farms for the sake of its horns, which are in demand in China for the preparation of a drug called *panty*. Bee-keeping is of very ancient origin, and is profitable in the Achinsk, Minusinsk, Kusnetsk, Biisk and Zmyeinogorsk districts; the destruction of the forests and the desiccation of the steppe have diminished it elsewhere. In spite of the vast forest wealth of the region the timber industry is little developed, mainly owing to the lack of transport facilities; the Tomsk district is markedly deficient in timber and receives some of its timber from camel transport across the Kirghiz steppe. If the Yenisei sea-route comes into regular use, a timber export may spring up on that river. There are timber mills at Omsk, Novo-Sibirsk and Tomsk; those at Novo-Sibirsk use the wood from the district between Barnaul and the railway, but these mills supply local needs only, as do the mills at Irkutsk.

Mining.—The mineral wealth of the region is great, but little worked at present. Rich deposits of magnetic iron ore exist on the Telbes, a tributary of the Kondoma near Kuznetsk, with beds of good coking coal 20 m. away. Gold exists in quantity, but is hampered by lack of proper dredging apparatus. The Mariinsk taiga gold mines are prosperous, and the first dredger in west Siberia was established here, but the Altai placer mining is declining. The Bogom-Darovanni reef gold mine near the Abakan river is up-to-date and flourishing. The Yenisei gold areas, one in the region between the Pit and the Angara rivers, and one in the upper basins of the Teya and Kalami, tributaries of the Stony Tunguska, are less fully developed in the absence of roads. They are, however, able to get food from the rich Minusinsk district and do not suffer from the danger of starvation, as do some mines in Yakutsk. The Bodaibo district on the Vitim river lies within the Siberian Area and produces 25% of all the gold in U.S.S.R. The gold is alluvial and 13 tons can be produced per annum; transport is a difficulty, since necessaries have to be brought from Irkutsk, but a recently constructed light railway to the Vitim river has somewhat lessened the costs. There is an assaying and gold-smelting laboratory at Bodaibo. Silver is produced in quantity in the Altai region, and platinum from Verkhoture in the Tara river district. Platinum occurs with the gold in the Pitski Mountains and in the Vitim district. Asbestos is worked in the Angara district and from the dolomite veins of the left bank of the Kamishta, a tributary of the Abakan. It is reported from other

places in the Altai, but is not at present worked (1928). Graphite of good quality exists near Turukhansk on the Yenisei and on the Lower Tunguska, but is little exploited. Mica is spasmodically worked in the Krasnoyarsk district.

There are antimony mines in the Yeniseisk district and in Minusinsk also, while radium has recently been found on the Ayakhta, a tributary of the Pit, and osmiridium is known in the Nizhne-Udinsk district. Coal is mined in the Kuznetsk beds which extend from Sudzhenka on the railway to 40 m. S. of Kuznetsk and the output in 1926–27 was 1,950 tons, mainly of coking or semi-anthracite coal used on the railway. The Minusinsk region, and Dudinsk on the Lower Yenisei have rich deposits, as yet little worked. Copper exists in the Minusinsk district, and near Verkhne-Udinsk. Salt is obtained from salt lakes in the Baraba steppe; from Lake Abakanskoe, which produces about 7,500 tons per annum, and from Ussolye near Irkutsk the annual output is about 10,000 tons. Glauber's salt (sulphate of sodium) is found in the lakes of the Baraba steppe. Hot mineral springs exist near Biisk. Lime, building-stone and clays are abundant and the Irkutsk district produces kaolin and white clay for porcelain. The jasper and porphyry of the Altai region are famous. The above is an indication only of the great mineral wealth of the Siberian Area; much of the region is as yet unsurveyed and of the mineral wealth reported (*see* Yenisei River), little is worked. Increasing colonization and consequent improvement of transport may lead to a great development of mining.

Industries and Communications.—Factories are springing up in the larger towns, the chief occupations being distilling, brewing, tanning, soap and tallow making, flour-milling, saw-milling, weaving, oil-milling, glass-making, brick and cement making and pottery. There are printing works at Omsk, Tomsk and Irkutsk, and the latter town has cigarette-case factories, steam sausage and pearl-barley factories. Rope-making is usually a *koustar* (peasant) industry, but Barnaul and Minusinsk have rope factories. The most famous glass factory is that 28 m. from Krasnoyarsk, established in 1840. Of timber industries, apart from saw-milling, Minusinsk has boat-building and Omsk, Tomsk and Irkutsk carriage-building; Omsk also manufactures railway sleepers. At Tomsk and Biisk are match factories. In the western districts *koustar* industries carried on in the peasants' cottages are common; they are less so in the east. The most noted of these are the smiths and joiners of Kuznetsk and Tomsk, the making of metal pots for milk and *barnaulkas*, or skin coats of the Barnaul district, the cedar-nut oil of Biisk, the pottery of Yeniseisk, the boot-making of the Irkutsk district. Woodwork, the dressing of sheep-skin and wool products, weaving and metal work are widespread peasant industries in the Yenisei basin and the Irkutsk district.

The Yenisei and its tributaries form the main avenue of communication north of the trans-Siberian railway, but rivers and roads alike are impassable during spring and autumn. The great military road or *Trakt* of Siberia passes through the south from Omsk via Tomsk and Krasnoyarsk to Irkutsk, and traffic along it is by post horse in summer and sledge in winter. Even this road is difficult and in places impassable in spring and autumn. In many places there are no bridges and ferries are used. The effect of the building of the railway in 1891–1905 in these conditions was marked and immediate; villages became towns with large populations in a few years, colonization and settlement near the railway increased, and the possibilities of export produced remarkable developments, *e.g.*, the dairy industry. In 1915 a branch from Novo-Sibirsk to Barnaul and Semipalatinsk was opened, with a branch line to Biisk and this line is now being prolonged to link up with the Turkestan and Orenburg-Tashkent railways. The effect on the development of Siberian products, especially grain and coal, should be marked, and settlement will be further increased. Other branch lines link Tatarskaya, 105 m. E. of Omsk, with Slavgorod and the Kulundinsk steppes, practically uninhabited in 1907, but rapidly settled during 1907–12, Taiga with Kuznetsk, and Achinsk with Minusinsk. No branch lines go northward except a short one to Tomsk.

Colonization.—The administrative centre is Novo-Sibirsk, (*q.v.*), and other towns (*q.v.*) are Barnaul, Irkutsk, Krasnoyarsk, Omsk and Tomsk, with populations from 70 to 120 thousand. Biisk has a population of 45,574 and Minusinsk of 20,403. It will be noted that all these towns are on the railway. Colonization did not begin to any extent, in the west, until the 18th century, when forts were constructed from Omsk south-eastwards along the Irtysh to protect the settlers from Kirghiz raids. Criminal, political and religious exiles were banished to Siberia up to 1900; the first mention of such exile is in 1648. In 1904 exile for political offences was again restored and is still in force (1928). Between 1823 and 1898, 700,000 exiles, with 216,000 voluntary followers passed through Tobolsk. Of the religious exiles the *raskolnik* or dissenters from the ecclesiastical changes introduced by Nikon, and from the changes introduced by Peter the Great, formed a valuable element among the colonists, being ascetic, industrious and abstemious. Some colonists were peasants ordered to settle at certain places so as to maintain road communication. But the largest element and the most important was the voluntary immigrants, who are still pushing eastwards in great numbers and gradually bringing all the fertile regions of the south of the Siberian Area under cultivation. Between 1896 and 1909 over a million immigrants settled in the Altai region and few returned. Of those settling east of the Yenisei and in the Irkutsk district, many found the climatic conditions impossible and returned westwards. Education varies with accessibility. The large towns on the railways have schools and technical institutions, but the more remote settlements and the nomads, present a difficult problem and among them the illiteracy rate is high. (R. M. F.)

SIBI, a town and district of Baluchistan. The town is now an important junction on the Sind-Peshin railway, where the Harnai line and the Quetta loop line meet, near the entrance of the Bolan pass, 88 m. S.E. of Quetta. Pop. (1901) 4,551. The district, which was constituted in 1903, has an area of 4,152 sq.m.; pop. (1901) 74,555. The greater part became British territory by the treaty of Gandamak in 1879; the rest is administered under a perpetual lease from the khan of Kalat. Political control is also exercised over the Marri-Bugti country, with an additional area of 7,129 sq. m. Pop. (1901) 38,919.

See *Sibi District Gazetteer.*

SIBIU (Ger. *Hermannstadt,* Hung. *Nagyszeben*), a town of Transylvania, Rumania, capital of the department of Sibiu. Pop. (1928) 33,400, of which 16,000 were Germans, 12,000 Rumanians, 5,400 Magyars. Sibiu is beautifully situated in the fertile valley of the Sibiu, surrounded by mountains. An old "Saxon" colony, it still retains a mediaeval Germanic appearance. The Gothic Protestant church, begun in the 14th century and finished in 1520, contains a beautiful font (1438) and a mural painting of the Crucifixion by Johannes von Rosenau (1445). The "new church," a 15th century addition, comprising the western part of the building, contains many beautiful monuments of Saxon notables. The fine 15th century town hall contains the archives of the "Saxon nation." Sibiu is the seat of an Orthodox archbishopric and of the superintendent of the Transylvanian Protestants. It contains a good museum, an Orthodox seminary, a law academy, several secondary schools and manufactures of cloth, linen, leather, caps, boots, soaps, candles, ropes and breweries and distilleries.

Sibiu was a Roman colony (Libinium) re-founded by colonists from Nuremberg in the 12th century. Its history is bound up with that of the Saxon communities in Transylvania (*q.v.*), and it was at one time capital of the principality of Transylvania.

SIBONGA, a municipality (with administration centre and 24 *barrios* or districts) of the province and island of Cebu, Philippine Islands, on the east coast 30 m. S.W. of Cebu, the provincial capital. Pop. (1918), 27,199. It is a port for the coasting trade and is connected by rail with Cebu. Corn and tobacco are the principal products. In 1918, it had 499 household industry establishments with output valued at 92,000 pesos. Of the 13 schools, 11 were public. The language is Cebu-Bisayan.

SIBSAGAR, a town and district of British India, in Assam. The town is situated on the Dikhu river, 8 m. from the Brahmaputra, and is picturesquely built round a magnificent tank. Pop.

(1921) 5,329.

The DISTRICT OF SIBSAGAR has an area of 5,202 sq.m.; population (1921), 823,197. It consists of a level plain, much overgrown with grass and jungle, and intersected by numerous tributaries of the Brahmaputra. Reserved forests extend over 1,100 square miles. Sibsagar is the chief centre of tea cultivation in the Brahmaputra valley. It contains a large number of well-managed tea-gardens, which in 1921 had a population of quarter of a million and 100,000 acres under tea with an output of nearly 50 million pounds. There are also several timber mills.

SIBTHORP, JOHN (1758–1796), English botanist, was born at Oxford on Oct. 28, 1758, the youngest son of Dr. Humphrey Sibthorp, Sherardian professor of botany at Oxford. He graduated at Oxford in 1777, and studied medicine at Edinburgh and Montpellier. In 1784 he succeeded his father in the Sherardian chair. He travelled to Göttingen and Vienna, in preparation for a botanical tour in Greece (1786). Returning to England at the end of the following year he took part in the foundation of the Linnaean Society in 1788, and published *Flora Oxoniensis* (1794). He made a second journey to Greece, but died at Bath of consumption on Feb. 8, 1796. He bequeathed his books on natural history and agriculture to Oxford university, where he founded the Sibthorpian professorship of rural economy, attaching it to the chair of botany. The task of preparing the works *Flora Graeca* and *Florae Graecae Prodromus* was undertaken by Sir J. E. Smith.

SIBYLLA, a proper name, afterwards used as a common noun (as we say, "a Daniel"); the derivation and meaning are unknown but certainly are not Greek; they are possibly Semitic. In the disturbed period preceding the development of the full classical culture; *i.e.*, about 800–600 B.C., religious movements of all sorts were common in Greece and Asia Minor, and especially, inspired prophets were numerous. Of these one of the most famous was Sibylla of Marpessus, a village near Troy, also claimed as a native of Erythrae; of her Heracleitus says (Frag. 12, Bywater) that "with her maddened mouth . . . she reaches a thousand years with her voice by the power of the god"; *i.e.*, Apollo, by whom this real or imaginary person was thought to be inspired. Numerous prophecies, generally in hexameter verse, the usual metre of Apolline oracles, were attributed to her, and her great popularity led ultimately to her multiplication, numerous places claiming, from about the 4th century on, to be her native city, or to have been visited by her, or to be the birthplace of another Sibyl of like inspiration. Varro (*ap.* Lactantius, *divin. instit.* I. 6.) gives a list of ten, which includes the famous Cumaean Sibyl, often identified with the Erythraean.

She was supposed to be the authoress of the Sibylline Oracles, which were kept in the temple of *Iuppiter Capitolinus* at Rome under the care of the *quindecimviri* (*see* ROMAN RELIGION), and consulted in emergencies by order of the Senate. Apollo loved her and granted her the gift of prophecy, and also a life of as many years as she had grains of dust in her hand; but she forgot to ask for youth, and so gradually withered away almost to nothing. It was presumably she who offered Tarquinius Superbus nine books of prophecies, and, on his declining to pay the price asked, burned first three and then three more, finally selling the remainder for the sum she originally demanded for all. (Ovid, *Metam.*, xiv., 130 et seq.; Dionysius Hal. iv. 62). Of the official collection supposed thus to have originated, one or two fragments still survive (*see* Diels, *Sibyllinische Blätter*).

Finally, Jewish and Christian apologists discovered a Judaean or Babylonian Sibyl, to whom were attributed the numerous prophecies, still extant, containing Judaeo-Christian propaganda.

See Bouché-Leclercq, *Histoire de la Divination dans l'Antiquité*, ii. p. 133 et seq.; Buchholtz in Roscher's *Lexikon*, s.v.; Wissowa, *Religion u. Kultus*, 2nd. ed. p. 534 et seq., and authorities cited there.

SIBYLLINE ORACLES, a collection of Apocalyptic writings, composed in imitation of the heathen Sibylline books by the Jews and, at a later date, by the Christians in their efforts to win the heathen world to their faith. The fact that they copied the form in which the heathen revelations were conveyed (Greek hexameter verses) and the Homeric language is evidence of a degree of external Hellenization, which is an important fact in the history of post-exile Judaism.

Book III. contains Jewish oracles relative to the Golden Age established by Roman supremacy in the East about the middle of the 2nd century B.C. (especially 175–181: *cf.* I. Macc. viii. 1–16). The evacuation of Egypt by Antiochus Epiphanes at the bidding of the Roman ambassadors suits the warning addressed to "Greece" (lines 732–740) against overweening ambition and any attempt upon the Holy City, which is somewhat strangely enforced by the famous Greek oracle, "Let Camarina be, 'tis best unstirred." Older than these are the Babylonian oracle (97–154) and the Persian (381–387). A later Jewish oracle (46–62) refers to the wars of the second Triumvirate of Rome, and the whole compilation seems to come from a Christian redactor.

Book IV. is a definite attack upon the heathen Sibyl (the Jews and Christians did not attempt to pass off their "forgeries" as genuine) as the mouthpiece of Apollo by a Jew who speaks for the Great God and yet uses a Greek review (49–114) of ancient history from the Assyrian empire. There are references to the legendary escape of Nero to Parthia (119–124) and the destruction of Jerusalem in A.D. 70 (130–136).

Book V. contains a more developed form of the myth of *Nero redivivus* in which a panegyric on him (137–141) has been brought up to date by some Jew or Christian, and eulogies of Hadrian and his successors (48–51) side by side with the legend of the miserable death of Titus in quittance of his destruction of Jerusalem (411–413) which probably represents the hope of the zealots who survived it.

The remaining books appear to be Christian (some heretical) and to belong to the 2nd and 3rd centuries.

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SICANI, generally regarded (together with the Elymi) as the oldest inhabitants of Sicily. Sicania and the Siculi (*q.v.*) or Siceli are mentioned in Homer (*Odyssey*, XX. 383, XXIV. 307), the latter apparently being known to the Greeks as slave dealers. From the similarity of name, it would be natural to identify the Sicani with the Siculi, but ancient authorities expressly state that they were two distinct peoples (*see* SICILY: *History, ad init.*). At first the Sicani occupied nearly the whole of the island, but were gradually driven by the Siculi into the interior and the north and north-west. The most important of the towns to which a Sicanian origin can be assigned and the site of which can be determined, are: Hyccara (*Muro di Carini*), taken and plundered by the Athenians during the Sicilian expedition (415 B.C.); and Omphakē, between Agrigentum (*Girgenti*) and Gela (*Terranova*).

SICILY (Ital. *Sicilia*), an island of the Mediterranean sea belonging to Italy, separated from the mainland by the Straits of Messina, which at their narrowest part are about 2m. in width. In shape it is roughly triangular, whence the ancient poetical name of *Trinacria,* referring to its three promontories of Pelorum (now Faro) in the north-east, Pachynus (now Passero) in the south-east, and Lilybaeum (now Boeo) in the west. Its area, exclusive of the adjacent small islands, is 9,860sq.m.; while the area of the whole group is 9,936 sq.m. Pop. (1921) 4,061,452.

The island occupies that part of the Mediterranean in which the shallowing of the waters divides that sea into two basins, and in which there are numerous indications of frequent changes in a recent geological period. The channel between Cape Bon in Tunis and the south-west of Sicily (a distance of 80m.) is, on the whole, shallower than the Straits of Messina, being for the most part under 100 fathoms in depth, and exceeding 200 fathoms only for a very short interval, while the Straits of Messina have almost everywhere a depth exceeding 150 fathoms.

The north coast is generally steep and cliff-bound and abundantly provided with good harbours, of which that of Palermo is the finest. In the west and south and in the south part of the east side, the hills are much lower and recede farther from the sea. The coast is for the most part flat, more regular in outline and less favourable to shipping, while in the east, where the sea-

bottom sinks rapidly down towards the eastern basin of the Mediterranean, steep rocky coasts prevail except opposite the plain of Catania. In the northern half of this coast the lava streams of Mount Etna stand out for a distance of about 20m. in a line of bold cliffs and promontories.

The surface of Sicily lies for the most part more than 500ft. above the level of the sea. Caltanissetta, in the centre, stands 1,900ft. above sea-level. Considerable mountains occur only in the north, where the lower slopes of all the heights form one continuous series of olive-yards and orangeries. Of the rest of the island the greater part forms a plateau varying in elevation and mostly covered with wheat fields. The only plain of any great extent is that of Catania, watered by the Simeto, in the east; to the north of this plain the active volcano of Etna rises with an exceedingly gentle slope to the height of 10,868ft. from a base 400sq.m. in extent. This is the highest elevation of the island. The steep and narrow crystalline ridge which trends north-eastwards, and is known to geographers by the name of the Peloritan mountains, does not reach 4,000ft. The Nebrodian mountains, a limestone range connected with the Peloritan range and having an east and west trend, rise to a somewhat greater height, and farther west, about the middle of the north coast, the Madonie culminate at the height of nearly 6,500ft. From the western end of the Nebrodian mountains a lower range (in some places under 1,500ft. in height) winds on the whole south-eastwards in the direction of Cape Passaro. With the exception of the Simeto, the principal perennial streams—the Salso, the Platani and the Belice—enter the sea on the south coast.

Geology.—In general, the older beds occur along the northern coast, and progressively newer and newer beds are found towards the south. Folding, however, has brought some of the older beds to the surface in the hills which lie to the north and north-east of Sciacca. The Monti Peloritani at the north-eastern extremity of the island consist of gneiss and crystalline schists; but with this exception the whole of Sicily is formed of Mesozoic and later deposits, the Tertiary beds covering by far the greater part. Triassic rocks form a discontinuous band along the northern coast, and are especially well developed in the neighbourhood of Palermo. They rise again to the surface in the southern part of the island, in the hills which lie to the north of Sciacca and Bivona. In both areas they are accompanied by Jurassic, and occasionally by Cretaceous, beds; but of the latter there are only a few small patches. In the south-eastern part of the island there are also a few very small outcrops of Mesozoic beds. The Eocene and Oligocene form a broad belt along the northern coast, very much more continuous than the Mesozoic band, and from this belt a branch extends southwards to Sciacca. Another patch of considerable size lies to the east of Piazza Armerina. Miocene and Pliocene deposits cover nearly the whole of the country south of a line drawn from Etna to Marsala; and there is also a considerable Miocene area in the north about Mistretta. Volcanic lavas and ashes of a recent geological period form not only the whole of Etna but also much of the Monti Iblei in the south.

Climate.—The climate of Sicily resembles that of the other lands in the extreme south of Europe. As regards temperature, it has the warm and equable character which belongs to most of the Mediterranean region. At Palermo in only seven of the 30 years 1871–1900, was the thermometer observed to sink below the freezing-point; frost thus occurs in the island even on the low grounds, though never for more than a few hours. On the coast snow is seldom seen, but it does fall occasionally. On the Madonie it lies till June, on Etna till July. The annual rainfall, except on the higher mountains, does not reach 30in., and it occurs chiefly in the winter months, while during June, July and August the whole rainfall does not exceed 2in., except on the slopes of the mountains in the north-east. Hence most of the streams dry up in summer. The chief scourge is the scirocco, which is experienced in its most characteristic form on the north coast.

Flora.—The flora of Sicily is remarkable for its wealth of species. The families most abundantly represented are the *Compositae, Cruciferae, Labiatae, Caryophyllaceae* and *Scrophulariaceae.* The *Rosaceae* are also abundantly represented, and among them are numerous species of the rose. The general aspect of the vegetation of Sicily, however, has been greatly affected, as in other parts of the Mediterranean, by the introduction of plants within historical times. Besides the olive, all the members of the orange tribe, the agave and prickly pear have been introduced since the beginning of the Christian era. With respect to vegetation and cultivation three zones may be distinguished. The first reaches to about 1,600ft. above sea-level, the upper limit of the members of the orange tribe; the second ascends to about 3,300ft., the limit of the growth of wheat, the vine and the hardier evergreens; and the third, that of forests, reaches from about 3,300ft. upwards. Among other trees may be mentioned the sumach, the date-palm, the plantain, various bamboos, cycads, and the dwarf-palm. The *Arundo Donax,* the tallest of European grasses, is largely grown for vine-stakes.

Population.—For the area and population of the several provinces *see* ITALY. Between 1881 and 1901 the population increased at the rate of 20·5% and between 1901 and 1921 at the rate of 13·8%. The average density is extremely high for a country which lives almost exclusively by agriculture, and is much higher than the average for Italy in general.

Agriculture.—Two types of agriculture prevail in Sicily—the extensive and the intensive. The former covers mainly the interior of the island and half the southern coast, whilst the latter is generally adopted on the eastern and northern coasts. Large holdings of well over 1,000ac. are indispensable to the profitable pursuit of extensive agriculture.

Intensive agriculture in Sicily is limited to fruit trees and fruit-bearing plants. Large extents of land along the coasts are exclusively cultivated as vineyards, or as olive, orange and lemon groves. The by-products of the citrus-essences, citrate of lime, etc., are also of some importance. Vegetables are grown chiefly in the neighbourhood of large cities. Almonds are freely cultivated, and they seem to be the only trees susceptible also of cultivation upon the *latifondi* together with grain. A large export trade in almonds is carried on with north and central Europe. Hazelnuts are grown in woods at a level of more than 1,200ft. above the sea. These also are largely exported to central Europe for use in confectionery. The locust bean (used for forage), figs and peaches are widely grown, while in certain zones the pistachio and the manna-ash yield rich returns. On the more barren soil the sumach shrub, the leaves of which are used for tanning, and the prickly pear grow freely. The latter fruit constitutes, with bread, the staple food of the poorest part of the rural population for several months in the year.

Climatic conditions prevent cattle-raising in Sicily from being as prosperous an undertaking as in central Italy. The total number of bullocks in the island is calculated to be 221,357 (1918). Sheep and goats, which subsist more easily on scanty pasturage, are more numerous, the total number being calculated at 1,553,623. The wool harvest is scanty, and the production of butter a negligible quantity, though there is abundance of the principal product of Sicilian pasture lands, cheese of various kinds, for which there is a lively local demand. The Sicilian race of horses would be good but has degenerated in consequence of insufficient nourishment and overwork. A better breed of horses is being obtained by more careful selection, and by crossing with Arab and English stallions imported by the Government.

The absence of forests, which cover hardly 3% of the total area of the island, constitutes a serious obstacle to the prosperity of Sicilian pastoral and agrarian undertakings. The few remaining forests are almost all grouped around Etna and upon the high zone of the Madonian mountains. Plans for reforesting certain areas have been advanced.

In that part of the island which is cultivated intensively some 3,084,000hectol. of wine were produced in 1926 and had not the phylloxera devastated the vineyards during the last decade of the 19th century the production would be considerably higher; 132,900 tons of olives, 162,200hectol. of olive oil and 595,100 tons of oranges and lemons were also produced. The zone of the *latifondi,* or extensive culture, yielded 143,000 tons of beans in 1926. The total exports in 1925 were half as much again as

the imports, and about 70% of the former were agricultural products.

Mining.—The most important Sicilian mineral is undoubtedly sulphur, mined principally in Caltanissetta and Girgenti, and in minor quantities in Palermo and Catania (208,447 tons in 1925).

Another Sicilian mineral industry is the production of common salt and rock-salt. The centre of the asphalt mining industry is the province of Syracuse (200,000 tons in 1925). Pumice stone is also exported from Lipari.

Other Industries.—Deep-sea fisheries give employment to many Sicilians, who exercise their calling not only off the coasts of their island, but along the north African shore, from Morocco to Tripoli. In 1914 the total number of fishermen was 46,583, as against 127,558 for the whole of Italy, and 8,789 tons of fish were caught. Only 32 tons of coral were obtained in 1914, for a value of £15,168—about one-tenth of the quantity for 1900. The sponge divers brought up sponges valued at £24,000. The estimated hauls of tunny fish were 2,088 tons, valued at £72,780.

The majority of the Sicilian industries are directly connected with various branches of agriculture. Such, for instance, is the preparation of the elements of citric acid. The total production of raw citrate of calcium was 82,190 tons in 1924–5, of which 4,678 tons were exported, and 1,020 of tartaric acid; 2,780 tons of citric acid, produced at Palermo and Linate in Lombardy, were also exported. Older and more flourishing is the Marsala industry. Marsala wine is a product of the western vineyards situated slightly above sea-level. Another flourishing Sicilian industry carried on by a large number of small houses is that of preserving vegetables in tins. An artificial lake at Piana dei Greci above Palermo is used for the production of electric power and for the irrigation of the Conca d'Oro. Good furniture is made at Palermo and lace (mostly from old patterns) at several places.

Communications.—Before 1860 there was no railway in Sicily. The total length of Sicilian railways is now nearly 1,200m., all single lines. Their construction was rendered very costly by the mountainous character of the island. Messina is connected with the railway system of the mainland by ferry-boats from Villa San Giovanni and Reggio. From Messina lines run along the northern coast to Palermo, and along the east coast, *via* Catania to Syracuse: the latter line is prolonged along the south of the island *via* Canicatti to Aragona Caldare, Girgenti and Porto Empedocle. From Catania another line runs westward through the centre of the island *via* San Caterina Xirbi (with a branch to Canicatti) to Roccapalumba (with a branch to Aragona Caldare), and thence northwards to Termini, on the line between Messina and Palermo. This is the direct route from Catania to Palermo. From Catania begins the line round Etna following its south, west and north slopes, and ending at Giarret Riposto on the east coast railway. From Valsavoia (14m. south of Catania on the line to Syracuse) a branch line runs to Caltagirone. From Palermo a line runs southwards to Corleone and San Carlo (whence there are diligences to Sciacca on the south coast) and another to Castelvetrano, Marsala and Trapani. Narrow-gauge railways have been constructed, especially in the south, so that Catania is linked up with Ragusa and Castelvetrano with Porto Empedocle and Licata. A steam tramway runs from Messina to the Faro at the north-east extremity of the island, and thence along the north coast to Barcelona, and another along the east coast from Messina to Giampilieri. Communications by sea are important. A steamer leaves Naples every night for Palermo, and *vice versa*. Palermo, Messina and Catania (*qq.v.*) are the most important harbours. Porto Empedocle and Licata share with Catania most of the sulphur export trade, and the other ports of note are Marsala, Trapani, Syracuse.

Economic, Intellectual and Moral Conditions.—As a general rule, trade and the increase of production have not kept pace with the development of the ways of communication. The poverty of the Sicilian population is accentuated by the unequal distribution of wealth among the different classes of society. About one-fifth of the total area of the island belongs to 1,025 individuals, and half of this is properly cultivated, the rest being badly or insufficiently so. But the proportion of the area of the island used for agricultural purposes is very high—no less than 94·6%. A small but comparatively wealthy class—composed principally of the owners of *latifondi*—resides habitually in the large cities of the island, or even at Naples, Rome or Paris.

Emigration only attained serious proportions within the last decade of the 19th century. In 1897 the emigration from the island was 15,994; in 1898, 21,320; and in 1899, 24,604. Since then it has increased: in 1905 the emigrants numbered 106,000, and in 1906, 127,000 (3·5% of the population). Of these about three-fourths were adults; but the rapid increase in the population has more than covered the deficiency.

Emigration has fallen since the World War. When in 1860, Sicily was incorporated in the Italian kingdom, hardly a tenth of the population could read and write. Upon the completion of unity, elementary schools were founded everywhere; but, though education was free, the indigence of the peasants in some regions prevented them from taking full advantage of the opportunities offered. In 1921, 51% of the whole population over six years old, and in 1925, 74% of the persons married, could read. Brigandage of the classical type has disappeared from Sicily, and energetic proceedings are now, for the first time, being taken against the Mafia (*q.v.*). (G. G. CH.; G. MO.; T. A.)

New Measures.—The institution in 1925 of the *Provveditorato alle opere pubbliche in Sicilia* (a special commission for public works) has rendered co-ordination and rapid action possible. Over 1,200 miles of high-roads are being improved, and over 450 miles of new roads are to be finished by 1931. Important harbour works, schools, aqueducts and other public works have been undertaken, the total cost of which will be some £8,000,000. Marshy land is being drained and new villages are being built. Much is being done in the way of co-operation and the granting of credits, especially since the Bank of Sicily ceased to be a bank of issue, and became (like the Bank of Naples and the Monte dei Paschi at Siena) a public credit institution. It was thus able to create an association for the cultural and economic development of the island, out of which has already grown a regular motor service for tourists along the main routes. The National Association for the interests of southern Italy maintained in 1925–26 159 day-schools, frequented by 14,588 pupils, and 742 schools for adults, which in the first five years were frequented by 162,955 pupils.

Archaeology.—The pre-Hellenic inhabitants of Sicily are called by classical authors Sicani or Siculi, variant names of kindred tribes who doubtless migrated at much the same time from north Africa. It is, however, very convenient to retain the two names, to apply the term Sicanian to the stone age, and to reserve Siculan for the Chalcolithic and the bronze and iron ages, the first Siculan period being Chalcolithic, the second Siculan being bronze age, while the beginnings of the iron or the third Siculan period will be from 900 to 700 B.C., and the beginning of a fourth Siculan may be placed at 700 B.C. when the native civilization is hybridized with the Greek.

The Sicanian Period.—Pottery incised with geometrical designs, including one bell-beaker, the Sicanian period is known principally from two sites, Stentinello and Matrensa. Stone implements from these places were of poor quality and there were no other objects of interest except the pottery, which is hand-made and baked in an open fire. The surface is blackish-grey, and the ornament upon it, which looks as if it were merely incised, has a strange regularity produced by real stamps, not by puncture by bone awls. This phenomenon is unique at this early time. Most unfortunately no vases have been recovered intact, but from the fragments it is inferred that there were, at any rate, hemispherical bowls, basins with ring handles and conical vases with a ring foot. The pottery of the caverns at Villafrati and Moarda belongs to a later stage of the Neolithic. The finding of a bell-beaker connects it with the civilization of the dolmen-builders.

Many parts of Sicily still remain to be explored for traces of the Sicanian period, but so far as the present material goes, the first Siculan does not seem to have evolved from the Sicanian, or, if it has, the steps are still missing; for all the outward and

material evidence of the two civilizations shows them to be very different. A few rock-hewn tombs of the first Siculan period have been discovered near Palermo and a considerable number near Girgenti, but the largest cemeteries were found by Paolo Orsi in the Syracusan district. The principal sites are those of Castelluccio, Melilli, Monte Racello, Monte Tabuto, Vallelunga and Monte Salia. The typical burial was in a rock-hewn chamber, the construction varying according to the nature of the ground, so that at Monte Tabuto the dead were buried in disused flint-mines, while at Monte Racello natural caverns were enlarged for the purpose, and actual surface-graves were even formed out of slabs on the top of the broken ground. At Castelluccio, however, which may be taken as the standard case, the circular or elliptical chambers were hewn in a vertical face of rock and entered by a short horizontal corridor.

Each chamber contained many skeletons, in one case no less than twenty-six. They were invariably buried in the squatting position, accompanied by a small number of weapons and ornaments and a regular equipment of pottery. It seems that the idea was to seat them as at a banquet, with large jars beside them to hold water, and smaller decorated cups out of which to drink it. The weapons and implements were sometimes of stone, especially flint, sometimes of copper in primitive forms as if the Neolithic period was only just past and hardly forgotten. Of personal ornaments there were few. Of pottery, all hand-made, there were three kinds, viz., a rough household ware, pots of a better clay coated with a red or yellow slip and—far the most important—a ware covered either with a cream-coloured or dark-red slip on which very simple geometric patterns were executed in dark-brown. This painted ware is the peculiar distinction of the first period. Nothing very closely resembling it is known anywhere else.

A curious fact is that an elaborately carved bone ornament found at Castelluccio is so nearly identical with one found in the second city of Hissarlik that the two must have had a common origin.

The Second Siculan Period.—The second Siculan period of the full bronze age is represented at its best by the cemeteries of Plemmirio, Milocca, Cozzo Pantano and Thapsos close to Syracuse, and by Caldare and Cannatello near Girgenti. All these contain Mycenaean imports, of which the earliest are clearly to be dated as late Minoan third period. (*See* AEGEAN CIVILIZATION.) Bronze swords from the same sites are also quite definitely of Mycenaean origin, and prove the existence of a considerable direct trade with the Aegean. To Aegean influence is probably due the remarkable development in tomb-construction which characterizes the second Siculan. All the cemeteries consist of rock-hewn tombs; the construction is no more than a natural and logical evolution from the rock-tombs of the first Siculan. The roof of the chamber is sometimes of tholos form, which again recalls Aegean precedents. Inside it is usually elliptical; a raised bench cut in the rock runs round it, and niches are often hewn in the walls. Within this chamber the dead were buried as if seated at a stately banquet with the finest products of Sicilian potters for their table service and the rarest of foreign drinking cups. The size of the great food-basins is remarkable; they are often two and a half or three feet in height.

The native pottery is made principally in a grey-faced ware ornamented with moulded strips or with a few sparsely incised lines; there is also a yellow-faced ware. Painted ware is unknown. The shapes are very few—a high stand, a biconical cup with side handles, a conical cup, a jug and one or two large water jars. Foreign trade added the amphora, pyxis, pedestalled cup and stirrup-handled vase, and gave a great impetus to metal-working. Swords, daggers and even basins were imported, but the various hoards of bronze objects show that a great quantity of native work must have existed. The tombs, however, were systematically ransacked for metals, after the Roman time. Another proof of foreign influence is the introduction of the fibula, which appears at Cozzo Pantano for the first time. The earliest fibulae are of two types, the plain violin-bow with bamboo-knots and the harp-shaped or elbowed fibula, each made in a very massive form.

These four cemeteries near Syracuse must be assigned on the evidence of the foreign imports to the 14th and 13th centuries B.C. Caldare and Cannatello, further inland, date from the 12th to 11th centuries. Latest of all, and marking the last stage of the bronze age, is Cassibile, a large cemetery near Syracuse, in which there were no Mycenaean products and the fibulae were perceptibly less archaic.

Intermediary Period.—Next in chronological order come four sites between Syracuse and Girgenti which span the gap between the bronze and iron ages, the later graves in them belonging entirely to the early iron age. On Orsi's system they are to be classed as intermediate between the second and the third Siculan. These are Pantalica, Grammichele, Caltagirone and Monte Dessueri. Here the form of the tomb is already beginning to be modified, the number of burials in each grave is smaller, and the tomb-furniture is later in character. This is especially perceptible in the personal ornaments; the fibulae have quite changed, for in place of the primitive violin-bow the simple rounded bow is predominant and more sophisticated forms, like the eyed harp-fibula, begin to appear.

In addition to arm-rings and finger-rings and mirrors of bronze there are now found, though rarely, gold-rings, silver armlets and silver rings. Rectangular bronze "razors" come into use, like those known in Italy but of different origin. There are no weapons, perhaps owing to the rifling of the graves, but flame-shaped and leaf-shaped bronze knives occur. The native pottery is very varied in form at this time, the best of it being in a ware faced with red haematite. Feather-patterned ware soon goes out of fashion; the impulse towards originality is killed by a fondness for geometrically painted wares, the products of new Greek schools. These begin to appear sporadically about 900 B.C.

The Iron Age.—On a site like Pantalica, with a range of several centuries, we pass into the iron age without any striking changes. Modifications occur in the types of the fibulae and there is a gradual, but quite perceptible, deterioration of the pottery. All the bronze-age types of fibulae gradually give way to later forms, of which the most general and popular is the two-eyed serpentine, which continues in use down to 500 B.C.

The first appearance of this fibula marks a distinct chronological point; it is the beginning of the early iron age, and if the contents of tombs belonging to this stage are isolated, and examined separately from the rest, then certain definite characteristics begin to appear. The old Siculan civilization of the great days survives in a much impoverished form; it has entered upon its decadence. The architecture has lost all its beauty and elaboration of detail. Within a very simple chamber the dead are no longer seated at a banquet, but extended at full length on the ground with their heads resting on a block of stone; and the objects buried with them consist of little but a few small water-jars and trumpery pots. We now pass into Orsi's third period, early in the 9th century. The partial regeneration of Siculan life which begins gradually in the 9th century is entirely due to Greek influence, through trade, which preceded any actual colonization by fully 150 years. Thus everything of interest in Siculan life from the 9th century to the 5th B.C. is either a Greek importation or the direct imitation of a Greek original.

From a number of sites, the most important of which were Lentini (the ancient Leontinoi), Licodia and Finocchito, were obtained examples of geometrically painted vases, the earliest of which are of pure Dipylon style, while the latest are a hybridized product which may be termed Graeco-Siculan. A characteristic vase shown from Lentini, belongs to the third Siculan period. If not an actual importation it is a close copy of some Dipylonic original at least as early as the 8th century B.C. At Lentini there were still earlier types, little oenochoae and askoi painted with the simplest kind of linear designs. This style is not found even in the first of the Greek colonies, and must therefore, precede the period of colonization. Orsi is evidently justified in assigning it to the 8th and possibly to the 9th century B.C.

The introduction of these new models led to the imitation of purely Greek shapes by the native potters, so that oenochoae and askoi were copied in the rough country ware, and to a closer study of decorative designs, which resulted in the production of

a new kind of white-faced ware with geometrical patterns painted upon it. This gradually improved in technique until it reached its high-water mark in the late third and early fourth Siculan periods. The Graeco-Siculan ware continued in use until it was finally replaced about 500 B.C. by purely Greek imported vases.

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HISTORY

Original Inhabitants.—The island (Σικελία, *Sicilia*) obviously takes its name from the Sicels (Σικελοί, *Siculi*), a people whom we find occupying a great part of the island, chiefly east of the river Gela. We are told that they found in the island a people called Sicans (Σικανοί, *Sicani*); but the outstanding fact is that archaeologically no substantial difference between them can be found; and probably both are branches of the Libyco-Iberian stock.

In the north-west corner of the island we find a small territory occupied by a people who seem to have made much greater advances towards civilized life, the Elymi, who probably came from Asia Minor, where they had already fallen under Greek influence. Their towns were Eryx and Segesta.

Foreign Colonists.—The Greeks were not the first colonizing people who were drawn to the great island. As in Cyprus and in the islands of the Aegean, the Phoenicians were before them. Numerous small trading settlements grew up on promontories and small islands all round the coast, not much later, no doubt, than their colonies in North Africa and their factories in southern Spain. These were unable to withstand the Greek settlers, and the Phoenicians of Sicily withdrew step by step to form three considerable towns in the north-west corner of the island near to the Elymi, at the shortest distance by sea from Carthage—Motya, Solus and Panormus (*see* PALERMO).

Greek Colonization.—This begins with the foundation in 735 B.C., of the Sicilian Naxos by Chalcidians of Euboea under Theocles. The next year Corinth began her system of settlement in the west: Corcyra, the path to Sicily, and Syracuse were planted as parts of one enterprise. From this time, for about 150 years, Greek settlement goes steadily on. The east coast, nearest to Greece and richest in good harbours, was occupied first. Here, between Naxos and Syracuse, arose the Ionian cities of Leontini and Catana (729 B.C.), and the Dorian Megara Hyblaea (726 B.C.). Settlement on the south-western coast began in 691–90 B.C. with the joint Cretan and Rhodian settlement of Gela, and went on in the foundations of Selinus (the most distant Greek city on this side), of Camarina (598 B.C.), and in 582 B.C. of the Geloan settlement of Acragas (Agrigentum, Girgenti), planted on a high hill, a little way from the sea, which became the second city of Hellenic Sicily. On the north coast the Ionian Himera (founded in 648 B.C.) was the only Greek city in Sicily itself, but the Cnidians founded Lipara in the Aeolian Islands. At the north-east corner, opposite to Italy, and commanding the strait, arose Zancle, a city of uncertain date (first quarter of the 8th century B.C.) and mixed origin, better known as Messana (Messene, Messina).

But there were also independent Sicel towns in the interior, and there was a strong religious intercommunion between the two races. Sicel Henna (Enna, Castrogiovanni) is the special seat of the worship of Demeter and her daughter.

In the 7th century B.C. and the early part of the 6th the Greek cities of Sicily had their full share in the general prosperity. Their political constitutions were aristocratic, but civil dissensions led very early to the rise of tyrants. The most famous if not the first is Phalaris (*q.v.*) of Acragas (Agrigentum). Under his rule the city at once sprang to the first place in Sicily, and he was the first Siceliot ruler who held dominion over two Greek cities, Acragas and Himera. This time of prosperity was also a time of intellectual progress. Stesichorus of Himera (*c.* 632–556 B.C.) holds a great place among the lyric poets of Greece. The architecture and sculpture of this age have also left some of their most remarkable monuments among the Greek cities of Sicily, especially at Selinus. In this period, too, begins the fine series of Sicilian coins (*see* NUMISMATICS: *Sicily*).

Growth of Tyrannies.—A change began in the 6th century. The Phoenician settlements in Sicily became dependent on Carthage, whose growing power began to be dangerous to the Greeks of Sicily. Meanwhile the growth of tyrannies in the Greek cities was beginning to group several towns together under a single master, and thus to increase the greatness of particular cities at the expense of their freedom. Thus Theron of Acragas (488–472), acquired also, like Phalaris, the rule of Himera. Anaxilaus of Rhegium, occupied Zancle and changed its name to Messana. The Deinomenid dynasty, began at Gela in 505, and was in 485 translated by Gelon (*q.v.*) to Syracuse. That city now became the centre of a greater dominion over both Greeks and Sicels than the island had ever before seen. But Gelon, like several later tyrants of Syracuse, takes his place—and it is the redeeming point in the position of all of them—as the champion of Hellas against the barbarian. Gelon was followed by his brother Hieron (478–467), the special subject of the songs of Pindar, whose influence extended as far as Italy, where he supported Locri against Anaxilaus of Rhegium and Cumae against the Etruscans. Acragas meanwhile flourished under Theron; but a war between him and Hieron led to slaughter and new settlement at Himera.

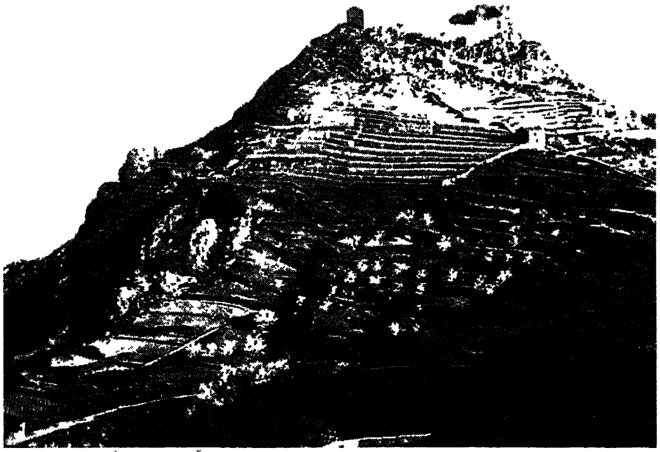
None of these tyrannies was long-lived. The power of Theron fell to pieces under his son Thrasydaeus. When the power of Hieron passed in 467 B.C. to his brother Thrasybulus the freedom of Syracuse was won by a combined movement of Greeks and Sicels. About 50 years of great prosperity followed. Art, science, poetry had all been encouraged by the tyrants. Empedocles of Acragas is best known from the legends of his miracles and of his death in the fires of Aetna; but he was not the less philosopher, poet and physician, besides his political career. Gorgias (*q.v.*) of Leontini had a still more direct influence on Greek culture, as father of the technical schools of rhetoric throughout Greece. Architecture, too, advanced, and the Doric style gradually lost somewhat of its ancient massiveness.

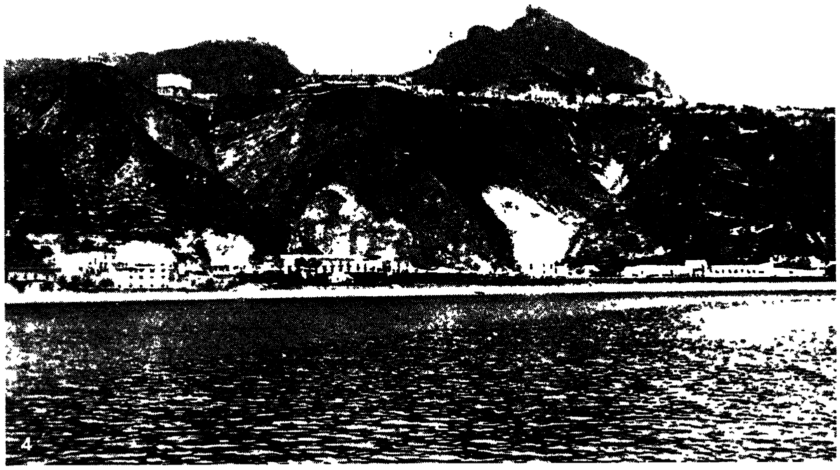
During this time of prosperity there was no dread of Carthaginian inroads. But now comes the great Sicel movement under Ducetius, who, between force and persuasion, came nearer towards uniting his people into one body than had ever been done before by founding the new city of Palicae in the plain. His power grew, and Acragas could withstand him only by the help of Syracuse. But his work was cut short by his death in 440, though his foundation of *Kale Akte* lived on, and we presently hear of Sicel towns under kings and tyrants, all marking an approach to Greek life.

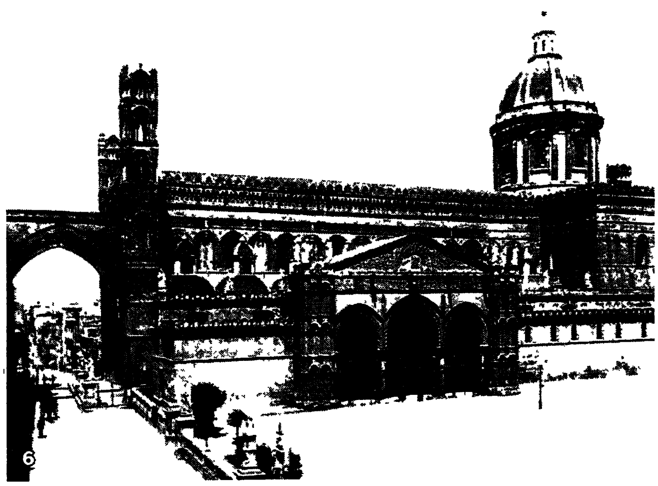
Interference of Athens.—Sicilian isolation was broken in upon by the great Peloponnesian War. The Siceliot cities were drawn into alliance with one side or the other, till the main interest of Greek history gathers for a while round the Athenian attack on Syracuse.

The interference of Athens in Sicilian affairs in 415 was partly in answer to the cry of the exiles of Leontini, partly to a quite distinct appeal from the Elymian Segesta. That city, an ally of Athens, asked for Athenian help against its Greek neighbour Selinus.

The details of the great Athenian expedition (415–413) belong partly to the political history of Athens (*q.v.*), partly to that of Syracuse (*q.v.*). But its results make it a marked epoch in Sicilian history, and the Athenian plans, if successful, would have changed the whole face of the West. The whole war was remarkable for the large entrance of the barbarian element into the Athenian reckonings; it was undertaken on behalf of Segesta; the Sicels gave Athens valuable help; the greater barbarian powers out of Sicily also came into play. Some help actually came from Etruria. But Carthage was more far-sighted. If Syracuse was an object of jealousy, Athens, succeeding to her dominion, creating a power too nearly alike to her own, would have provoked far greater jealousy. So Athens found no active support save at Naxos and Catana, though Acragas, if she would not help the invaders, at least gave no help to her own







PHOTOGRAPHS, E.N.A.

PICTURESQUE SICILIAN VIEWS

1. Ruins of a castle built in 396 B.C., high on the hillside, overlooking Taormina; formerly the Acropolis of Tauromenium
2. Looking down on Girgenti (Agrigentum) from the rock of Athena. The rock of Athena is identified by some scholars with the Acropolis of the Greek city of Acragas
3. Old house and courtyard in Taormina, the Casa Floresta
4. Taormina seen from the sea. The hill of Mola may be seen in the background
5. Cloisters of the Benedictine Monastery of Monreale. The arches, decorated with mosaic, are supported by 216 pairs of columns. The style is Southern Italian Romanesque
6. Cathedral at Palermo, completed in 1185 by Archbishop Walter of the Mill, an Englishman. The arch on the left is one of the two which connect the cathedral with the old Campanile

rival. But after the Spartan Gylippus came, almost all the other Greek cities of Sicily were on the side of Syracuse. The main result of the expedition, as regards Sicily, was to bring the island more thoroughly into the thick of Greek affairs. Syracuse, threatened with destruction by Athens, was saved by the zeal of her metropolis Corinth in stirring up the Peloponnesian rivals of Athens to help her, and by the advice of Alcibiades after his withdrawal to Sparta. All chance of Athenian dominion in Sicily or elsewhere in the west came to an end. Syracuse repaid the debt by good service to the Peloponnesian cause, and from that time the mutual influence of Sicily and old Greece is far stronger than in earlier times.

Carthaginian Wars.—But before the war in old Greece was over, 70 years after the great victory of Gelon (410), the Greeks of Sicily had to undergo barbarian invasion on a vaster scale than ever. The disputes between Segesta and Selinus called in these enemies also. Carthage, after a long period of abstention from intervention in Sicilian affairs, and the observance of a wise neutrality during the war between Athens and Syracuse, stepped in as the ally of Segesta, the enemy of her old ally Selinus. Her leader was Hannibal, grandson and avenger of the Hamilcar who had died at Himera. In 409, at the head of a vast mercenary host, he sailed to Sicily, attacked Selinus (*q.v.*), and stormed the town after a murderous assault of nine days. Thence he went to Himera, with the object of avenging his grandfather. By this time the other Greek cities were stirred to help, while Sicels and Sicans joined Hannibal. At last Himera was stormed, and 3,000 of its citizens were solemnly slaughtered on the spot where Hamilcar had died. Hannibal then returned to Carthage after an absence of three months only. The Phoenician possessions in Sicily now stretched across the island from Himera to Selinus. The next victim was Acragas, against which another expedition sailed in 406 under Hannibal and Himilcon; the town was sacked and the walls destroyed, and the population took refuge at Gela.

Meanwhile the revolutions of Syracuse affected the history of Sicily and of the whole Greek world. Dionysius (*q.v.*) the tyrant began his reign of 38 years in the first months of 405. Almost at the same moment, the new Carthaginian commander, Himilcon, attacked Gela and Camarina. Dionysius, coming to the help of Gela, was defeated, and evacuated both it and Camarina, leaving them for the Carthaginians to plunder. He was charged (no doubt with good ground) with treachery. But now a peace, no doubt arranged at Gela, was formally concluded. Carthage was confirmed in her possession of Selinus, Himera and Acragas, with some Sican districts which had opposed her. The people of Gela and Camarina were allowed to occupy their unwalled towns as tributaries of Carthage. Leontini, latterly a Syracusan fort, as well as Messana and all the Sicels, were declared independent, while Dionysius was acknowledged as master of Syracuse. Under him Sicily became for the first time the seat of a great European power, while Syracuse, as its head, became the greatest of European cities.

The reign of Dionysius (405–367) is divided into marked periods by four wars with Carthage, in 398–397, 392–391, 383–378 and 368–367. In the first Dionysius took and destroyed the Phoenician stronghold of Motya; but Himilcon founded Lilybaeum as a substitute on the mainland in the following year (396), destroyed Messana, founded the hill-town of Tauromenium above Naxos for Sicels who had joined him, defeated the fleet of Dionysius off Catana and besieged Syracuse. But the Carthaginians suffered from pestilence in the marshes of Lysimeleia; and after a masterly combined attack by land and sea by Dionysius Himilcon went away utterly defeated, taking with him his Carthaginian troops and forsaking his allies. Gela, Camarina, Himera, Selinus, Acragas itself, became subject allies of Dionysius. The Carthaginian dominion was cut down to what it had been before Hannibal's invasion. Dionysius then planted mercenaries at Leontini, conquered some Sicel towns, Henna among them, and made alliances with others. He restored Messana, peopling it with motley settlers, among whom were some of the old Messenians from Peloponnesus. But yielding to Spartan opposition Dionysius moved them to the north coast, where they founded Tyndaris. He took the Sicel Cephaloedium (Cefalù), and even the old Phoenician border-fortress of Solous was betrayed to him. He beat back a Rhegine expedition; but his advance was checked by a failure to take the new Sicel settlement of Tauromenium. His enemies of all races now declared themselves. Many of the Sicels forsook him; Acragas declared herself independent; Carthage again took the field.

In the war of 392–391 most of the Sicels joined the Carthaginian leader Magon; but he was successfully withstood at Agyrium by Agyris, the ally of Dionysius. The two tyrants drove Carthage to a peace by which she abandoned all her Sicel allies to Dionysius, who founded the towns of Hadranum and Halaesa for them. This time he took Tauromenium and settled it with his mercenaries.

Dionysius in 390–387 warred against the Italiot cities in alliance with their Lucanian enemies. Rhegium, Croton, the whole toe of the boot, were conquered. In the Adriatic he helped Hellenic extension, desiring no doubt to secure the important trade route into central Europe. He planted directly and indirectly some settlements in Apulia, while Syracusan exiles founded the more famous Ancona. He helped the Parians in their settlements of Issa and Pharos; he took into his pay Illyrian warriors with Greek arms, and helped the Molossian Alcetas to win back part of his kingdom. He was even charged with plotting with his Epirot ally to plunder Delphi, and sent a fleet along the west coast of Italy, to carry off the wealth of the great temple of Caere.

In the third war (383–378) Dionysius seems for once to have had his head turned by a first success. His demand that Carthage should altogether withdraw from Sicily was met by a crushing defeat. Then came a treaty by which Carthage kept Selinus and part of the land of Acragas. Dionysius had also to pay 1,000 talents. In the last years of his reign he gave help to Sparta against Thebes, sending Gaulish and Iberian mercenaries to take part in Greek warfare. His last war with Carthage, which began with an invasion of western Sicily, and which was going on at his death in 367 B.C., was ended by a peace by which the Halycus remained the boundary.

The tyranny of Dionysius fell, as usual, in the second generation; but it was kept up for ten years after his death by the energy of Philistus, now minister of his son Dionysius the younger. It fell with the return of the exile Dion in 357.

Between the death of Dion in 354 and the coming of Timoleon in 344 we hear of a time of confusion in which Hellenic life seemed likely to die out. The cities, Greek and Sicel, were occupied by tyrants. The work of Timoleon (*q.v.*), whose headquarters were first at Tauromenium, then at Hadranum, was threefold—the immediate deliverance of Syracuse, the restoration of Sicily in general to freedom and Greek life, and the defence of the Greek cities against Carthage. The great victory of the Crimissus in 339 led to a peace with Carthage with the old frontier; but all Greek cities were to be free, and Carthage was to give no help to any tyrant.

During the 20 years after the death of Timoleon (336–317) the Carthaginians played off one city and party against another, and Agathocles (*q.v.*), following the same policy, became in 317, by treachery and massacre, undisputed tyrant of Syracuse, and spread his dominion over many other cities. Acragas, strengthened by Syracusan exiles, now stands out again as the rival of Syracuse. The Carthaginian Hamilcar won many Greek cities to the Punic alliance. Agathocles, however, with Syracuse blockaded by a Carthaginian fleet, planned to carry the war into Africa.

For more than three years (310–307) each side carried on warfare in the land of the other. Carthage was hard pressed by Agathocles, while Syracuse was no less hard pressed by Hamilcar. Agathocles won many battles and towns; he quelled mutinies of his own troops; by inviting and murdering Ophellas, lord of Cyrene, he doubled his army and brought Carthage near to despair. Meanwhile Syracuse, all but lost, had driven back Hamilcar, and had taken him prisoner in an unsuccessful attack on Euryelus, and slain him when he came again with the help of the Syracusan exile Deinocrates. Acragas, deeming Agathocles and the barbarians alike weakened, proclaimed freedom for the Sicilian cities under her own headship. But her hopes perished

when Agathocles came back from Africa, landed at Selinus, and marched to Syracuse, taking one town after another. He now relieved Syracuse from the Carthaginian blockade; his mercenaries gained a victory over Acragas; and he sailed again for Africa; when fortune turned against him there he left his sons and his army to death, bondage or Carthaginian service, and came back to Sicily almost alone. Yet he could still gather a force which enabled him to seize Segesta, to slay or enslave the whole population and to settle the city with new inhabitants. A peace with Carthage, with the old boundary, secured Agathocles in the possession of Syracuse and eastern Sicily (301).

At some stage of his African campaigns Agathocles had taken the title of king. In his old age he took a wife of the house of Ptolemy; he gave his daughter Lanassa to Pyrrhus, and established his power as the first Sicilian ruler of Corcyra.

The Appearance of Rome.—On the death of Agathocles tyrants sprang up in various cities. Acragas, under its king Phintias, won back for the moment somewhat of its old greatness. By a new depopulation of Gela, he founded the youngest of Siceliot cities, Phintias, at the mouth of the southern Himera. Messana was seized by the disbanded Campanian mercenaries of Agathocles (*c.* 282), who proclaimed themselves a new people in a new city by the name of Mamertines, children of Mamers or Mars. Messana became an Italian town—"Mamertina civitas."

The Campanian occupation of Messana is the first of the chain of events which led to the Roman dominion in Sicily. Pyrrhus (*q.v.*) came as the champion of the western Greeks against all barbarians, whether Romans in Italy or Carthaginians in Sicily. His Sicilian war (278–276) was a mere interlude between the two acts of his war with Rome.

The Greek king, on his way back to fight for Tarentum against Rome, had to cut his way through Carthaginians and Mamertines in Roman alliance. His saying that he left Sicily as a wrestling-ground for Romans and Carthaginians was the truth of the matter. Very soon came the first war between Rome and Carthage (the "First Punic War").

Sicily never had a more hopeful champion than Hieron II. of Syracuse, who, claiming descent from Gelon, pressed the Mamertines hard. He all but drove them to the surrender of Messana; he even helped Rome to chastise her own rebels at Rhegium.

The exploits of Hieron had already won him the title of king (270) at Syracuse; but his alliance with Rome (263) marks a great epoch in the history of the Greek race. He was the first of Rome's kingly vassals. His only obligation was to give help to the Roman side in war; within his kingdom he was free.

First Punic War.—During the 23 years of the First Punic War (264–241) the rest of the island suffered greatly. The war for Sicily was fought in and around Sicily, and the Sicilian cities were taken and retaken by the contending powers (*see* PUNIC WARS). By the treaty which ended the war in 241 Carthage ceded to Rome all her possessions in Sicily, which thus became the first Roman province.

We have no picture of Sicily in the first period of Roman rule. One hundred and seventy years later, several towns within the original province enjoyed various degrees of freedom, which they had doubtless kept from the beginning. Panormus, Segesta, with Centuripae, Halaesa and Halicyae, once Sicel but now Hellenized, kept the position of free cities. The rest paid tithe to the Roman people as landlord. The province was ruled by a praetor sent yearly from Rome. It formed, as it had even from the Carthaginian period, a closed customs district. Within the Roman province the new state of things called forth much discontent; but Hieron remained the faithful ally of Rome through a long life. On his death (215) and the accession of his grandson Hieronymus, his dynasty was swept away by the last revolution of Greek Syracuse. The result was revolt against Rome, the great siege and capture of the city, the addition of Hieron's kingdom to the Roman province. Two towns only, besides Messana, which had taken the Roman side, Tauromenium and Netum, were admitted to the full privileges of Roman alliance. Some towns were destroyed; the people of Henna were massacred. Acragas, again held for Carthage, was the centre of a campaign (214–210).

Roman Sicily.—Independent Sicilian history now comes to an end for many ages. The allied cities kept their several terms of alliance; the free cities kept their freedom; elsewhere the land paid to the Roman people, according to the law of Hieron, the tithe which it had paid to Hieron. But, as the tithe was let out to *publicani,* oppression was easy. The praetor, after the occupation of Syracuse, dwelt there in the palace of Hieron as in the capital of the island. But, as a survival of the earlier state of things, one of his two quaestors was quartered at Eryx, the other being in attendance on himself. Under the supreme dominion of Rome even the unprivileged cities kept their own laws, magistrates and assemblies, provision being made for suits between Romans and Sicilians and between Sicilians of different cities.

Sicily was the first land to be tilled by slave-gangs, on the estates both of rich natives and of Roman settlers. It became the granary of Rome and the free population naturally degenerated and died out. The slaves were most harshly treated, and even encouraged by their masters to rob. The land was full of disorder, and the praetors shrank from enforcing the law against offenders, many of whom, as Roman knights, might be their own judges. Of these causes came the two great slave-revolts of the second half of the 2nd century B.C. The first lasted from 136 to 132, the time of Tiberius Gracchus and the fall of Numantia. Enna and Tauromenium were the headquarters of the revolt. The second lasted from 104 to 99, the time of the Cimbrian invasion.

Pirates troubled the coast, and all other evils were outdone by the three years' government of Verres (73–71 B.C.). Verres plundered and impoverished everywhere, removing anything of value, especially works of art, that took his fancy, and there is hardly a city that had not to complain of what it suffered at his hands. Another blow was the occupation of Messana by Sextus Pompeius in 43 B.C. He was master of Sicily for seven years, and during this period the corn supply of Rome was seriously affected. Augustus planted Roman colonies at Palermo, Syracuse, Tauromenium, Thermae, Tyndaris and Catana, but, as elsewhere, Latin in no way displaced Greek; it was simply set up alongside of it for certain purposes. In the division of provinces between Augustus and the senate, Sicily fell to the latter. Under the empire it had practically no history. Christianity was not introduced until after the middle of the 1st century A.D. Few emperors visited Sicily; Hadrian was there, as everywhere, in A.D. 126, and ascended Etna. Septimius Severus was proconsul of Sicily before he became emperor, probably in 189. In the division of Constantine, when the word "province" had lost its meaning, when Italy itself was mapped out into provinces, Sicily became one of these last. Along with Africa, Raetia and western Illyricum, it became part of the Italian praefecture; along with the islands of Sardinia and Corsica, it became part of the Italian diocese.

The earlier stages of Teutonic advance in the empire did not touch Sicily. Alaric thought of a Sicilian expedition, but a storm hindered him. Sicily was reached by the Vandals from Carthage; Gaiseric (440) subdued the great island for which Roman and Phoenician had striven, and his capture of Sicily was not a piratical incursion, but part of a larger design. But eventually (476) he made a treaty with Odoacer and gave up the island on condition of a tribute, which was never paid by Theodoric. Sicily was (from 491) ruled by a Gothic count and the Goths claimed to have treated the land with special tenderness. Theodoric gave Lilybaeum to the Vandal king Thrasamund as the dowry of his sister Analafrida, but it had returned to the possession of the Goths when Belisarius, conqueror of Africa, demanded it in vain as part of the Vandal possessions as a pretext for declaring war (533). In the Gothic war Sicily was the first land to be recovered for the empire, and that with the good will of its people (535). Panormus alone was stoutly defended by its Gothic garrison. In 550 Totila took some fortresses, but the Goths were driven out the next year.

See E. A. Freeman, *History of Sicily* (1891–94); Pauly-Wissowa, *Realencyclopädie, s.v.* Σικελια for the ancient geography, history, etc. of the island (bibl.); B. Pace, "Arti ed artisti della Sicilia antica" (1922) (*Memorie dei Lincei* 5. xv. 469 *sqq.*) for a survey of the ancient art; and B. Pace, "I Barbari e i Bizantini in Sicilia" (from *Archivio Storico Siciliano,* vols. xxxv., xxxvi.) (Palermo, 1911), for the 5th–9th

centuries after Christ. The very numerous rock cut churches, catacombs and habitations of this period are characteristic.

(E. A. F.; T. A.)

Sicily Under the Eastern Empire.—Sicily was thus won back to the Roman dominion. For 430 years some part of Sicily, for 282 years the whole of it, again remained a Roman province. In the later mapping out of the empire into purely military divisions, the *theme* (θέμα) of Sicily took in both the island and the nearest peninsula of the mainland, the oldest Italy. The island itself was divided for financial purposes into Syracuse and Lilybaeum. The Lombard and Frankish masters of the peninsula never fixed themselves in the island. When the Frank took the imperial crown of the West, Sicily still kept its allegiance to the Augustus at Constantinople, but was torn from the empire by the next race of conquerors.

Ecclesiastical Relations with Italy.—This connection of Sicily with the eastern division of the empire no doubt largely helped to keep up Greek life in the island. Still the connection with Italy was close, especially the ecclesiastical connection. The great source of our knowledge of Sicily in the century which followed the reconquest by Belisarius is the *Letters* of Pope Gregory the Great. Gregory's *Letters* are largely occupied with the affairs of the great Sicilian estates held by the Roman Church, as by the churches of Milan and Ravenna, but they also illustrate the general condition of the island. We hear of Manichaeans; Jews were plentiful, and Gregory causes compensation to be made for the unlawful destruction of synagogues. Of paganism we find no trace, save that pagan slaves were held by Jews. Sicily belonged to the Latin patriarchate; but we already see glimmerings of the coming disputes between the Eastern and Western Churches.

Early Saracen Inroads.—In the 9th, 10th and 11th centuries the old drama of Sicily was acted again. The island was again disputed between Europe and Africa. Panormus and Syracuse were again the headquarters of races and creeds, of creeds even more than of races. The older religious differences were small compared with the strife for life and death between Christendom and Islam. Gregory and Mohammed were contemporaries, and, though Saracen occupation did not begin in Sicily till more than two centuries after Gregory's death, Saracen inroads began much sooner. In 655 part of Sicily was plundered, and its inhabitants carried to Damascus. Then came the strange episode of the visit of Constans II. (641–668), the first emperor, it would seem, who had set foot in Sicily since Julian. After a war with the Lombards, after 12 days' plunder of Rome, he came on to Syracuse, where he was murdered in 668. Sicily now saw for the first time the setting up of a tyrant in the later sense. Mezetius, commander of the Eastern army of Constans, revolted, but Sicily and Roman Italy kept their allegiance to the new emperor, Constantine Pogonatus, who came in person to destroy him. Then came another Saracen inroad from Alexandria, in which Syracuse was sacked. Towards the end of the 8th century, though Sicily itself was untouched, its patricians and their forces play a part in the affairs of southern Italy as enemies of the Frankish power. Charlemagne himself was believed to have designs on Sicily; but, when it came to Saracen invasion, the sympathies of both pope and Caesar lay with the invaded Christian land.

Saracen Conquest.—In 813 a peace for ten years was made between the Saracens and the patrician Gregory. A few years after it expired Saracen settlement in the island began. About this time Crete was seized by Spanish adventurers. But the first Saracen settlers in Sicily were the African neighbours of Sicily, and they were called to the work by treason within the island. The second Semitic conquest of Sicily began in 827 at Mazzara on the old border of Greek and Phoenician. The advance of the invaders was slow. In two years all that was done was to occupy Mazzara and Mineum, and seemingly to destroy Agrigentum, well used to destruction. Attacks on Syracuse failed; so did attacks on Henna—*Castrum Ennae,* now changing into *Castrum Johannis,* Castrogiovanni. The actual gain was small; but the invaders took seizin alike of the coast and of the island.

A far greater conquest followed when new invaders came from Spain. In 831 Panormus passed away for ever from Roman, for 230 years from Christian, rule. Syracuse was for 50 years, not only, as of old, the bulwark of Europe, but the bulwark of Christendom. By the conquest of Panormus the Saracens were firmly rooted in the island. It became the seat of the amir or lord of Sicily. For a time, the Saracen advance was hindered by dissensions between the African and the Spanish settlers. In the end the Muslim conquests in Sicily became an Aghlabite principality owning at best a formal superiority in the princes of Kairawān. With the Saracen occupation begins a new division of the island, which becomes convenient in tracing the progress of Saracen conquest. This is into three valleys, known in later forms of language as Val di Mazzara or Mazza in the N.W., Val di Noto in the S.E. and Val Demone in the N.E. The first Saracen settlement of Val di Mazzara answers roughly to the old Carthaginian possessions. From Panormus the amir or lord of Sicily, Mohammed ibn Abdallah, sent forth his plunderers throughout Sicily and even into southern Italy. There, however, they made no lasting settlements.

The chief work of the next ten years was the conquest of the Val di Noto, but the first great advance was made elsewhere. In 843 the Saracens won the Mamertine city, Messina, and thus stood in the path between Italy and Sicily. At last, in 859, the very centre of the island, the stronghold of Henna, was taken, and the main part of Val di Noto followed. But the divisions among the Muslims helped the Christians; they won back several towns, and beat off all attacks on Syracuse and Tauromenium. It is strange that the reign of Basil the Macedonian (867), a time of such renewed vigour in the empire, was the time of the greatest of all losses in Sicily. In Italy the imperial frontier largely advanced; in Sicily imperial fleets threatened Panormus. But in 875 the accession of Ibrāhīm ibn Ahmad in Africa changed the face of things. The amir in Sicily, Ja'far ibn Ahmad, received strict orders to act vigorously against the eastern towns. In 877 began the only successful Semitic siege of Syracuse. The next year the city passed for the first time under the yoke of strangers to the fellowship of Europe.

Thus in 51 years the imperial and Christian territory in Sicily was cut down to a few points on or near the eastern coast, to the Val Demone in short without Messina. But between Muslim dissension and Christian valour the struggle had still to be waged for 87 years. Henna had been the chief centre of Christian resistance a generation earlier; its place was now taken by the small fort of Rametta not far from Messina. The Muslims of Sicily were busy in civil wars. In 900 Panormus had to be won by a son of Ibrāhīm from Muslim rebels provoked by his father's cruelty. But when Ibrāhīm himself came into Sicily, renewed efforts against the Christians led to the first taking of Tauromenium (908), of Rametta and of other points. The civil war that followed his death, the endless revolutions of Agrigentum hindered any real Saracen occupation of eastern Sicily. The emperors never gave up their claims to Sicily or their hopes of recovering it. Besides the struggle with the Christians in the island, there was often direct warfare between the empire and the Saracens; but such warfare was more active in Italy than in Sicily. In 956 a peace or truce was made by the emperor Constantine Porphyrogenitus. A few years later, Otto the Great, the restorer of the Western empire, looked to Sicily as a land to be won back for Christendom. In 963 Tauromenium was taken, and became for 100 years a Mohammedan possession. Rametta was the last stronghold to fall (965).

Reconquest by Eastern Empire.—Thus in 138 years the Arab did what the Canaanite had never done. The whole island was a Semitic, that is a Mohammedan, possession. But its first and longest period lasted only 73 years. In 1038, George Maniaces, the first captain of his time, was sent by the eastern emperor to win back the lost land. He too was helped by Saracen dissensions. The amir Abul-afar became a Roman vassal, and, like Alaric of old, became *magister militum* in the Roman army. His brother and rival, Abuhafas, brought help from Africa; and finally all joined against the Christians. Four years of Christian victory (1038–42) followed. In the host of Maniaces were men of all races. Town after town was delivered, first Messina,

then Syracuse, then a crowd of others. The exact extent of the reconquest is uncertain; Byzantine writers claim the deliverance of the whole island; but it is certain that the Saracens never lost Panormus. But court influence spoiled everything: Maniaces was recalled; under his successor Stephen, brother-in-law of the emperor Michael, the Saracens won back what they had lost. Messina alone held out, for how long a time is uncertain. But a conqueror came who had no empresses to thwart him. In 1060 began the 30 years' work of the first Roger.

Sicily Under Saracen Rule.—Thus for 263 years the Christian people of some part or other of Sicily were in subjection to Muslim masters. The land was won bit by bit. One town was taken by storm; another submitted on terms harsher or more favourable. The condition of the Christians varied from that of personal slaves to that of communities left free on the payment of tribute. The great mass were in the intermediate state usual among the non-Mohammedan subjects of a Mohammedan power. While the conquest was going on, the towns that remained unconquered gained in point of local freedom. They became allies rather than subjects of the distant emperor. So did the tributary districts, as long as the original terms were kept. But, as ever, the condition of the subject race grew worse. After the complete conquest of the island, while the mere slaves had turned Mohammedans, there is nothing more heard of tributary districts. Still, Christianity and the Greek tongue never died out; churches and monasteries received and held property; there still are saints and scholars. It would be rash to deny that traces of other dialects may not have lingered on; but Greek and Arabic were the two written tongues of Sicily when the Normans came. The Sicilian Saracens were hindered by their internal feuds from ever becoming a great power; but they stood high among Mohammedan nations. Their advance in civilization is shown by their position under the Normans, and above all by their admirable style of architecture. (*See* PALERMO.) They had a literature which Norman kings studied and promoted. The Normans, in short, came into the inheritance of the two most civilized nations of the time, and allowed them to flourish side by side.

Norman Conquest.—The most brilliant time for Sicily as a power in the world begins with the coming of the Normans. Never before or after was the island so united or so independent. Some of the old tyrants had ruled out of Sicily; none had ruled over all Sicily. The Normans held all Sicily as the centre of a dominion which stretched far beyond it. The conquest was the work of one man, Count Roger of the house of Hauteville. (*See* ROGER I.) The conquests of the Normans in Italy and Sicily form part of one enterprise; but they altogether differ in character. In Italy they overthrew the Byzantine dominion; their own rule was perhaps not worse, but they were not deliverers. In Sicily they were welcomed by the Christians as deliverers from infidel bondage.

As in the Saracen conquest of Sicily, as in the Byzantine recovery, so in the Norman conquest, the immediate occasion was given by a home traitor. Count Roger had already made a plundering attack, when Becumen of Catania, driven out by his brother, urged him to serious invasion. Messina was taken in 1060, and became for a while the Norman capital. The Christians everywhere welcomed the conqueror. But at Troina they presently changed their minds, and joined with the Saracens to besiege the count in their citadel. At Catania Becumen was set up again as Roger's vassal, and he did good service till he was killed. Roger soon began to fix his eye on the Saracen capital. But Palermo was not taken until 1071, and then only by the help of Duke Robert, who kept the prize to himself. Still its capture was the turning-point in the struggle. Taormina (Tauromenium) was won in 1078. Syracuse, under its amir, Benarvet, held out stoutly. He retook Catania by the help of a Saracen to whom Roger had trusted the city, and whom he himself punished. Catania was won back by the count's son Jordan. But progress was delayed by Jordan's rebellion and by the absence of Roger in his brother's wars. In 1085 Syracuse was won. Next year followed Girgenti and Castrogiovanni, whose chief became a Christian. Noto held out till 1090. Then the whole island was won, and Roger completed his conquest by a successful expedition to Malta.

Saracens Under Norman Rule.—The condition of the Saracens under the Normans differed in different places according to the circumstances of conquest. The Mohammedan religion was everywhere tolerated, in many places much more. But it would seem that, just as under the Muslim rule, conversions from Christianity to Islam were forbidden. On the other hand, conversions from Islam to Christianity were not always encouraged; Saracen troops were employed from the beginning, and Count Roger seems to have thought them more trustworthy when unconverted. At Palermo the capitulation secured to the Saracens the full enjoyment of their own laws; Girgenti was long mainly Saracen; in Val di Noto the Saracens kept towns and castles of their own. The ecclesiastical relations between Greeks and Latins are harder to trace. At the taking of Palermo the Greek bishop was restored; but his successors were Latins, and Latin prelates were placed in the bishoprics which Count Roger founded. Urban II. visited Sicily to promote the union of the Church, and he granted to the count those special ecclesiastical powers held by the counts and kings of Sicily as hereditary legates of the Holy See which grew into the famous Sicilian monarchy. But Greek worship went on; at Messina it lingered till the 15th century, and it has been since brought back by the Albanian colonists. But the Greeks of Sicily have long been united Greeks, admitting the authority of the see of Rome.

Linguistic Elements in Sicily.—In its results the Norman conquest of Sicily was a Latin conquest far more thorough than that which had been made by the Roman commonwealth. The Norman princes protected all the races, creeds and tongues of the island, Greek, Saracen and Jew. But new races came to settle alongside of them, all of whom were Latin as far as their official speech was concerned. The Normans brought the French tongue with them; it remained the court speech during the 12th century, and Sicily was thrown open to all speakers of French, many of whom came from England. There was constant intercourse between the two great islands, both ruled by Norman kings, and many natives of England filled high places in Sicily. But French was only a language of society, not of business or literature. The languages of inscriptions and documents are Greek, Arabic and Latin, in private writings sometimes Hebrew. The kings understood Greek and Arabic, and their deeds and works were commemorated in both tongues. Hence comes the fact, at first sight so strange, that Greek, Arabic and French have all given way to a dialect of Italian. But the cause is not far to seek. The Norman conquest opened Sicily to settlers from Italy, above all from the Norman possessions in Italy. Under the name of Lombards, they became an important, in some parts a dominant, element. Thus at Messina, where we hear nothing of Saracens, we hear much of the disputes between Greeks and Lombards. The Lombards had hardly a distinct language to bring with them. At the time of the conquest, French had already become a distinct speech from Latin; Italian hardly was such. The Lombard element, during the Norman reign, shows itself, not in whole documents or inscriptions, but in occasional words and forms, as in some of the mosaics at Monreale. And, if any element, Latin or akin to Latin, had lingered on through Byzantine and Saracen rule, it would of course be attracted to the new Latin element, and would help to strengthen it. It was this Lombard element that had the future before it. Greek and Arabic were antiquated, or at least isolated, in a land which Norman conquest had made part of western Europe and Latin Christendom. Even the French element was in some sort isolated, and later events made it more so. But the Lombard element was constantly strengthened by settlement from outside. Thus, in the face of Italian, both Greek and Arabic died out. Step by step, Christian Sicily became Latin in speech and in worship. But this was not till the Norman reigns were over. Till the end of the 12th century Sicily was the one land where men of divers creeds and tongues could live side by side.

Hence came both the short-lived brilliancy of Sicily and its later decay. In Sicily there were many nations all protected by the Sicilian king; but there was no Sicilian nation. Greek, Saracen,

Norman, Lombard and Jew could not be fused into one people; it was the boast of Sicily that each kept his laws and tongue undisturbed. Such a state of things could live on only under an enlightened despotism; the discordant elements could not join to work out really free and national institutions. Sicily had parliaments, and some constitutional principles were well understood. But they were assemblies of barons, or at most of barons and citizens; they could only have represented the Latin elements, Norman and Lombard, in the island. The elder races, Greek and Saracen, stand outside the relations between the Latin king and his Latin subjects. Still, as long as Greek and Saracen were protected and favoured, so long was Sicily the most brilliant of European kingdoms. But its greatness had no groundwork of national life; for lack of it the most brilliant of kingdoms presently sank below the level of other lands.

Roger I.—Four generations only span the time from the birth of Count Roger, about 1030, to the death of the emperor Frederick II. in 1250. Roger, great count of Sicily, was, at his death in 1101, succeeded by his young son Simon, and he in 1105 by the second Roger, the first king. He inherited all Sicily, save half Palermo—the other half had been given up—and part of Calabria. The rest of Palermo was soon granted; the Semitic capital became the abiding head of Sicily. On the death of his cousin, Duke William of Apulia, Roger gradually founded (1127–40) a great Italian dominion. To the Apulian duchy he added (1136) the Norman principality of Capua, Naples (1138), the last dependency of the Eastern empire in Italy, and (1140) the Abruzzi, an undoubted land of the Western empire. He thus formed a dominion which has been divided, united and handed over from one prince to another oftener than any other State in Europe, but whose frontier has hardly changed at all. In 1130 Roger was crowned at Palermo, by authority of the anti-pope Anacletus, taking the strange title of "king of Sicily and Italy." This, on his reconciliation with Pope Innocent II., he exchanged for "king of Sicily and of the duchy of Apulia and of the principality of Capua." By virtue of the old relations between the popes and the Normans of Apulia, he held his kingdom in fief of the Holy See, a position which on the whole strengthened the royal power. But his power, like that of Dionysius and Agathocles, was felt in more distant regions. His admiral, George of Antioch, Greek by birth and creed, warred against the Eastern empire, won Corfu for a season, and carried off the silk-workers from Thebes and Peloponnesus to Sicily. But Manuel Comnenus ruled in the East, and, if Roger threatened Constantinople, Manuel threatened Sicily. In Africa the work of Agathocles was more than renewed; Mahdia and other points were won and kept as long as Roger lived. These exploits won him the name of the "terror of Greeks and Saracens." To the Greeks, and still more to the Saracens, of his own island he was a protector and something more. His love for mathematical science, geography, etc., in which the Arabs excelled, is noteworthy.

William I. and II.—Roger's son William, surnamed the Bad, was crowned in his father's lifetime in 1151. Roger died in 1154, and William's sole reign lasted till 1166. It was a time of domestic rebellions, chiefly against the king's unpopular ministers, and it is further marked by the loss of Roger's African conquests. After William the Bad came (1166–89) his son, William the Good. Unlike as were the two men in themselves, in their foreign policy they are hardly to be distinguished. The Bad William has a short quarrel with the pope; otherwise Bad and Good alike appear as zealous supporters of Alexander III. and as enemies of both empires. The Eastern warfare of William the Good is stained by the frightful sack of Thessalonica; it is marked also by the formation of an Eastern State under Sicilian supremacy (1186). Corfu with Durazzo, Cephalonia and Zante, was granted by William to his admiral, Margarito, with the strange title of king of the Epeirots. He founded a dynasty, though not of kings, in Cephalonia and Zante. Corfu and Durazzo were to be more closely connected with the Sicilian crown.

Tancred.—The brightest days of Sicily ended with William the Good. His marriage with Joanna, daughter of Henry of Anjou and England, was childless, and William tried to procure the succession of his aunt Constance and her husband, King Henry VI. of Germany, son of emperor Frederick I. But the prospect of German rule was unpopular, and on William's death the crown passed to Tancred, an illegitimate grandson of King Roger, who figures in English histories in the story of Richard I.'s crusade. In 1191 Henry, now emperor, asserted his claims; but, while Tancred lived, he did little, in Sicily nothing, to enforce them.

William III.—On the death of Tancred (1194) and the accession of his young son, William III., the emperor came and conquered Sicily and the Italian possessions, with an amount of cruelty which outdid any earlier war or revolution. First of four Western emperors who wore the Sicilian crown, Henry died in 1197, leaving the kingdom to his young son, Frederick, heir of the Norman kings through his mother.

The relations between the various races of the islands are most instructive. The strong rule of Roger kept all in order. He called himself the defender of Christians; others, on account of his favour to the Saracens, spoke of him as a pagan. He certainly encouraged Saracen art and literature in every shape. His court was full of eunuchs. Under William the Good the Saracens seem to be losing their position. Hitherto they had been keeping their own civilization alongside of others. By a general outbreak on the death of William the Good, the Saracens, especially those of Palermo, were driven to take shelter in the mountains, where they sank into a wild people. The Jews, too, begin to sink into bondmen.

Emperor Frederick II.—The Germans who helped Henry to win the Sicilian crown did not become a new element in the island, but only a source of confusion during the minority of his son. Frederick—presently to be the renowned emperor Frederick II., was crowned at Palermo in 1198; but the child, deprived of both parents, was held to be under the protection of his lord, Pope Innocent III. During his minority the land was torn in pieces by turbulent nobles, revolted Saracens, German captains seeking settlements, the maritime cities of Italy, and professed French deliverers. In 1210 the emperor Otto IV., who had overrun the continental dominions, threatened the island. In 1212, just when Frederick was reaching an age to be of use in his own kingdom, he was called away to dispute the crown of Germany and Rome with Otto. Eight years more of disorder followed; in 1220 the emperor-king came back. He brought the Saracens of the mountains back again to a life in plains and cities, and presently planted a colony of them on the mainland at Nocera, when they became his most trusty soldiers. His necessary absences from Sicily led to revolts. He came back in 1233 from his crusade to suppress a revolt of the eastern cities, which seem to have been aiming at republican independence. A Saracen revolt in 1243 is said to have been followed by a removal of the whole remnant to Nocera. Some, however, certainly stayed or came back; but their day was over.

Under Frederick the Italian or Lombard element finally prevailed in Sicily. Of all his kingdoms Sicily was the best-beloved. He spoke all its tongues; he protected, as far as circumstances would allow, all its races. The heretic alone was persecuted; he was the domestic rebel of the church; Saracen and Jew were entitled to the rights of foreigners. Yet Frederick, patron of Arabic learning, suspected even of Muslim belief, failed to check the decline of the Saracen element in Sicily. The Greek element had no such forces brought against it. It was still a chief tongue of the island, in which Frederick's laws were put forth as well as in Latin. But it was clearly a declining element. Greek and Saracen were both becoming survivals in an island which was but one of the many kingdoms of its king. The Italian element advanced at the cost of all others. Frederick chose it as the court speech of Sicily, and he made it the speech of a new-born literature. Sicily, strangely enough, became the cradle of Italian song.

Manfred.—Two emperors had now held the Sicilian crown. On Frederick's death, in 1250, the crown passed to his son Conrad, not emperor indeed, but king of the Romans. He was nominally succeeded by his son Conradin. The real ruler under both was Frederick's natural son, Manfred. In 1258, on a false rumour of the death of Conradin, Manfred was himself crowned king of

Palermo. He had to found the kingdom afresh. Pope Innocent IV. had crossed into Sicily, to take advantage of the general discontent. The cities, whose growing liberties had been checked by Frederick's legislation, strove for practical, if not formal, independence, sometimes for dominion over their fellows. Messina laid waste the lands of Taormina, because Taormina would not obey the bidding of Messina. Yet, among these and other elements of confusion, Manfred succeeded in setting up again the kingly power, first for his kinsmen and then for himself. His reign continued that of his father, so far as a mere king could continue the reign of such an emperor. The king of Sicily was the first potentate of Italy, and came nearer than any prince since Louis II. to the union of Italy under Italian rule. He sought dominion, too, beyond the Adriatic: Corfu, Durazzo, and a strip of the Albanian coast became Sicilian possessions as the dowry of Manfred's Greek wife. But papal enmity was too much for him. His overlord claimed to dispose of his crown, and hawked it about among the princes of the West.

Charles of Anjou.—More came of the grant of Urban IV. (1264) to Charles, count of Anjou, and through his wife sovereign count of Provence. Charles, crowned by the pope in 1266, marched to take possession of his lord's grant. Manfred was defeated and slain at Benevento. Sicily was now again a province. But a province Sicily had no mind to be. In the continental lands Charles founded a dynasty; the island he lost after 16 years. His rule was not merely the rule of a stranger king surrounded by stranger followers; the degradation of the island was aggravated by gross oppression, grosser than in the continental lands. The continental lands submitted, with a few slight efforts at resistance. The final result of the Angevin conquest of Sicily was its political separation from the mainland.

Sicilian feeling was first shown in the support given to the luckless expedition of Conradin in 1268. Frightful executions in the island followed his fall. The rights of the Swabian house were now held to pass to Peter, king of Aragon, husband of Manfred's daughter Constance. The connection with Spain, which has so deeply affected the whole later history of Sicily, now begins. Charles held the Greek possessions of Manfred and had designs both on Epeiros and on Constantinople. The emperor Michael Palaeologus and Peter of Aragon became allies against Charles; the famous John of Procida acted as an agent between them; the costs of Charles's eastern warfare caused great discontent. The actual outbreak of 1282, the famous Sicilian Vespers, was stirred up by the wrongs of the moment. It began a struggle which ended, after 20 years, in the establishment of an Aragonese dynasty in Sicily. (*See* VESPERS, SICILIAN.)

Thus the great island of the Mediterranean again became an independent power. And, as far as legislation could make it, Sicily became one of the freest countries in Europe. By the laws of king Frederick III. (*q.v.*) parliaments were to be regularly held, and without their consent the king could not make war, peace or alliance. But Sicily never rose to the greatness of its Greek or its Norman days, and its old character had passed away. Of Greeks and Saracens we now hear only as a degraded remnant, to be won over, if it may be, to the Western Church. The kingdom had no foreign possessions; yet the isle of Gerba, off the African coast, was held for a short time, and traces of the connection with Greece went on in various shapes. If the kings of Sicily on this side the Pharos kept Corfu down to 1386, those beyond the Pharos became, in 1311, overlords of Athens, when that duchy was seized by Catalan adventurers, disbanded after the wars of Sicily. In 1530 the Sicilian island of Malta became the shelter of the Knights of Saint John, driven by the Turk from Rhodes, and Sicily has received several colonies of Christian Albanians, who have replaced Greek and Arabic by yet another tongue. (*See* NAPLES, KINGDOM OF.) (E. A. F.; T. A.)

BIBLIOGRAPHY.—Many Christian catacombs and Byzantine rock-cut villages, churches and tombs have been explored of recent years. *See* the comprehensive work by the late J. Führer and V. Schultze, "Die altchristlichen Grabstätte Siziliens" (Berlin, 1907, *Jahrbuch des K.D. archäologischen Instituts, Ergänzungsheft* vii.); and several articles by P. Orsi in the *Notizie degli scavi,* and in *Byzantinische Zeitschrift* (1898, 1; 1899, 613); also M. Amari, *Storia dei Musulmani di Sicilia* (1854–72); F. Chalandon, *Histoire de la domination normande en Italie et en Sicile* (1907).

SICILY, BANK OF, a public utility, non-profit earning bank with its seat in Palermo. Its foundation dates back to 1850 when two banks, established in 1843, amalgamated as the *Banco Regio dei Reali Domini al di là del Faro* for the collection of revenue in Sicily (then part of the Kingdom of the Two Sicilies), for receiving deposits, and with the right to issue notes. In 1867, when Italy had become a United Kingdom, the Bank assumed its present name of *Banco di Sicilia* and was recognised as a Bank of Issue, a privilege it enjoyed until the unification of the note issue in the *Banca d'Italia* in 1926. The *Banco di Sicilia* performs all banking operations; it has an important Savings Bank and an agricultural credit department organized under the provisions of the Act of 1906. Since 1922 it has played a part of increasing importance in the economic life of the Island, organizing a special "Foundation for the cultural and economic progress of Sicily" endowed with a capital grant of 30 million lire, the "V. Emanuel III. Institute for land reclamation in Sicily" (capital 20 million lire), the "General Warehouse Association of Sicily" (cap. 12 million lire), and the "Association for promoting the Tourist Industry in Sicily." It has 61 branch banks in Italy; on Jan. 31, 1929 it had a capital of 425 million lire and held 682 million lire in deposits on current and savings account. In 1925 it established in New York City the *Banco di Sicilia Trust Co.* (cap. in 1927 $1,100,000) which acts as a deposit bank for Italian emigrants. In 1927 this Trust Co. organized, under the laws of the State of New York, a holding and investment company, the "Bansicilia Corporation." (IG. M.)

SICKERT, WALTER RICHARD (1860–), British painter and etcher, was born at Munich May 31, 1860, the son of the painter, Oswald Adalbert Sickert, a contributor to *Fliegende Blätter,* and grandson of Johannes Sickert of Altona, painter and lithographer. Sickert studied under Whistler in Chelsea, but in 1885, following the advice of Degas, began to paint from drawings instead of from nature. His subject pictures include "Mamma mia po'aretta" (1903), "Noctes Ambrosianae" (1906), "The Camden Town Murder" (1906), "Army and Navy" (1913), "Ennui" (1914), "Sinn Fein" (1915), "Pierrots on Brighton Beach at Night" (1915), "Baccarat at Dieppe" (1920) and "Supper at the Casino" (1920). He also produced some architectural paintings, including "Hotel Royal, Dieppe" (1900), "Lansdowne Crescent" (1917) and "Pulteney Bridge" (1918). He became a member of the Société du Salon d'Automne, the Society of Twelve and the International Society, a fellow of the Royal Society of Painters, Etchers and Engravers, and in 1928 was elected president of the Royal Society of British Artists. He was elected A.R.A. in 1924. As a teacher he exercised a strong influence over the younger British painters.

SICKINGEN, FRANZ VON (1481–1523), German knight, was born at Ebernburg near Worms on March 2, 1481. He fought for the emperor Maximilian I. against Venice in 1508, inherited large estates on the Rhine, and increased his wealth and reputation by numerous feuds. In 1513 he took up the quarrel of Balthasar Schlör, a citizen who had been driven out of Worms, and attacked this city with 7,000 men. He made war upon Antony, duke of Lorraine, and compelled Philip, landgrave of Hesse, to pay him 35,000 gulden. In 1518 he interfered in a civil conflict in Metz, ostensibly siding with the citizens against the governing oligarchy. He led an army of 20,000 men against the city, compelled the magistrates to give him 20,000 gold gulden and a month's pay for his troops. In 1518 Maximilian released him from the ban, and he took part in the war carried on by the Swabian League against Ulrich I., duke of Württemberg. In the contest for the imperial throne upon the death of Maximilian in 1519, Sickingen accepted bribes from Francis I., king of France, but when the election took place he led his troops to Frankfort, where their presence assisted to secure the election of Charles V. For this service he was made imperial chamberlain and councillor, and in 1521 he led an expedition into France, which ravaged Picardy, but was beaten back from Mezières and forced to retreat. About 1517 Sickingen became intimate with Ulrich von Hutten,

and gave his support to Hutten's schemes. In 1519 a threat from him freed John Reuchlin from his enemies, the Dominicans, and his castles became in Hutten's words *a refuge for righteousness.* Here many of the reformers found shelter, and a retreat was offered to Martin Luther. After the failure of the French expedition, Sickingen, aided by Hutten, formed, or revived, a scheme to overthrow the spiritual princes and to elevate the order of knighthood. He declared war against his old enemy, Richard of Greiffenklau, archbishop of Trier, and marched against that city. Trier was loyal to the archbishop, and the landgrave of Hesse and Louis V., count palatine of the Rhine, hastened to his assistance. Sickingen fell back on his castle of Landstuhl, near Kaiserslautern, collecting much booty on the way. On Oct. 22, 1522 the council of regency placed him under the ban, to which he replied, in the spring of 1523, by plundering Kaiserslautern. The rulers of Trier, Hesse and the Palatinate decided to press the campaign against him, and having obtained help from the Swabian League, marched on Landstuhl. On May 6, 1523 he was forced to capitulate, and died the next day. He was buried at Landstuhl, and in 1889 a splendid monument was raised at Ebernburg to his memory and to that of Hutten.

See H. Ulmann, *Franz von Sickingen* (Leipzig, 1872); F. P. Bremer, *Sickingens Fehde gegen Trier* (Strassburg, 1885); H. Prutz, "Franz von Sickingen" in *Der neue Plutarch* (Leipzig, 1880), and the "Flersheimer Chronik" in Hutten's *Deutsche Schriften,* edited by O. Waltz and Szamatolati (Strassburg, 1891).

SICKLE: *see* REAPING.

SICKLES, DANIEL EDGAR (1825–1914), American soldier and diplomatist, was born in New York city on Oct. 20, 1825. He learned the printer's trade, studied in the University of the City of New York (now New York university), and was admitted to the bar in 1846. In 1853 he became corporation counsel of New York city, and from 1857 to 1861 was a Democratic representative in Congress. At the outbreak of the Civil War, Sickles was active in raising United States Volunteers in New York, became a brigadier-general of volunteers in Sept. 1861, led a brigade of the Army of the Potomac with credit up to the battle of Antietam, and then succeeded to a divisional command. He took part with distinction in the battle of Fredericksburg, and in 1863 as a major-general commanded the III. Army Corps. His energy and ability were conspicuous in the disastrous battle of Chancellorsville (*q.v.*); and at Gettysburg (*q.v.*) the part played by his corps in the desperate fighting around the Peach orchard was one of the most noteworthy incidents in the battle. He himself lost a leg and his active military career came to an end. Sickles was one of the few successful volunteer generals who served on either side. In 1869 he was retired with the rank of major-general (U.S.A.). He was minister to Spain from 1869 to 1873, and took part in the negotiations growing out of the "Virginius affair." (*See* SANTIAGO, CUBA.) In 1893–95 he was again a representative in Congress. His last years were disturbed by financial difficulties. He died in New York city on May 3, 1914.

SICULI, ancient Sicilian tribe (Gr. *Sikelói*). In historical times it occupied the eastern half of the island to which it gave its name. It plays a large though rather shadowy part in the early traditions of pre-Roman Italy. There is abundant evidence that the Siculi once lived in Central Italy east and even north of Rome (*e.g.* Servius *ad Aen.* vii. 795; Dion. Hal. i. 9. 22; Thucydides vi. 2). Thence they were dislodged by the Umbro-Safine tribes, and finally crossed to Sicily. They were distinct from the Sicani (*q.v.*; Virg. *Aen.* viii. 328) who inhabited the western half of the island.

The towns of the Siculi were under independent rulers. They played an important part in the history of the island after the arrival of the Greeks (*see* SICILY). Their agricultural pursuits and the volcanic nature of the island made them worshippers of the gods of the nether world, and they have enriched mythology with some national figures. The most important of these were the Palici, protectors of agriculture and sailors, who had a lake and temple in the neighbourhood of the river Symaethus, the chief seat of the Siculi; Adranus, father of the Palici, a god akin to Hephaestus, in whose temple a fire was always kept burning; Hybla (or Hyblaea), after whom three towns were named, whose sanctuary was at Hybla Gereatis. The connexion of Demeter and Kore with Henna (the rape of Proserpine) and of Arethusa with Syracuse is due to Greek influence. Their chief towns were: Agyrium (*San Filippo d'Argirò*); Centuripa (or Centuripae; *Centorbi*); Henna (*Castrogiovanni,* a corruption of Castrum Hennae through the Arabic *Casr-janni*); Hybla, three in number, (*a*) Hybla Major, called Geleatis or Gereatis, on the river Symaethus, probably the Hybla famous for its honey, although according to others this was (*b*) Hybla Minor, on the east coast north of Syracuse, afterwards the site of the Dorian colony of Megara, (*c*) Hybla Heraea in the south of the island. For authorities *see* SICILY.

SICYON (or SECYON, the older local form), an ancient Greek city in northern Peloponnesus between Corinth and Achaea, on a low triangular plateau about 2 m. from the Corinthian Gulf, at the confluence of the Asopus and the Helisson. Between city and port lay a fertile plain with olive-groves and orchards. Its primitive name was Aegialeia "beach-town"; its original population Ionian; the myth and cult of Adrastus show early connection with Argos; and in the *Iliad* it is a dependency of Agamemnon. After the Dorian invasion it had the three Dorian tribes with an equally privileged tribe of Aigialeis (probably old Ionian) and a class of land-serfs (*κορυνηφόροι* or *κατωνακοφόροι*). For some centuries Sicyon remained subject to Argos, and acknowledged a certain suzerainty as late as 500 B.C. But virtual independence was established in the 7th century by anti-Dorian tyrants, known after their founder as the Orthagoridae, whose mild rule lasted longer than any other Greek tyranny (about 665–565 B.C.). The founder's grandson Cleisthenes held intercourse with many commercial centres of Greece and south Italy and gave his heiress in marriage to Megacles of Athens, whose son was the Athenian legislator of that name. Cleisthenes (*q.v.*) besides reforming the city's constitution and replacing Dorian cults by the worship of Dionysus, was chief instigator of the First Sacred War (590) in the interest of Delphi. After the fall of the tyranny, Cleisthenes' institutions survived till the end of the 6th century, when Dorian supremacy was re-established, and the city joined the Peloponnesian League. Henceforth its policy was usually determined by Sparta or by its powerful neighbour Corinth. During the Persian wars Sicyon furnished 3,000 heavy-armed men; its school of bronze sculptors produced Canachus (*q.v.*) a master of the late archaic style. In the 5th century it suffered like Corinth from the commercial rivalry of Athens and was repeatedly harassed by Athenian ships. In the Peloponnesian war Sicyon followed Sparta and Corinth. Again in the Corinthian war Sicyon sided with Sparta. In 369 when it was captured and garrisoned by the Thebans a powerful citizen Euphron established himself tyrant by popular support. His deposition by the Thebans and subsequent murder freed Sicyon for a while, but new tyrants arose with the help of Philip II. of Macedon. Nevertheless during this period Sicyon reached its zenith as a centre of art: its school of painting under Eupompus attracted Pamphilus and Apelles as students; its sculpture culminated in Lysippus and his pupils. After participating in the Lamian war and the campaigns of the Macedonian pretenders the city was captured (303) by Demetrius Poliorcetes, who transplanted the inhabitants to the Acropolis and renamed the site Demetrias. In the 3rd century it passed from tyrant to tyrant, until in 251 it was liberated and enrolled in the Achaean League (*q.v.*). The destruction of Corinth (146) brought an acquisition of territory and presidency over the Isthmian games; yet in Cicero's time Sicyon had fallen deep into debt. Under the empire it was quite obscured by the restored Corinth and Patrae; Pausanias (A.D. 150) found it almost desolate. In Byzantine times it became a bishop's seat, and its later name "Hellas" reveals it as a refuge for Greeks from Slavonic immigrants of the 8th century.

An insignificant village, Vasiliko, now occupies the site. Ancient fortifications are still visible, and remains of a theatre, a stadium, aqueducts and foundations of buildings.

BIBLIOGRAPHY.—Strabo, pp. 382, 389; Herodotus v. 67–68, vi. 92, ix. 28; Thucydides i. 108, 111; iv. 70, 101; v. 52, 82; Xenophon, *Hellenica,* iv., vi., vii.; Diodorus xviii. 11, xx. 102; Pausanias ii. 5–11; W. M. Leake, *Travels in the Morea* (1830), iii. pp. 351–381; E. Curtius, *Peloponnesos* (Gotha, 1851), ii. pp. 482–505; *American Journal of Archaeology,* v. (1889) pp. 267–303, viii. (1893) pp. 288–400,

xx. (1905) pp. 263–276; L. Dyer in the *Journal of Hellenic Studies* (1906), pp. 76–83; for coins, B. V. Head, *Historia Numorum* (1887), pp. 345–346; also NUMISMATICS, section *Greek*, § "Patrae–Sicyon."

SIDDONS, SARAH (1755–1831), English actress, the eldest of 12 children of Roger Kemble, was born in the "Shoulder of Mutton" public-house, Brecon, Wales, on July 5, 1755.

She became attached to William Siddons, whom she married at Trinity Church, Coventry, on Nov. 26, 1773. In 1774 she played Belvidera in Otway's *Venice Preserved* at Cheltenham, and moved to tears a party of "people of quality" who had come to scoff. Garrick then sent his deputy to see her as Calista in Rowe's *Fair Penitent*, the result being that she was engaged to appear at Drury Lane at a salary of £5 a week.

After a very successful engagement at Bath, beginning in 1778 and lasting five years, she again appeared at Drury Lane, when her acting as Isabella in Garrick's version of Southerne's *Fatal Marriage* (Oct. 10), was a triumph, only equalled in the history of the English stage by that of Garrick's first night at Drury Lane in 1741 and that of Edmund Kean's in 1814.

As Lady Macbeth, Mrs. Siddons found the highest and best scope for her gifts. It fitted her as no other character did, and as perhaps, it will never fit another actress. Her tall figure, brilliant beauty, expressive eyes and her dignity of demeanour heightened the tragedy of the part. After Lady Macbeth she played Desdemona, Rosalind and Ophelia, all with great success; in Queen Catherine—which she first played on the occasion of her brother John Kemble's spectacular revival of *Henry VIII.* in 1788—she discovered a part almost as well adapted to her peculiar powers as that of Lady Macbeth. As Volumnia in Kemble's version of *Coriolanus* she also secured a triumph. It was of course inevitable that comparisons should be made between her and her only peer Rachel, who undoubtedly excelled her in intensity and the portrayal of fierce passion, but Rachel was a less finished artist, and lacked Mrs. Siddons' dignity and pathos. Her last appearance was on June 9, 1819, as Lady Randolph in Home's *Douglas*, for the benefit of Mr. and Mrs. Charles Kemble.

In private life Mrs. Siddons enjoyed the friendship and respect of many of her most eminent contemporaries. Horace Walpole at first refused to join the fashionable chorus of her praise, but he was ultimately won over. Dr. Johnson wrote his name on the hem of her garment in the famous picture of the actress as the Tragic Muse by Reynolds (now in the Dulwich Gallery). Mrs. Siddons died in London on June 8, 1831, and was buried in Paddington churchyard.

In 1897 Sir Henry Irving unveiled at Paddington Green a marble statue of her by Chavalliaud, after the portrait by Reynolds. There is also a statue by Chantrey in Westminster Abbey. Portraits by Lawrence and Gainsborough are in the National Gallery, and a portrait ascribed to Gainsborough is in the Garrick Club, London, which also possesses two pictures of the actress as Lady Macbeth by G. H. Harlow.

See Thomas Campbell, *Life of Mrs. Siddons* (2 vols., 1834); P. H. Fitzgerald, *The Kembles* (3 vols., 1871); Frances Ann Kemble, *Records of a Girlhood* (3 vols., 1878); A. Maurois, *Portrait d'une actrice* (1927).

SIDE (mod. *Eski Adalia*), an ancient city on the Pamphylian coast about 12 m. E. of the mouth of the Eurymedon. Possessing a good harbour in the days of small craft, it was the most important place in Pamphylia. Alexander visited and occupied it, and there the Rhodian fleet defeated that of Antiochus the Great, and in the succeeding century the Cilician pirates established here their chief seat. An inscription shows it had many Jews in early Byzantine times. The great ruins cover a large promontory, fenced from the mainland by a ditch and wall which has been repaired in mediaeval times and is singularly perfect. Within this is a maze of structures out of which rises the colossal ruin of the theatre, built up on arches like a Roman amphitheatre.

See C. Lanckoronski, *Les Villes de la Pamphylie et de la Pisidie*, i. (1890).

SIDEBANDS, a term used in radio to denote frequencies on either side of the carrier frequency produced by the process of single frequency modulation (*q.v.*).

SIDEBOARD. Originally the sideboard was what its name implies—a side-table, to which the modern dinner-wagon very closely approximates. Then two- or three-tiered sideboards were in use in the Tudor period, and were perhaps the ancestors, or collaterals, of the court-cupboard, which in skeleton they much resembled. Early in the 18th century they began to be replaced by side-tables properly so called. In the beginning these tables were entirely of wood and comparatively slight, but before long it became the fashion to use a marble slab instead of a wooden top, which necessitated a somewhat more robust construction. Many of the sideboard tables of this period were exceedingly handsome, with cabriole legs, claw or claw and bill feet, friezes of acanthus, much gadrooning and mask pendants. Many such tables came from Chippendale's workshops, but although that great genius beautified the type he found, he had no influence upon the evolution of the sideboard. That evolution was brought about by the growth of domestic needs. Save upon its surface, the sideboard-table offered no accommodation; it usually lacked even a drawer. Even, however, in the period of Chippendale's zenith separate "bottle cisterns" and "lavatories" for the convenience of the butler in washing the silver as the meals proceeded were, no doubt, sometimes in use. By degrees it became customary to place a pedestal, which was really a cellarette or a plate-warmer, at each end of the sideboard-table. One of them would contain ice and accommodation for bottles; the other would be a cistern. Sometimes a single pedestal would be surmounted by a wooden vase lined with metal and filled with water, and fitted with a tap. To whom is due the brilliant inspiration of attaching the pedestals to the table and creating a single piece of furniture out of three components there is nothing to show with certainty. It is most probable that the credit is due to Shearer, who unquestionably did much for the improvement of the sideboard; Hepplewhite and the brothers Adam distinguished themselves in the same field but it was Sheraton who brought it to its full *floraison*. By the use of fine exotic woods, the deft employment of satin wood and other inlays, and by the addition of gracefully ornamented brass-work at the back, sometimes surmounted by candles to light up the silver, Sheraton produced effects of great elegance. But for sheer artistic excellence in the components of what presently became the sideboard, the Adams stand unrivalled; some of their inlay and brass mounts were almost equal to the first work of the great French school.

SIDERITE or CHALYBITE. A mineral consisting of carbonate of iron, $FeCO_3$ (48·2% of iron) and forming an important ore of iron (*spathic iron-ore*).

SIDEROSTAT, an instrument which, like the coelostat and heliostat (*q.v.*), reflects a portion of the sky in a fixed direction notwithstanding the diurnal motion of the heavens. The name is applied especially to the polar siderostat, a form of telescope in which the observer looks down the polar axis on to a mirror; by adjusting the mirror he can bring any part of the sky into the field of view without changing his own position.

SIDGWICK, HENRY (1838–1900), English philosopher, was born at Skipton in Yorkshire on May 31, 1838. He was educated at Rugby and at Trinity, Cambridge. In 1859 he was elected to a fellowship at Trinity, and soon afterwards appointed to a classical lectureship there. This post he held for ten years, but in 1869 exchanged his lectureship for one in moral philosophy. In that year he resigned his fellowship on religious grounds. He retained his lectureship, and in 1881 was elected an honorary fellow. In 1874 he published his *Method of Ethics* (6th ed. 1901, containing emendations written just before his death). In 1875 he was appointed praelector on moral and political philosophy at Trinity, in 1883 Knightbridge professor of moral philosophy, and in 1885, the religious test having been removed, his college once more elected him to a fellowship on the foundation. Sidgwick took an active part in the business of the university, and in many forms of social and philanthropic work. He was one of the founders and first president of the Society for Psychical Research, and was a member of the Metaphysical Society. He took a leading part in promoting the higher education of women. It was at his suggestion and with his help that Miss Clough

opened a house of residence for students; and when this had developed into Newnham college, and in 1880 the North hall was added, Sidgwick, who had in 1876 married Eleanor Mildred Balfour (sister of A. J. Balfour), went with his wife to live there for two years. He died on Aug. 28, 1900. On the death of Miss Clough, the first principal of Newnham, in 1892, Mrs. Sidgwick succeeded her and retained the position until 1910. In that year she retired and until 1919 was bursar of the college. In 1910 she became secretary of the Society for Psychical Research.

Sidgwick was deeply interested in psychical phenomena, but his energies were primarily devoted to the study of religion and philosophy. As early as 1862 he described himself as a theist. For the rest of his life, though he regarded Christianity as "indispensable and irreplaceable—looking at it from a sociological point of view," he found himself unable to return to it as a religion. In political economy he was a Utilitarian on the lines of Mill and Bentham.

His chief works are *Principles of Political Economy* (1883, 3rd ed. 1901); *Scope and Method of Economic Science* (1885); *Outlines of the History of Ethics* (1886, 5th ed. 1902), enlarged from his article ETHICS in the *Encyclopædia Britannica; Elements of Politics* (1891, 2nd ed. 1897), an attempt to supply an adequate treatise on the subject starting from the old lines of Bentham and Mill. The following were published posthumously: *Philosophy; its Scope and Relations* (1902); *Lectures on the Ethics of T. H. Green, Mr. Herbert Spencer and J. Martineau* (1902); *The Development of European Polity* (1903); *Miscellaneous Essays and Addresses* (1904); *Lectures on the Philosophy of Kant* (1905).

See a *Memoir* of Henry Sidgwick, written by his brother with the collaboration of his widow (1906).

SIDI-BEL-ABBÈS, chief town of an arrondissement in the department of Oran, Algeria, 48 m. by rail S. of Oran, 1,552 ft. above the sea, on the right bank of the Mekerra. The population is 43,148, of which 28,024 are Europeans (21,295 French or naturalised French, of whom the majority is of Spanish origin). The town is the headquarters of the 1er régiment of the Foreign Legion. It is encircled by a crenellated and bastioned wall with a fosse, and has four gates, named after Oran, Daia, Mascara and Tlemçen respectively. Starting from the gates, two broad streets, shaded by plane trees, traverse the town east to west and north to south, the latter dividing the civil from the military quarters.

See Léon Bastide, *Bel Abbès et son arrondissement* (Oran, 1881); Léon Adoue, *Histoire de Sidi-bel-Abbès* (1927).

SIDMOUTH, HENRY ADDINGTON, 1ST VISCOUNT (1757–1844), English statesman, son of Dr. Anthony Addington, was born on May 30, 1757. Educated at Winchester College and Brasenose College, Oxford, he was elected, by the favour of William Pitt, member of parliament for Devizes in 1784. By close attention to his parliamentary duties, he obtained a wide knowledge of the rules and procedure of the House of Commons, and this fact, together with his intimacy with Pitt and his general popularity, secured his election as Speaker in June 1789. Like his predecessors, Addington continued to be a partisan after his acceptance of this office, took part at times in debate when the house was in committee; and on one occasion his partiality allowed Pitt to disregard the authority of the chair. He enjoyed the confidence of George III., and in the royal interest tried to induce Pitt to withdraw his proposal for the removal of the disabilities suffered by Roman Catholics. Rather than give way on this question Pitt resigned office early in 1801, when Addington formed a government. The new prime minister had the loyal support of Pitt; and the conclusion of the treaty of Amiens in March 1802 made him popular in the country. But Pitt, dissatisfied with the ministry for ignoring the threatening attitude of Napoleon, and making no preparations for a renewal of the war, withdrew his support. Addington then took steps to strengthen the forces of the crown, and made unsuccessful overtures to Pitt that both should serve under a new prime minister, or, later, that he himself should serve under Pitt. When the struggle with France was renewed in May 1803, it became evident that as a war minister Addington was not a success; and when Pitt became openly hostile, the continued confidence of the king and of a majority in the House of Commons was not a sufficient counterpoise to the ministry's waning prestige. Although careful and industrious, Addington had no brilliant qualities, and his mediocrity afforded opportunity for attack by his enemies. He resigned office in April 1804, and became the leader of the party known as the "king's friends." Pitt, who now returned to office, was soon reconciled with his old friend; in January 1805 Addington was created Viscount Sidmouth, and became lord president of the council. He left the cabinet in July 1805. In February 1806 he became lord privy seal in the ministry of Fox and Grenville, but resigned early in 1807 when the government proposed to throw open commissions in the army and navy to Roman Catholics and Protestant dissenters; in 1812 he joined the cabinet of Spencer Perceval as lord president of the council, becoming home secretary when the ministry was reconstructed by the earl of Liverpool in the following June. The ten years during which he held this office coincided with much misery and unrest among the labouring classes, and the government policy, for which he was mainly responsible, was one of severe repression. In 1817 the Habeas Corpus Act was suspended, and Sidmouth issued a circular to the lords-lieutenant declaring that magistrates might apprehend and hold to bail persons accused on oath of seditious libels. For this step he was severely attacked in parliament, and was accused of fomenting rebellion by means of his spies. Although shaken by the acquittal of William Hone on a charge of libel the government was supported by parliament; and after the "Manchester massacre" in August 1819 the home secretary thanked the magistrates and soldiers for their share in quelling the riot. He was mainly responsible for the policy embodied in the "Six Acts" of 1819. In December 1821 Sidmouth resigned his office, but remained a member of the cabinet without official duties until 1824, when he resigned owing to his disapproval of the recognition of the independence of Buenos Aires. Subsequently he took very little part in public affairs; but true to his earlier principles he spoke against Catholic emancipation in April 1829, and voted against the Reform Bill in 1832. He died at Richmond Park on Feb. 15, 1844.

See Hon. G. Pellew, *Life of Sidmouth* (London, 1847); Lord John Russell, *Life and Times of C. J. Fox* (London, 1859–66); Earl Stanhope, *Life of Pitt* (London, 1861–62); Sir G. C. Lewis, *Essays on the Administrations of Great Britain* (London, 1864); Spencer Walpole, *History of England* (London, 1878–1886).

SIDMOUTH, a town and watering-place of Devonshire, England, on the River Sid and the English channel, 167¾ m. W. by S. of London, by a branch of the Southern railway. Pop. (1931) 6,126. The town is shut in by hills which end in the forelands of Salcombe and High Peak. The shore line curves away, beyond these, westward to the Start and eastward to Portland—both visible from Sidmouth beach. Tradition tells of an older town buried under the sea; and Roman coins and other remains have been washed up on the beach. Traces of an ancient camp exist on High Peak. In the 13th century Sidmouth was a borough governed by a port.

SIDNEY or (SYDNEY), **ALGERNON** (1622–1683), English politician, second son of Robert, 2nd earl of Leicester, and of Dorothy Percy, daughter of Henry, 9th earl of Northumberland, was born at Penshurst, Kent. As a boy he showed much talent, which was carefully trained under his father's eye. In 1632 with his elder brother Philip he accompanied his father on his mission as ambassador extraordinary to Christian IV. of Denmark. In May 1636 Sidney went with his father to Paris, where he became a general favourite, and from there to Rome. In Oct. 1641 he was given a troop in his father's regiment in Ireland, of which his brother, known as Lord Lisle, was in command. In Aug. 1643 the brothers returned to England. At Chester their horses were taken by the Royalists, whereupon they again put out to sea and landed at Liverpool. Here they were detained by the Parliamentary commissioners, and by them sent up to London for safe custody. From this time Sidney ardently attached himself to the Parliamentary cause. On May 10, 1644, he was made captain of horse in Manchester's army, under the Eastern Association. He was shortly afterwards made lieutenant-colonel, and charged

at the head of his regiment at Marston Moor (July 2), where he was wounded, and rescued with difficulty. In April 1645 he was given the command of a cavalry regiment in Cromwell's division of Fairfax's army, was appointed governor of Chichester on May 10, and in December was returned to parliament for Cardiff. In July 1646 he went to Ireland, where his brother was lord-lieutenant, and was made lieutenant-general of horse and governor of Dublin. He had hardly reached Ireland when he was recalled and stationed at Dover castle as governor. He was at this time acting with the Independents, and was nominated one of the commissioners for the trial of Charles I. But he took no part in the trial, and remained at Penshurst until the trial was over. He states that he opposed the proceedings on the grounds, "first, that the king could be tried by no court; second, that no man could be tried by that court." In 1651 he lost his governorship of Dover castle, and spent some months in Holland. In the autumn he became a member of the council of State, but he disapproved of Cromwell's assumption of the supreme power, and retired to Penshurst, and then to The Hague, where he became a close friend of De Witt.

Upon the restoration of the Long Parliament, in May 1659, Sidney again took his seat, and was placed on the council of State. He was now, as before, especially concerned with the foreign work of the council. In June he was appointed one of three commissioners to mediate for a peace between Denmark, supported by Holland, and Sweden. He was probably intended to watch the conduct of his colleague, Admiral Montagu (afterwards 1st earl of Sandwich), who was in command of the Baltic squadron. Upon the conclusion of the treaty he went to Stockholm as plenipotentiary; and in both capacities he behaved with resolution and address. Meanwhile the Restoration had taken place and Sidney, instead of returning to England, went to Copenhagen, and then to Hamburg to await the turn of events. He then travelled by way of Venice to Rome. His father sent him very little money. Five shillings a day, he says, served him and two men very well for meat, drink and firing in Rome. He devoted himself to the study of books, birds and trees, and speaks of his natural delight in solitude being largely increased. In 1663 he left Italy, passed through Switzerland, where he visited Ludlow, and came to Brussels in September, where his portrait was painted by van Egmondt; it is now at Penshurst. He had thoughts of joining the imperial service, and offered to transport from England a body of the old Commonwealth men; but this was refused by the English court. The enmity against him was so great that now, as on other occasions, attempts were made to assassinate him. On the breaking out of the Dutch war, Sidney, who was at The Hague, urged an invasion of England, and shortly afterwards went to Paris, where he offered to raise a rebellion in England on receipt of 100,000 crowns. Unable, however, to come to terms with the French Government, he once more went into retirement in 1666,—this time to the south of France. In Aug. 1670 he was again in Paris, and Arlington proposed that he should receive a pension from Louis; Charles II. agreed, but insisted that Sidney should return to Languedoc.

His father was now very ill, and after much difficulty Sidney obtained leave to come to England in the autumn of 1677. Lord Leicester died in November; and legal business connected with other portions of the succession detained Sidney from returning to France as he had intended. He soon became involved in political intrigue, joining, in general, the country party, and holding close communication with Barillon, the French ambassador. In the beginning of 1679 he stood for Guildford, and was warmly supported by William Penn, with whom he had long been intimate, and whom he is said (as is now thought, erroneously) to have helped in drawing up the constitution of Pennsylvania. He was defeated by court influence, and his petition to the House, complaining of an undue return, never came to a decision. His *Letters to Henry Savile*, written at this period, are of great interest. He was in Paris, apparently only for a short while, in Nov. 1679. Into the prosecution of the Popish Plot Sidney threw himself warmly, and was among those who looked to Monmouth, rather than to William, to take the place of James in the succession, though he afterwards disclaimed all interest in such a question. He now stood for Bramber (Sussex), again with Penn's support, and a double return was made. He is reported on Aug. 10, 1679, as being elected for Amersham (Buckingham) with Sir Roger Hill. When parliament met, however, in Oct. 1680, his election was declared void. But now, under the idea that an alliance between Charles and William would be more hostile to English liberty than would the progress of the French arms, he acted with Barillon in influencing members of parliament in this sense.

Upon the dissolution of the last of Charles's parliaments the king issued a justificatory declaration. This was at once answered by a paper entitled *A Just and Modest Vindication, etc.*, the first sketch of which is imputed to Sidney. It was then, too, that his most celebrated production, the *Discourses concerning Government*, was concluded, in which he upholds the doctrine of the mutual compact and traverses the High Tory positions.

For a long while Sidney kept himself aloof from the duke of Monmouth, to whom he was introduced by Lord Howard. After the death of Shaftesbury, however, in Nov. 1682, he entered into the conferences held between Monmouth, Russell, Essex, Hampden and others. That treasonable talk went on seems certain, but it is probable that matters went no further. The watchfulness of the court was, however, aroused, and on the discovery of the Rye House Plot, Sidney, who had always been regarded in a vague way as dangerous, was arrested while at dinner on June 26, 1683. His papers were carried off, and he was sent at once to the Tower on a charge of high treason. For a considerable while no evidence could be found on which to establish a charge. Jeffreys, however, was made lord chief-justice in September; a jury was packed; and, after consultations between the judge and the crown lawyers, Sidney was brought to listen to the indictment on Nov. 7.

The trial began on Nov. 21; Sidney was refused a copy of the indictment, in direct violation of law, and he was refused the assistance of counsel. Hearsay evidence and the testimony of the perjured informer Lord Howard, whom Sidney had been instrumental in introducing to his friends, were first produced. This being insufficient, partial extracts from papers found in Sidney's study, and supposed only to be in his handwriting, in which the lawfulness of resistance to oppression was upheld, were next relied on. He was indicted for "conspiring and compassing the death of the king." Sidney conducted his case throughout with skill. Against the determination to secure a conviction, however, his courage, eloquence, coolness and skill were of no avail, and the verdict of "guilty" was given. On Nov. 25, Sidney presented a petition to the king. The necessity, however, of checking the hopes of Monmouth's partisans caused the king to be inexorable. The last days of Sidney's life were spent in drawing up his *Apology* and in discourse with Independent ministers. He was beheaded on the morning of Dec. 7, 1683. His remains were buried at Penshurst.

An edition of the *Discourses concerning Government*, containing his letters, the report of his trial, and the "Apology" written in his last hours, was published in 1763, and reprinted in 1772, with corrections and additions. There is a notice of Algernon Sidney in the preface to Collins's *Sidney Papers*, and some letters of his appear in that collection. *See* also A. C. Ewald, *Life and Times of Algernon Sidney* (2 vols., 1873); and the life by C. H. Firth in the *Dictionary of National Biography*. (O. A.; X.)

SIDNEY, SIR HENRY (1529–1586), lord deputy of Ireland, was the eldest son of Sir William Sidney, a prominent politician and courtier in the reigns of Henry VIII. and Edward VI., from both of whom he received extensive grants of land, including the manor of Penshurst in Kent, which became the principal residence of the family. Henry was brought up at court as the companion of Prince Edward, afterwards King Edward VI.; and he continued to enjoy the favour of the sovereign throughout the reigns of Edward and Mary. In 1556 he went to Ireland with the lord deputy, the earl of Sussex, who in the previous year had married his sister Frances Sidney; and from the first he had a large share in the administration of the country, especially in the military measures taken by his brother-in-law for bringing the native Irish chieftains into submission to the English Crown.

In the course of the lord deputy's Ulster expedition in 1557 Sidney devastated the island of Rathlin; and during the absence of Sussex in England in the following year Sidney was charged with the sole responsibility for the government of Ireland, which he conducted with marked ability and success. A second absence of the lord deputy from Ireland, occasioned by the accession of Queen Elizabeth, threw the chief control into Sidney's hands at the outbreak of trouble with Shane O'Neill, and he displayed great skill in temporizing with that redoubtable chieftain till Sussex reluctantly returned to his duties in August 1559. About the same time Sidney resigned his office of vice-treasurer of Ireland on being appointed president of the Welsh Marches.

In 1565 Sidney was appointed lord deputy of Ireland in place of Sir Nicholas Arnold, who had succeeded the earl of Sussex in the previous year. He found the country in a more impoverished and more turbulent condition than when he left it, the chief disturbing factor being Shane O'Neill in Ulster. With difficulty he persuaded Elizabeth to sanction vigorous measures against O'Neill; and although the latter successfully avoided a decisive encounter, Sidney restored O'Neill's rival Calvagh O'Donnell to his rights, and established an English garrison at Derry which did something to maintain order. In 1567 Shane was murdered by the MacDonnells of Antrim (*see* O'NEILL), and Sidney was then free to turn his attention to the south, where with vigour and determination he arranged the quarrel between the earls of Desmond and Ormonde, and laid his hand heavily on other disturbers of the peace; then, returning to Ulster, he compelled Turlough Luineach O'Neill, Shane's successor in the clan chieftainship, to make submission, and placed garrisons at Belfast and Carrickfergus to overawe Tyrone and the Glynns. In the autumn of 1567 Sidney went to England, and was absent from Ireland for the next ten months. On his return he urged upon Cecil the necessity for measures to improve the economic condition of Ireland, to open up the country by the construction of roads and bridges, to replace the Ulster tribal institutions by a system of freehold land tenure, and to repress the ceaseless disorder prevalent in every part of the island. In pursuance of this policy Sidney dealt severely with the Butlers in Munster.

Sidney left Ireland in 1571, aggrieved by the slight appreciation of his statesmanship shown by the queen; but he returned thither in September 1575 with increased powers and renewed tokens of royal approval, to find matters in a worse state than before, especially in Antrim, where the MacQuillins of the Route and Sorley Boy MacDonnell (*q.v.*) were the chief fomenters of disorder. Having to some extent pacified this northern territory, Sidney repaired to the south, where he was equally successful in making his authority respected. He left his mark on the administrative areas of the island by making shire divisions on the English model. At an earlier period he had already in the north combined the districts of the Ardes and Clandeboye to form the county of Carrickfergus, and had converted the country of the O'Farrells into the county of Longford; he now carried out a similar policy in Connaught, where the ancient Irish district of Thomond became the county Clare, and the counties of Galway, Mayo, Sligo and Roscommon were also delimited. He suppressed a rebellion headed by the earl of Clanricarde and his sons in 1576, and hunted Rory O'More to his death two years later. Meantime Sidney's methods of taxation had caused discontent among the gentry of the Pale, who carried their grievances to Queen Elizabeth. Greatly to Sidney's chagrin the queen censured his extravagance, and notwithstanding his distinguished services to the crown he was recalled in September 1578, and was coldly received by Elizabeth. He lived chiefly at Ludlow Castle for the remainder of his life, performing his duties as president of the Welsh Marches, and died there on May 5, 1586.

See A. Collins, *The Sidney Papers; Calendar of State Papers relating to Ireland, Henry VIII.–Elizabeth; Calendar of the Carew MSS.;* J. O'Donovan's edition of *The Annals of Ireland by the Four Masters* (7 vols., Dublin, 1851); Holinshed's *Chronicles*, vol. iii. (6 vols., London, 1807); Richard Bagwell, *Ireland under the Tudors* (3 vols., London, 1885); *Calendar of Ancient Records of Dublin*, edited by Sir J. T. Gilbert, vols. i. and ii. (Dublin, 1889); Sir J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865); J. A. Froude, *History of England* (12 vols., London, 1856–70).

SIDNEY, SIR PHILIP (1554–1586), English poet, statesman and soldier, eldest son of Sir Henry Sidney and his wife Mary Dudley, was born at Penshurst on Nov. 30, 1554. On Oct. 17, 1564, he was entered at Shrewsbury school, close to Ludlow Castle, his father's official residence as lord president of Wales. His life-long friend and first biographer, Fulke Greville, entered the school on the same day. In 1568 he went up to Christ Church, Oxford, where he formed friendships with Richard Hakluyt and William Camden. In 1572 Sidney received the Queen's leave to travel and learn foreign languages.

Travels.—He went first of all in the earl of Lincoln's suite to Paris, where he witnessed the St. Bartholomew massacre. From Paris he went to Frankfort-on-the-Main (1573), where he lodged with the printer Andrew Wechel, with whom also Herbert Languet was staying. Sidney had from his earliest youth an unwonted maturity of manner, which, combined with charm, gained him the confidence of men of affairs. In France he was in close connection with the Huguenot leaders, and Languet, an ardent Protestant, went on with him to Vienna. In October Sidney left for Italy; his letters to Languet afford considerable insight into the development of his character and ideas. Sidney stayed some time in Venice, and sat to Paolo Veronese for a portrait. In July 1574 he was seriously ill, and on his recovery returned to Vienna. He visited Poland with Languet, where he is said to have been offered the vacant crown, and then stayed at Vienna in a vaguely diplomatic capacity. He wrote a letter on the state of affairs to Burghley in Dec. 1574. The count moved to Prague in 1575, and from there he was summoned home.

At Court.—He found his sister Mary at court, and a patron in his uncle, Leicester. On one of the Queen's progresses he met Penelope Devereux, daughter of the Earl of Essex, then a child of twelve, who was later the "Stella" of his sonnets. Essex died the next year, and seems to have desired a match between Sidney and Penelope. A letter of 1576 even mentions a "treaty" between them. But nothing was done. In the spring of 1577 Sidney was sent to congratulate the new Elector Palatine and Emperor, and to promote generally the Protestant cause. He met Don John of Austria at Louvain, and went on to Heidelberg and Prague. He proposed a Protestant league and Church conference, and in a speech to the Emperor advocated a general league against Rome and Spain. On his way back he visited William of Orange. On his return home he paid the first of many visits to his sister Mary, who had married the Earl of Pembroke, at Wilton. Sidney now made it his business to defend his father's interests at Court, particularly from Lord Ormond, who was doing his best to prejudice the Queen against him. He drew up a detailed defence of his father's Irish government for presentation to the Queen. A rough draft of four sections is preserved in the British Museum (*Cotton MS., Titus B.*, xii., 557), which, even in its fragmentary state, justifies the estimate of it formed by Edward Waterhouse (*Sidney Papers*). At this time Sidney was beginning to be a figure in the world of letters; Spenser, whom he met in 1578, dedicated the *Shepherdes Calendar* to him the next year. He was a member of the Areopagus Society, which sought to introduce classical metres in English verse, and he wrote the Masque with which Leicester entertained the Queen at Wanstead in 1578, *The Lady of the May*. But Leicester's disgrace partially involved Sidney, and after a quarrel with Oxford, probably over the proposed Anjou marriage of the Queen, followed by more active opposition to the proposal in 1580 (Sidney Papers p. 287). Sidney had to leave the Court and returned to Wilton.

Stella.—Here Sidney began the *Arcadia* for his sister's amusement; not long afterwards he was allowed to return to Court. About this time must be placed the *Astrophel and Stella* sonnets. The date is not the only obscure point about them. His *Apologie for Poetrie* appeared about 1581 and he was knighted in 1583. That autumn he married Frances, daughter of Sir Francis Walsingham. He still desired active service, took a keen interest in the enterprises of Frobisher, Hakluyt and Raleigh, and was especially enthusiastic for the Protestant cause against Spain. He advocated a direct attack on Spain, and was himself preparing to sail with Drake in 1585 when the Queen recalled him. At last he was given

a command in the Netherlands, as governor of Flushing.

Active Service and Death.—In July 1586 he made a successful raid on Axel, near Flushing, and in September he joined the force of Sir John Norris, who was operating against Zutphen. On the 22nd he joined a small force sent out to intercept a convoy of provisions. During the fight that ensued he was struck in the thigh by a bullet. He succeeded in riding back to the camp. The often-told story that he refused a cup of water in favour of a dying soldier, with the words, "Thy need is greater than mine," is in keeping with his character. He owed his death to a quixotic impulse. Sir William Pelham happening to set out for the fight without greaves, Sidney also cast off his leg-armour, which would have defended him from the fatal wound. He died at Arnheim, on Oct. 17, 1586, and was buried at St. Paul's.

Sidney's death was a personal grief to people of all classes. Some two hundred elegies were produced in his honour. Of all these tributes the most famous is *Astrophel, A Pastoral Elegie,* added to Edmund Spenser's *Colin Clout's Come Home Again* (1595). Spenser wrote the opening poem; other contributors are Sidney's sister, the countess of Pembroke, Lodowick Bryskett and Matthew Roydon.

Writings.—Sidney's writings were not published during his lifetime. *A Worke concerning the trewnesse of the Christian Religion,* translated from the French of Du Plessis Mornay, was completed and published by Arthur Golding in 1587.

The Countesse of Pembroke's Arcadia written by Philippe Sidnei (1590), in quarto, is the earliest edition of Sidney's famous romance. A folio edition, issued in 1593, is stated to have been revised and rearranged by the countess of Pembroke, for whose delectation the romance was written. She was charged to destroy the work sheet by sheet as it was sent to her. The circumstances of its composition partly explain the difference between its intricate sentences, full of far-fetched conceits, repetition and antithesis, and the simple and dignified phrase of the *Apologie for Poetrie.* The style is a concession to the fashionable taste in literature which the countess may reasonably be supposed to have shared; but Sidney himself, although he was no friend to euphuism, was evidently indulging his own mood in this highly decorative prose.

Sonnets.—The series of sonnets to Stella were printed in 1591 as *Sir P.S.: His Astrophel and Stella,* by Thomas Newman, with an introductory epistle by T. Nash, and some sonnets by other writers. In 1598 the sonnets were reprinted in the folio edition of Sidney's works, entitled from its most considerable item *The Countesse of Pembroke's Arcadia,* edited by Lady Pembroke, with considerable additions. The songs are placed in their proper position among the sonnets, instead of being grouped at the end, and two of the most personal poems (possibly suppressed out of consideration for Lady Rich in the first instance), which afford the best key to the interpretation of the series, appear for the first time. Sidney's sonnets adhere more closely to French than to Italian models. The octave is generally fairly regular on two rhymes, but the sestet usually terminates with a couplet. The *Apologie for Poetrie* was one of the "additions" to the countess of Pembroke's *Arcadia* (1598), where it is entitled "The Defence of Poesie." It first appeared separately in 1594 (unique copy in the Rowfant Library, reprint 1904, Camb. Univ. Press). Sidney takes the word "poetry" in the wide sense of any imaginative work, and deals with its various divisions. Apart from the subject matter, which is interesting enough, the book has a great value for the simple, direct and musical prose in which it is written. *The Psalmes of David,* the paraphrase in which he collaborated with his sister, remained in MS. until 1823, when it was edited by S. W. Singer. A translation of part of the *Divine Sepmaine* of G. Salluste du Bartas is lost. There are two pastorals by Sidney in Davison's *Poetical Rhapsody* (1602).

Letters and Memorials of State . . . (1746) is the title of an invaluable collection of letters and documents relating to the Sidney family, transcribed from originals at Penshurst and elsewhere by Arthur Collins. Fulke Greville's *Life of the Renowned Sir Philip Sidney* (1652, ed. by Nowell Smith, 1907), is a panegyric dealing chiefly with his public policy. *The Correspondence of Sir Philip Sidney and Hubert Languet* was translated from the Latin and published with a memoir by Steuart A. Pears (1845). The best biography of Sidney is *A Memoir of Sir Philip Sidney* by H. R. Fox Bourne (1862). A revised life by the same author is included in the "Heroes of the Nations" series (1891). Critical appreciation is available in J. A. Symonds's *Sir Philip Sidney* (1886), in the "English Men of Letters" series; in J. J. A. Jusserand's *English Novel in the Time of Shakespeare* (1890); and in modern editions of Sidney's works, among which may be mentioned Mr. A. W. Pollard's edition (1888) of *Astrophel and Stella,* Professor Arber's reprint (1868) of *An Apologie for Poetrie,* and Mr. Sidney Lee's *Elizabethan Sonnets* (1904) in the re-issue of Professor Arber's *English Garner,* where the sources of Sidney's sonnets are fully discussed. *See* also a collection of *Sidneiana* printed for the Roxburghe Club in 1837, a notice by Mrs. Humphry Ward in Ward's *English Poets,* i. 341 *seq.,* and a dissertation by Dr. K. Brunhuber, *Sir Philip Sidney's Arcadia und ihre Nachläufer* (Nürnberg, 1903). A complete text of Sidney's prose and poetry, edited by Albert Feuillerat, is included in the Cambridge English Classics (1914–23).

SIDNEY, a city of western Ohio, U.S.A., the county seat of Shelby county; 40 m. N. of Dayton, on the Miami river and the Dixie highway. It is served by the Baltimore and Ohio, the Big Four and electric railways. Pop. (1920), 8,590 (96% native white); 1930, Federal census, 9,301. The city lies on an elevated table-land, in a rich agricultural region. It has a large tannery and various other manufacturing industries. Sidney was laid out in 1819 to be the county seat in place of Hardin (5 m. W.) where the first court had been held in May, and was named after Sir Philip Sidney. It was incorporated as a village in 1820, as a town in 1824 and as a city in 1897.

SIDON, once the principal city of Phoenicia, now the principal town of the southern district of Great Lebanon under the French mandate. Sidon is to-day a city of 10,000 inhabitants, the majority of whom are Muslims. Its houses are grouped round a castle dominating a promontory to the south of which was the ancient Egyptian harbour, now little more than a memory, and the modern harbour to the north half silted up. Around the town as far as the eye can see stretch gardens of orange trees, apricots, bananas and lemons—the fortune of Sidon.

History.—Older than Tyre and acknowledged as its mother, Sidon has had an eventful history. The Homeric poems laud the skill of its artisans. The Philistines destroyed its fleet and laid the city in ashes. Assyria and Babylonia coveted the wealth of her bazaars and a splendid succession of monarchs led armies against her to disturb her peace and loot her treasures. In the 7th century B.C. during a pause in Babylonian oppression Egypt intervened. The Persian yoke in due course supplanted the Babylonian and an injudicious revolt against Artaxerxes Ochus met with condign punishment. Unlike Tyre it submitted without resistance to Alexander the Great. The Seleucids of Syria, the Ptolemies of Egypt, and the Romans exercised lordship in turn. Herod the Great, as was his wont, embellished the town. Jesus visited its neighbourhood and St. Paul on his way to Rome was permitted to land to visit his friends and refresh himself. Sidon's bishop attended the Council of Nicea. To maintain its independence it leagued itself with the Crusaders (1107), and four years later Baldwin dealt faithfully with the city for bad faith. Saladin took and dismantled it after Hattin. The Franks were back again within it in 1197, only to see it relapse quickly into Muslim hands and be turned to ruins. The Franks rebuilt (1228), the Saracens redevastated (1249). King Louis restored it (1253); the Mongols ravaged it (1260). Once more assisted to rise by the Templars it was abandoned after the fall of Acre (1291). It blossomed into vigorous existence, in the 17th century under Fakhr ed-Dīn, the Druse emir, who encouraged and protected its commerce. Jezzār Pasha drove the French forth from its gates (1791). In 1840 it was bombarded by the allied fleets (Britain, Austria, Turkey), and British troops occupied it Oct. 6, 1918.

Archaeology.—A large necropolis was discovered south-east of the town in 1855, and yielded in the tomb chambers numerous sarcophagi and wall-paintings. The most important were the sarcophagi of two Sidonian kings, Eshmunazar (now in the Louvre), and Tabnith (in Constantinople). Both have valuable Phoenician inscriptions. A further discovery of 17 magnificent sarcophagi was made in 1887, including the famous "Alexander" sarcophagus. (*See* GREEK ART.) They are now in the museum at Constantinople. Recently a fresh archaeological survey and excavations

have been made in the Sidon area under French auspices.

See T. Macridy Bey, *Le Temple d' Echmoun à Sidon* (1904); G. Contenau, *Mission Archéologique à Sidon* (1914); C. C. Torrey, "A Phoenician Necropolis at Sidon": *Annual Amer. Sch. Or. Research Jerusalem* (1919-20); G. Contenau, *La Civilisation Phénicienne* (1926) 21 *seq.* (E. Ro.)

SIEBENGEBIRGE ("The Seven Hills"), a group of hills on the Rhine, 6 m. above Bonn. They are of volcanic origin. The district is a favourite tourist resort. The hills are as follows: Drachenfels (1,067 ft.) surmounted by the ruins of an old castle; immediately behind it, Wolkenburg (1,076 ft.); and to the north Petersberg (1,096 ft.), with a pilgrimage chapel; then, to the south, a chain of four—viz., Ölberg (1,522 ft.), the highest of the range; Löwenburg (1,506 ft.); Lohrberg (1,444 ft.), and, farthest away, Nonnenstromberg (1,107 ft.). At the foot of the Drachenfels, (north side) lies the little town of Königswinter, whence a mountain railway ascends to the summit, and a similar railway runs up the Petersberg. Ruins crown almost every hill.

SIEDLCE, a town of Poland in the province of Lublin, 56 m. E.S.E. of the city of Warsaw, on the Brest–Litewski railway. It is a Roman Catholic episcopal see. The Oginskis, to whom it belonged, have embellished it with a palace and gardens. Pop. (1921), 30,800, two-thirds Jews.

SIEGBURG, a town in the Prussian Rhine Province, on the river Sieg, 16 m. by rail S.E. of Cologne by the railway to Giessen. Pop. (1925) 18,614. The town, which was founded in the 11th century, attained the height of its prosperity in the 15th and 16th centuries owing to its pottery wares. Siegburg pitchers (*Siegburger Krüge*) were widely famed.

SIEGE, the "sitting down" of an army or military force before a fortified place for the purpose of taking it, either by direct military operations or by starving it into submission (*see* FORTIFICATION AND SIEGECRAFT).

SIEGEN, a town in the Prussian province of Westphalia, situated 63 m. E. of Cologne by rail, on the Sieg, a tributary entering the Rhine opposite Bonn. Pop. (1925) 30,951. Siegen was the capital of an early principality belonging to the house of Nassau. In 1815 the congress of Vienna assigned it to Prussia. The town contains two palaces of the former princes of Nassau-Siegen. The surrounding district, to which it gives its name, abounds in iron-mines, and iron founding and smelting are the most important branches of industry in and near the town. Rubens is said to have been born here in 1577.

SIEMENS, ALEXANDER (1847–1928), British electrical engineer, was born in Hanover on Jan. 22, 1847, and was educated at Berlin and Hanover. In 1867 he was employed by Siemens Brothers, Woolwich, for whom he helped to build the Indo-European telegraph line in Persia (1868), and to lay the Black sea cable in 1869. He served in the Prussian army during the Franco-Prussian War, afterwards returning to England to work for Sir William Siemens, in England, Canada and the United States. In 1878 he became a naturalized British subject, and in 1879 was appointed departmental manager in Siemens Brothers. He was associated with Sir William Siemens in the development of the regenerative furnace, and he developed a system of lighting public halls with arc lamps. His methods were put into practice in the reading room of the British Museum and in the Albert hall. Siemens was also responsible for the installation of electric light at Godalming, the first English town to be so lighted. He served as president of the Institution of Electrical Engineers and the Institution of Civil Engineers. He died Feb. 19, 1928.

SIEMENS, ERNST WERNER VON (1816–1892), German electrician, was born on Dec. 13, 1816, at Lenthe in Hanover. After attending the gymnasium at Lübeck, he entered the Prussian army as a volunteer, and for three years was a pupil in the military academy at Berlin. Between 1838 and 1848 he served in the artillery, and was entrusted with many specialized works such as the fortification of Eckernförde harbour and the laying of the first telegraph line in Germany, that between Berlin and Frankfort-on-Main. Thenceforward he devoted his energies to furthering the interests of the newly founded firm of Siemens and Halske, which under his guidance became one of the most important electrical undertakings in the world, with branches in different countries that gave it an international influence.

As his entrance into commercial life was almost synchronous with the introduction of electric telegraphy into Germany, many of his inventions and discoveries relate to telegraphic apparatus. In 1847 he suggested the use of gutta-percha as a material for insulating metallic conductors. Then he investigated the electrostatic charges of telegraph conductors and their laws, and established methods for testing underground and submarine cables and for locating faults in their insulation (*see* TELEGRAPH: *Submarine Telegraphy*); further, he carried out observations and experiments on electrostatic induction and the retardation it produced in the speed of the current. He also devised apparatus for duplex and diplex telegraphy, and automatic recorders. He suggested that the unit of electrical resistance should be taken as the resistance of a column of pure mercury one metre high and one square millimetre in cross-section, at a temperature of 0° C. Another task to which he devoted much time was the construction of a selenium photometer. He also claimed to have been, in 1866, the discoverer of the principle of self-excitation in dynamo-electric machines. Siemens wrote several papers on meterological subjects, discussing among other things the causation of the winds and the forces which produce, maintain and retard the motions of the air. In 1886 he devoted half a million marks to the foundation of the Physikalisch-Technische Reichsanstalt at Charlottenburg, and in 1888 he was ennobled. He died at Berlin on Dec. 6, 1892. His scientific memoirs and addresses were collected and published in an English translation in 1892, and three years later a second volume appeared, containing his technical papers.

SIEMENS, SIR WILLIAM [KARL WILHELM] (1823–1883), British inventor, engineer and natural philosopher, was born at Lenthe in Hanover on April 4, 1823. After being educated in the polytechnic school of Magdeburg and the University of Göttingen, he visited England at the age of nineteen in the hope of introducing a process in electroplating invented by himself and his brother Werner. The invention was adopted by Messrs. Elkington, and Siemens returned to Germany to enter, as a pupil, the engineering works of Count Stolberg at Magdeburg. In 1844 he was again in England with another invention, the "chronometric" or differential governor for steam engines. Finding that British patent laws afforded the inventor a protection which was then wanting in Germany, he thenceforth made England his home; in 1859 he became a naturalized British subject. After some years spent in active invention and experiment at mechanical works near Birmingham, he went into practice as an engineer in 1851. He worked mainly in two distinct fields, the applications of heat and the applications of electricity. Siemens became F.R.S. in 1862; he was president of many professional societies and the recipient of academic honours. He died in London on Nov. 19, 1883.

In the application of heat Siemens's work began just after J. P. Joule's experiments had placed the doctrine of the conservation of energy on a sure basis. Siemens, in the light of the new ideas, sought to improve the efficiency of the steam engine as a converter of heat into mechanical work. He applied the regenerator to the steam engine and later he attempted to apply it to internal combustion or gas engines. In 1856 he introduced the regenerative furnace, the idea of his brother Friedrich (1826–1904), which avoids the loss of heat by the hot gases which pass up the chimney. But another invention was required before the regenerative furnace could be thoroughly successful. This was the use of gaseous fuel, produced by the crude distillation and incomplete combustion of coal in a distinct furnace or gas-producer. The complete invention was applied at Chance's glass-works in Birmingham in 1861, and furnished the subject of Faraday's farewell lecture to the Royal Institution. It was soon applied to many industrial processes, but it found its greatest development a few years later at the hands of Siemens himself in the manufacture of steel. To produce steel directly from the ore, or by melting together wrought-iron scrap with cast-iron upon the open hearth, had been in his mind from the first, but it was not till 1867, after two years of experiment in "sample steel works" erected by himself for the purpose, that he

achieved success. The product is a mild steel of exceptionally trustworthy quality, the use of which for boiler-plates has done much to make possible the high steam-pressures that are now common, and has consequently contributed, indirectly, to the improvement in the thermodynamic efficiency of heat engines. Just before his death Siemens was at work on a plan to use gaseous fuel from a Siemens producer in place of solid fuel beneath the boiler, and to apply the regenerative principle to boiler furnaces. He believed that gaseous fuel would in time supersede solid coal for domestic and industrial purposes; and among his last inventions was a house grate to burn gas along with coke, which he regarded as a possible cure for city smoke.

In electricity Siemens's name is closely associated with the growth of land and submarine telegraphs, the invention and development of the dynamo, and the application of electricity to lighting and to locomotion. In 1860, with his brother Werner, he invented the earliest form of what is now known as the Siemens armature; and in 1867 he communicated a paper to the Royal Society "On the Conversion of Dynamical into Electrical Force without the aid of Permanent Magnetism," in which he announced the invention by Werner Siemens of the dynamo-electric machine, an invention which was also reached independently and almost simultaneously by Sir Charles Wheatstone and by S. A. Varley. The Siemens-Alteneck or multiple-coil armature followed in 1873. While engaged in constructing a trans-Atlantic cable for the Direct United States Telegraph Company, Siemens designed the very original and successful ship "Faraday," by which that and other cables were laid. One of the last of his works was the Portrush and Bushmills electric tramway, in the north of Ireland, opened in 1883, where the water-power of the river Bush drives a Siemens dynamo, from which the electric energy is conducted to another dynamo serving as a motor on the car. In the Siemens electric furnace the intensely hot atmosphere of the electric arc between carbon points is employed to melt refractory metals. Another of the uses to which he turned electricity was to employ light from arc lamps as a substitute for sunlight in hastening the growth and fructification of plants. Among his miscellaneous inventions were the differential governor, and a highly scientific modification of it, described to the Royal Society in 1866; a water-meter which acts on the principle of counting the number of turns made by a small reaction turbine through which the supply of water flows; an electric thermometer and pyrometer, in which temperature is determined by its effect on the electrical conductivity of metals; an attraction meter for determining very slight variations in the intensity of a gravity; and the bathometer, by which he applied this idea to the problem of finding the depth of the sea without a sounding line.

Siemens's writings consist for the most part of lectures and papers scattered through the scientific journals and the publications of the Royal Society, the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Iron and Steel Institute, the British Association, etc.

See William Pole's *Life* of Siemens (1888). (J. A. E.)

SIEMENS. The founder of the Siemens Concern was Werner Siemens, who as a young artillery officer in 1847 started a repair shop for telegraphy apparatus in a few humble rooms in the back-yard of a Berlin apartment house. Scarcely one year after beginning Siemens received an order from the German Government to instal a complete telegraph line running from Berlin to Frankfurt a/M. In spite of the increase of his undertaking, Werner Siemens found time to pursue scientific studies and he succeeded in making one of the most practical inventions, the modern dynamo-machine, which converts mechanical into electric energy.

The year 1866, when this machine was invented, is the beginning of our modern science of electro-technics. In 1879 at a Berlin trade exhibition Messrs. Siemens and Halske demonstrated the first electrical railway and the name of Siemens very soon became known even beyond the frontiers of Germany as that of an electrical undertaking comprising all branches of electro-technics, telephony, electric power and light.

The branches of telephony and electro-chemistry were separated from the rest in 1903 and were conducted as separate departments under the style of Siemens and Halske, whereas the departments dealing with heavy current problems and the Nürnberg firm of Schuckert and Co. formed the foundation of the Siemens Schuckertwerke.

The Siemens Bauunion was created to deal with the civil engineering branch of the works, connected with underground railways, power plants, hydro-electric works, etc.

The Siemens Concern employs to-day more than 110,000 workmen, including engineers and commercial staff, who work partly in the various factories forming a district of Greater Berlin called Siemensstadt and partly in the factories, which belonged previously to the Schuckert Co. in Nürnberg, and which have since been largely extended.

Recently the turbine works at Mühlheim on the Ruhr were acquired; there steam turbines are manufactured. There are further, under the control of the Siemens Concern, a number of other works, engaged in the supply of accessories and sundry parts for the principal factories. (L. F. Sz.)

SIEMENS' STEEL: *see* Iron and Steel.

SIENA, a city and archiepiscopal see of Tuscany, Italy, capital of the province of Siena, 59 m. by rail S. of Florence and 31 m. direct. Pop. (1921), 32,768 (town); 43,879 (commune). The area of the city within the walls is about 2½ sq.m., and the height above sea-level, 1,115 feet. The plan, spreading from the centre over three hills, closely resembles that of Perugia. The city possesses a university, founded in 1203 and limited to the faculties of law and medicine (447 students in 1925–26).

The horse races of Siena known as the "Palio delle Contrade" have a European celebrity. They are held in the public square, the curious and historic Piazza del Campo (now Piazza di Vittorio Emanuele) in shape resembling an ancient theatre, on the 2nd of July and the 16th of August of each year; they date in their present form from the 17th century and were instituted in commemoration of victories and in honour of the Virgin Mary (the old title of Siena having been "Sena vetus civitas Virginis"). Siena is divided into 17 *contrade* (wards), each with a distinct appellation and chapel and flag of its own; and every year 10 of these *contrade*, chosen by lot, send each one horse to compete for the prize *palio* or banner. The aspect of Siena during these meetings is very characteristic, and the whole festivity bears a mediaeval stamp in harmony with the architecture and history of the town.

Among the noblest fruits of Sienese art are the public buildings adorning the city. The cathedral, one of the finest examples of Italian Gothic architecture, obviously influenced in plan by the abbey of S. Galgano (*infra*), built in black and white marble, was begun at the end of the 12th century, but interrupted by the plague of 1248 and wars at home and abroad, and by 1325 a great part of it and the baptistery of San Giovanni were completed; a further enlargement (which would have made what had been already built into merely a transept of a larger church) was begun in 1339 but never carried out and a few ruined walls and arches alone remain to show the magnificence of the uncompleted design, which would have produced one of the largest churches in the world. In 1355 the construction of the older church was resumed.

The splendid west front, of tricuspidal form, enriched with a multitude of columns, statues and inlaid marbles, dates from 1377 *seq.*: it closely resembles that of Orvieto, which is earlier in date (begun in 1310). Both façades have been recently restored, and the effect of them not altogether improved by modern mosaics. The fine Romanesque campanile belongs to the first half of the 14th century. Conspicuous among the art treasures of the interior is the well-known octagonal pulpit by Nicolò Pisano, dating from 1265–68. It rests on columns supported by lions and is finely sculptured. Numerous statues and bas-reliefs by Renaissance artists adorn the various altars and chapels. The cathedral pavement is inlaid with designs in colour and black and white, representing biblical and legendary subjects; the finest portions beneath the domes, with scenes from the history of Abraham, Moses and Elijah, are by Domenico Beccafumi and are executed with marvellous boldness and effect. The choir stalls also deserve mention: the older ones (from S. Benedetto, a church long ago destroyed)

are in *tarsia* work; the others, dating from the 16th century, are carved from Riccio's designs. The Piccolomini library, adjoining the *duomo,* was founded by Cardinal Francesco Piccolomini (afterwards Pius III.) in honour of his uncle, Pius II. Here are Pinturicchio's famous frescoes of scenes from the life of the latter pontiff, and the collection of choir books (supported on sculptured desks) with splendid illuminations by Sienese and other artists. The church of San Giovanni, the ancient baptistery, beneath the cathedral is approached by an outer flight of marble steps built in 1451. It has a beautiful but incomplete façade designed by Giovanni di Mino del Pellicciaio in 1382, and a marvellous font with bas-reliefs by Donatello, Ghiberti, Jacopo della Quercia and other 15th-century sculptors. The Opera del Duomo contains Duccio's famous Madonna (or Maestà) painted for the cathedral in 1308–11, and other works of art.

Among the other churches are S. Maria di Provenzano, a vast building of some elegance, designed by Schifardini (1594); Sant' Agostino, rebuilt by Vanvitelli in 1755, containing a Crucifixion and Saintes by Perugino, a Massacre of the Innocents by Matteo di Giovanni and the Coming of the Magi by Sodoma; the beautiful church of the Servites (15th century), which contains another Massacre of the Innocents by Matteo di Giovanni and other good examples of the Sienese school; San Francesco, recently restored, containing fine paintings by the two Lorenzetti and others, close to which is the 15th century oratory of S. Bernardino, with fine frescoes by Sodoma, Pacchia and Beccafumi (1518–32) and a good ceiling (1496); San Domenico, a fine 13th-century brick building with a single nave and transept, containing Sodoma's splendid fresco, the Swoon of St. Catherine, and a contemporary portrait of the saint in a fresco by Andrea di Vanni. This church crowns the Fontebranda hill above the famous fountain of that name immortalized by Dante, and in a steep lane below stands the house of St. Catherine, now converted into a church and oratory, and maintained at the expense of the inhabitants of the Contrada dell' Oca. It contains some good works of art, but is chiefly visited for its historic interest. The Accademia di Belle Arti contains a good collection of pictures of the Sienese school, illustrating its development.

The Palazzo Pubblico in the Piazza del Campo (1288–1309) built of brick, is a fine specimen of pointed Gothic, and was designed by Agostino and Agnolo. The light and elegant tower (Torre del Mangia) soaring from one side of the palace (1338–48) is 334 ft. high, and the chapel standing at its foot as a public thank-offering after the plague of 1348 was begun in 1352 and completed in 1376. The interior is lined with works of art. The two ground-floor halls contain a Coronation of the Virgin by Sano di Pietro and a splendid Resurrection by Sodoma. In the Sala dei Nove or della Pace above are the noble allegorical frescoes of Ambrogio Lorenzetti, representing the effects of just and unjust government; the Sala del Mappamondo is painted by Simone Martini and others, the Cappella della Signoria by Taddeo di Bartolo, and the Sala di Consistoro by Beccafumi. Another hall, the Sala di Balia, has frescoes by Spinello Aretino (1408) with scenes from the life of Pope Alexander III., while yet another has been painted by local artists with episodes in recent Italian history. The former hall of the grand council, built in 1327, was converted into the chief theatre of Siena by Riccio in 1560, and, after being twice burnt, was rebuilt in 1753 from Bibbiena's designs. Another Sienese theatre, that of the Rozzi, in Piazza San Pellegrino, designed by A. Doveri and erected in 1816, although modern, has an historic interest as the work of an academy dating from the 16th century, called the Congrega de' Rozzi, that played an important part in the history of the Italian comic stage.

The city is adorned by many other noble edifices both public and private, among which the following palaces may be mentioned: Tolomei (1205); Buonsignori, an elegant mediaeval brick construction; the Palazzo del Capitano di Giustizia; Sansedoni; Marsili; Piccolomini, now belonging to the Government and containing State archives; Saracini; Piccolomini delle Papesse, like the other Piccolomini mansion, designed by Bernardo Rossellino, and now the Banca d'Italia; the enormous block of the Monte de' Paschi, a bank of considerable wealth and antiquity, enlarged and partly rebuilt in the original style between 1877 and 1881; the old Dogana and Salimbeni palaces; the Palazzo Spannochi, a fine early Renaissance building by Giuliano da Maiano; the Loggia di Mercanzia (1417–28) imitating the Loggia dei Lanzi at Florence, with sculptures of the 15th century; the Loggia del Papa, erected by Pius II.; and other fine buildings. We may also mention the two celebrated fountains, Fonte Gaia and Fontebranda; the former in the Piazza del Campo, by Jacopo della Quercia (1409–19), but freely restored in 1868, the much-damaged original reliefs being now in the Opera del Duomo; the Fonte Nuova, near Porta Ovile, by Camaino di Crescentino, also deserves notice (1298). Thanks to all these architectural treasures, the narrow Sienese streets with their many windings and steep ascents are full of picturesque charm, and, together with the collections of excellent paintings, foster the local pride of the inhabitants and preserve their taste and feeling for art. The mediaeval walls and gates are still in the main preserved. The ruined Cistercian abbey of S. Galgano, founded in 1201, with its fine church (1240–68) is interesting and imposing. It lies some 20 m. south-west of Siena.

A kind of marzipan, known as *panforte,* is a speciality of Siena, and ironwork and wood carving are still carried on.

Literary History.—The literary history of Siena begins (13th century) with Folcacchiero the humorist, Cecco Angiolieri, and Bindo Bonichi. Next comes St. Catherine (Benincasa) of Siena (1347–80: *q.v.*) and St. Bernardino (Albizzeschi) of Siena (1380–1444), a popular preacher. Pope Pius II. (*q.v.*) may also be mentioned, as well as several members of the Sozzini family, one of whom, Lelio (1525–62), founded the sect of the Socinians; Bernardino Ochino (1487–1564), a supporter of Protestantism, the satirist Girolamo Gigli (1660–1722) and the economist Sallustio Bandini (1677–1760).

Art.—Lanzi happily designates Sienese painting as "Lieta scuola fra lieto popolo" ("the blithe school of blithe people"). The special characteristics of its masters are freshness of colour, vivacity of expression and distinct originality. The Sienese school of painting owes its origin to the influence of Byzantine art; but it improved that art, impressed it with a special stamp and was for long independent of all other influences. Consequently Sienese art seemed almost stationary among the general progress and development of the other Italian schools, and preserved its mediaeval character down to the end of the 15th century, when the influence of the Umbrian and—to a slighter degree—of the Florentine schools began to penetrate into Siena, followed a little later by that of the Lombard. The first master of real significance was Duccio di Buoninsegna (*c.* 1260–1318); then followed Simone Martini (or Memmi), Lippo Memmi, Pietro and Ambrogio Lorenzetti, and Taddeo di Bartolo, to name only the principal painters. In the 15th century we have Domenico di Bartolo, Sano di Pietro, Giovanni di Paolo, Stefano di Giovanni (Il Sassetta) and Matteo di Giovanni di Bartolo, who fell, however, behind their contemporaries elsewhere, and made indeed but little progress. The 16th century boasts the names of Bernardino Fungai, Guidoccio Cossarelli, Giacomo Pacchiarotto, Girolamo del Pacchia and especially Baldassare Peruzzi (1481–1537), who while especially celebrated for his frescoes and studies in perspective and chiaroscuro was also an architect of considerable attainments (*see* ROME); Giovanni Antonio Bazzi, otherwise known as Il Sodoma (1477–1549), who, born at Vercelli in Piedmont, and trained at Milan in the school of Leonardo da Vinci, came to Siena in 1504 and there produced some of his finest works, while his influence on the art of the place was considerable; Domenico Beccafumi, otherwise known as Micharino (1486–1551), noted for the Michelangelesque daring of his designs; and Francesco Vanni.

There may also be mentioned many sculptors and architects, such as Lorenzo Maitani, architect of Orvieto cathedral (1275–1330), Camaino di Crescentino and his son Tino di Camaino, sculptor of the monument to Henry VII. in the Campo Santo of Pisa; Lando di Pietro, entrusted by the Sienese commune with the proposed enlargement of the cathedral (1339), and perhaps author of the famous Gothic reliquary containing the head of S. Galgano in the Chiesa del Santuccio, which, however, is more usually attributed to Ugolino di Vieri, author of the tabernacle in the cathe-

dral at Orvieto, or Jacopo della Quercia (1371–1438), the creator of the Fonte Gaia, in the Piazza del Campo; Lorenzo di Pietro (Il Vecchietta), a pupil of Della Quercia; Antonio Federighi (d. 1490); Neroccio di Bartolommeo (1447–1500); Francesco d'Antonio, a skilful goldsmith of the 16th century; Francesco di Giorgio Martini (1439–1502), painter, sculptor, military engineer and writer on art; Giacomo Cozzarelli (1453–1515); and Lorenzo Mariano, surnamed Il Marrina (1476–1534). Wood carving also flourished here in the 15th and 16th centuries, and so also did the ceramic art. According to the well-known law, however, the Renaissance, made for the people of the plains, never fully took root in Siena, as in other parts of Tuscany, and the loss of its independence and power in 1555 led to a suspension of building activity, so that the baroque of the 17th and the classicism of the 18th centuries have had hardly any effect here; and few towns of Italy are so unspoilt by restoration or the addition of incongruous modern buildings, or preserve so many characteristics and so much of the real spirit (manifested to-day in the grave and pleasing courtesy of the inhabitants) of the middle ages, which its narrow and picturesque streets seem to retain. Siena is, indeed, unsurpassed for its examples of 13th and 14th century Italian Gothic, whether in stone or in brick.

See W. Heywood, *Our Lady of August and the Palio* (Siena, 1899) and other works; R. H. Hobart Cust, *The Pavement Masters of Siena* (London, 1901); Langton Douglas, *History of Siena* (London, 1902); E. G. Gardner, *The Story of Siena* (London, 1902); *St. Catherine of Siena* (London, 1908); W. Heywood and L. Olcott, *Guide to Siena* (Siena, 1603); A. Jahn Rusconi, *Siena* (Bergamo, 1904); C. Chledowski, *Siena* (1923); M. Kirchstein, *Siena* (1923). (C. PA.; T. A.)

HISTORY

Siena was an ancient city of the Etruscans; in the time of Augustus it was a Roman colony, known as *Saena Julia.* There are, however, very few relics of antiquity found there. The present city is almost entirely mediaeval. It has been the seat of a bishopric since the 7th century and possibly earlier; and the development of Sienese history is closely connected with the growth of the Church and the power of the episcopate. Under the rule of the Lombards in the 8th century Siena was governed by *Gastaldi* and was not subject to the dukes of Tuscany; in the quarrel between the bishops of Siena and of Arezzo, the *Gastaldi* were supported by the people in their adherence to the cause of their bishops; and the counts who, in the time of Charlemagne, superseded the *Gastaldi,* were also faithful to the church in civic matters, until in the 11th century, after 1056, the bishops gradually made themselves independent, at any rate within the city, of the counts and the consuls who succeeded them. During the 12th century the consuls, who were patricians, had to make concessions to the plebeians; and in 1137 there was a government by 100 nobles and 50 plebeians. Just as the power of the counts yielded to the bishops', and the bishops' to the consuls', so the nobles had to give way, until in 1199 there was a government by a foreign *podestà;* so Siena became a feudatory of the Italian kingdom, and was a tenant *in capite* of the emperor. Her rule was admitted by the lords of the neighbouring country, who were in the same relation to her as was Siena to the emperor, who welcomed on his side, as against Florence, the growing power of the city and *contado.*

Florentine Wars.—Yet the great quarrel between Siena and Florence in the 13th century would have probably occurred if there had been neither pope nor emperor, neither Guelf nor Ghibelline. The conflict was primarily economic. Siena at the beginning of the 13th century was the bank and trade-capital of Italy; for the freedom of trade the Sienese bankers and traders desired to keep safe the master roads to Rome, to the sea, and to the North. It was for this purpose that she made feudatories of the neighbouring lords, in an effort to associate them with her enterprise. Florence, desiring also a commercial supremacy, was Siena's natural enemy. She supported those lords who were irked by their allegiance to the city, and resisted the efforts of the Sienese to establish themselves in such key positions as Montepulciano in the south, or Poggibonsi in the north. So the history of Siena in this century is a history of futile and ultimately hopeless wars—wars to secure the fidelity of her feudatories, a struggle which must involve her in conflict with Florence. In 1254 a treaty was concluded between the two cities; but three years later Florence found a pretext of war in the fact that Siena had given shelter to Ghibellines she had expelled. Siena appealed to Manfred for military assistance while Florence equipped a large citizen army. The first victory, though small, was Florence's, whose forces on May 18, 1260 conquered a small force outside Siena; but on Sept. 4 the Florentines were signally defeated, and the Guelf cause for the moment lost.

Had Manfred lived the course of history might have been different: but his death, and a defeat at Benevento (1266) badly damaged the Ghibellines. The cause of the Guelfs made more and more adherents throughout Italy. Lucca, Pistoia, Volterra joined the party and the succession of Charles of Anjou to the throne of Naples added greatly to its prestige. Siena was disheartened, too, by the death of Provenzano Salvani, who was killed in cold blood by his captor in the battle of Calle do Valdelsa (1269), and Siena's loyalty to the Ghibellines was also shaken by the growth in the city of a strong Guelf and popular party. There was war in the *contado* and unrest in the city, and in 1273 when Charles of Anjou visited Siena, there was nothing but sentiment left for the Ghibelline side; Siena had lost any chance of wresting the supremacy from Florence by espousing the cause of the Guelfs. For while Siena might have gained a position of power as leader of the Ghibellines she was hopelessly outclassed by other cities when she joined the increasing party of the Guelfs.

To her wars with Florence were added internal dissensions. The rule of the nobles had become so tyrannical that in 1277 it was decreed that no patrician could occupy the chief magistracy; power was to remain in the hands of the middle-classes and traders who were adherents of the Guelfs. The size of the magistracy—which had varied from 24 to 36 members—was reduced to 15 in 1280, and seven years later to nine. This government by nine merchants was successful for about 70 years, and under it Siena, while she may have lost in political importance, gained much in peace and prosperity. Florence was no longer alarmed at a possible rival, trade flourished, the university was reorganized with the help of scholars from Bologna, great buildings were constructed—indeed for this period Siena is as good an example as one could wish of a successful oligarchic plutocracy.

The 14th Century.—In the early years of the 14th century there were many minor riots and battles, and in 1355 when the Emperor Charles IV. passed through Siena he gave his blessing to an irregular government of 12 which had been set up by the reformers against the nine. Power was given to the proletarians —the lower classes called *ordini* and *monti;* but they depended for not a little of their authority on the backing of the nobles. It was really a rising of the patricians and the plebeians against the tradesmen. The whole city was faction-ridden, and there is nothing but a dreary passing back of power from one set to another. Charles IV. intervened in 1368 on behalf of a rebellion; and he with Malatesta di Rimini attacked the public palace and was completely defeated by the Sienese who rallied to the call of the 15. The emperor was captured, and used his imprisonment to borrow money from Biccherna, for which he granted Siena a *privilegium* and appointed the magistrates imperial vicars for ever in Siena and the district. After this the new government had the usual difficulties with the dissatisfied and the unenfranchised, and took refuge in the usual device of creating a special police, whose chief was called *esecutore,* which should repress the activities of the nobles. The continuance of internal disorders was naturally an incentive to those forces outside the city proper. The lords, who had once been feudatories to the growing power of the Ghibelline city, threw off its yoke and were helped in their disloyalty by mercenary companies from Brittany and Gascony.

The age-long quarrel between Siena and Arezzo gained a new impetus from the contentions between Carlo di Durazzo and Louis of Anjou for the crown of Naples. First Durazzo held Arezzo,

and then Louis; but when the Sienese hoped to win the city thus ravaged by two alien lords, Louis sold Arezzo to Florence (1384), whose might was too formidable and whose claim on Arezzo was too close for Siena to dispute. Disappointed of this addition to their suzerainty, the Sienese turned on the reformers who had managed and mismanaged their affairs. A successful revolution was concluded in 1385, and resulted in the expulsion of many families on whose industry and experience in trade the prosperity of Siena largely depended. Once more there was a change in the form of government. In 1387 there was a renewal of war between Florence and Siena, who called to aid her Gian Galeazzo, duke of Milan, who made himself master of Siena, and the city became the property of one tyrant until 1403.

The 15th Century.—The city now became involved in the schism which was threatening the very life of the Papacy. Siena, as well as Florence, declared itself against Gregory XII (1409); and Ladislaus of Naples, his supporter attacked Sienese territory. His death ended this war; and then came another conflict with Florence, which supported Venice and Eugenius IV., while Siena favoured Milan and the king of the Romans. In 1433 the warring parties made peace. There was another affray with Florence in 1454; and in a year or two later some of the citizens plotted to hand over Siena to Alphonso of Naples, whose death ended the conspiracy. In these years the magistracy was strengthened by the creation of an extraordinary body, the *balia,* which could act independently of the ordinary council. When Aeneas Sylvius Piccolomini was elected pope in 1455, the Sienese readmitted the nobles to a share in the government, a special concession which came to an end with the pope's death in 1464; although any members of the Piccolomini house were declared, *eo ipso,* to be *popolani* and privileged. In 1480, after the conclusion of the war of Milan and Florence against Naples and the pope, Alphonso, duke of Calabria, tried to obtain suzerainty of Siena. An alliance between the *noveschi* and some of the plebeians favoured his claims, and a revolt (June 1480) ended in a reorganization of the government. The old reformers as such were excluded, and the power vested in the hands of the *popolani* and a body called *aggregati,* consisting of nobles, and citizens of other orders who had not before been allowed to take office. The Neapolitan royal family, however, fell out of favour in 1487, when the king of Naples gave some of the Sienese territories to Florence. For nine months there were riots in the city which culminated on Feb. 20, 1483. The *popolani* took again the spoils of office. But in 1487 the *noveschi,* prosperous, influential tradesmen, returned, and overthrew the *popolani,* and placed the State of Siena under the patronage of Our Lady.

The 16th Century.—Her legate in government was a returned exile, Pandolfo Petrucci, who was till his death in 1512 master of Siena. He was a thoroughly sensible tyrant. Expelled by Cesare Borgia in 1502, he was restored through the intervention of the Florentine Government and the king of France in March 1503. A contemporary chronicler who was no friend of Pandolfo, says that he can be named *cum Joanne Bentivolio et Laurentio Medici.* He founded no dynasty of permanence, and in 1522 Siena became a free city under the protection of the Emperor Charles V.

On Aug. 5, 1552, the Spanish "protection" ended. To attain this end Siena had called in Cosimo of Florence as well as France, and once more she suffered from the possession of powerful friends. There were battles and desperate diplomacies; until in 1555 the Spaniards, having defeated the French, took possession of the town; Philip II. of Spain then gave Siena to Cosimo I. de'Medici, head of her old rival Florence. Her separate history as a city-state ceases, though she retained a separate administration for another 200 years. In 1859 she once more took a leading part in the politics of Italy, for Siena was the first Tuscan city to vote for the annexation of Piedmont and the monarchy of Victor Emmanuel II.

Siena to-day is a city of 32,800 inhabitants, an archiepiscopal see, capital of a province and seat of a university. It is celebrated for the celebration of Il Palio, a race in which each ward competes for a banner; it is held on July 2 and Aug. 10, and its horses race in the old Piazza del Campo.

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SIENETJO, a Shangalla tribe living in south-west Abyssinia near the Sudan frontier, perhaps a remnant of the primitive population. They are apparently Hamitic and have a yellowish skin. Their women never intermarry with the Negroes or Arabs. Sienetjo villages are usually built on hilltops. They are an industrious people, skilful jewellers, weavers and smiths.

SIENKIEWICZ (Syĕn-kyĕ'vĭch), **HENRYK** (1846–1916), Polish novelist, was born at Wola Okrzejska near Lukow, in Siedlce, Russian Poland. He studied philosophy at Warsaw university. His first work, a humorous novel entitled *A Prophet in his own Country,* appeared in 1872. In 1876 Sienkiewicz visited America, and contributed an account of his travels to the *Gazeta Polska.* His best-known romance, *Quo Vadis?,* a study of Roman society under Nero, has been translated into more than 30 languages. Originally published in 1895, *Quo Vadis?* was first translated into English in 1896, and dramatized and film versions of it have been produced in many countries. Of greater literary merit is the trilogy of novels describing 17th-century society in Poland during the wars with the Cossacks, Turks and Swedes. This trilogy comprises *Ogniem i mieczem* ("With Fire and Sword," 1890, 1892 and 1895), *Potop* ("The Deluge," Boston, Mass., 1891) and *Pan Woxodyjowski* ("Pan Michael," 1893). Among other very successful novels and collections of tales which have been translated into English are *Bez Dogmatu* ("Without Dogma," 1893; Toronto, 1899), *Janko muzykant: nowele* ("Yanko the Musician and other stories," Boston, Mass., 1893), *Krzyżacy* ("The Knights of the Cross," numerous British and American versions), *Hania,* ("Hania," 1897) and *Ta Trzecia* ("The Third Woman," 1898). Sienkiewicz lived much in Cracow and Warsaw, and for a time edited the Warsaw newspaper *Slowo;* he also travelled in England, France, Italy, Spain, Greece, Africa and the East, and published a description of his journeys in Africa. In 1905 he received the Nobel prize for literature. During the early years of the World War, he devoted his energies to the organization of relief for its Polish victims. He died in Switzerland in 1916 while engaged on that task. His body was transferred to Cracow in 1924.

For a bibliography of the English translations of Sienkiewicz's writings, *see* W. L. Phelps, *Essays on Modern Novelists* (1910). *See* also Monica M. Gardner, *The Patriot Novelist of Poland: Henryk Sienkiewicz* (1926).

SIERADZ, a small town of Poland, in the province of Lodz, situated on the Warta, 110 m. S.W. of the city of Warsaw. It is one of the oldest towns of Poland, founded prior to the introduction of Christianity, and was formerly known as Syra or Syraz. The annals mention it in 1139. Several *seims,* or diets, of Poland were held there during the 13th to 15th centuries, and it was a wealthy town until nearly destroyed by a fire in 1447. The old castle, which suffered much in the Swedish war of 1702–1711, was destroyed by the Germans in 1800. There are two churches, dating from the 12th and 14th centuries respectively.

SIERO, a town of northern Spain, in the province of Oviedo, on the river Nora, and on the Oviedo-Infiesto railway. Pop. (1920) 27,210.

SIERRA LEONE, a British colony and protectorate on the west coast of Africa. It is bounded west by the Atlantic, north and east by French Guinea and south by Liberia. Area about 27,250 sq.m.; pop. (1921) 1,541,311, of whom 1,161 were white and 599 Asiatics (mostly Syrian traders). The coast-line, following the indentations, is about 400 m. in length, extending from 9° 2′ N. to 6° 55′ N. It includes the peninsula of Sierra Leone—23 m. long with an average breadth of 14 m.—Sherbro and minor islands, also Turner's peninsula, a narrow strip of land southward of Sherbro island, extending in a south-east direction about 60 m. and in reality an island. Except in the Sierra Leone peninsula, Sherbro island and Turner's peninsula, the colony proper does not extend inland to a greater depth than half a mile. The protectorate, which adjoins the colony to the north and east, extends from 7° N. to 10° N. and from 10° 40′ W. to 13° W.

Physical Features.—Sierra Leone is a well-watered, hilly country. The seaward face of the Sierra Leone peninsula is traversed by thickly wooded ranges with conical peaks which in Pickett Hill attain a height of 2,912 feet. Elsewhere a low coast plain extends inland 30 to 50 m. The plateau, which forms the greater part of the protectorate, has an altitude varying from 890 to 3,000 ft. On the north-east border, by the Niger sources, are mountains exceeding 5,000 ft. The most fertile parts of the protectorate are Sherbro and Mendiland in the south-west. In the north-west the district between the Great Scarcies and the Rokell rivers is flat, and is named Bullom (low land). In the south-east bordering Liberia is a belt of densely forested hilly country extending 50 m. S. to N. and very sparsely inhabited.

The hydrography of the country is comparatively simple. Six large rivers rise in the Futa Jallon highlands in or beyond the northern frontier of the protectorate and in whole or in part traverse the country with a general south-west course; the Great and Little Scarcies in the north, the Rokell and Jong in the centre, and the Breat Bum and Sulima (or Moa) in the south. These rivers are navigable for short distances, but in general rapids or cataracts mark their middle courses. South of the estuary of the Scarcies the deep inlet known as the Sierra Leone river forms a perfectly safe and commodious harbour accessible to the largest vessels. At its entrance on the southern shore lies Freetown. In the south east the Morro river marks the frontier with Liberia.

Climate.—The climate of the coastal regions is hot and moist, and fever was formerly so prevalent as to earn for Sierra Leone the reputation of being "the white man's grave." On the coast the mean annual temperature is: maximum 88° F, minimum 72° F. The shade temperature rarely rises above 95° F. The rainfall, which varies a great deal, is from 150 to 180 or more inches per annum. The average rainfall at Freetown for the 21 years ended 1916 was 164·8 inches. In 1896 no fewer than 203 in. were recorded. In 1894, a "dry" year, only 144 in. of rain fell. In no other part of West Africa is the rainfall so heavy. December, January, February and March are practically rainless; the rains, beginning in April or May, reach their maximum in July, August and September, and rapidly diminish in October and November. During the dry season, when the climate is much like that of the West Indies, there occur tornadoes and long periods of the *harmattan*—a north-east wind, dry and desiccating, and carrying with it from the Sahara clouds of fine dust, which sailors call "smokes." In the interior the rainfall is less and the temperature lower than on the coast. Exact statistics are lacking.

Flora.—The characteristic tree of the coast districts is the oil-palm. Other palm trees found are the date, bamboo, palmyra, coco and dom. The coast-line, the creeks and the lower courses of the river are lined with mangroves. Large areas are covered with brushwood, among which are scattered baobab, shea-butter, bread-fruit, corkwood and silk-cotton trees. The forests contain valuable timber trees such as African oak or teak (*Oldfeldia Africana*), rosewood, ebony, tamarind, camwood, odum—whose wood resists the attacks of termites—and the tolmgah or brimstone tree. The frankincense tree (*Daniellia thurifera*) reaches from 50 to 150 ft., the negro pepper (*Xylopia Aethiopica*) grows to about 60 ft., the fruit being used by the natives as pepper. There are also found the black pepper plant (*Piper Clusii*), a climbing plant abundant in the mountain districts; the grains of paradise or melegueta pepper plant (*Amomum Melegueta*), and other *Amomums* whose fruits are prized. Both *Landolphia florida* and *Landolphia owariensis* are found. Of several fibre-yielding plants the so-called aloes of the orders Amaryllidaceae and Liliaceae are common. The kola (*Cola acuminata*) and the bitter kola (*Garcinia cola*), the last having a fruit about the size of an apple, with a flavour like that of green coffee, are common. Of dye-yielding shrubs and plants camwood and indigo may be mentioned; of those whence gum is obtained the copal, acacia and African tragacanth (*Sterculia tragacantha*). Besides the oil-palm, oil is obtained from many trees and shrubs, such as the benni oil plant. Of fruit trees there are among others the blood-plum (*Haematostaphis Barteri*) with deep crimson fruit in grape-like clusters, and the Sierra Leone peach (*Sarcocephalus esculentus*). The coffee and cotton plants are indigenous; of grasses there are various kinds of millet, including *Paspalum exile*, the so-called hungry rice or Sierra Leone millet. Ferns are abundant in the marshes.

Fauna.—The wild animals include the elephant, leopard, panther, chimpanzee, grey monkey, antelope of various kinds, buffalo, wild hog, bush goat, bush pig, sloth, civet and squirrel. The hippopotamus, manatee, crocodile and beaver are found in the rivers, and both land and fresh-water tortoises are common. Serpents, especially the boa-constrictor, are numerous. Chameleons, lizards and iguanas abound, as do frogs and toads. Wild birds are not very common; among them are the hawk, parrot, owl, woodpecker, kingfisher, green pigeon, African magpie, the honey-sucker and canary. There are also wild duck, geese and other water fowl, hawk's bill, loggerheads and partridges. Mosquitoes, termites, bees, ants, centipedes, millipedes, locusts, grasshoppers, butterflies, dragonflies, sandflies and spiders are found in immense numbers. Turtle are common on the southern coastline, sand and mangrove oysters are plentiful. Fish abound; among the common kinds are the bunga (a sort of herring), skate, grey mullet and tarpon. Sharks infest the estuaries.

Inhabitants and Towns.—Sierra Leone is inhabited by various negro tribes, the chief being the Mendi, Timni, Limba, Bullom, Koranko and Suba. From the Mendi district many curious steatite figures which have been buried have been recovered and are exhibited in the British Museum. They show considerable skill in carving. Of "Hamitic" races the Fula inhabit the region of the Scarcies. Freetown is peopled by descendants of many negro tribes, and a distinct type known as the Sierra Leoni and popularly called creoles has been evolved; their language is English and pidgin English. The Susu are Mohammedans, but most of the negroes are pagans, and each tribe has its secret societies and fetishes. These are employed often for beneficent purposes, such as the regulation of agriculture and the palm-oil industry. There are many Christian converts and Mohammedans.

Besides Freetown (*q.v.*), the capital, the most important towns for European trade are Bonthe, the port of Sherbro, and Port Lokko, at the head of the navigable waters of a stream emptying itself into the Sierra Leone estuary. Waterloo is a large "creole" town in the Sierra Leone peninsula, in a market-garden district. In the interior are various populous centres. One of the best known is Falaba near the north-east frontier of the protectorate. It lies about 1,600 ft. above the sea. Falaba (pop. about 6,000) was founded towards the end of the 18th century by the Sulima (Yalunka) who revolted from the Fula, and its warlike inhabitants, soon attained supremacy over the neighbouring villages and country. Like many of the native towns, it is surrounded by a loopholed wall, with flank defences for gates. Kambia on the Great Scarcies, a place of some importance, can be reached by boat from the sea. On the railway running southeast from Freetown are Songo Town, Rotifunk, Mano, Bo, Baiima and Pendembu; on the northern railway are Makump, Makena and Kamabai.

Communications.—A railway, State owned and the first built in British West Africa, runs south-east from Freetown through the fertile districts of Mendiland to the Liberian frontier. Begun in 1896, the line reached Bo (136 m.) in the oil-palm district in 1903. It was continued to Baiima (220 m.) in 1905 and ends at Pendembu, a total length of 227½ miles. The gauge throughout is 2 ft. 6 in. The line cost about £1,000,000. From Boia on this line another railway, completed in 1916, goes north to Kamabai. It is 104 m. long. In 1927 the railway accounts were separated from the colony's general accounts. In that year railway revenue was £251,000 and expenditure £269,000.

Cable communication with Europe was established in 1886. Freetown is well served by steamers plying regularly to and from Liverpool, Plymouth, Hamburg and other ports.

Administration, Revenue, etc.—The country is administered as a crown colony, the governor being assisted by an executive and a legislative council. Since 1924 the legislative council has contained three members elected in the colony on the basis of manhood suffrage and also direct (nominated) representatives of the protectorate. The law of the colony is the Common Law

of England modified by local ordinances. There is a denominational system of primary and higher education. The schools are inspected by Government and receive grants in aid. Furah Bay college is affiliated to Durham university. There is a Wesleyan Theological college; a Government school (established 1906) at Bo for the sons of chiefs; a Government agricultural training college for natives at Njola (established 1919); a Government model school at Freetown and the Thomas Agricultural academy at Mabang (founded in 1909 by a bequest of £60,000 from S. B. Thomas, a Sierra Leonian). Since 1901 the Government has provided separate schools for Mohammedans. Revenue is largely derived from customs. In the protectorate a house tax is imposed. Revenue which had been £168,000 in 1899 (when railway building had begun and the protectorate taken over) was £618,000 in 1913 and in 1924, when normal conditions after the World War had returned, was £868,000. Expenditure was £145,000 in 1899; £622,000 in 1913 and £777,000 in 1924. In 1927 revenue (railways excluded) was £719,000 (£534,000 from customs) and expenditure £754,000, the excess of expenditure being provided from previous surplus balance.

The protectorate is divided for administrative purposes into districts, each under a European commissioner. Native law is administered by native courts, subject to certain modifications. The tribal system of Government is maintained, and the authority of the chiefs has been strengthened by the British.

Economic Conditions.—With a population of 55 to the square mile Sierra Leone has a fairly good labour supply: the great majority of the natives prefer, however, to work for themselves rather than for an employer. The wealth and external trade of the country is mainly dependent on the oil-palm, the kola nut being next in value. The Sierra Leonians (as apart from the natives) are traders, not producers, and agriculture proper is still almost confined to the cultivation of food crops for home consumption—chiefly rice and cassava. At one time rubber exports were of some account; this trade virtually ceased about 1910 partly because the rubber tree and vines were overtapped, chiefly through the superiority of plantation rubber grown in the East. The trade in rubber and in other produce, was also affected by the diversion of produce from the interior of French Guinea, which used to be brought by caravan to Sierra Leone, to Konakri. Without transit trade Sierra Leone is dependent on its own resources. In the 20 years 1907–27 the export of palm nuts rose from 35,000 tons to 65,000 tons, of palm oil from 2,600 to 3,600 tons. They formed from 70 to 80% of the local exports. The oil-palm industry was conducted in the wasteful traditional fashion of the natives. The "wild" oil-palm is found by the million, but, despite this unlimited supply, anxiety was caused by the prospective competition of the cultivated oil-palm in the East, and also by the increasing production of copra, which yields an oil similar to that of the palm. The administration therefore, in 1926–27, laid out a model plantation of 2,000 ac. to demonstrate to the natives the advantages of scientific methods of culture. Besides palm nuts and palm oil and the kola nut trade the export of ginger was of next importance. The cultivation of cocoa, however, began to have promising results from 1925. The greatest need for the development of trade was better means of transport. The 330 m. of railway had not been added to since 1916, and in 1926 there were but 400 m. of motor roads; a vigorous road-making campaign began in 1925. Until 1926 it was supposed that the country was without mineral wealth. In that year platinum and haematite were discovered. Subsequently gold, chromite corundum and other minerals were found and by 1929 production had begun.

Cotton goods are the chief imports, next in value are food stuffs and tobacco. Formerly trade spirits (from the continent of Europe) were imported in large quantities, the duty upon them yielding a large share of the revenue, but in accord with international agreements steps were taken to suppress the trade and between 1912 and 1924 the value of spirits imported fell from 6·29 to 1·10 of the total imports. The trade of Sierra Leone grew steadily. It was about £650,000 in 1887 and, excluding specie, had reached £2,782,000 in 1913. In 1924 the figures were:—Commercial imports £1,451,000; commercial exports £1,671,000, of which £1,510,000 represented the value of the local produce. For 1927 the figures (including specie) were:—Imports £2,112,000 (£1,296,000 British); exports £1,757,000. Of these exports £603,000 went to Great Britain. Kola nuts to Senegal, the Gambia and Nigeria. Germany takes a large proportion of the palm nuts (37,000 tons in 1927).

HISTORY

Sierra Leone (in the original Portuguese form Sierra Leona) was known to its native inhabitants as Romarong, or the Mountain, and received the current designation from the Portuguese discoverer, Pedro de Sintra (1462), either on account of the "lion-like" thunder on its hill-tops or to a fancied resemblance of the mountains to the form of a lion. Here, as elsewhere along the coast, the Portuguese had "factories"; and though none existed when the British took possession, some of the natives called themselves Portuguese and claimed descent from colonists of that nation. English traders were established on Bance and the Banana islands as long as the slave trade was legal. The existing colony has not, however, grown out of their establishments, but owes its birth to the philanthropists who sought to alleviate the lot of those negroes who were victims of the traffic in human beings. In 1786 Dr. Henry Smeathman, who had lived for four years on the West Coast, proposed a scheme for founding on the Sierra Leone peninsula a colony for negroes discharged from the army and navy at the close of the American War of Independence, as well as for numbers of runaway slaves who had found an asylum in London. In 1787 the settlement was begun with 400 negroes and 60 Europeans, the whites being mostly women of abandoned character. In 1788 "king" Nembana, a Timni chief, sold a strip of territory for the use of the settlers, and thus the British acquired the best harbour on the whole of the west coast of Africa. The first settlement, not unnaturally, proved a complete failure. In 1791 Alexander Falconbridge (formerly a surgeon on board slave ships) collected the survivors and laid out a new settlement (Granville's Town); and the promoters of the enterprise received a charter of incorporation as the Sierra Leone Company. In 1792 John Clarkson, a lieutenant in the British navy brought the colony 1,100 negroes from Nova Scotia. In 1794 the settlement, which had been again transferred to its original site and named Freetown, was plundered by the French. The governor at the time was Zachary Macaulay, father of Thomas Babington, Lord Macaulay. In 1807, when the inhabitants of the colony numbered 1,871, the company, which had encountered many difficulties, transferred its rights to the Crown. The slave trade having in the same year been declared illegal by the British parliament, slaves captured by British vessels in the neighbouring seas were brought to Freetown, and thus the population of the colony grew. Its development was hampered by the frequent changes in the governorship. Sydney Smith's jest that Sierra Leone had always two governors, one just arrived in the colony and the other just arrived in England, is but a slight exaggeration. In 22 years (1792–1814) there were 17 changes in the governorship. After that date, changes, although not quite so rapid, were still frequent. Many of these changes were due to deaths, but the resources of science have removed the reproach of Sierra Leone being "the white man's grave."

It took a good many years to build up an industrious and self-supporting community out of the heterogeneous human material "dumped down" at Sierra Leone. The settlers, whose language was English and who, for the most part, professed Christianity (the Church Missionary Society began work among them in 1804), were regarded by the natives as aliens and collisions between the settlers and neighbouring tribes were frequent. The settlers, after a time, took to trade and professional careers and as Freetown was a much used port of call for shipping a measure of prosperity was reached.

Hinterland Acquired.—From time to time small additions by purchase were made to the area of the colony, at first partly to cope with the slave trade, which continued to be carried on illicitly. Then, about 1850, a period of discouragement set in

and in 1865 a House of Commons committee reported against any further acquisitions of territory. Nevertheless, if only in the interests of trade, complete indifference to the hinterland was impossible. But the French had penetrated into the interior in a way which threatened to reduce the British possessions to small enclaves. In the task of extending British influence and in endeavours to stop inter-tribal warfare, the British authorities enlisted the services of Dr. Edward W. Blyden (a pure-blooded negro), who in 1872 visited Falaba and in 1873 Timbo, both semi-Mohammedan countries. Falaba—which had been visited in 1869 by Winwood Reade on his journey to the Niger—came definitely under British protection, but Timbo, which is in Futa Jallon, was allowed to become French territory. The area for expansion on the north was in any case limited by the French Guinea settlements, and on the south the territory of Liberia hemmed in the colony. In the east and north-east British officers also found themselves regarded as trespassers by the French.

An accidental collision between British and French troops at Waima (Dec. 23, 1893) showed the necessity for settling the Franco-British frontier. An agreement was signed in 1895, Great Britain securing a compact area something less than the size of Scotland. Over this area a British protectorate was proclaimed (Aug. 26, 1896). Slave raiding and slave dealing were at once declared illegal, and the widespread resentment thus caused was aggravated by the imposition of a hut-tax. A little later, Bai Bureh, a Timni chief, rose in revolt. In April, 1898, there followed a general rising of the Mendi, who began by murdering missionaries (including four women) and a large number of officials and police, chiefly Sierra Leonians, who were as obnoxious to the natives as were the whites. The dreaded "Poro" fetish was used by the chiefs to compel recalcitrants to join them. The insurrection, which cost some thousands of lives, was suppressed with severity.

Slavery Abolished.—Relations between the people of the protectorate and the administration improved gradually. The opening up of the country by railways, the establishment of schools and the support given by Government to the paramount chiefs in the exercise of their legitimate powers, all tended to a better understanding. Progress was slow, however, and was checked by the continued tolerance of domestic slavery. Though from time to time efforts to end it were made, the subject was not very seriously dealt with until 1919, and it was not until 1926 that an ordinance was passed by the local legislature which was intended to remove the last vestige of legal recognition of slavery. Events showed that that ordinance did not effect its purpose, for the supreme court of Sierra Leone decided (July, 1927) that a slave owner had "the right to use reasonable force to re-take a runaway slave." Immediate action was taken to remedy the defect disclosed, and in the following September another ordinance was passed abolishing in express terms the legal status of slavery in the protectorate. This ordinance came into force on Jan. 1, 1928, some 200,000 persons being affected. No great social upheaval followed; the majority of the ex-slaves remained with their former owners and intermarried with their families, while others acquired land and set up on their own account. It was noteworthy that the paramount chiefs with seats on the legislative council—themselves the largest slave-owners—voted in favour of the abolition of slavery and made no demand for compensation. An elective element for the colony and direct representation of the protectorate, was introduced into the legislature for the first time in 1924.

See H. C. Luke, *A Bibliography of Sierra Leone*, 2nd ed. (1925); T. N. Goddard, *The Handbook of Sierra Leone* (1925); *Correspondence Relating to Domestic Slavery in the Sierra Leone Protectorate* (British White Paper Cmd. 3,020, 1928). (F. R. C.)

SIERRA MORENA, THE, is so called because of the long dark line of the southern scarp of the Meseta as seen from the Andalusian plain. It has a mean elevation of about 2,500 feet rising above this in the east toward the steppe region of Albacete. The easternmost and loftiest ridge is called the Sierra de Alcaraz (5,900 ft.), while some of those in the extreme west are classed together as the Sierras de Aracena. The great breadth of the Sierra Morena long rendered it a formidable barrier between Andalusia and the north; as such it has played an important part in the social, economic and military history of Spain. It separates the plateau region of Castile and Estremadura from the Andalusian plain and the highlands of the Sierra Nevada system, and forms the water-shed between two great rivers, the upper Guadiana on the north and the Guadalquivir on the south. Parts of the Sierra Morena are rich in minerals; the central region yields silver, mercury and lead, while the Sierras de Aracena contain the celebrated copper mines of Tharsis and Rio Tinto (*q.v.*).

SIERRA NEVADA, THE, is a range of high mountains south of the basin of Andalusia in southern Spain. It is a well-defined range, stretching from the upper valley of the river Genil or Jenil eastwards to the valley of the river Almería. It owes its name, meaning "the snowy range," to the fact that several of its peaks exceed 10,000 feet in height and are thus above the limit of perpetual snow. Its culminating point, the Cerro de Mulhacen (11,421 ft.) reaches an altitude unequalled in Spain, while one of the neighbouring peaks, called the Picacho de Veleta (11,148 ft.), is only surpassed by Aneto (11,168 ft.), the loftiest summit of the Pyrenees. The Sierra Nevada is composed chiefly of soft micaceous schists, sinking precipitously down on the north, but sloping more gradually to the south and south-east. On both sides deep transverse valleys (*barrancas*) follow one another in close succession, in many cases with round, basin-shaped heads like the cirques of the Pyrenees (*q.v.*). In many of these cirques lie alpine lakes, and in one of them, the Corral de Veleta, there is even a small glacier, the most southerly in Europe. The transverse valleys open on the south into the longitudinal valleys of the Alpujarras (*q.v.*). On the north, east and west there are various minor ranges, such as the Sierras of Parapanda, Harana, Gor, Baza, Lucena, Cazorla, Estancias, Filabres, etc., which are connected with the main range, and are sometimes collectively termed the Sierra Nevada system.

SIERRA NEVADA MOUNTAINS [Span. for "Snowy Peaks"], a geologically young mountain range in western United States which begins at Tehachapi pass in southern California, extends northward 430 m. as part of the boundary between California and Nevada, and ends in southern Oregon where it merges with the Klamath or Siskiyou mountain group. Their geologic history is a fascinating record of relatively recent earth movement. Where they now rise the waters of Paleozoic and early Mesozoic seas laid down sediments, which were intruded by granitic magmas and compressed by heavy folding into lofty summits in mid-Mesozoic time. During the early Cretaceous these newborn mountains were peneplaned, to be uplifted and planed down repeatedly throughout Cretaceous and Tertiary time. Beginning probably in Cretaceous time profound faulting proceeded with down throw toward the east, and a gigantic block of the earth's surface, probably the largest single such block on the face of the earth, began tilting toward the Pacific, forever shutting out its waters from the great interior basin. By the close of Tertiary time a steaming expanse of volcanic mud had buried the whole of the northern Sierra, a chaotic contrast to the peaceful rolling hills of the Miocene time, clothed by verdant tropical vegetation. As the great block tilted more and more, the streams cut deeper and more sharply into the tuff-covered surface and during the late Tertiary and early Quaternary shaped the steep-walled canyons and rugged summits that characterize the Sierra Nevadas, then clothed by a luxuriant vegetation temperate instead of tropic in type. With the beginning of the Pleistocene ice age the summits became mantled in deep snow and glacial ice. The peaks and higher slopes were denuded of their forests, and reduced, upon the disappearance of the ice, to a desolate expanse of dazzling white granite and glaring schists.

For at least the last thousand years, the Sierra Nevada has stood as it is to-day, a wonderland of high rugged mountains, deep mysterious canyons, and glacier-scoured ridges, covered in their lower reaches with oak groves or chaparral thickets, their middle slopes set with sombre giant pines and sequoias, and their summits marked by storm-scarred dwarf pines. The longer, gentler

slope is toward the west, averaging about 200 ft. to the mile; the eastern slope is very steep, at its highest point above the valley opposite Owens lake dropping 10,000 ft. in a distance of 10 miles. Few passes cross the range, Kearsarge and Truckee being the most celebrated. The highest part of the range lies between 36° 30′ and 37° 30′ N. lat. and here the peaks range from 13,000 ft. to 14,502 ft., the latter being the altitude of Mt. Whitney, the highest peak of the range; and all the passes are about 12,000 ft. high. Eleven peaks in the range are above 14,000 feet. From Mt. Whitney the elevation of the range gradually diminishes northward. The precipitation on the foot-hills and lower slopes is relatively light but with altitude it increases rapidly, most of it falling as heavy snow, particularly on the summits, which thus become storehouses of moisture for irrigation and potable waters to supply power, agricultural and domestic needs of the population of the California valleys and coast.

Three main forest belts cover the flanks of the Sierra; the lower or main pine belt with sugar pine, yellow pine, Douglas spruce and incense cedar the dominant species; the silver fir belt with the white silver fir (*Abies concola*), and the red fir (*A. magnifica*) dominant species; and the upper pine belt of tamarack, mountain pine, juniper, hemlock spruce, white pine, nut pine and needle pine dominant with altitude in the order named; and finally at the summits the tangled dwarf pines showing not more than a foot of height or an inch of girth for a century's growth. The big trees (*Sequoia gigantea*) extend through the upper part of the lowest belt and the lower part of the middle belt. The foothills and alluvial fans at the foot of the southern Sierras are characterized by piñon or nut pine, digger pine, blue oak and interior live oak, and an underbrush distinguished by the pungent manzanita, and the rude chamiso.

The fauna of the Sierra is characterized by the ubiquitous Douglas red squirrel, the mountain goat and mountain sheep; white-tailed, black-tailed and occasionally mule deer; grizzly, black, cinnamon and brown bears, now all rare; by representative birds like the Sierra junco, blue-fronted jay, the famous Clarke nut-cracker and others; and by distinctive mountain trout, like the rainbow and the golden. (W. E. E.)

SIEYÈS (Sē-ā-yās), **EMMANUEL-JOSEPH** (1748–1836), French abbé and statesman, one of the chief theorists of the revolutionary and Napoleonic era, born at Fréjus, S. France, on May 3, 1748. He was educated for the church at the Sorbonne; but while there he eagerly imbibed the teachings of Locke, Condillac, and other political thinkers, in preference to theology. Nevertheless he entered the church, and owing to his learning and subtlety advanced until he became vicar-general and chancellor of the diocese of Chartres. At the crisis of 1788, when Necker asked for opinions as to the constitution of the estates Sieyès wrote his celebrated pamphlet, "What is the Third Estate?" He thus begins his answer—"Everything. What has it been hitherto in the political order? Nothing. What does it desire? To be something." For this *mot* he is said to have been indebted to Chamfort. The pamphlet had a great vogue, and its author was elected as the last (the twentieth) of the deputies of Paris to the States General. He strongly advised the constitution of the Estates in one chamber as the National Assembly, but he opposed the abolition of tithes and the confiscation of church lands. Elected to the special committee on the constitution, he opposed the right of "absolute veto" for the king, which Mirabeau unsuccessfully supported. He had a considerable influence on the framing of the departmental system, but after the spring of 1790 his influence was eclipsed by men of more determined character. Only once was he elected to the post of fortnightly president of the Constituent Assembly. Excluded from the Legislative Assembly by Robespierre's self-denying ordinance, he reappeared in the third National Assembly, known as the Convention (September 1792–September 1795); but he effaced himself partly from disgust, partly from timidity. He abjured his faith at the time of the installation of the goddess of reason; and afterwards he characterized his conduct during the reign of terror in the ironical phrase, *J'ai vécu.* He voted for the death of Louis XVI., but not in the contemptuous terms *La mort sans phrases* sometimes ascribed to him.

In 1795 he went on a diplomatic mission to The Hague. He dissented from the constitution of 1795 (that of the Directory) in some important particulars, but without effect, and thereupon refused to serve as a Director of the Republic. In May 1798 he went as the plenipotentiary of France to the court of Berlin in order to try to induce Prussia to make common cause with France against the Second Coalition. His conduct was skilful, but he failed in his main object. He was elected a Director in place of Rewbell in May 1799. Already he had begun to intrigue for the overthrow of the Directory; he now set himself to sap the base of the constitution of 1795. With that aim he caused the revived Jacobin Club to be closed, and made overtures to General Joubert for a *coup d'état* in the future. The death of Joubert at the battle of Novi, and the return of Bonaparte from Egypt marred his schemes; but ultimately he came to an understanding with the young general. After the *coup d'état* of Brumaire, Sieyès produced the perfect constitution which he had long been planning, only to have it completely remodelled by Bonaparte. Sieyès soon retired from the post of provisional consul, which he accepted after Brumaire; he entered the senate, where he defended the arbitrary and illegal proceedings whereby Bonaparte rid himself of the leading Jacobins. During the empire he rarely emerged from his retirement, but at the time of the Bourbon restorations (1814 and 1815) he left France. After the July revolution (1830) he returned; he died at Paris on June 20, 1836. The thin, wire-drawn features of Sieyès were the index of his mind, which was keen-sighted but narrow, dry and essentially limited. His lack of character and wide sympathies was a misfortune for the National Assemblies which he might otherwise have guided with effect.

See A. Neton, *Sieyès* (1748–1836) *d'après documents inédits* (Paris, 1900); also the chief histories on the French Revolution and the Napoleonic empire. (J. H. Ro.; X.)

SIFAKA, the name of three species of large Malagasy lemurs of the genus *Propithecus,* allied to the INDRI (*q.v.*), but distinguished by their long tails. Sifakas are variable in colouring, but always show a large amount of white. (*See* PRIMATES.)

SIGEBERT (d. 575), king of the Franks, was one of the four sons of Clotaire I. At the death of Clotaire in 561 the Frankish kingdom was divided among his sons, Sigebert's share comprising the Rhine and Meuse lands and the suzerainty over the Germanic tribes beyond the Rhine as far as the Elbe, together with Auvergne and part of Provence. At the death of his brother Charibert in 567 Sigebert obtained the cities of Tours and Poitiers, and it was he who elevated to the see of Gregory of Tours (*q.v.*), the historian of the Franks. Sigebert married a royal princess, Brunhilda, daughter of Athanagild, the king of the Visigoths; the nuptials were celebrated with great pomp at Metz, the Italian poet Fortunatus composing the epithalamium. Shortly afterwards Sigebert's brother Chilperic I. married Brunhilda's sister, Galswintha; but the subsequent murder of this princess embroiled Austrasia and Neustria, and civil war broke out in 573. Sigebert appealed to the Germans of the right bank of the Rhine, who attacked the environs of Paris and Chartres and committed frightful ravages. He was entirely victorious, and pursued Chilperic as far as Tournai. But just when the great nobles of Neustria were raising Sigebert on the shield in the villa at Vitry, near Arras, he was assassinated by two bravoes in the pay of Fredegond, Chilperic's new wife. At the beginning of his reign Sigebert had made war on the Avars, who had attacked his Germanic possessions, and he was for some time a prisoner in their hands.

See Gregory of Tours, *Historia Francorum,* book iv.; Aug. Thierry, *Récits des temps mérovingiens* (Brussels, 1840), and Aug. Digot, *Histoire du royaume d'Austrasie* (Nancy, 1863). (C. Pf.)

SIGEBERT OF GEMBLOUX (*c.* 1030–1112), mediaeval chronicler, became in early life a monk in the Benedictine abbey of Gembloux. Later he was a teacher at Metz, and about 1070 he returned to Gembloux, where, occupied in teaching and writing, he lived until his death on Oct. 5, 1112. As an enemy of the papal pretensions he took part in the momentous contest between Pope Gregory VII. and the emperor Henry IV.; and he also wrote

against Pope Paschal II. Sigebert's most important work is a *Chronographia*, or universal chronicle, covering the years 381–1111, which is published in vol. vi. of the *Monumenta Germaniae historicae Scriptores*, with valuable introduction by L. C. Bethmann.

See S. Hirsch, *De vita et scriptis Sigiberti Gemblacensis* (Berlin, 1841); A. Molinier, *Les Sources de l'histoire de France*, tomes ii. and v. (1902–04); and W. Wattenbach, *Deutschlands Geschichtsquellen*, Band ii. (Berlin, 1894).

SIGEL, FRANZ (1824–1902), German and American soldier, was born at Sinsheim, in Baden, on Nov. 18, 1824. He graduated at the military school at Carlsruhe, and became an officer in the grand ducal service. When the Baden insurrection broke out, Sigel was a leader on the revolutionary side in the brief campaign of 1848 and again in 1849, and then took refuge in Switzerland. A political exile, he emigrated in 1852 to the United States, working in turn as journalist and schoolmaster, and both at New York and St. Louis, whither he removed in 1858, he conducted military journals. When the Civil War broke out in 1861, Sigel was active in raising and training Federal volunteer corps. He became a brigadier-general (U.S. Volunteers), and was with Nathaniel Lyon at Wilson's creek and with J. C. Frémont in the advance on Springfield in the autumn. In 1862 he took a conspicuous part in the desperately fought battle of Pea ridge, which definitely secured Missouri for the Federals. Promoted to be major-general of volunteers he was ordered to Virginia, and was soon placed in command of a corps of Pope's "Army of Virginia." In this capacity he took part in the unsuccessful second Bull Run campaign. In 1864 he was placed in command of the corps in the Shenandoah valley, but was defeated by Gen. John C. Breckinridge at Newmarket (May 15), and was superseded. He resigned his commission in May 1865, and became editor of a German journal in Baltimore, Maryland. In 1867 he removed to New York city where he later served as collector of internal revenue and as pension agent. His last years were devoted to the editorship of the *New York Monthly*, a German-American periodical. He died in New York city on Aug. 21, 1902. A monument (by Karl Bitter) in his honour was unveiled in Riverside drive, New York city, in 1907.

SIGER DE BRABANT (*c.* 1235–1281/84), French philosopher and leader of Latin Averroism at Paris, first came into notice in 1266 during the conflict between the four "nations," when the papal legate decided that Siger was the ringleader. In 1271 he was involved in a similar struggle, the minority among the "nations" choosing him as rector in opposition to the elected candidate, Aubri de Rheims. After three years the matter was settled by the papal legate, Simon de Brion, afterwards Pope Martin IV. and Siger retired from Paris to Liège. Following on the general condemnation of 1277, Siger and Bernier de Nivelles were summoned to appear on a charge of heresy, especially in connection with the *Impossibilia*, but they fled to Italy, Siger being killed at Orvieto by an insane secretary. Dante, in the *Paradiso* (x. 134–6), curiously assigns the praise of Siger to St. Thomas.

The importance of Siger in philosophy lies in his acceptance of Averroism in its entirety, which drew upon him the opposition of his most distinguished contemporaries, including Albertus Magnus and Aquinas, and the condemnations by Bishop Tempier of Paris in 1270 and in 1277. The doctrines which were especially criticized were—the denial of the Divine power to create more than one being; the assertion of the eternity of the world, of the infinity of eternal intelligence, of the unity of intellect in all men, and of the possibility of a double truth—one for revelation and one for reason; the rejection of personal immortality and of the real distinction between essence and existence.

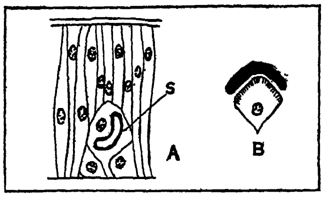
In addition to the opuscula printed in P. Mandonnet's *Siger de Brabant et l'Averroisme latin du XIII^e siècle* (Fribourg, 1899; 2nd ed., 1911), Grabmann has discovered ms. commentaries on some of Aristotle's works, and also ms. *Quaestiones*, described in *Sitz. Berichte Bayer Akad. Wissensch. Philos.-philo. u. hist. Kl.* (1924), and in *Misc. Fr. Ehrle* (1924). *See* also M. de Wulf, *Hist. of Phil.* (2 vols., Eng. trans. 1926), and Überweg. *Gesch. der Phil.* Bd. 2 (1928).

SIGERSON, DORA (*c.* 1870–1918), Irish poet, the daughter of Dr. George Sigerson, was born in Dublin about 1870. In 1896 she married Clement K. Shorter (*q.v.*). She contributed, as a girl, to the *Irish Monthly*, and published several volumes of verse, notably *The Fairy Changeling* (1897), *Ballads and Poems* (1898); and *As the Sparks Fly Upwards* (1904). For her material she drew largely on Irish folk-lore.

SIGHT, SENSE OF. Under the term "eyes" we include organs, or, in the simplest cases, groups of sensory cells, which are specially adapted for the perception of light. Nevertheless, sensitiveness to light can frequently be established for animals in which eyes are not demonstrable. We must assume, therefore, either that the whole surface of the skin is sensitive to light, or that single sensory cells are scattered in the skin which are very inconspicuous in their structure, and which are the bearers of this sense of light perception.

THE STRUCTURE OF THE EYES IN THE LOWER ANIMALS

Already in the Protozoa, however, true eyes are found. In Volvox and other Flagellates they consist of a lens, and, behind this, an accumulation of the plasma, which frequently is pigmented. The earthworm has isolated photo-sensitive cells, which may be distinguished by their structure; the simplest of the vertebrates (*Branchiostoma*) has numerous isolated photo-sensitive cells scattered over the whole of the dorsal nerve cord, each of which is half surrounded by a pigment cell (fig. 1).



AFTER HESSE

FIG. 1.—(A) SECTION THROUGH THE SKIN OF AN EARTHWORM. (S) PHOTO-SENSITIVE CELL, (B) PHOTO-SENSITIVE CELL WITH PIGMENT-CAP FROM BRANCHIOSTOMA

Eyes of the most simple kind originate through the concentration of a number of such photo-sensitive cells in a small space.

Eye-spots.—Eye-spots are found in Medusae, starfishes and some Annelid worms (fig. 2). The first step in the perfecting of this very primitive apparatus is the sinking of the eye-spot into a pit-like depression, thus forming an eye-cup (optic cup). This type already, perhaps, is adapted for the perception of the direction of light, and is of very general occurrence, being found in some worms, gastropods, bivalves, starfishes, Arthropods, etc. (fig. 3). This type of eye when it occurs in Arthropods is called an *ocellus*, and is more complicated, as the thin cuticle, which envelopes the whole of the body, becomes thickened over it, and forms a strongly arched, or occasionally, ball-shaped lens. At the same time division of labour takes place among the cells forming the eye-cup. The sides of this remain transparent, and secrete a kind of vitreous humour, only the cells situated at the back of the cup forming the retina (fig. 4a). In yet other cases two layers may be formed in the optic cup by a peculiar process of folding, which cannot be described here. A vitreous outer layer and an inner retinal layer can then be distinguished (fig. 4b). The open cup-shaped eye may become quite closed in, forming an optic vesicle, by the growing together of the outer margins (as in many Chaetopod worms, gasteropods and cuttlefishes). The interior of this optic vesicle is then filled by a jelly-like substance, the vitreous humour. The anterior portion of the vesicle is transparent, like the skin which grows over it; the inner half becomes the retina (fig. 5). This type of eye is found in its most perfect form in some worms (*Alciope*) and gasteropods (*Helix, Limax*) with the formation of a lens, which is free in the vitreous humour, and condenses the rays of light. The cuttlefish alone shows a further development. This is the highest of all invertebrate animals. In general, as well as in psychical, development, it ranks at least as high as fishes.

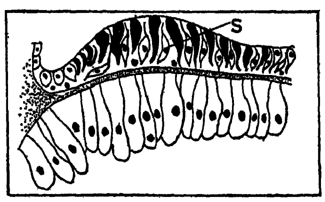


FIG. 2.—EYE-SPOT OF A MEDUSA: S RETINAL CELLS

The eye represented in fig. 6, presents a striking resemblance to that of a vertebrate. All the separate parts of the one are repeated in the other. The posterior chamber is the principal part; it is bounded at the back by the retina, and in front by the

iris. It is filled by a jelly—the vitreous humour.

The lens is spherical, as in fishes. It differs from the lens of a fish, however, in that it does not consist of cells; it is divided by a delicate skin which separates the anterior chamber of the eye from the posterior, half lying to the front, and half to the back.

The anterior chamber is closed by a transparent cornea, in front of which are movable eyelids. The power of accommoda-

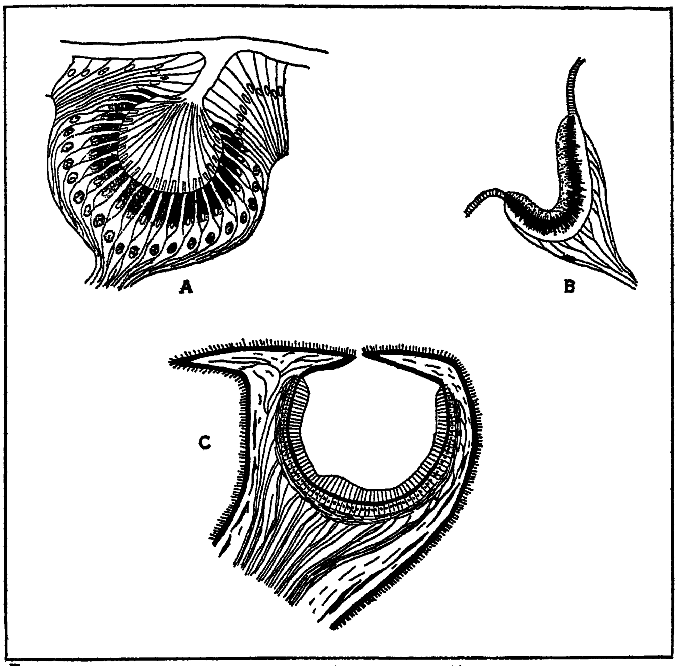


FIG. 3.—OPEN, CUP-SHAPED EYES OF (A) CHAETOPOD WORM (SYLLIS); (B) GASTROPOD, COMMON LIMPET (PATELIA); (C) CHAMBERED CEPHALOPOD (NAUTILUS)

tion is exactly the same as in the vertebrate eye. The cuttlefish can focus its sight either for near vision or for distant by means of particular muscles, which alter the length of the axis of the eye. It is hardly necessary to mention that the pupil in the iris can be expanded or contracted according to the strength of the light falling on it. In the structure of the retina, also, the eye of the cuttlefish is equivalent to those of vertebrates.

It is made up of more than 100,000 elements per sq.mm., and thus is certainly adapted for the formation of a sharp image. Lastly, it may be mentioned, that in size also it is in no way

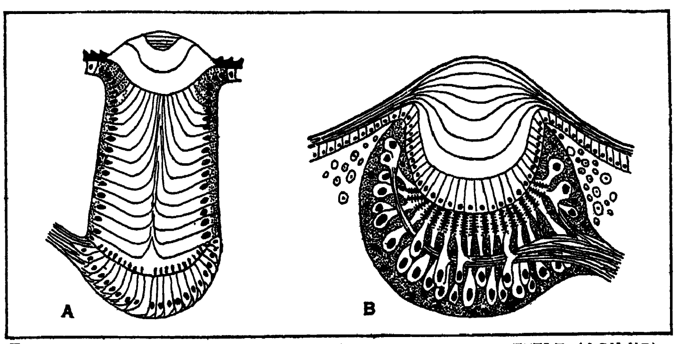


FIG. 4.—CUP-SHAPED EYES OF (A) THE LARVA OF A BEETLE (ACILUS); (B) A SPIDER (TEGENARIA)

inferior to the vertebrate eye. Eyes 37 cm. in diameter have been found in the giant cuttlefishes of the genus Architeuthis.

The eyes of turbellarian worms and leeches have a somewhat different structure. In these animals, it is true, eye-cups are present, but they are not formed by the retinal cells themselves, but of pigment cells, which absorb the light, while the sensory cells penetrate into the interior of the cup (fig. 7).

Faceted Eyes.—We find quite a different type in the faceted eyes of insects and crustaceans. As the name implies, the eye may be seen to be formed of a great number of facets, usually square or hexagonal in shape, which in their regularity resemble closely those cut on a precious stone. Each facet corresponds to a single eye or *ommatidium,* which always takes the shape of an elongated cone. In each of these eyes, taken by itself, the following parts may be distinguished. The outermost part consists of a small, somewhat rounded, transparent lens. Under this is the

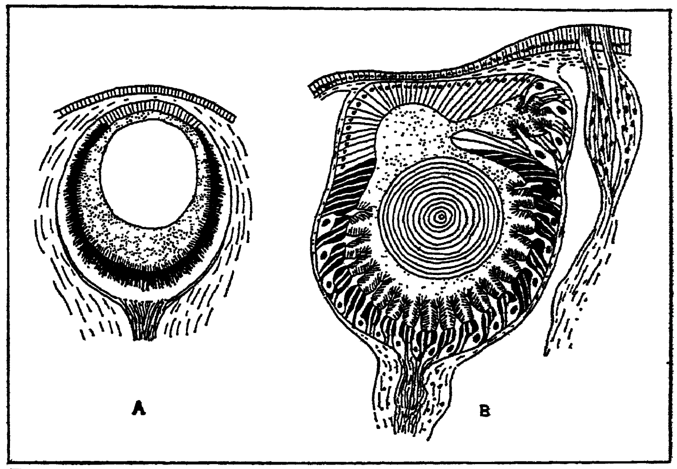


FIG. 5.—CLOSED, VESICULAR EYES OF (A) A MARINE GASTROPOD (MUREX); (B) A LAND GASTROPOD SLUG (LIMAX)

crystalline cone, a conspicuous structure, usually gelatinous, which is quite transparent, and allows the rays of light to pass freely, and directs their path. If we examine the eye of a diurnal insect, we find that the inner extremity of the crystalline cone is adjacent to the cells which, collectively, correspond to our retina. Each ommatidium has only 6 or 7 of these cells. Among them they secrete a remarkable body, the rhabdom, which evidently represents a kind of transformer.

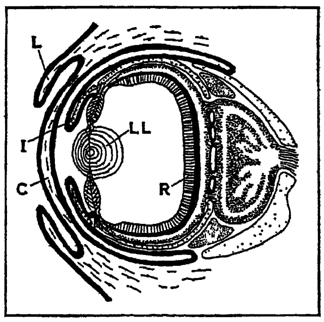
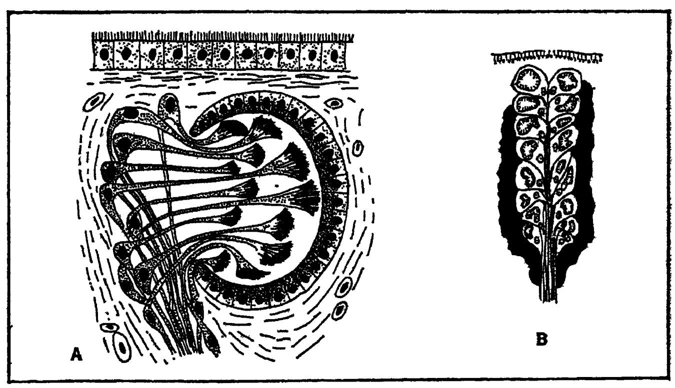


FIG 6.—EYE OF A CUTTLEFISH; L. LID; C. CORNEA; I. IRIS; LL. LENS; R. RETINA

The rays of light which enter the eye are focused on the rhabdom, and there are evidently brought into such a form of energy that they are available to the sensory cells. The nervous layer immediately adjoins the sensory cells. In diurnal insects each ommatidium is separated from its neighbour by a layer of pigment.

Somewhat comprehensive conclusions may be drawn from the structure of the faceted eye as to its functional powers. It seems certain that each ommatidium functions separately. It



AFTER HESSE

FIG. 7.—(A) EYE OF A TURBELLARIAN WORM (PLANARIA): (B) EYE OF A LEECH (HIRUDO)

projects the image of a point of light. The whole image seen thus by an insect is composed only of as many elements as the eye possesses facets. The number of these, however, is surprisingly small. Even those insects which have the best sight, such as dragonflies, have only about 60,000 ommatidia. With this we

must compare the fact that in the vertebrate eye a single sq.mm., which gives only an exceedingly small portion of the whole image, contains about 300,000–700,000 separate elements. It follows as a matter of course that only in a very slight degree is an insect

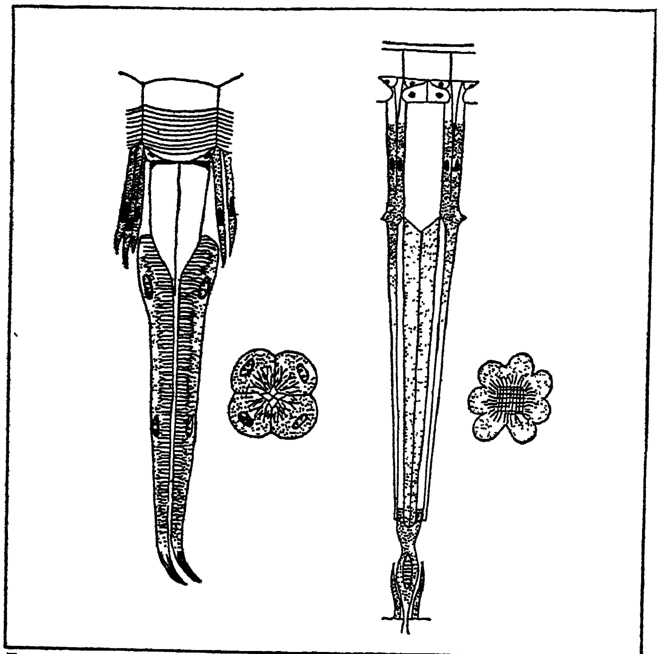
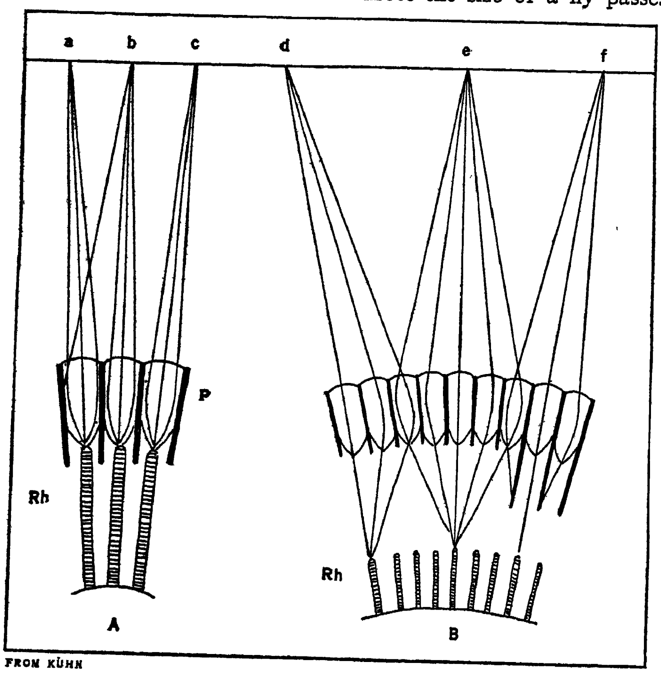


FIG. 8.—(LEFT) OMMATIDIUM FROM THE FACETED EYE OF AN INSECT (COCKROACH, PERIPLANETA) AND CROSS-SECTION THROUGH THE RETINULA. (RIGHT) OMMATIDIUM OF A CRUSTACEAN (CRAYFISH, ASTACUS), WITH CROSS-SECTION THROUGH THE RETINULA

able to distinguish form, as is borne out by the previously mentioned experiments. Most insects, which have only a few thousands or even hundreds of ommatidia, cannot do this at all. On the other hand, these eyes are eminently adapted for the perception of movement. When an insect the size of a fly passes

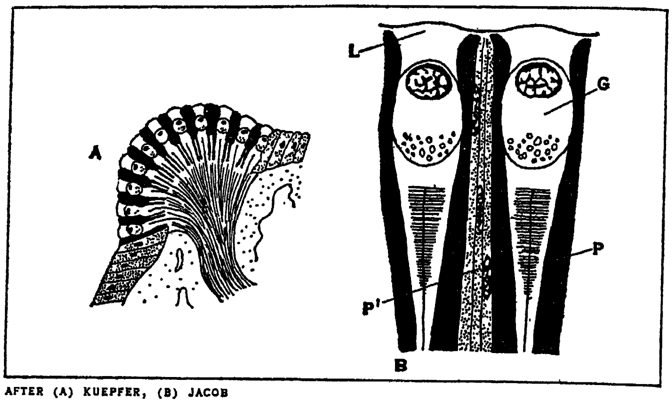


FROM KÜHN

FIG. 9.—PATH OF THE LIGHT-RAYS IN A FACETED EYE: (A) IN ONE GIVING AN APPOSITION-IMAGE, (B) IN ONE GIVING A SUPERPOSITION-IMAGE; P. PIGMENT; RH. RHABDON

in front of a dragonfly at a distance of about 2 metres, it is seen by the latter only as a black point, for it can be proved that, in this case, only one single ommatidium catches the image of the fly. In spite of this it is pursued, captured and eaten.

Eyes of Nocturnal Insects.—The eyes of nocturnal insects and of the mostly nocturnal crustaceans are constructed in a remarkably different manner from those of diurnal insects. As is to be expected, such an eye is constructed so as to admit a greater amount of light than that of a diurnal insect. This is attained by the ommatidia being no longer separated by pigment layers. In addition, the crystalline cone has, in such animals, other physical peculiarities. The physiologist Exner has proved this conclusively for the eyes of the glow-worm. He showed



AFTER (A) KUEPFER, (B) JACOB

FIG. 10.—FACETED EYE FROM THE MARGIN OF THE MANTLE OF THE BIVALVE MOLLUSC ARCA

(A) Transverse section through the edge of the mantle. (B) Two Ommatidia, more strongly magnified. L. Lens. G. Vitreous humour. P. Pigment coat of sensory cell. P' Interstitial pigment cells

that the light given out by a luminous point penetrates not only one ommatidium but many (fig. 9). After leaving the crystalline cone, however, the rays are refracted in such a way that, ultimately, they again become focused upon one point of the retina. Each rhabdom receives, therefore, a much greater amount of light than those in the eyes of diurnal insects. On account of the arrangement one upon the other of the points of light which come from the various crystalline cones, such eyes are described as giving "superposition images," while those of diurnal insects give "apposition images." It is of interest that crustaceans are able to use their eyes either for superposition or for apposition vision, according to their needs. This is attained by the movement of the pigment in the cells which separate the ommatidia.

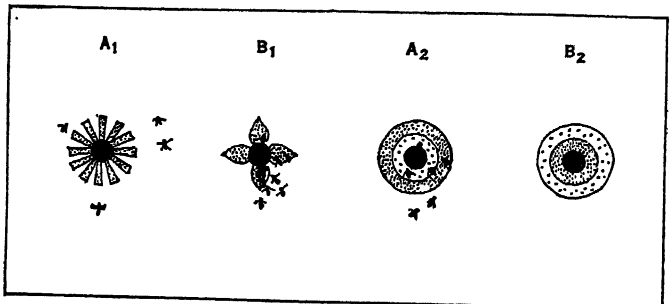


FIG. 11.—TRAINING HONEY-BEES TO DISTINGUISH FORMS

B_1 and A_2 are the boxes with forms to which the bee had been previously trained to come; A_1 and B_2 are other boxes

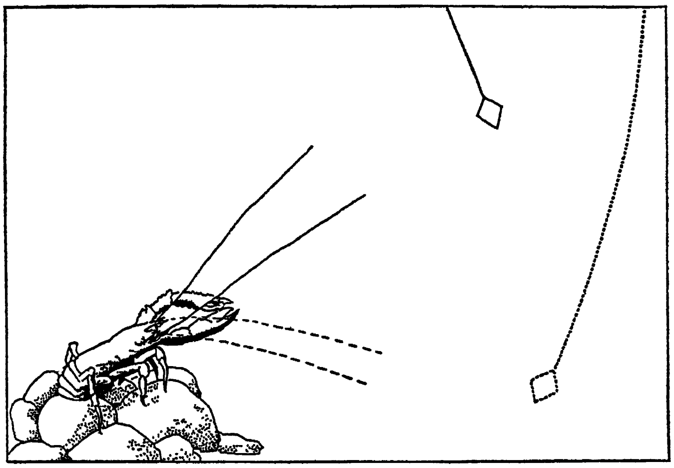
Faceted eyes are found in some bivalves (*Arca*) and Chaetopod worms, as well as in Arthropods, but serve, however, only for perception of movement (fig. 10).

THE FUNCTION OF THE EYE

To man the eye is by far the most important of all the sense organs. With the help of our eyes we recognise our fellow men, animals and plants, the things we use in daily life, in short all the world around us. He who studies the sight of animals is apt to make the mistake of supposing that their eyes function like ours.

Such perception of form as permits us, from the appearance of an object, to draw conclusions as to its other qualities, and thus to understand its nature, is only to be found in the highest animals, mammals, birds, and, perhaps, some reptiles. Even the

frog does not recognise a motionless fly as desirable food, but is quite indifferent to it; it is, so to speak, "intellectually blind." This applies in a still greater degree to the invertebrate or lower animals. Of these, so far as is known at present, only bees and their relatives show a definite sense of form. Von Frisch demonstrated that bees can be trained to distinguish forms. Food was given them in a closed box, into which they were obliged



AFTER DOFLEIN

FIG. 12.—GALATHEA SQUAMOSA, SHOWING REACTION TO OPTICAL PERCEPTION OF AN APPROACHING OBJECT, BY BENDING ANTENNAE DOWN

to crawl through a hole. Around this hole was glued the picture of a flower, while round a hole in another box, which was placed beside the first, but was empty, was gummed the picture of another flower. After food had been given thus for several days, the boxes, which could be distinguished only by the difference in the pictures of the flowers, were placed before the bees empty. A much greater number of visits was paid to the box which had contained food (*see* fig. 11). Bees, therefore, are able to distinguish between two flowers according to their shape. Similar experiments may be made also by using simple geometrical figures.

Perception of Movement.—As far as is known at present, none of the other lower animals are capable of such a performance. It is easy to guess for what purpose they use their eyes if we consider the behaviour of some mammals. The hare takes not the least notice of the sportsman standing motionless at the edge of the wood, but as soon as he makes the slightest movement, it takes to flight. It, therefore, exhibits in a marked degree the power of perception of movement. Spontaneous movement can take place only in living organisms. Since the animal heeds only the movement, and not the motionless form, it is able, in the simplest way, to distinguish between "living" and "lifeless."

The power of perceiving movement is very distributed. Schrader has made interesting experiments with falcons. These intelligent birds, under normal conditions also, are able to distinguish motionless prey as such. If, however, the cerebrum is removed, they notice movement only. A falcon from which the cerebrum has been removed, pursues and strikes a living, active mouse just as skilfully as would a normal bird; as soon as the mouse is dead, however, it takes no more interest in it. In general, frogs and salamanders snap only at moving prey, and every angler knows that fishes act in the same way. Among the lower animals interesting observations have been made on insects, crustaceans and molluscs. The scallop, *Pecten jacobaeus,* has, on the edges of its mantle, a large number of eyes of complex structure. On account of the poor development of its brain, however, it is unable to distinguish its enemies by means of sight, and is able only to perceive movement. If another animal crawls slowly towards it, as soon as the scallop perceives the movement, it extends the long, thread-like tentacles, which are its olfactory organs. By means of these it determines whether the approaching animal is friend or foe. If it be the former, the scallop quickly becomes quiet again; if the latter, it swims away hurriedly. A corresponding co-operation between eyes and feelers is often to be seen in decapod crustaceans. These animals react to a moving object by holding the antennae straight out towards it. (*See* fig. 12.) Uexkuell showed that the house-fly finds its mate by means of this perception of movement. If a small, black bead, about the size of a fly, is fastened to a thread, and drawn fairly rapidly through the air, the male flies immediately throw themselves upon it. If the surface of the bead be smeared with a sticky substance, it makes an ideal fly-trap. That dragonflies and other predatory insects only pursue moving prey need hardly be mentioned.

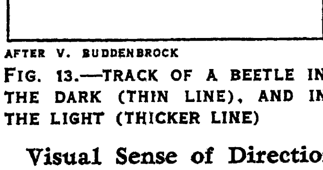
The most lowly animals which undoubtedly possess the power of perceiving movement are certain marine Chaetopod worms (*Branchiomma*). They live in tubes, constructed by themselves, from which only their heads project, which bear numerous, long tentacles. Each tentacle has at its extremity a compound eye. If one makes a rapid movement with the hand in front of the aquarium, every worm retreats into its tube with lightning rapidity. That this is a typical case of the visual perception of movement is proved by the fact that darkness or light, produced by the switching off or on of an electric lamp, without movement, makes no impression whatever upon the animals.

That the lower animals perceive and take heed of motionless objects is really only to be observed when they have to turn aside from their path on account of them. When an insect flies about in a forest it must not run the risk of colliding with every tree. This also applies to the deliberately moving gasteropods.

We can well observe in these slow-moving creatures how skilfully they avoid the obstacles which may be placed in their path. This is also the case if we place between the animals and the obstacle a glass screen, which excludes all impressions of it other than visual ones. We do not know as yet how widespread this "avoiding reaction" is in the animal kingdom. On the other hand, visual perception of direction is almost universal. This power enables the animal to pursue an orderly path in a straight line. It hardly requires to be proved that it is a necessity of life for all freely-moving animals to crawl, fly or swim straight ahead. It suffices to remember that, without this power, an animal runs the risk of moving round and round in circles, in a quite aimless manner. Mephistopheles says in "Faust":—

> I tell you, the man who speculates,
> Is like a beast upon a barren heath,
> Led in a circle by an evil spirit,
> While just beyond are spreading, fresh, green fields.

We can conjure up this evil spirit in our experiments by conducting them in darkness. If we allow small insects to creep about in the dark on a piece of glass lightly smeared with soot, we can see from their tracks that they have crawled here and there, not indeed in circles, but in a totally aimless manner, without moving far from one place (*see* fig. 13). We can increase this restriction of movement by amputating one of the legs of the insect; it then frequently runs in a narrow spiral, always turning towards the same side. As soon as we admit light into the darkened chamber, however, matters are instantly changed; the creature runs away from the light in a course straight as a line.



AFTER V. BUDDENBROCK

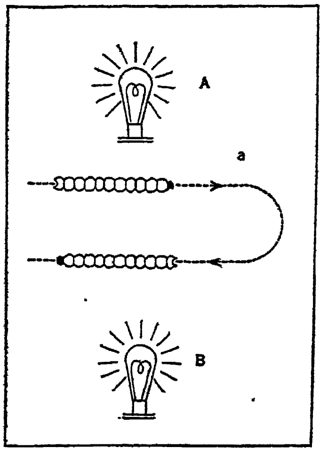
FIG. 13.—TRACK OF A BEETLE IN THE DARK (THIN LINE), AND IN THE LIGHT (THICKER LINE)

Visual Sense of Direction.—These experiments prove the existence of the visual perception of direction. This applies to human beings also. It has long been known that a man in desert or snow covered regions, or in dense brush, unable to use his sight for orientation, moves round in circles, and, after walking for hours, finds himself back at the point from which he started. The manner in which man and the higher animals orientate themselves in space by means of sight is generally known. Quite unconsciously they choose some prominent object, such as a

tree, for which they aim; on approaching this they select as their goal another, more distant object, lying in the same direction.

The lower animals regulate their movements on a different principle. They shape their course in relation to the light.

This method of orientation is well illustrated by the following example. Xenophon frequently writes in his "Anabasis":—"We marched keeping the sun on our right." That is to say, we can in a quite unfamiliar region, travel in a straight course in a particular direction, if we take care that the rays of the sun and the line of march enclose a constant angle. What man does intelligently the lower animals accomplish by blind instinct.



AFTER V. BUDDENBROCK

FIG. 14.—THE MOVEMENTS OF A CATERPILLAR IN RELATION TO LIGHT

The particular motion with relation to the light may be demonstrated experimentally in two ways. A small candle is put on a table in a dark room, and the animal to be studied is placed about half a metre distant from the light. (Some small beetles or caterpillars are good subjects for this experiment.) The animal begins by running past the light, apparently without heeding it; if, however, we suddenly take up the light and place it on the other side of the animal, the latter turns in an angle of 180°, and continues its way in the opposite direction to that previously followed (fig. 14). This very pretty experiment does not succeed with all species. The following is simpler, and can be carried out with all sorts of insects, crustaceans, and gasteropods. The animal is placed on a table near the light, and left to its own devices; it may then be observed that, under the influence of the light which radiates outwards in a circle, the animal performs a circus-movement round the source of illumination. It moves, therefore, in such a way that the angle formed by the light rays and its path remains constant. In this instance the angle is roughly a right angle; the animal is able, however, to change it at will. For example, it may crawl in such a way that the light falls upon its eyes obliquely, from behind; it then moves in a spiral which gradually removes it from the light (*see* fig. 15).

The long known fact that nocturnal insects are attracted by a lighted lamp is connected with this particular type of movement. Usually, on their nocturnal flights, they orientate themselves by the moon, the clouds, or other far distant sources of light. If, however, they come by chance within the influence of a near source of light, such as an electric arc-lamp, they are compelled to fly around the artificial light in circles or in spirals. Often enough they come thus into the immediate neighbourhood of the light, and are burnt.

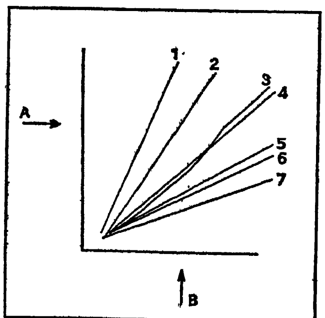
Visual perception of direction in animals may show itself in quite another way, namely, in what is called *phototaxis.*

The following example illustrates what is meant by this. If a bee is taken, and released in the middle of a room, it flies with absolute certainty towards the window, and, therefore, towards the light. Such an animal is called *positively phototactic.* The cockroach illustrates an opposite condition; it is *negatively phototactic.* It avoids the light, and when turned out of its hiding place, it will assuredly make for the dark.

That phototaxis is not always a constant character is shown by the bee. We cannot say off-hand "the bee is positively phototactic." It is so only under quite definite conditions; in very many other circumstances it is not so. For example, when it returns from gathering honey, and flies into the dark hive, it is much rather to be described as negatively phototactic.

Sometimes it is easy to state the conditions under which an animal will become phototactic. The bee becomes positively phototactic if it is caught, and strives to free itself. In nature, where there are no glazed windows, brightness means the open air and the sky. A very clear example of phototaxis appearing only under certain conditions is furnished by the water scorpion (*Nepa cinerea*). This creature lives in shallow waters among the plants on the bottom. It is, however, an air-breather, and is obliged to ascend to the surface of the water from time to time, in order to inhale it. In this it is aided by positive phototaxis, which, in this case, co-operates with negative geotaxis. Since light only enters the water from above, the creature, which becomes phototactic only with lack of air, creeps up the water plants as much as possible in a vertical direction, until it reaches the surface. Scarcely, however, has it breathed in the fresh air, when phototaxis ceases, and the water scorpion is able to descend again into the deeper regions. As a final example, the water-flea, *Daphnia,* may be mentioned, in which we can produce phototaxis at will. We have only to introduce water containing carbon dioxide into a vessel in which there are Daphnia, to see at once that all the animals swim as quickly as possible towards the light. Here, however, we must again make it clear that, normally, the light enters from above. Daphnia live in stagnant waters, frequently very unclean, at the bottom of which poisonous carbon dioxide can be very easily formed through putrefactive processes. In this instance, phototaxis serves to protect the Daphnia from poisoning by carbon dioxide.

The Mechanism of Phototaxis.—While these matters are comparatively simple, the naturalists of the present day are as yet very divided in their opinions regarding the mechanism of phototaxis. There are various theories, of which we may, perhaps, go so far as to say that each is correct in some instances. The best known is the Theory of Tropisms (also called the Ray-Verworn Theory, or the Theory of Tropotaxis). It is founded on the fact that the majority of animals which are prototactic have bilateral symmetry. These all have a median plane dividing the body into two, absolutely identical halves. The entire animal is regarded as a small automaton. The light rays which fall on the eye are converted into nervous energy, which is conducted to the brain. The latter transmits the stimulus to the limbs, which are under its control, and thus, according to this theory, the movements of the legs are, by a natural law, dependant on the strength of the illumination of the eyes. If the rays of light come from the front, they strike both eyes equally, and, therefore, the legs of each side move with equal force, and the animal runs straight forward. If, however, the light comes from one side, so that one eye is more strongly illuminated than the other, there is also a difference between the two sides in the working of the legs. The consequence must be that the animal turns until its median plane coincides with the direction of the light rays. When this is accomplished, it again runs in a straight line towards the light. This theory is so very striking in its great simplicity that, at first, it was received with much enthusiasm, particularly by everyone interested in Natural Philosophy.



AFTER MÜLLER

FIG. 15.—TRACK OF A NEGATIVELY PHOTOTACTIC WOODLOUSE UNDER THE INFLUENCE OF TWO BEAMS OF LIGHT AT RIGHT ANGLES (A & B)

With time, however, the opposition to this theory has been greatly increased, and there are many naturalists who have almost completely relinquished it. Frequently, the law which governs the movements of such animals is known by another name, namely the *"Law of Resultants."* Thus, if we allow an animal to crawl into a field of light which is formed by two crossing beams, it is compelled to move according to the resultant. A fine example of this manner of reaction has been furnished by Frl. Müller, who worked with woodlice (*see* fig. 15). It appears that the animals under the influence of two equally strong beams of light, run exactly in the diagonal; if the beams are made to be of unequal strength the angle alters. It can be

calculated in advance if we know the strength of both beams of light.

A second theory, which is in opposition to the theory of tropisms, asserts that the lower animals behave similarly to man and the higher animals. If a man walks towards a light, or let us say in a general way towards some optically perceptible point, first of all he fixes his eyes on the light, that is to say he moves them so that the light falls on the central point (*fovea centralis*); he then turns his head and body towards the light and goes straight forward. Kuehn has named this kind of reaction "*telotaxis*"; it is fundamentally opposed to tropotaxis, as will appear if we close one eye. A telotactically reacting animal is just as well able to direct its course when using only one eye as when using both; a tropotactically reacting animal, on the other hand, when it has only one eye is compelled continually to move round in circles. It is easy to convince oneself, on the basis of this alternative, that the majority of the more highly developed animals, such as insects or the higher groups of Crustacea, behave for the most part telotactically.

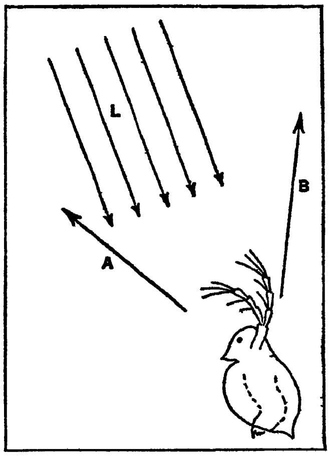
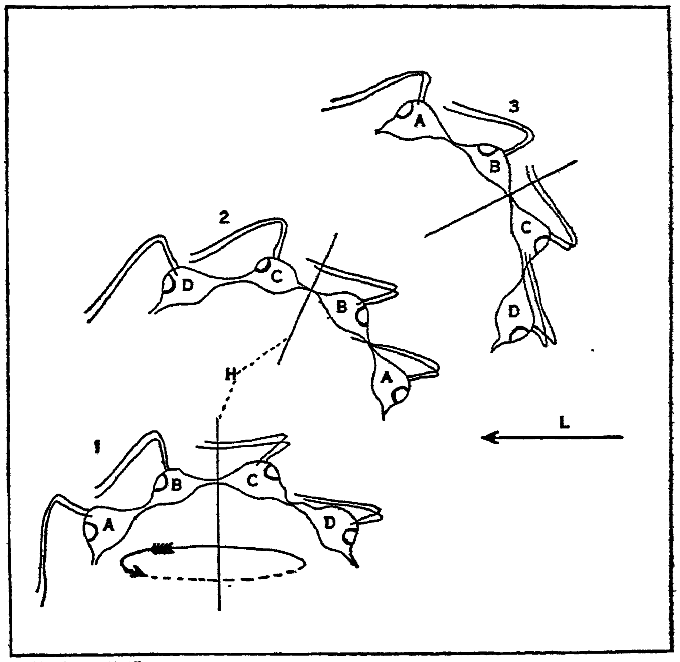


FIG. 16.—UPWARD MOVEMENT OF A POSITIVELY PHOTOTACTIC DAPHNIA, DIAGRAMMATIC

The numerous partial refutations which the theory of tropisms has undergone cannot be given in detail here. Only one particularly important argument can be mentioned. It used to be considered a proof of its validity that animals blind on one side constantly run round in circles. If they are positively phototactic, they continually turn towards the side on which they can see; if they are negatively phototactic they turn towards the blind side. Now, in the first place, this certainly does not apply to all cases. The majority of the higher insects learn very quickly to run straight when they have only one eye. Above all, Mast was able to prove that the animal does not move round in circles involuntarily, as the theory of tropisms would require, but that the animal voluntarily runs round thus, and moves its legs in such a manner as to attain this end. If some of the legs are amputated the remaining ones completely alter their movements, so that, in spite of the totally different locomotor conditions, the circus movement is still possible.

A second argument of general application is as follows:—The naturalist usually makes use of horizontal light in his experiments, which strikes the animal from one side. Only under these artificial conditions is it possible to turn about an axis which lies in the plane of symmetry of the body. Under natural conditions, on the contrary, the light, as far as aquatic animals are concerned, comes always from above. The Daphnia on becoming positively phototactic turns from its former position, not to right or left, but backwards. That it swims in the end towards the light, and not in the direction A or B is impossible to understand on the theory of tropisms (fig. 16).

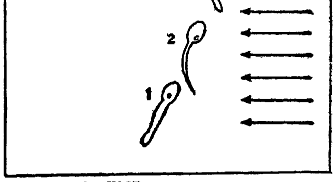
Frequently, however, it is impossible to decide with certainty from such rough experiments the manner in which an animal orientates itself in relation to light, and a closer, more exact analysis is required. We are indebted to S. O. Mast for the best work on this subject. He showed that in many cases, neither tropotaxis nor telotaxis sufficed to account for the phenomena. As the first example we may mention briefly the researches of Mast on the orientation of the colonial Flagellate, *Volvox*. The colony is composed of about 20,000 individuals, which are arranged on the surface. Each zooid has two flagella, and an eye-spot, provided with a lens. The colony has an anterior pole, which is always turned towards the front in swimming, and a longitudinal axis round which it rotates. If a light is placed to one side of a positively phototactic colony, it turns until the anterior pole is directed to the light, and then swims straight towards it. This gives the impression of being a clear case of tropotaxis, but Mast was able to prove that the zooids on the illuminated and on the shaded sides differ, not in the strength of the lashing of the flagella, but in the direction of the strokes. On the former side the flagella lash sideways, on the latter, straight out to the back (*see* fig. 17). It is apparent, therefore, that in this reaction we are dealing neither with a case of tropotaxis nor with one of telotaxis, but with a phenomenon *sui generis*. Very interesting are the orientation movements of



AFTER S. O. MAST

FIG. 17.—PHOTOTACTIC ORIENTATION OF A VOLVOX COLONY, SHOWING ONLY FOUR CELLS. L. THE DIRECTION OF LIGHT

asymmetrical animals, as for example one-eyed animals such as the Ascidian larvae also studied by Mast. These animals are negatively phototactic, and in swimming revolve about their longitudinal axis. When the light comes from one side, the eye, which is set in a pigmented cup, is alternately illuminated and in shadow with each revolution. Every time it is in shadow, the animal makes a stroke with its tail towards the ocular side; every time it is illuminated, it makes a stroke towards the abocular side (*see* fig. 18). In this way the larva quickly turns away from the light.



AFTER S. O. MAST

FIG. 18.—REACTION OF THE NEGATIVELY PHOTOTACTIC, ASYMMETRICAL LARVA OF AMAROUCIUM

We find the least development of the sense of sight in those animals which are unable to perceive either images, movements, or direction, but can only distinguish light and darkness.

They react mostly to alterations in the light intensity to which they are accustomed. A very common phenomenon of this kind is the "shadow reflex." Many of the lower animals, particularly those which dwell in shells or shelters of some kind, into which they can withdraw, do so directly a shadow falls on them.

An animal particularly suitable for the demonstration of this reflex is the vineyard (Roman) snail, *Helix pomatia*, which has a wide distribution in Europe. If we cause a shadow to fall upon its head, it withdraws its horns very quickly, or completely retreats into its shell. Among marine animals may be mentioned

the small sessile crustacean, *Balanus,* which, every time a shadow falls on it, withdraws its feet, which normally move in a constant rhythm. Further, many tubicolous worms react in a similar way, and many bivalves close their shells, if a shadow falls on them.

In short, the phenomenon is unusually widespread. The biological significance of this shadow reflex most certainly is that by this means the animal hides from danger, since the shadow may perhaps indicate the approach of some animal. This is, of course, a very poor expedient, since, in the first place, it fails to give protection from enemies which are in an opposite direction to the sun, and, in the second place, it causes the animal to withdraw unnecessarily thousands of times. Animals which do not possess any well-developed sense organs to give them certain warning of the approach of their enemies, are obliged, however, to help themselves even in this primitive manner.

The animals here mentioned, which respond to the slightest shadow, very frequently do not react in any way if we increase the degree of illumination. Other animals withdraw only in the latter circumstance, and are not disturbed by any shadows. Among these is the sand-dwelling *Mya arenaria,* which is found on the coasts of Europe and America. It lives in the sand at a depth of about 20 cm., and makes a shaft which leads upwards in a vertical direction, in which lies its tubular siphon, the organ by means of which it takes in food and oxygen. If this fleshy siphon were pushed so far out of the shaft that it stretched out into the water, fishes would immediately come and bite it off. The light reflex serves to prevent this; as soon as the siphon pushes out into the water, it is exposed to stronger light, and the reflex movement of withdrawal promptly takes place.

It is just these simple phenomena which are frequently of interest to the naturalist, since by their means we may easily understand the laws which govern the perceptual life of animals, and of mankind also. Weber's Law is very well known. This states that a man is first sensitive to a new stimulus when it stands in a particular numerical ratio to that already present.

Thus, if originally light "L" prevails, an animal sensitive to shadow first withdraws when the light is shaded by about L/20. In this case the value of L is quite immaterial.

The table is compiled from the results of the author's experiments on *Balanus.* L_1 indicates the original light, L_2 the greatest amount of light which yet gives rise to the shadow reflex. L_1/L_2 is, as can be seen, roughly constant.

L_1	L_2	L_1/L_2
1,000	967	1·034
933	875	1·066
750	720	1·0415
500	480	1·0415
250	240	1·0415

From these experiments the fact of *Adaptation* may be proved as a logical inference. The sensitiveness of our eyes is considerably greater in weak light than in strong. The eye thus adapts itself completely to the light conditions present. Starting with an original intensity of 1,000 light units, *Balanus* first reacts when this is diminished by 33 units. With an original intensity of 250 units the animal first notices a diminution by 10 units. On pursuing the subject further, we find that with an original intensity of 25 units, diminution of this by only one unit is noticed by the animals. The eye, therefore, becomes more sensitive as darkness increases.

THE COLOUR-SENSE OF ANIMALS

Colours play such a large part in human life that the question whether animals also possess a sense of colour is of extreme interest to us. In speaking of the colour-sense of animals it behoves us to make it perfectly clear at the outset that it is quite impossible for us to study the sensations of animals. We cannot even say anything about the sensations experienced by our fellow men. On the other hand, we can decide objectively whether an animal is able to distinguish different colours.

The investigation of the colour-sense of animals has followed a remarkably zig-zag course. In the time of Darwin man, almost universally, was convinced that the lower organisms also possessed a sense of colour similar to his own. Later we went to the opposite extreme. Hess pronounced the definite opinion that all invertebrates and fishes were totally colour-blind, and that only the highest organisms, such as mammals, birds, reptiles and amphibians, were able to enjoy the colours of nature. This sweeping generalisation was contradicted, and so gave rise to a very active investigation of the whole subject. The result of these labours may be summarised thus:—very many of the lower animals, such as cuttlefishes, insects and the higher Crustacea, do indeed possess a sense of colour. Further, in cases in which it has not yet been proved to exist we hesitate to draw the conclusion that it is absent.

Experiments.—The methods by which we have sought to investigate the colour-sense in various animals are very numerous. All animals which possess a certain amount of intelligence can be trained to distinguish a particular colour. v. Frisch was the first to attempt this, with bees. It is just in dealing with these insects, for which the array of colours in flowers would seem to have been evolved, that this statement by Hess must give cause for reflection.

In order to understand the following it is necessary to consider more precisely the nature of coloured light. In this two factors are always to be distinguished, the brightness of the light, in physical terms, the intensity, and the colour of the light, or in physical terms its wave-length. In studying the colour-sense of animals we are concerned only with the question whether they are able to distinguish light of different wave-lengths, and we have to take the greatest care, therefore, that the reactions of the animals are not connected with differences in the intensity of the light. v. Frisch made use of the "chess-board" method. On a square board were fixed a large number of pieces of cardboard of all shades of grey, from the lightest white-grey to the darkest black-grey. Among these was placed a piece of cardboard of the colour on which the bees had been trained (blue). If the bees had no sense of colour, but distinguished between the different pieces of cardboard only by their degree of brightness, they would confuse the blue with one or other of the greys, one of which would certainly be of the same tone. If, on the other hand, they had a true colour-sense, such confusion would not occur. The result of the experiment was in favour of the possession of such a sense by the bees. The trained bees, having been accustomed to find their food on a blue background, flew to the blue pieces of cardboard only, and paid no attention to any of the others.

Since these fundamental researches were made by v. Frisch, the colour-sense of bees has been studied with much finer technique, particularly by Kuehn. Above all, we have learnt to train these insects to distinguish the pure colours of the spectrum. We are now able, therefore, to form a fairly precise estimation of the colour-sense of these insects. Bees perceive all wave-lengths between 650–313 $\mu\mu$. Within this range they distinguish four different colours. The first comprises wave-lengths from 650 to about 500 $\mu\mu$, and includes our red of shorter wave-length, and also yellow and green. Seemingly, all these appear to them as one colour. On the other hand, the red of longer wave-length, which we use in our photographic dark-rooms, bees do not distinguish at all; they confuse it with black. The second comprises wave-lengths from 500–480 $\mu\mu$ and corresponds to our blue-green, the third lies between 480 and 400 (our blue and violet). Lastly, bees perceive a fourth visual region in the ultra-violet, which is beyond our powers of sight.

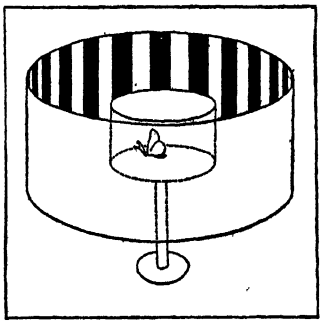
It lies between 400–310 $\mu\mu$. Bees may therefore be trained to distinguish ultra-violet just as well as blue or yellow.

A sense of colour has been proved to exist also in Lepidoptera, dragonflies and flies; perhaps it is universal among insects.

We have gone to work in quite a different manner to prove the existence of a colour-sense in Crustacea. Some of these possess the remarkable power of matching their colouration to that of the surface on which they live. On light backgrounds they are light, on dark ones they are dark. This is brought about by means of particular pigment cells (chromatophors) which are present everywhere beneath the transparent cuticle. The majority

of species have several kinds of chromatophores of different colours. *Crangon,* the species which up to the present has been studied most, has white, yellow, red and black. Stimulation takes place through the eyes; blind crustaceans are no longer able to mimic their background. The light stimuli which reach the eye are communicated to the brain, and by this are transmitted to the pigment cells in a way which we do not yet understand more exactly. Koller was able to prove that the chromatophores which expand are always those which conform in colour to the background. On a grey ground the black cells expand, on a yellow ground, the yellow cells, and on a red ground the red cells. The intensity of the light plays as unimportant a part as in the case of bees.

With the simple inquiry whether a given animal is able to see or distinguish between colours the problem of the colour-sense of animals is by no means exhausted. It can be proved that every organism, including man himself, responds differently to light and its colours, according to the conditions under which it finds itself. According to Schlieper's investigations, in the optomotor reactions about to be described, all the animals studied hitherto act as if they were colour-blind, even those in which a sense of colour has been proved beyond all doubt, either by the "training method" or in some other way. The best-known instance of such a reaction occurring in everyday life is what is called "railroad nystagmus." If we watch a person opposite us in a railway carriage who is looking out of the window, we notice that his eyes do not remain still. They seek to follow the images of the rapidly passing landscape, and move in the direction opposite to that in which the train is going. They are directed forwards again in a particular rhythm. When studying animals we can represent the railway by a rotating cylinder, in the middle of which is placed the animal under observation. The inside of the rotating cylinder has vertical strips of paper stuck on it, of which half are coloured and half grey (fig. 19). Every animal must be studied in relation to a whole series of such cylinders, which differ from one another in the shades of grey, while the coloured strips are the same in all of them. The individual animals react differently to the rotation. Some move the head, some the feelers, some the eyes. In every species, however, a particular combination of grey and colour can be found to which no movement-reaction takes place. This means that, in this instance, the animal perceives no difference between the grey and the coloured strips; it sees a uniform grey, and is thus, in this experiment, certainly as blind to colours as in the previously described experiments it was aware of them. The reaction to the other "grey and coloured" combinations is only to the different degrees of brightness of the strips, not to perception of the colour contrast. The following little table may make this clear; it is taken from the results of experiments with the common white butterfly, *Pieris brassicae,* using the colour "blue." Grey 1 is the lightest, 12 is the darkest; the measured angle is that described by the feelers of the captive insect.



AFTER SCHLIEPER

FIG. 19.—OPTOMOTOR REACTION IN BUTTERFLIES AND MOTHS

Shades of grey	Angle
1	10–15°
3	5°
4 and 5	0°
6	3°
8	10–15°
10	15–20°
12	25°

From these results emerges the startling fact, which has not yet been explained, that the same animal reacts sometimes as if perceiving colours, at others as if colour-blind.

Another important result can be obtained by the methods used by Schlieper. By comparison with the grey papers, of known numerical degrees of brightness, we can calculate the relative brightness which different colours possess for the individual animals. We then reach the remarkable result that this value for the whole of the animal kingdom corresponds to that which prevails in totally colour-blind human beings. This had already been affirmed by Hess, but not sufficient heed was paid to it.

Relative Brightness-values of Hering's Coloured Papers for

	Ladybirds (*Coccinella*)	Bees	Shore crab (*Carcinus maenas*)	*Epinephelus justina*	Man (dark adapted)	Lizard (*Lacerta*)	Man (light adapted)
Green	62	69	64	64	65	64	74
Yellow	51	62	49	49	53	73	79
Blue	24	22	24	23	25	16	22
Red	8	14	11	10	9	57	31

(W. v. BUD.)

SIGHTS. It is a matter of common experience that, owing to the curvature of trajectories, it is necessary in order to propel a missile to any considerable distance, to throw it upward as well as forward, or, to use the technical term, to give it elevation. It is also well known that the trajectories of artillery projectiles fired from rifled guns have in addition a slight curvature in the horizontal plane known as drift. These considerations are discussed quantitatively in the article BALLISTICS and it is there shown how to calculate the elevation and drift correction necessary in any particular case. The process of pointing the gun in the proper direction and giving it the proper elevation is known as laying the gun. Sights are the mechanical devices employed to facilitate accurate laying. Before going on to any detailed discussion of sights it will be convenient here to give definitions of the various technical terms employed in sighting:—

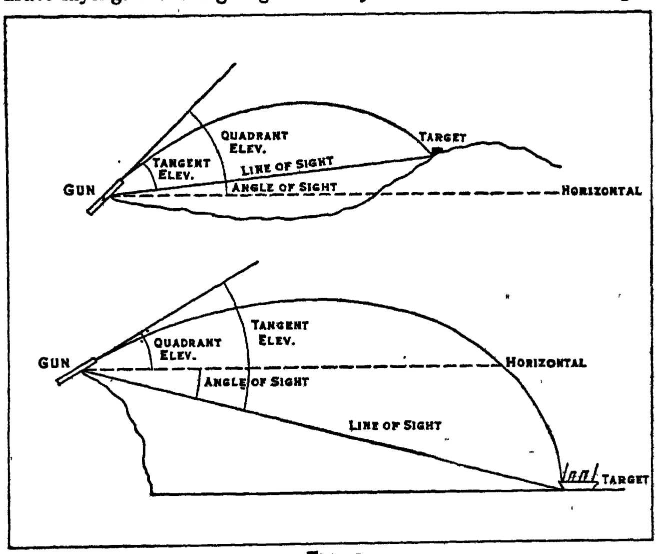


FIG. 1

Line of Fire—The horizontal direction of the target from the gun.

Line of Sight—The line joining gun and target.

Angle of Sight—The angle between the line of sight and the horizontal plane through the gun.

Axis of the Sight—The line joining the hind sight to the fore sight. In the case of telescopic sights, the sight axis is the optical axis of the telescope.

Elevation—The angle the axis of the gun is elevated above some line of reference; in particular, quadrant elevation is the angle between the axis of the gun and the horizontal plane, while tangent elevation is the angle between the axis of the gun and the line of sight.

The process of laying is best considered under two distinct headings (a) laying for line, or direction (b) laying for elevation.

In the earliest days of smooth-bore cannon and short ranges, laying for line was achieved by looking along the top of the gun and laying for elevation was neglected, the range being so short that it was sufficiently accurate to lay the gun along the line of sight (known as point-blank fire). The earliest pattern of sight used in laying for elevation was the tangent scale and foresight, and this is still the arrangement used for the sighting of rifles and machine guns.

The principle can easily be seen from fig. 2. The clamp is

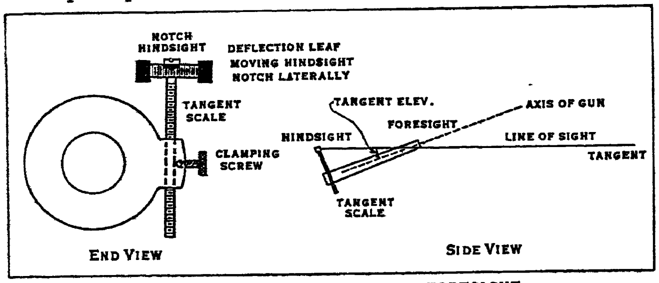


FIG. 2.—TANGENT SCALE AND FORESIGHT

loosened and the tangent bar raised by an amount varying with the desired range. To bring the notch on the tangent scale, the foresight and the target into line it is necessary to elevate the gun and the amount of elevation will depend on the amount the tangent scale has been raised. Thus the graduations on the tangent scale can be marked with the number of yards corresponding to the range realized by that particular elevation. It will be seen that the fundamental principle is that of establishing an angle between the axis of the sight and the axis of the gun, then bringing the axis of the sight to point at the target thus elevating the gun above the line of sight. Since in this case the line of sight is taken as the line of reference, laying is by tangent elevation.

Practically all modern sights are based on this principle, the chief developments being the use of a telescope mounted on a rocking bar (fig. 3) in lieu of the notch and foresight and the mounting of the sight as a whole on some non-recoiling part of the carriage instead of on the gun itself. This latter development, rendered possible by the introduction of mountings in which the gun recoils axially in a cradle, has led to increased rates of fire and also to the use of accurate optical and mechanical systems which could not have withstood the stresses experienced by any form of sight mounted on the gun itself.

Laying for Line.—A brief consideration of the factors affecting laying for line will indicate the requirements to be fulfilled by any satisfactory sight. (i.) Obtaining the line of fire. This consists in pointing the gun in the direction of the target by

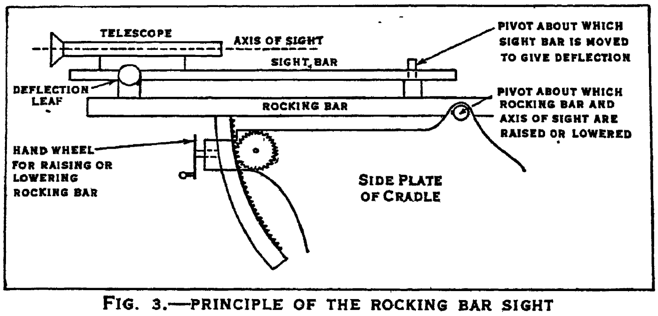


FIG. 3.—PRINCIPLE OF THE ROCKING BAR SIGHT

swinging the mounting as a whole in the horizontal plane. If the target is visible from the gun, this can be done by direct laying through a telescope mounted with its axis parallel to that of the gun. If the target is not visible from the gun, it will be necessary to get the gun in the line of fire by turning it through a calculated angle from the line to some object visible from the gun. A telescope movable about a vertical axis on which is mounted a horizontal circular disc graduated in degrees solves the fundamental part of the problem and is the basis of the panoramic or dial sight, described in the next section (fig. 6). (ii.) Corrections for wind, travel of target, etc. Having got the gun in the line of fire it will be necessary to apply minor corrections, called deflections, to compensate for the above effects. This can be done by mounting the telescope so that it can be moved in a horizontal plane right or left of the line of fire. A typical arrangement is that shown in the rocking bar sight (fig. 3). (iii.) Correction for drift. The deviation due to drift (*see* BALLISTICS) necessitates a correction varying with the range, and since it can be calculated beforehand it should, if possible, be set on the sight automatically. This can be done by means of a cam, or better, as follows:—

It can be shown that the angular deviation due to drift is, in all cases, approximately proportional to the tangent of the angle of elevation. On this basis a correction can be applied with sufficient accuracy by tilting the sight and applying the elevation at a small angle to the vertical (fig. 4). (iv.) Correction for tilt of trunnion axis or want of level of mounting. If the axis about which the gun is elevated is not truly horizontal the act of elevating will also swing the gun to the right or left, necessitating in consequence a correction for line. This error can be corrected by giving a deflection correction the amount of which must be calculated from the measured value of the tilt, but in most modern equipments the correction is made automatically by means of what is known as the oscillating bracket. Briefly the principle is as follows:—The sighting arrangements are mounted on a bracket which can be rotated ("cross-levelling") about an axis parallel to the axis of the gun—before laying for line the whole of the sighting arrangement is corrected for tilt by a cross-levelling screw and spirit bubble.

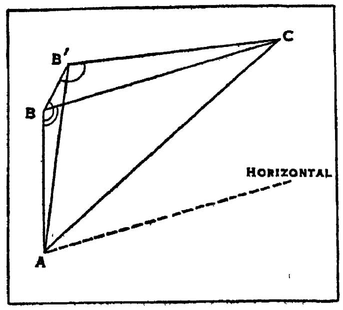


FIG. 4.—CORRECTION FOR DRIFT BY TILTING SIGHT

Laying for Elevation.—The angle of elevation can be given to the gun as quadrant elevation or tangent elevation. The basis of laying by quadrant elevation is the establishment of a given angle between the axis of the gun and the horizontal. This can be done by the use of a clinometer or similar instrument, or by attaching to some fixed part of the mounting a plate graduated in degrees, and arranging for a pointer to be geared to the elevating mechanism so as to indicate the angle through which the gun has been elevated. In some patterns, the pointer is fixed and the dial is rotated by the gearing.

Laying by tangent elevation necessitates mechanical devices for pointing the sights used for laying for line direct at the target,

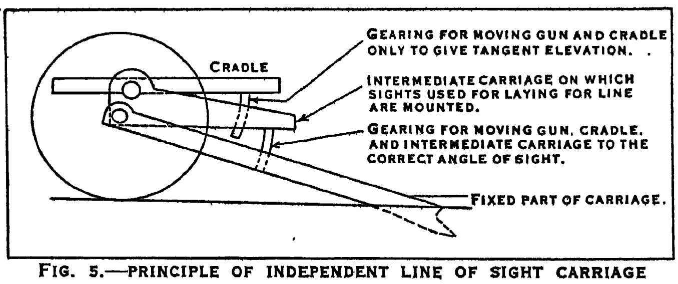


FIG. 5.—PRINCIPLE OF INDEPENDENT LINE OF SIGHT CARRIAGE

thus giving the correct angle of sight, and for elevating the gun through a further angle equal to the desired tangent elevation.

Independent Line of Sight.—The arrangement outlined above for giving tangent elevation has developed in modern light field equipments into the mounting known as the independent line of sight. It consists (fig. 5) of the introduction of an intermediate carriage between the carriage proper and the gun and cradle. One elevating mechanism elevates or depresses the gun and the intermediate carriage, on which the sights used for laying for line are mounted. This enables both gun and sights to be brought to the correct angle of sight. A second elevating mechanism is provided for elevating the gun and cradle only, and is used to establish the correct tangent elevation between the axis of the gun and the axis of the sight.

An arrangement of this nature permits of alterations in range without throwing the sights off the target. For this reason it was introduced into the British service for light field artillery, where one of the essentials is rapidity of fire—one layer can lay on the target continuously while the other puts on correction to tangent elevation. It should be noted that with the independent line of sight the axis of the sight bracket is not parallel to the axis of the

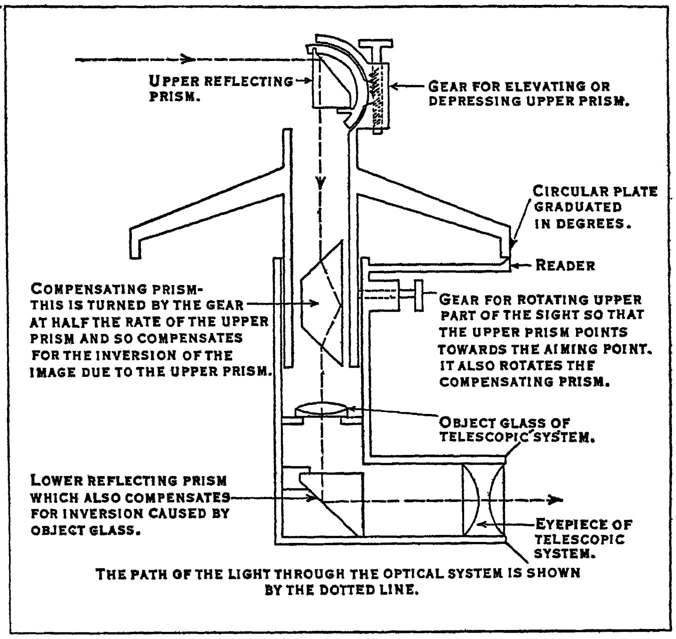


FIG. 6.—DIAL OR PANORAMIC SIGHT

gun (since the sights are mounted on the intermediate carriage, not on the cradle) so that corrections for drift cannot be made by tilt of sight, nor can want of level of mounting be corrected for by cross-levelling the sight. In guns fitted with the independent line of sight mounting, drift is usually corrected for by tilting the trunnion axis. The foregoing are the general principles and methods adopted in the design of sights.

Sights for Mobile Artillery.—The almost universal practice is to provide a dial or panoramic sight for laying for line; the principle of the arrangement can be seen from fig. 6.

With light artillery a common practice in laying for elevation is to use a mounting with the independent line of sight, drift being corrected for by tilt of trunnions. In the latest British equipments the two gears on the carriage are not entirely independent and the mounting is known as the "semi-independent line of sight" mounting. Cross levelling gear is provided and a means of correcting for drift is incorporated in the range gear. With medium and heavy mobile artillery oscillating sights of the rocking bar type are used. The arrangement of such a sight is shown diagrammatically in fig. 7.

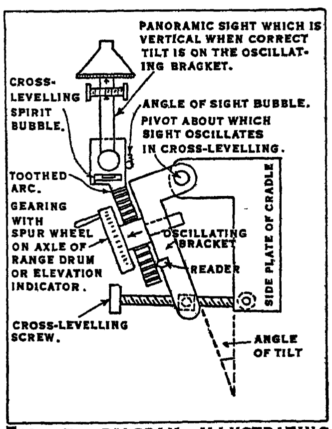


FIG. 7.—DIAGRAM ILLUSTRATING PRINCIPLE OF OSCILLATING SIGHT

In this type the dial sight is connected to a toothed arc which gears with an elevation indicator on the oscillating bracket. The arc is slightly tilted with respect to the sight to compensate for drift as elevation is applied. The dial sight carries an adjustable bubble, by means of which the angle of sight is applied, and also a bubble for cross-levelling the sight.

Sights for Fixed Artillery (Coast Defence).—In fixed coast defence mountings the design of sights is simplified by the following facts:—

(1) The mounting has been made level and therefore no method of correcting for tilt of mounting need be incorporated. (2) Economy of weight and space is not so important as in mobile mountings. (3) Each gun being at a constant (except for rise and fall of tide) height above sea level, the angle of sight at once determines the range (see description of Depression Range Finders in article RANGE-FINDERS). (4) Direct laying for line can almost always be used.

Laying for line being direct a telescope mounted as in fig. 3 solves the problem, and also permits of the application of deflection for wind, travel of target, etc. Laying for elevation is usually by quadrant elevation and a geared elevation indicator graduated in yards. This constitutes the normal method of conducting fire with the medium and heavy natures. An alternative method is that by which the gun is given quadrant elevation by elevation indicator and is directed for line by giving it a bearing from true north. This method of control can be conducted from a distant

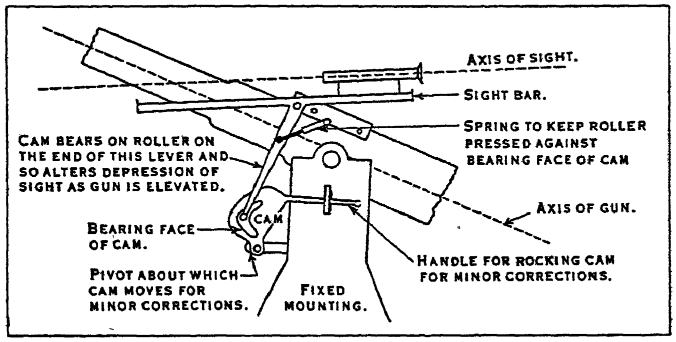


FIG. 8.—PRINCIPLE OF THE AUTOMATIC SIGHT

control post by means of position-finding instruments (*see* article RANGE-FINDERS) and is in most respects similar to central fire-control methods used in battleships.

With the lighter natures of coast artillery, the role of which is to deal with fast-moving torpedo craft, rapidity of fire is essential and the layer should be able to lay and control his gun with as much ease as a rifleman does his weapon. This can be affected by means of the automatic sight which makes use of the fact, stated above, that for each gun the angle of sight determines the range and therefore it is possible so to interconnect gun and sight that when the sight is pointing at the target, the gun has the correct line and elevation. Fig. 8 shows the general arrangement of an automatic sight.

Sights for Anti-Aircraft Artillery.—When firing at aircraft, it becomes necessary to ensure not only that the trajectory passes through the target, but also that the shell will burst at that point. Time-fuzes are used for bursting the shell and the problem of laying now is to give correct line, elevation and fuze-length. Further, the high speeds of modern aircraft make travel deflections no longer minor corrections and, as the target now moves at considerable and varying heights above the gun, change of angle of sight has also to be taken into account. Thus in this branch of artillery work sights will have to be designed so as to permit of two types of deflection—vertical deflection, due to change in angle of sight and lateral deflection, due to travel of target across the front of the gun. The laying arrangements will, in addition, have to provide some interconnection between fuze and elevation used.

The methods of laying fall into two divisions:—

(1) Control from a central post.
(2) Laying at the gun.

Control from a Central Post corresponds to central control in battleship. Some predicting instrument observes the target, selects some point on its course, predicts the time it will arrive there, passes the necessary quadrant elevation, bearing, and fuze to the gun which is laid by indicator just as in the corresponding case in coast defence—in this case no sight arrangements other than the indicators are necessary.

In laying at the gun sights of the oscillating type are used. Angle of sight is obtained by direct observation of the target. Predicting instruments give the necessary deflections which are

put on the sights, the sights being kept pointed at the target; this results in the gun being laid on the position at which the target is to be hit, known as the future position. The fuze having been ordered the layer now gives tangent elevation to the gun till a pointer cuts the corresponding fuze-line on a dial geared to the elevating mechanism. The gun is now at the correct tangent elevation. The process is continuous as the

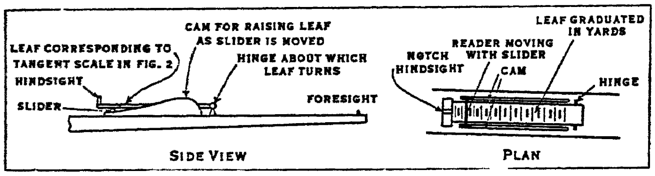


FIG. 9.—ARRANGEMENT OF RIFLE SIGHT

angle of sight is constantly changing and the layer for elevation has to keep on altering his elevation so as to keep the pointer on the fuze line corresponding to the fuze loaded in the gun.

Rifles and Machine Guns.—The sights used for this class of weapon vary very little throughout the world. Except for special purposes, telescopic sights are not used. The type is the tangent sight, consisting of a fixed fore-sight near the muzzle and a hind-sight (notch or aperture) movable in a vertical plane usually by swinging about a horizontal axis fixed transversely to the barrel. This swinging leaf takes the place of the tangent scale in fig. 2.

(G. O. C. P.; A. V. K.)

SIGHT-SINGING. The statement has often been made that in Tudor times ability to sing at sight was regarded as an accomplishment which should be possessed by every educated person. To what extent this ideal was actually realized is no doubt another matter—certainly it must have been confined to a comparatively small section of society and must have been still further limited by the scarcity of printed music. The people no doubt sang their folk songs, but these were acquired by ear.

About the middle of the last century, John Hullah (*q.v.*), an English musician seeking a method of singing from notation, turned to the Continent for inspiration, and established in Great Britain a system of teaching sight-singing, based on the principle of a fixed tonic. About the same time, John Curwen, an English Non-conformist minister, developing a method of teaching and training devised by a Miss Glover, evolved what is known as the tonic sol-fa system. This system employed not a fixed but a movable tonic, and for a time controversy ran high between the rival schools. The fixed-doh method had, however, one serious weakness, for it pre-supposed on the part of the singer a sense of absolute pitch, which is possessed by very few, and the system of a movable tonic, with its strong appeal to the perception of relative pitch, which can be cultivated in all save the aurally defective, has consequently almost completely superseded, at all events throughout the English-speaking world, the older method.

On the continent of Europe sight-singing instruction is still mostly based on a fixed tonic, though considerable attention has been given in France to a method evolved by Chevé (1850), which is based on a movable tonic, and which uses numbers instead of names for the degrees of the scale. In the United States the general method of teaching sight-singing is that based on a direct application of a movable tonic to staff notation.

SIGIRI, the Lion's Rock, the ruin of a remarkable stronghold 7° 59′ N., and 81° E., 14 m. N.E. of Dambulla, and about 17 m. W. of Pulasti-pura, the now ruined ancient capital of Ceylon. There a solitary pillar of granite rock rises to a great height out of the plain, and the top actually overhangs the sides. On the summit of this pencil of rock there are five or six acres of ground; and on them, in A.D. 477, Kasyapa the Parricide built his palace, and thought to find an inaccessible refuge from his enemies. His father Dhatu Sena carried to completion, among other good works, an ambitious irrigation scheme—probably the greatest feat of engineering that had then been accomplished anywhere in the world. This was the celebrated Kala Wewa, or Black Reservoir, more than 50 m. in circumference. The fresco paintings in the galleries are the most interesting of the extant remains. They are older than any others found in India, and have been carefully copied, and, as far as possible, preserved.

See H. C. P. Bell, *Archaeological Reports* (Colombo, 1892–1906); H. W. Cave, *Ruined Cities of Ceylon* (London, 1906).

SIGISMUND (1368–1437), Roman emperor and king of Hungary and Bohemia, was a son of the emperor Charles IV. and Elizabeth, daughter of Bogislaus V., duke of Pomerania. He was born on Feb. 15, 1368, and in 1374 was betrothed to Maria, the eldest daughter of Louis the Great, king of Poland and Hungary. Having become margrave of Brandenburg on his father's death in 1378, he was educated at the Hungarian court from his eleventh to his sixteenth year, and was entirely devoted to his adopted country. His wife Maria, to whom he was married in 1385, was captured by the rebellious Horvathys in the following year, and only rescued with the aid of the Venetians in June 1387. Sigismund had been crowned king of Hungary on March 31, 1387, and having raised money by pledging Brandenburg to his cousin Jobst, margrave of Moravia, he was engaged for the next nine years in a ceaseless struggle for the possession of this unstable throne. (*See* HUNGARY.)

In 1396 Sigismund led the combined armies of Christendom against the Turks, who had taken advantage of the temporary helplessness of Hungary to extend their dominion to the banks of the Danube. This crusade, preached by Pope Boniface IX., was very popular in Hungary. The nobles flocked in thousands to the royal standard, and were reinforced by volunteers from nearly every part of Europe, the most important contingent being that of the French led by John, duke of Nevers, son of Philip II., duke of Burgundy. After capturing Widdin, he sat down before the fortress of Nicopolis, to retain which Sultan Bajazid raised the siege of Constantinople, and at the head of 140,000 men completely overthrew the Christian forces (Sept. 25–28, 1396). Deprived of his authority in Hungary, Sigismund then turned his attention to securing the succession in Germany and Bohemia, and was recognized by his childless step-brother Wenceslaus as vicar-general of the whole empire. But on the deposition of Wenceslaus (1400) Rupert III., elector palatine of the Rhine, was elected German king in his stead. Sigismund was involved in domestic difficulties out of which sprang a second war with Ladislaus of Naples; and on his return to Hungary in 1401 he was once imprisoned and twice deposed. This struggle in its turn led to a war with Venice, as Ladislaus before departing to his own land had sold the Dalmatian cities to the Venetians for 100,000 ducats. In 1401 Sigismund assisted a rising against Wenceslaus, during the course of which the German and Bohemian king was made a prisoner, and Sigismund ruled Bohemia for nineteen months. In 1410 the German king Rupert died, when Sigismund, ignoring his step-brother's title, was chosen German king, or king of the Romans, first by three of the electors on Sept. 20, 1410, and again after the death of his rival, Jobst of Moravia, on July 21, 1411; but his coronation was deferred until Nov. 8, 1414, when it took place at Aix-la-Chapelle.

During a visit to Italy the king had obtained from John XXIII. a promise that a council should be called to Constance in 1414. He took a leading part in the deliberations of this assembly, and during the sittings made a journey into France, England and Burgundy in a vain attempt to secure the abdication of the three rival popes. (*See* CONSTANCE, COUNCIL OF.) The complicity of Sigismund in the death of John Huss is a matter of controversy. He had granted him a safe-conduct and protested against his imprisonment; and it was during his absence that the reformer was burned. An alliance with England against France, and an attempt to secure peace in Germany by a league of the towns, which failed owing to the hostility of the princes, were the main secular proceedings of these years. In 1419 the death of Wenceslaus left Sigismund titular king of Bohemia, but he had to wait for seventeen years before the Czechs would acknowledge him. But although the two dignities of king of the Romans and king of Bohemia added considerably to his importance, and indeed made him the nominal head of Christendom, they financially embarrassed him. It was only as king of Hungary that he had succeeded in establishing his authority and in doing anything for the order and good government of the land. Entrusting the gov-

ernment of Bohemia to Sophia, the widow of Wenceslaus, he hastened into Hungary; but the Bohemians, who distrusted him as the betrayer of Huss, were soon in arms; and the flame was fanned when Sigismund declared his intention of prosecuting the war against heretics who were also communists. Three campaigns against the Hussites ended in disaster; the Turks were again attacking Hungary; and the king, unable to obtain support from the German princes, was powerless in Bohemia. His attempts at the diet of Nuremberg in 1422 to raise a mercenary army were foiled by the resistance of the towns; and in 1424 the electors, among whom was Sigismund's former ally, Frederick I. of Hohenzollern, margrave of Brandenburg, sought to strengthen their own authority at the expense of the king. Although the scheme failed, the danger to Germany from the Hussites led to fresh proposals, the result of which was that Sigismund was virtually deprived of the leadership of the war and the headship of Germany. In 1431 he went to Milan where on Nov. 25, he received the Lombard crown; after which he remained for some time at Siena, negotiating for his coronation as emperor and for the recognition of the Council of Basel by Pope Eugenius IV. He was crowned emperor at Rome on May 31, 1433, and after obtaining his demands from the pope returned to Bohemia, where he was recognized as king in 1436, though his power was little more than nominal. On Dec. 9, 1437 he died at Znaim, and was buried at Grosswardein. By his second wife, Barbara of Cilli, he left an only daughter, Elizabeth, who was married to Albert V., duke of Austria, afterwards the German king Albert II., whom he named as his successor. As he left no sons the house of Luxemburg became extinct on his death.

Sigismund was one of the most far-seeing statesmen of his day, and steadily endeavoured to bring about the expulsion of the Turks from Europe by uniting Christendom against them. As king of Hungary he approved himself a born political reformer, and the military measures which he adopted in that country enabled the kingdom to hold its own against the Turks for nearly a hundred years. His sense of justice and honour was slight; but as regards the death of Huss he had to choose between condoning the act and allowing the council to break up without result.

Bibliography.—The more important works to be consulted are *Repertorium Germanicum; Regesten aus den päpstlichen Archiven zur Geschichte des deutschen Reichs im XIV. und XV. Jahrhundert* (Berlin, 1897); E. Windecke, *Denkwürdigkeiten zur Geschichte des Zeitalters Kaisers Sigmund* (Berlin, 1893), and *Das Leben Königs Siegmund* (Berlin, 1886); J. Aschbach, *Geschichte Kaiser Sigmunds* (Hamburg, 1838–45); W. Berger, *Johannes Hus und König Sigmund* (Augsburg, 1871); G. Schönherr, *The Inheritors of the House of Anjou* (Buda-Pesth, 1895); and J. Acsády, *History of the Hungarian Realm*, vol. i. (Buda-Pesth, 1903). Of the German books Aschbach is the fullest, and Windecke the most critical. Schönherr is the best Hungarian authority. Acsády is too indulgent to the vices of Sigismund. *See* also A. Main, *The Emperor Sigismund* (1903).

SIGISMUND I. (1467–1548), king of Poland, the fifth son of Casimir IV. and Elizabeth of Austria, was elected grand-duke of Lithuania on Oct. 21, 1505 and king of Poland on Jan. 8, 1506. He had served his apprenticeship in the art of government first as prince of Glogau and subsequently as governor of Silesia and margrave of Lusatia under his elder brother Wladislaus of Bohemia and Hungary. His little principality of Glogau soon became famous as a model state, in the prevailing anarchy of waning principalities, and as governor of Silesia he suppressed the robber knights with an iron hand, protected the law-abiding classes, and revived commerce. In Poland his first step was to recover control of the mint, and place it in the hands of capable middle-class merchants and bankers, like Caspar Beer, Jan Thurzo, Jan Boner, the Betmans, who reformed the currency and opened out new ways for trade and commerce. In foreign affairs Sigismund was largely guided by the Laskis (Adam, Jan and Hieronymus), Jan Tarnowski and others, most of whom he selected himself. His first wife, whom he married in Feb. 1512, was Barbara Zapolya, daughter of Stephen Zapolya of Hungary. On Barbara's death three years later without male offspring, Sigismund (in April 1518) married the beautiful and wealthy Bona Sforza, a kinswoman of the emperor and granddaughter of the king of Aragon, who used her great financial and economic talents almost entirely for her own benefit, corrupted society, degraded the clergy, and became universally detested.

During the first twenty years of his reign, Sigismund was almost incessantly at war with Muscovy. The Tatars too, ravaged the border with a frequency which ultimately led to the establishment of the Cossacks. (*See* Poland: *History*.) Protracted quarrels, again, with the grand-masters of the Teutonic Order, who were anxious to shake off Polish suzerainty led to a war in 1520–21, but were composed in 1525 when the last grand-master professed Lutheranism and as first duke of Prussia did public homage to the Polish king in the market-place of Cracow.

Personally a devout Catholic, Sigismund was nevertheless too wise and just to permit the persecution of non-Catholics; and in Lithuania, where a fanatical Catholic minority of magnates dominated the senate, he resolutely upheld the rights of his Orthodox subjects, and protected the Jews.

After his 60th year there was a visible decline in Sigismund's energy and capacity. His gigantic strength and herculean build lent him the outward appearance of health and vigour, but during the last two-and-twenty years of his reign he apathetically resigned himself to the course of events. He died on April 1, 1548. By Bona he had five children—one son, Sigismund Augustus, who succeeded him, and four daughters, Isabella, who married John Zapolya, prince of Transylvania, Sophia, who married the duke of Brunswick, Catherine, who as the wife of John III. of Sweden became the mother of the Polish Vasas, and Ann, who subsequently wedded King Stephen Báthory.

See August Sokolowski, *History of Poland* (Pol.) vol. ii. (Vienna, 1904); Zygmunt Celichowski, *Materials for the history of the reign of Sigismund the Old* (Pol.) (Posen, 1900); Adolf Pawinski, *The youthful years of Sigismund the Old* (Pol.) (Warsaw, 1893); Adam Darowski, *Bona Sforza* (1904).

SIGISMUND II. (1520–1572), king of Poland, was the only son of Sigismund I. (*q.v.*), whom he succeeded in 1548, and Bona Sforza. At his first diet (Oct. 31, 1548), he came into conflict with the *szlachta*, now becoming powerful, who, secretly supported by the Austrian court and the queen-mother, threatened to renounce their allegiance unless he repudiated his second wife, the beautiful Lithuanian Calvinist, Barbara Radziwill, daughter of the famous Black Radziwill. But his firm refusal produced a reaction, and at the second diet (1550) the *szlachta* was less turbulent. On the death of Barbara, under suspicious circumstances, five days after her coronation (Dec. 7, 1550) Sigismund made a purely political marriage with the Austrian archduchess Catherine, sister of his first wife Elizabeth, who had died young. Catherine proving childless, Sigismund, being the last male of the Jagiellos in the direct line, was anxious to have an heir, and the diet had undertaken to legitimize and acknowledge any fruit of his liaisons with Barbara Gizanka and Anne Zajanczkowska; but the Habsburgs, who coveted the throne, successfully opposed the wish of the Protestant party, that he should divorce Catherine and remarry. Actually he survived the queen's death (Feb. 28, 1572) barely six months and died childless. Sigismund's reign was a period of internal turmoil and external expansion. He saw the invasion of Poland by the Reformation, the democratic upheaval which placed all political power in the hands of the *szlachta;* the collapse of the ancient order of the Knights of the Sword in the north (which led to the acquisition of Livonia by the republic); and the consolidation of the Turkish power in the south. Sigismund's most striking and personal achievement was the union of Lublin, which made of Poland and Lithuania one body politic; and put an end to the jealousies and discords of centuries. (*See* Poland: *History*.) He died at Knyszyne on July 6, 1572.

SIGISMUND III. (1566–1632), king of Poland and Sweden, son of John III, king of Sweden, and Catherine Jagiellonika, sister of Sigismund II., king of Poland, thus uniting in his person the royal lines of Vasa and Jagiello. Educated as a Catholic by his mother, he was on the death of Stephen Báthory elected king of Poland (Aug. 19, 1587) through the efforts of the Polish chancellor, Jan Zamoyski, and of his own aunt, Anne, queen-dowager of Poland. Sigismund promised to maintain a fleet in the

Baltic, to fortify the eastern frontier against the Tatars, and not to visit Sweden without the consent of the Polish diet. The articles of Kalmar regulated the future relations between Poland and Sweden, when Sigismund should succeed his father as king of Sweden. The two kingdoms were to be perpetually allied, but each of them was to retain its own laws. Sweden was also to enjoy her religion subject to such changes as a general council might make. During Sigismund's absence from Sweden that realm was to be ruled by seven Swedes, six to be elected by the king and one by Duke Charles, his Protestant uncle. Sweden, moreover, was not to be administered from Poland. The Poles first wished the cession of Estonia to Poland, but eventually the territorial settlement was postponed; and Sigismund was duly crowned at Cracow on Dec. 27, 1587.

From the first Sigismund was out of sympathy with the majority of his subjects. As a man of education and refinement, he was unintelligible to the *szlachta*, who regarded all artists and poets as either mechanics or adventurers. His reserve was called stiffness and his calm, haughtiness. Even Zamoyski who had placed him on the throne complained that the king was possessed by a dumb devil. He lacked, moreover, the tact and bonhomie of the Jagiellos.

The first 23 years of the reign are the record of a constant struggle between Zamoyski and the king. In 1592 Sigismund married the Austrian archduchess Anne, and a reconciliation was patched up between the king and the chancellor to enable the former to secure possession of his Swedish throne vacant by the death of his father John III. He arrived at Stockholm on Sept. 30, 1593 and was crowned at Upsala on Feb. 19, 1594, after he had consented to the maintenance of the "pure evangelical religion" in Sweden. On July 14, 1594 he departed for Poland leaving Duke Charles and the senate to rule Sweden during his absence. Four years later (July 1598) Sigismund was forced to fight for his native crown by the usurpation of his uncle, aided by the Protestant party in Sweden. He landed unopposed at Kalmar. After fruitless negotiations, Sigismund advanced with his army, but was defeated by the duke at Stängebro on Sept. 25. He never saw Sweden again, but refused to abandon his claims; and this unfortunate obstinacy was to involve Poland in a whole series of unprofitable wars with Sweden.

In 1602 Sigismund wedded Constantia, the sister of his deceased first wife, an event which strengthened the hands of the Austrian party at court and still further depressed the chancellor. At the diet of 1605 Sigismund endeavoured to substitute a decision by a plurality of votes for unanimity in the diet. The opposition of Zamoyski nullified the effect of this salutary reform. His death, however, in the same year left his more ardent followers without a check. From 1606 to 1610 Poland was in an anarchical condition. On foreign affairs these disorders had a disastrous effect. Poland was unable to take the opportunity of breaking the power of the tsars, which the collapse of Muscovy had shaken. At the outbreak of the Thirty Years' War Sigismund prudently leagued with the emperor against the Turks and the Protestants. Sigismund died very suddenly in his 66th year, leaving two sons, Wladislaus and John Casimir, who succeeded him in rotation.

See Aleksander Rembowski, ***The Insurrection of Zebrzydowski*** (Pol.) (Cracow, 1893); Stanislaw Niemojewski, *Memoires* (Pol.) (Lemberg, 1899); *Sveriges Historia*, vol. iii. (Stockholm, 1881); Julian Ursyn Niemcewicz, *History of the Reign of Sigismund III.* (Pol.) (Breslau, 1836).

SIGMARINGEN, a town of Germany, chief town of Hohenzollern, on the right bank of the Danube, 55 m. S. of Tübingen, on the railway to Ulm. Pop. (1925) 5,282. The castle of the Hohenzollerns crowns a high rock above the river.

The division of Sigmaringen or Hohenzollern is a part of Prussia and has an area of 440 sq.m. and a population (1925) of 71,773. It was formerly divided into the principalities of Hohenzollern-Sigmaringen and Hohenzollern-Hechingen. *See* HOHENZOLLERN.

SIGMOID: *see* ALIMENTARY SYSTEM.

SIGNAL (a word common in slightly different forms to nearly all European languages, derived from Lat. *signum*, a mark, sign), a means of transmitting information, according to some prearranged system or code, in cases where a direct verbal or written statement is unnecessary, undesirable, or impracticable. The methods employed vary with the circumstances and the purposes in view, and the medium into which the transmitted idea is translated may consist of visible objects, sounds, motions, or indeed anything that is capable of affecting the senses, so long as an understanding has been previously effected with the recipient as to the meaning involved. Any two persons may thus arrange a system for the transmission of intelligence between them, and secret codes of this kind, depending on the inflections of the voice, the accent on syllables or words, the arrangement of sentences, etc., have been so elaborated as to serve for the production of phenomena such as are sometimes attributed to telepathy or thought transference. With the many private developments of such codes we are not here concerned, nor is it necessary to attempt an explanation of the systems of drum-taps, smoke-fires, etc., by which certain primitive peoples are supposed to be able to convey news over long distances with astonishing rapidity; the following article is confined to giving an account of the organized methods of signalling employed at sea, in military operations and on railways, these being matters of practical public importance.

SIGNALLING. "Puff—double-puff; double-puff—puff!" So ran the signals made by the Picts beyond the Roman wall, their smoke puffs seen by the sentries of the legions but the signallers invisible and their meaning unguessed. And so, for thousands of years before, had savage peoples signalled their tidings of peace and war. The antiquity of signalling is undoubted, its lineage long and illustrious. For long centuries its chief purpose was to convey news of great events over great distances, and its application to the control of troops in battle is a development of yesterday.

THE PLACE OF SIGNALLING IN WAR

Its older forms, which are prehistoric, must be numbered among those savage arts that civilization kills but cannot emulate, of which the mysterious passage of news through the African bush is an example, to this day. Compared with them the famous beacon fires, calling England to arms as the Armada sailed up channel, were crude enough. The semaphore stations, each with its tall mast and signalling arms, which linked London with the south coast while Napoleon's Grand Army waited at Boulogne, were an advance, for they could spell out any message—they have given its name to more than one Telegraph hill in the south of England. In the early 19th century also, Sir Home Popham introduced the system of flag hoists in the British navy. But it is only with the help of applied science that civilized man has lately learnt to communicate with his fellows at a distance, by means of the "electric telegraph" of the mid-nineteenth century, to be followed two generations later by wireless telegraphy.

In spite of our evidence of man's need from early times to communicate afar, on the field of battle for countless years we see little sign of any attempt at control by signal. "Horns are heard blowing in the mist, and a confused uproar of savage tumult and outrage." Kings and captains, themselves in the thick of the press, were content to command by voice and example. It is not that the need was never felt; we learn in the Song of Roland how Charles the Great, as he marched north out of Spain, heard his lieutenant's horn blown for help in the mountains behind him; how he heard the signal twice and misread it, grasped its meaning the third time and turned back too late to save his rearguard. For one such incident made immortal in verse there must have been many lost in obscurity. None the less, through ages of warfare, the means of control in battle were more or less adequate to the needs. Firearms came and the long bow disappeared; modern nations appeared in arms, first the French and then the Germans, and tens of thousands co-operated on the battlefield in an iron discipline. Yet troops still fought in close order; generals continued to command from the saddle; the word of command, trumpet and bugle call and the galloping staff officer gave to commanders all the control they needed. The duke of Wellington could say at Waterloo, "The whole line will advance," and could watch the squares swing into line as his order took effect.

Then came the industrial revolution which was to affect war no less than every other branch of human activity, and in half a

century all was changed. In 1861 the beginning of the American Civil War saw the old order but little altered; the technique of war remained comparatively simple and dealt in the traditional elements of horse, foot and smooth-bore artillery. In 1918 the end of the World War saw armies so vast and so complex in armament that the most elaborate signal systems scarcely sufficed for their control. The process continues apace. In the second decade after the war we find a commander still disposing of infantry, artillery and cavalry, it is true; but half the infantry is armed with machine guns or automatic rifles; the gunner rarely sees his enemy; cavalry carry machine guns and must co-operate with mechanized fire units to retain their power of movement. The three older arms are altered beyond recognition, and in addition a commander has tanks, armoured cars and aircraft. These elements, widely deployed under the enemy's fire, he must weld into a single living organism, driven by one brain and working to one end. The problem of signalling is to enable a commander to achieve this ideal, and all his powers of fire and movement avail him only in so far as the problem is solved. Moreover, he must see before he can strike. All commanders grope in the fog of war, and the extent to which that fog may thin from time to time or allow a precious clear glimpse depends very much upon the state of signal communication. In addition, the infinite material needs of a modern army make as great demands upon intercommunication as does the actual conduct of battle.

ORIGIN AND GROWTH OF SIGNALLING

Birth of Signalling.—Before coming to any account of signalling in modern armies, we must go back a little to the invention of the electric telegraph. The first application of this invention to war was made by the British army in the Crimea in 1854, where a telegraph line was laid from Varna to the monastery of St. Georgia, from which lines were laid to Lord Raglan's headquarters and thence to established stations in the trenches. It was a curious intrusion of science and organization into a military system which was famous for neither and which was based upon the Brown Bess and the pack transport of the Peninsular War. In the Indian Mutiny three years later the scattered British forces were kept in telegraphic touch with one another and with the Government in Calcutta, and although this was an application of a civil telegraph service to military needs rather than an example of military signalling, yet it was remarkable as the first example of how the new system could be used to co-ordinate the movements of armies, and above all to transmit vital intelligence. That the newly established telegraph service was controlled by the Government and not by the forces of mutiny was one of the deciding factors in that struggle.

The American Civil War of 1861–65 saw a great development in the use of telegraphy with the armies in the field; and in the short and decisive Prussian campaign against Austria in 1866 a field telegraph equipment played an important part in keeping the directing brain of von Moltke in touch with the headquarters of the various armies. A few months afterwards the first British field telegraph unit was formed, entitled the Field Electric Telegraph Train, Royal Engineers. This unit is worth looking at a little closely, for it contained in itself the germ from which sprang the signal organization of the British armies which fought in the World War. It comprised two wire wagons and two office wagons; the two wire wagons each carried four miles of insulated cable on eight half-mile drums, and it is clear from this that here was a unit designed for the tactical control of troops in battle, as opposed to the long distance strategic uses of the telegraph which have been mentioned hitherto. Jointed poles were carried for raising the cable clear over roadways, but otherwise it was laid on the ground. Each office wagon formed a travelling telegraph office, and it is to be noted that in addition to the Morse recording instruments with which it was fitted, it carried visual signalling apparatus in wicker panniers suitable for pack animals, so that wire and visual communication could supplement one another.

So we come to visual signalling. In 1861 it had occurred to two British officers, Capt. Bolton of the 12th Regiment and Capt. Colomb, R.N., that the dots and dashes of the Morse alphabet could be transmitted by visual signals no less than by electric impulses over a wire. Working together they developed what they called "the flashing system," which made use of shutters or flags by day and lamps by night to form the dots and dashes, and which stands to this day with little change save in detail. The authorities took favourable notice of the new invention in a letter dated from the War Office on March 30, 1863. By 1865 it had been adopted for the British navy and army, and a code for signalling between H.M. ships and troops ashore had been drawn up. The following extract from *The Times* of Aug. 20, 1864, is interesting: "The Lords of the Admiralty . . . proceeded on board the 'Pigmy,' where they passed nearly an hour inspecting the signal apparatus fitted on board for carrying out the experimental signalling by day and by night, between positions in mid-Channel and Portsmouth Dockyard, under the direction of Captain Frank Bolton of the 12th Regiment, and Commander Colomb of Her Majesty's Navy. Their Lordships expressed their gratification at the manner in which this effective system of joint naval and military telegraphy had been developed by the exertions of these two officers. . . ."

Whether the idea travelled across the Atlantic or whether, as is likely enough, the same thought had spontaneous birth in two hemispheres, is not clear; but it is certain that the Federal army under Gen. Grant employed visual signalling in the American Civil War of 1861–65. In the British army the innovation had not long to wait for its trial on active service, and in the Abyssinian campaign of 1867–68 the 10th Company of Sappers in Sir Robert Napier's force contained an officer and a number of "telegraphers" especially instructed in the new art. Its success was immediate and remarkable, and it is perhaps difficult for later generations to realize the impression which it must have made upon an army accustomed only to the traditional means of message carrying by galloper and aide-de-camp. Some of the messages transmitted give interesting glimpses into the campaigning conditions of the country and period, but here there is room to quote one only: "From Captain Pottinger to Major Murray, R.A. Bring your battery up to Magdala. Better come on elephants. One hundred yards extremely Steep."

Later Developments up to the World War.—From the foregoing it may be seen that signalling started simultaneously in the old and new world during the '60s of last century. In the years which followed it grew in diverse ways according to the soil in which it was planted, and one of its most remarkable developments was the use of the heliograph for long distance communication on the northwest frontier of India. It was perhaps inevitable that those armies with traditions of fighting over wide spaces in undeveloped lands should pay more attention to signalling than did the forces of Continental Europe. Whatever the reasons there seems little doubt that Britain with her colonial empire, and the United States with their empty and uncivilised West attached especial importance to this branch of war. In fact it was not until 1902 that the first German signalling regulations appeared. The British army profited by the experience of its Indian frontier and colonial wars, and the South African campaign at the end of the century found it equipped with highly specialized Royal Engineer telegraph units, capable equally of erecting overhead telegraph wires, or of laying field cables across country at a speed limited only by that of the six-horse teams which drew the cable wagons.

The South African War was followed in the British army by a flowering and expanding period in both organization and training, such as it had not before experienced in times of peace. Signalling shared to the full in this development. Wireless telegraph units were added to the army, principally for communication with cavalry formations. Message carrying became recognized as the ally and not the rival of telegraphy in the field, and despatch riders on horse and motor cycle were included in the signal organization; their rôle was to carry the longer and less pressing messages and so to leave the telegraph free to deal immediately with short and urgent reports and orders. The intercommunication problem was thus seen as a whole, and this inclusion of despatch riding in the signal organization is one of the points which most distinguished the British from the Continental systems. The "telegraph" units of the South African War, which dealt only in line telegraphy,

gave place to "signal" units employing in co-operation line telegraphy, visual telegraphy and despatch riding. And as the British army was during this period definitely organized into divisions and brigades, so each formation had its own signal unit allotted to it for peace and war.

During these years the *signal office* organization came to be recognized, whereby at each important headquarters in the field the signal unit establishes a signal office, controlling all the available means of communications. Here the line telegraph operators work and the despatch riders wait their call, while the visual and wireless stations are as close outside as they can be placed. All outgoing messages from the headquarters are taken over at the signal office and there handed to the appropriate operator or despatch rider, and from there all incoming messages are distributed.

The British signal units were found from the Royal Engineers. It remained for the United States to go a step further and to form a separate signal corps; a notable organization which did not take long to make its mark in the world of science. In considering the policies which led the one country to retain signalling as a branch of military engineering and the other to form a specialist corps, it must be remembered that all telegraphic communication in Great Britain is a Government monopoly vested in the postmaster-general, so that the army's attention is confined to the purely military problem of communication in the field. The United States had no such federal organization, and their signal corps could and did provide important Government communications. Included among these was the wireless connection between the United States and their detached territories in Alaska. This pre-war period was marked by the wide use of heliograph and lamp signalling which the Germans made in their 1905 campaign in South-west Africa; and—of far greater import—by the intensive field telephone system in the siege operations of the Russo-Japanese War in 1904–05.

THE WORLD WAR

Trench Warfare and Fire Power.—The Powers entered upon the World War in 1914 equipped in varying degrees with line, visual and wireless telegraphy. In organization, military status and efficiency the signalling services of the armies varied greatly. At one end of the scale was Great Britain, whose signal units were worthy of that "perfect miniature" of which they formed part—the original Expeditionary Force. It seems that the small British army felt instinctively a greater need for efficient intercommunication in war to develop its full striking power, as compared with the vast forces of the Continent, which trained yearly by armies and army corps together and had long experience in the administration and manoeuvre of masses. At the other end of the scale stood Russia, putting her trust in numbers and neglecting the means to co-ordinate their movements. It was a neglect for which she paid dearly, and the annihilation of the Russian columns in East Prussia at the hands of Marshal von Hindenburg was due largely to the total lack of communication between them. At the same time the German drive through Belgium and Northern France, with which the war opened and which so nearly succeeded, owed its miscarriage in part to the failure of the wireless communication which was to have connected their general headquarters with the armies of the right wing. For a few short weeks the tide of battle in the west ebbed and flowed before it settled down to the long-drawn, bloody and apparently fruitless hammer and tongs of trench warfare. The outstanding feature of the latter phase was the overwhelming effect of fire. This, it is true, had been foreshadowed by the Russo-Japanese War and by progressive developments in magazine rifles, machine guns and both field and heavy artillery, but its terrific power was none the less a surprise to both sides.

Buried Cables and Emergency Methods.—Under the growing intensity of bombardment it soon became impossible to protect cables laid on the surface, and both sides were forced to put their lines underground; these were at first only a foot or two below the surface, but the steadily increasing weight of metal drove them deeper and deeper, until by 1918 six feet was the common depth and new systems were being installed eight feet underground. Thus on each side as the war went on there grew an immense gridwork of deep-buried cables, with main arteries every few thousand yards along the front running from the rear up to the forward trenches, joined across by lateral routes. Each buried route might contain 10, 20, 50 or more conductors and the systems included hundreds of underground test points and distributing centres. In the back areas, comparatively immune from shelling, the buried cables gave place to overhead systems stretching back over the lines of communication and conforming to the normal practice of civil telegraph engineering. So we have the phenomenon of rival armies, each seeking desperately to break through its opponent's line and fight in the open, growing more and more dependent upon a telephone system which must inevitably be left behind if that object should be gained.

The cables, even the most deeply buried, might be and frequently were cut at critical moments. At once the alternative visual and wireless methods held in reserve, inadequate though they were, became of vital importance. Visual signalling could no longer, under such a fire, be carried out by the traditional soldierly figure standing square on his feet with a flag. It generally took the form instead of an electric signalling lamp working through a deep embrasure, or of a small inconspicuous shutter showing just above the parapet; and any form of visual signalling working from the rear forwards was more than likely to be seen by the enemy and to draw his fire. Wireless signalling at that time laboured under the drawback that an exposed aerial was necessary, no less liable to be shot away than the cables were to be cut. The need for something less vulnerable led to the revival of an old principle, that of earth induction, whereby an alternating current in a length of wire connected to earth at each end induces corresponding impulses in a similar wire up to a distance of a few thousand yards. The wires could be buried and the instruments protected in dugouts so that the whole became comparatively shell-proof. As, however, each transmitter affected every receiver within its range they could be installed only at wide intervals along a front. Finally, each side evolved a code of firework signals, such as coloured lights, to be fired by the forward infantry if they should be attacked, each signal conveying its own message to the supporting artillery.

Other means were sought, less costly in life and less vulnerable to fire. These expedients all took the form of message carrying, and their agents were pigeons, messenger dogs and rockets. Of the three, pigeons were by far the most reliable; they might be delayed by darkness, chased by hawks, lost in the smoke and uproar or killed in crossing a barrage, but they made their lofts on the whole with remarkable regularity and sometimes showed a pathetic courage. More than one reached its loft wounded and died as it alighted, and one such in the French army was officially decorated for valour. Messenger dogs were less successful; their intelligence made them temperamental. Success demanded special treatment and a rigid discipline, which must be enforced not only by their kennelmen but by all with whom the dogs came in contact. Under these circumstances it was natural that the Germans, with their instinct for regulation, should achieve better results than their enemies. Nothing could prevent the British soldier from making a pet of any dog in his vicinity, and a dog which had been made much of in a forward position would not face the shell-swept open to regain his kennel. None the less in proper hands they could prove their worth. Rockets could carry a message some 2,000 yards across a region where neither runner nor signaller could live and where no wire could remain uncut; but to be successful they were required to drop a message with some certainty within reasonable reach of their destination, and this was a stage of reliability to which they never attained.

Air Co-operation.—While signalling was adapting itself to meet such changes in its old tasks, it found itself faced with a new duty, that of communicating with aircraft. A commander might have his eyes in the air above the enemy lines, but without the nerve connecting eye to brain he was little the better for it. At the outset aircraft of both sides were employed solely on reconnaissance and the pilot made his report after landing. It was not

long, however, before there was added to this the duty of observing for artillery, and this was made possible only by the adaptation of wireless telegraphy for signalling the fall of shell to the guns. At the same time the need arose for bodies of infantry, isolated after an attack and cut off by fire from their friends, to report their position and their predicament. This need was met to a limited extent in the different armies by codes of ground signals, displayed by the isolated troops to their own aircraft. The signals consisted generally of canvas strips laid out on the ground in set forms or groups of letters, each with its special meaning.

Tapping an Enemy's Communications.—The conditions of warfare on the Western front gave rise to a further new activity of signalling. A commander at all times has sought to read his enemy's mind; to divine "what is happening on the other side of the hill." In the war each commander found himself faced by the impenetrable barrier of the enemy's front line, behind which stretched the cables carrying intelligence of inestimable value to him, could he but hear it. So the rival intelligence bureaus asked their signallers if there were no means of tapping the enemy's cables. The experts worked for a time in closely guarded secrecy, and soon on either side unaccountable miscarriages began to occur. An attack would be planned in scrupulous detail; troops and staff would play their parts faultlessly, but at the critical moment an enemy bombardment, perfectly timed and directed, would turn the packed assembly trenches into a bloody chaos. Like incidents were repeated, for which the only possible explanation was that the enemy was possessed in detail of the plans for the operation.

But it is difficult in war to keep any development hidden for long. Somebody blundered on one side or the other; perhaps a prisoner boasted or an instrument was captured, and the secret was out. The experts of either side had taken the new invention of the triode valve, as it had been developed up to that point by wireless engineers, and had evolved from it an instrument so sensitive that it could read the traffic over an enemy's cables some thousands of yards away. The mysterious forewarnings vouchsafed were merely the enemy's operation orders intercepted word for word. The extent to which such eavesdropping was possible depended on various technical factors, and it was much reduced by the use of metallic circuits instead of earth return cables, but henceforth either side could use its forward cable system only in the knowledge that enemy listeners were straining their ears to overhear. Wireless telegraphy suffered of course at all times under the same limitation, to a much greater degree.

The Last Phase; Open Warfare.—On the Western front from the end of 1914 till the spring of 1918 the struggle grew in intensity but did not change its nature. The combatants fought where they stood; the line sagged and swayed as here or there a short advance was made at bitter cost; but it did not break and the chief concern of signalling was with fire power, to enable commanders to direct their ever-growing masses of emplaced artillery. Then came the German break-through by a supreme effort in March 1918—a feat of arms which was to spend itself within sight of victory and to be checked, held and at last turned back by the Western armies in their final advance to victory. The armies fought once more over the open; signalling was again concerned with troops in movement, and the underground telephone systems, constructed at such cost through three years of war, had to be left behind. The very reliance which their possessors had learnt to place in them became itself a handicap; few of the original combatants survived; those few had grown accustomed to the war of the trenches, and to most of those who fought in 1918 war without a lavish telephone system was a strange conception. Moreover, the armies which emerged from their trenches in 1918 were not those which had gone to ground three years beforehand; with more artillery and machine guns, with aerial co-operation, with tanks and armoured cars and with the new tactical methods which all these demanded, they could never again be satisfied with the 1914 scale of signal communication. Commanders were faced with the problem of how to co-ordinate movement, to direct fire power and to administer their formations in open warfare, unaided by the trench telephone system to which all had grown accustomed.

MARINE SIGNALLING

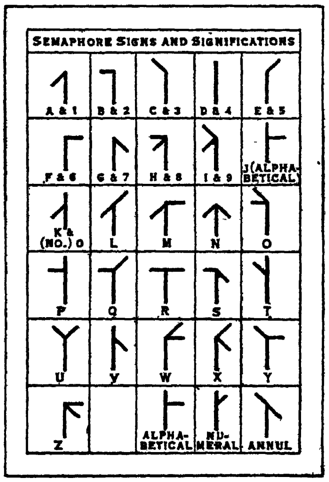
The main difference to be noted between signalling at sea and on land is that in the former case no physical connection, whether by wire or messenger, is possible. One is therefore restricted to visual, sound or wireless methods.

Visual methods, which are normally not effective beyond horizon distances (depending on visibility at the time), fall into two main categories, viz., day and night.

Flags.—By day, coloured flags and pendants have long been employed. These, originally, had purely arbitrary meanings, depending in many systems on the actual position where they were displayed in a ship. In the middle of the nineteenth century, however, standard colours were agreed upon internationally, and an "International" code of signals for use at sea was brought into force. The flags of the code include the twenty-six letters of the alphabet and a "code" pendant. By means of hoists not exceeding four flags, it is possible to make any signal from the International Code or spell out words not contained therein. The code has since been translated into the languages of the principal maritime Powers. A new edition of the International Code of Signals is now in active preparation.

Separate sets of flags and elaborate systems of grouping are in use by most navies to meet their special requirements.

Semaphore.—Visual communication by day can also be carried out by means of the semaphore, a device which exhibits one or more straight arms in certain positions. The early forms of the system were principally used by coast stations and were of the nature of fixed signals. These coast semaphores still exist, chiefly in France, but have been superseded, so far as signalling between ships is concerned, by a moving semaphore system employing only two arms, which are moved to consecutive positions (indicating letters of the alphabet) as necessary to spell out the message. It can be made by a mechanical semaphore or with the signalman's own arms. International agreement on this system has not been reached, but the alphabet shown here is in force in Great Britain and the United States. This is an extremely rapid form of communication at short distances, and transmission speeds of 25 words a minute or over can be attained by expert signalmen.



Flashing.—For longer distances by day, most large vessels are now equipped with powerful lamps or searchlights fitted with some form of louvre shutter, enabling the light to be flashed. Using Morse, messages can be spelt out verbatim or code groups signalled as desired. With brilliant lights of this nature communication can be effected by night between ships at more than horizon distance, provided that weather conditions are favourable.

At night, plain and coloured lanterns in various combinations constituted the earliest form of signalling, being superseded eventually by the introduction of flashing in conjunction with the Morse Code. Both by day and at night, the speed of transmission by flashing is comparatively slow on account of the physical limitations of the human eye, and a rate of 12 words a minute is seldom exceeded in practice.

Fireworks, *e.g.*, bonfire beacons, Roman candles, rockets, Very's lights, etc., have all been pressed into the service of signalling, but only the three last named still survive and their use is mainly confined to short messages of a standard nature, such as signals of distress, requests for a pilot, etc.

Sound Signals.—During fog or conditions of low visibility generally, sound signals are possible, and were until comparatively recent years in fairly common use. Formerly, more particularly in men-of-war, blank charges were fired from guns at various intervals to convey the meaning desired, but here again the Morse Code

was triumphant over the older method, first by means of the hand-worked foghorn and later by sirens driven by steam or compressed air. Sound signalling under these conditions, however, is extremely cumbrous and much slower even than flashing, and nowadays is chiefly used to indicate a ship's presence to others who may be in her vicinity.

Many modern navies have now adopted a system of underwater signalling in which sound impulses are communicated to the water by means of an electrically-driven oscillator and received by a microphone in the hull of other ships, who read off the signal in ordinary head telephones. Telegraphic speeds up to 20 words can be reached thus, though the range of transmission does not usually exceed 12 miles except under very good conditions.

Up to the end of the last century, the limitations of range inherent in the foregoing systems of signalling rendered long-distance communication with ships impossible. Once at sea and over the horizon, it was only possible to direct their movements or issue orders by cable messages sent to their known ports of call or the coast signal stations with which they would speak on their voyage. Conversely, a ship out of sight of land was equally impotent to report her position or notify distress or other casualty.

Wireless Signalling.—Wireless telegraphy (*see* WIRELESS TELEGRAPHY), with which the great majority of seagoing vessels are now legally bound to be equipped, has achieved one of the most spectacular changes of our age. It may fairly be said that no ship is now beyond the range of wireless, even though her own installation may be too weak to ensure her communication with the shore at all times.

It is hardly within the scope of this article to do more than indicate a few of the ways in which wireless telegraphy (including also its younger cousin, wireless telephony) serves the mariner. So far as navigation is concerned, powerful shore stations send out daily time signals correct to a fraction of a second, direction finding stations (if the ship herself has not a direction finding receiver on board) furnish her with her bearing from them, while a distress message in any of the seven seas will bring perhaps half a dozen vessels rushing to her aid. By means of wireless, passengers in ocean-going liners get their daily newspaper and bankers are enabled to pursue their financial operations on the high seas. Shipowners can divert their vessels in search of profitable cargoes, and admiralties control their fleets with a precision undreamed of in the old naval wars.

Historical Development.—The necessity of some plan of rapidly conveying orders or intelligence to a distance was early recognized. Polybius describes two methods, one proposed by Aeneas Tacticus more than three centuries before Christ, and one perfected by himself, which, as any word could be spelled by it, anticipated the underlying principle of later systems. The signal codes of the ancients are believed to have been elaborate. Generally some kind of flag was used. Shields were also displayed in a preconcerted manner, as at the battle of Marathon, and some have imagined that the reflected rays of the sun were flashed from them as with the modern heliograph. In the middle ages flags, banners and lanterns were used to distinguish particular squadrons, and as marks of rank, as they are at present, also to call officers to the admiral, and to report sighting the enemy and getting into danger. The invention of cannon made an important addition to the means of signalling. In the instructions issued by Don Martin de Padilla in 1597 the use of guns, lights and fires is mentioned. The introduction of the square rig permitted a further addition, that of letting fall a sail a certain number of times. Before the middle of the 17th century only a few stated orders and reports could be made known by signalling. Flags were used by day, and lights, occasionally with guns, at night. The signification then, and for a long time after, depended upon the position in which the light or flag was displayed. Orders, indeed, were as often as possible communicated by hailing or even by means of boats. As the size of ships increased the inconvenience of both plans became intolerable. Some attribute the first attempt at a regular code to Admiral Sir William Penn (1621–1670), but the credit of it is usually given to James II. when duke of York. Notwithstanding the attention paid to the subject by Paul Hoste and others, signals continued strangely imperfect till late in the 18th century. Towards 1780 Admiral Kempenfelt devised a plan of flag-signalling which was the parent of that now in use. Instead of indicating differences of meaning by varying the position of a solitary flag, he combined distinct flags in pairs. About the beginning of the 19th century Sir Home Popham improved a method of conveying messages by flags proposed by R. Hall Gower (1767–1833), and greatly increased a ship's power of communicating with others. The number of night and fog signals that could be shown was still very restricted. In 1867 an innovation of prodigious importance was made by the adoption in the British navy of Vice-Admiral (then Captain) Philip Colomb's flashing system, on which he had been at work since 1858.

SIGNATURE (through Fr. from Lat. *signatura*, *signare*, to sign, *signum*, mark, token, sign), a distinguishing sign or mark, especially the name, or something representing the name, of a person used by him as affixed to a document or other writing to show that it has been written by him or made in accordance with his wishes or directions. In the early sense of something which "signifies," *i.e.* marks a condition, quality or meaning, the word was formerly also used widely, but now chiefly in technical applications. In old medical theory, plants and minerals were supposed to be marked by some natural sign or symbol which indicated the particular medicinal use to which they could be put; thus yellow flowers were to be used for jaundice, the "scorpion-grass," the old name of the forget-me-not, was efficacious for the bite of the scorpion; many superstitions were based on the human shape of the roots of the mandrake or mandragora; the bloodstone was taken to be a cure for hemorrhage; this theory was known as the "doctrine of signatures." (*See* T. J. Pettigrew, *Superstitions connected with Medicine or Surgery*, 1844.) In printing or bookbinding the "signature" is a letter or numeral placed at the bottom of the first page of a section of a book, as an assistance to the bookbinder in folding and arranging the sections consecutively; hence it is used in connection with a sheet ready folded. In music it is the term applied to the signs affixed at the beginning of the stave showing the key or tonality and the time or rhythm.

SIGN-BOARD, strictly a board placed or hung before any building to indicate its character. The French *enseigne* indicates its essential connection with what is known in English as a flag (*q.v.*), and in France banners not infrequently took the place of sign-boards in the middle ages. Sign-boards, however, are best known in the shape of painted or carved advertisements for shops, inns, etc.; they are in fact one of various emblematic methods used from time immemorial for publicly calling attention to the place to which they refer. The ancient Egyptians and Greeks are known to have used signs, and many Roman examples are preserved, among them the widely-recognized bush to indicate a tavern, from which is derived the proverb "Good wine needs no bush." In some cases, such as the bush, or the three balls of pawnbrokers, certain signs became identified with certain trades, but apart from these the emblems employed by traders—evolving often into trade-marks—may in great part be grouped according to their various origins. Thus, at an early period the cross or other sign of a religious character was used to attract Christians, whereas the sign of the sun or the moon would serve the same purpose for pagans. Later, the adaptation of the coats-of-arms or badges of noble families became common; these would be described by the people without consideration of the language of heraldry, and thus such signs as the Red Lion, the Green Dragon, etc., have become familiar. Another class of sign was that which exhibited merely persons employed in the various trades, or objects typical of them, but in large towns where many practised the same trade, and especially, as was often the case, where these congregated mainly in the same street, such signs did not provide sufficient distinction. Thus a variety of devices came into existence—sometimes the trader used a rebus on his own name (*e.g.*, two cocks for the name of Cox); sometimes he adopted any figure of an animal or other object, or portrait of a well known person, which he considered likely to attract attention. As early as the 14th century there was a law in England compelling publicans to exhibit signs, for in 1393 the prosecution of

a publican for not doing so is recorded. In France edicts were directed to the same end in 1567 and 1577. Since the object of sign-boards was to attract the public, they were often of an elaborate character. Not only were the signs themselves large and sometimes of great artistic merit (especially in the 16th and 17th centuries, when they reached their greatest vogue) but the posts or metal supports protruding from the houses over the street, from which the signs were swung, were often elaborately worked, and many beautiful examples of wrought-iron supports survive both in England and on the Continent. The signs were a prominent feature of the streets of London at this period. But here and in other large towns they became a danger and a nuisance in the narrow ways. Already in 1669 a royal order had been directed in France against the excessive size of sign-boards and their projection too far over the streets. In Paris in 1761 and in London about 1762–73 laws were introduced which gradually compelled sign-boards to be removed or fixed flat against the wall. For the most part they only survived in connection with inns, for which some of the greatest artists of the time painted sign-boards.

See J. Larwood and J. C. Hotten, *History of Sign-boards* (London, 1866).

SIGNIA (mod. *Segni*), an ancient town of Latium (*adiectum*), Italy, on a projecting lower summit of the Volscian mountains, above the Via Latina, some 35 m. S.E. of Rome. The modern railway station, 33 m. S.E. of Rome, lies 5 m. S.E. of Signia, 669 ft. above sea-level. The modern town (2,192 ft.) occupies the lower part of the ancient site. Pop. (1921) 7,044. Its foundation as a Roman colony is ascribed to Tarquinius Superbus, and new colonists were sent there in 495 B.C.

The city wall, constructed of polygonal blocks of the mountain limestone and 1¼ m. in circumference, is still well preserved and has several gates; the largest, Porta Saracinesca, is roofed by the gradual inclination of the sides until they are close enough to allow of the placing of a lintel. The other gates are mostly narrow posterns covered with flat monolithic lintels, and the careful jointing of the blocks of which some of them are composed may be noted. Their date need not be so early as is generally believed and they are quite certainly not pre-Roman. Above the modern town, on the highest point, is the church of S. Pietro, occupying the central cella of the ancient Capitolium of Signia (which had three cellae). The walls consist of rectangular blocks of tufa, and the whole rests upon a platform of polygonal masses of limestone. An open circular cistern in front of the church lined with rectangular blocks of tufa may also be noted.

SIGNIFICS is the systematic study of signs and symbols of every kind, including not only words and their meanings, but also volitional intentions and axiological significance (or values). The aim of significs is to classify, correlate and interpret meanings of every kind. (*See* MEANING; SEMANTICS.)

See E. Martinak, *Psychologische Untersuchungen zur Bedeutungslehre* (1901).

SIGN LANGUAGE. Speech as a mode of human intercourse is normally used between persons who are in visible contact. Therefore the gestures, facial expressions, bodily movements of the two parties are integral, even at times essential, elements in the intercourse. Thus "when the postural tensions and the spoken word contradict each other it is plain which should be given credence" (W. A. White, *Foundations of Psychiatry*, 1921, p. 79). There is therefore in all speech when the two parties are in visible contact an element of natural gesture. From this concept we arrive at the position that to speak with the hands is to think with the hands.

Organized sign language is found in many parts of the world. In Assam "the signs used depend on the genius and personality of the speaker, but the natural aptitude for their use is such that from one Naga to another their meaning is rarely obscure. Indeed the writer has known a dumb man make a long and detailed complaint of an assault in which nothing was missing except proper names, and even these were eventually identified by means of the dumb man's description of his assailant's dress and personal appearance" (J. H. Hutton, *Angami Nagas*, 1921, p. 291). Natural gestures form the basis of an extended system of sign language, as is evident in Australia.

See L. Lévy-Bruhl, *Les fonctions mentales dans les sociétés inférieures* (1910), trans. L. A. Clare, *How Natives Think* (1926); C. Wissler, *Man and Culture* (1923); W. B. Spencer and F. J. Gillen, *The Arunta* (2 vols., 1927–28). See *Deaf and Dumb Education and Welfare of.*

SIGN-MANUAL, ROYAL, the autograph signature of the sovereign, by which he expresses his pleasure either by order, commission or warrant. A sign-manual warrant may be either an executive act, *e.g.*, an appointment to an office, or an authority for affixing the Great Seal. The Anglo-Saxon kings did not sign their charters, their names being invariably written by an official Scribe. There is no royal signature before those of Richard II.

The employment of marks or signs manual went out of general use after the 12th century, in the course of which the affixing or appending of seals became the common method of executing deeds.

In the course of the 14th century the name-signature was added to the seal; and by the 15th century it had become established. The *signum manuale* disappeared but the term survived, and was transferred to the signature. In England, an act, 23 of 1830, provided for the use of a Stamp in place of the sign-manual under certain restrictions. The sign-manual must be counter-signed by a principal secretary of State or other responsible minister.

SIGNORELLI, LUCA (*c.* 1450–1523), Italian painter, of the Umbro Tuscan School, was born in Cortona—his full name being Luca d'Egidio di Ventura. Luca was apprenticed to Piero della Francesca at Arezzo where he lived in the house of his uncle Lazzaro Vasari. His first recorded work was the decoration of an organ at Landi near Cortona. In 1472 Luca worked at Arezzo and in 1474 at Città di Castello on paintings no longer extant. In 1475 he probably was in Florence; from 1479–1481 his presence in Cortona is proved by documents. During this time probably Pope Sixtus IV. commissioned Signorelli to paint the frescoes, now mostly very dim, in the shrine of Loreto. In 1482–83 he worked in the Sistine Chapel in Rome. In the fresco "The Last Will of Moses" he was helped by assistants; he painted also two apostles and three portrait figures into Perugino's fresco "The handing over of the keys to St. Peter." Luca may have stayed in Rome till 1484. After a visit to Gubbio and Perugia he returned to his native Cortona, which remained from this time his ordinary home. From 1497 he began some professional excursions. At Monteoliveto near Siena he painted frescoes of the life of St. Benedict (1497) and in S. Agostino, Siena, an altarpiece (1498). The next year he went to Orvieto, and here he produced the works which, beyond all others, stamp his greatness in art. These are the frescoes in the chapel of S. Brizio, in the cathedral, which already contained some pictures on the vaulting by Fra Angelico. The works of Signorelli represent the "Last Days of the Mundane Dispensation," with the "Pomp and the Fall of Antichrist," and the "Eternal Destiny of Man," and occupy three vast lunettes, each of them a single picture. In one of them, Antichrist, after his portents and impious glories, falls headlong from the sky, crashing down into an innumerable crowd of men and women. "Paradise," the "Elect and the Condemned," "Hell," the "Resurrection of the Dead," and the "Destruction of the Reprobate" follow in other compartments. To Angelico's ceiling Signorelli added a section showing figures blowing trumpets, etc.; and in another ceiling he depicted the Madonna, Doctors of the Church, Patriarchs and Martyrs. There is also a great deal of subsidiary work connected with Dante, and with the poets and legends of antiquity. The daring and terrible invention of the great compositions, with their powerful treatment of the nude and of the most arduous foreshortenings, and the general mastery over complex grouping and distribution, marked a development of art which had never previously been attained. In 1502 he returned to Cortona, and painted a dead Christ, with the Marys and other figures now in the cathedral.

In 1506 he was in Siena to submit his design of "The Judgment of Solomon" for the pavement of the cathedral. In 1507 he executed a great altarpiece for S. Medardo at Arcevia in Umbria—the "Madonna and Child," with the "Massacre of the Innocents" and other episodes. In 1508 Pope Julius II. determined to re-adorn the *camere* of the Vatican, and he summoned to Rome Signorelli, in company with Perugino, Pinturicchio and Bazzi

(Sodoma). They began operations, but were shortly all superseded to make way for Raphael, and their work was taken down. Luca afterwards lived for the most part in Cortona. The works of his later years though signed with his name were mostly the work of his pupils. In 1521 Luca painted the panel of "The Holy Trinity, Virgin, Infant and Saints" in the Uffizi, Florence; and in 1523 he had completed the "Virgin, Infant, Angels and Saints" at Foiano. His last work, left unfinished, was a fresco of the "Baptism of Christ" in the chapel of Cardinal Passerini's palace near Cortona. Signorelli entered the magistracy of Cortona as early as 1488. In the year 1523 he died there.

Signorelli surpassed all his contemporaries in showing the structure and mechanism of the nude in immediate action. His drawings in the Louvre demonstrate this. He aimed at powerful truth rather than nobility of form; colour was comparatively neglected, and his chiaroscuro exhibits sharp oppositions of lights and shadows. He had a vast influence over the painters of his own and of succeeding times, but had no pupils or assistants of high mark. Among his chief works not mentioned above may be named: "The Flagellation" in the Brera, Milan (an early work); "School of Pan"; two groups of Saints (from S. Agostino, Siena); and the portrait of a lawyer—all four in the Berlin Museum. In the Uffizi Florence are: "The Madonna with Child and Shepherds" and "The Holy Family." The National Gallery, London, has a "Circumcision" and other works.

See R. Vischer, *Signorelli und die italienische Renaissance* (1879); M. Crutwell, *Luca Signorelli* (1899); Girolamo Mancini, *Vita di Luca Signorelli* (Florence 1903); Leutpold Dussler, *Luca Signorelli* (Berlin and Leipzig, 1926); Sir D. E. Colnagni, *Dictionary of Florentine Painters* (1928).

SIGOURNEY, LYDIA HUNTLEY (1791–1865), American author, was born in Norwich (Conn.), Sept. 1, 1791. She was a precocious child, and became one of the most popular authors of her day. After conducting schools in Norwich and Hartford, she was married, in 1819, to Charles Sigourney, a Hartford merchant. She contributed more than 2,000 articles to nearly 300 periodicals, and wrote more than 50 books. She died in Hartford, June 10, 1865. She was called "The American Hemans."

SIGSBEE, CHARLES DWIGHT (1845–1923), an American naval officer, was born on Jan. 16, 1845, in Albany, N.Y. He graduated from the U.S. Naval Academy in 1863 and served in the latter part of the Civil War at the battle of Mobile, and in the attacks on Ft. Fisher. He received his commission as master in 1866, lieutenant 1867, lieutenant-commander 1868 and commander 1882. He made a deep sea exploration of the Gulf of Mexico and invented several deep sea appliances and machines. He was chief hydrographer of the Naval department, 1893–97, and superintendent of naval construction at the Academy at Annapolis. He was commissioned captain in 1897 and put in command of the battleship *Maine*. The *Maine* was ordered to Havana harbour in Jan. 1898, and was there mysteriously destroyed by a terrific explosion on the 15th of February. Sigsbee commanded the cruiser *St. Paul* which performed excellent service throughout the Spanish-American War. He was promoted to rear admiral in 1903. He died in New York July 19, 1923. He wrote *Deep Sea Sounding and Dredging* (1880); *Personal Narrative of the Battleship Maine* (1899).

SIGÜENZA, a city of central Spain and episcopal see in the province of Guadalajara on the Madrid-Saragossa railway, 87 m. north-east of Madrid, on the left bank of the Henares. Pop. (1920) 4,013. Sigüenza, the ancient Segontia, climbs in picturesque irregular streets of many-coloured crumbling sandstone to the Alcazar on the top of the hill. The chapel of Santa Catalina has flags captured from the English in 1589.

SIGURD (*Sigurðr*) or **SIEGFRIED** (M.H.G. *Sîfrit*), the hero of the *Nibelungenlied,* and of a series of poems of an earlier date in the *Elder Edda,* as well as of the prose *Völsunga Saga,* which is based, in great part, upon the latter. According to both the Scandinavian and German versions of his legend, he was the son of a certain Sigmundr (Siegmund), a king in the Netherlands, or the "land of the Franks." The exploits of this Sigmundr and his elder sons Sinfjötli and Helgi form the subject of the earlier parts of *Völsunga Saga,* and Siegmund and (his nephew) Fitela (*i.e.* Sinfjötli) are also mentioned in the Anglo-Saxon poem *Beowulf.* According to the Scandinavian story Sigmundr was slain in battle before the birth of Sigurd, but the German story makes him survive his son. Sigurd acquired great fame and riches by slaying the dragon Fáfnir, but the chief interest of the story centres in his connection with the court of the Burgundian king Gunnar (Gunther). He married Guðrun (Kriemhild), the sister of that king, and won for him by a stratagem the hand of the Valkyrie Brynhild, with whom he had himself previously exchanged vows of love. A quarrel arose between Brynhild and Guðrun, in the course of which the former learnt of the deception which had been practised upon her and this led eventually to the murder of Sigurd. According to the Scandinavian version he was slain by his brother-in-law, Guttorm, according to the German version by the knight Hagen. Gunnar's brothers were subsequently slain while visiting Atli (Etzel), or Attila, king of the Huns, who married Guðrun after Sigurd's death. According to the German story they were killed at the instigation of Kriemhild in revenge for Siegfried. The Scandinavian version attributes the deed to Atli's lust for gold.

The story of Sigurd is of German rather than Scandinavian origin, and has given rise to more discussion than any other subject connected with the Teutonic heroic age. Like Achilles he is represented as the perfect embodiment of the ideals of the race, and, as in the case of the Greek hero, it is customary to regard his personality and exploits as mythical. There is no question, however, that the Burgundian king who is said to have been his brother-in-law was an historical person who was slain by the Huns, at the time when the Burgundian kingdom was overthrown by the latter. Sigurd himself is not mentioned by any contemporary writer; but, apart from the dragon incident, there is nothing in the story which affords sufficient justification for regarding his personality as mythical. Opinions, however, vary widely as to the precise proportions of history and fiction which the story contains. The story of Siegfried in Richard Wagner's famous opera-cycle *Der Ring der Nibelungen* is mainly taken from the northern version; but many features, especially the characterization of Hagen, are borrowed from the German story, as is also the episode of Siegfried's murder in the forest.

See NIBELUNGENLIED and also R. Heinzel, "Über die Nibelungensage," in *Sitzungsberichte der K. Akademie der Wissenschaften* (1885); H. Lichtenberger, *Le poème et la légende des Nibelungen* (1891); B. Symons, "Heldensage" in H. Paul's *Grundriss der germ. Philologie,* vol. iii. (Strasbourg, 1900); and R. C. Boer, *Untersuchungen über den Ursprung und die Entwicklung der Nibelungensage* (Halle, 1906). Also Th. Abeling, *Das Nibelungenlied und seine Literatur* (1907).

SIGURÐSSON, JÓN (1811–1879), Icelandic statesman and man of letters, was born in the west of Iceland in 1811. He received an excellent education. In 1830 he was secretary to the bishop of Iceland, the learned Steingrimr Jónsson. In 1833 he went to Copenhagen to study Icelandic history and literature. His important works include: *Lögsögumannatal og Lögmanna à Islandi* ("Speakers of the Law and Law-men in Iceland"); the edition of *Landnáma* and other sagas in *Islendinga Sögur,* i.–ii. (Copenhagen, 1843–1847); the large collection of Icelandic laws edited by him and Oddgeir Stephensen; and last, not least, the *Diplomatarium Islandicum,* which after his death was continued by others.

But although he was one of the greatest scholars Iceland has produced, he was still greater as a politician. The Danish rule had, during the centuries following the Reformation, gradually brought Iceland to the verge of economic ruin. Jón Sigurðsson began a hard struggle against the Danish government to obtain a reform. In 1854 the trade of Iceland was declared free to all nations. In 1840 the Althing was re-established as an advisory, not as a legislative body. But when Denmark got a free constitution in 1848, which had no legal validity in Iceland, the island felt justified in demanding full home rule. To this the Danish government was vehemently opposed; it convoked an Icelandic National Assembly in 1851, and brought before that body a bill granting Iceland small local liberties, but practically incorporating Iceland in Denmark. This bill was indignantly rejected, and, instigated by Jón Sigurðsson, another was demanded of far more liberal tendencies. The Danish governor-general then dis-

solved the assembly, but Jón Sigurðsson and all the members with him protested to the king against these unlawful proceedings. The struggle continued with great bitterness on both sides, but gradually the Danish government was forced to grant many important reforms. (*See* ICELAND, *History.*)

The grant of the constitution in 1874 was, in fact, the victory of Jón Sigurðsson, whose high personal qualities had rallied all the nation round him. He made Reykjavik not only the political, but the spiritual capital of Iceland by removing all the chief institutions of learning to that city; he was the soul of many literary and political societies, and the chief editor of the *Ny Félagsrit,* which has done more than any other Icelandic periodical to promote the cause of civilization and progress in Iceland. Jón Sigurðsson lived the greater part of his life in Copenhagen, and died there in 1879; but his body, together with that of his wife, Ingibjörg Einarsdóttir, whom he had married in 1845, and who survived him only a few days, was taken to Reykjavik and given a public funeral. On his monument was placed the inscription: "The beloved son of Iceland, her honour, sword and shield."

(S. BL.; X.)

SIGYNNAE, an obscure people of antiquity (Gr. Σίγυνναι Σίγυννοι). They are variously located by ancient authors. According to Herodotus (v. 9), they dwelt beyond the Danube, and their frontiers extended almost as far as the Veneti on the Adriatic.

The similarity between Sigynnae and Zigeuner is obvious, and it has been supposed that they were the forefathers of the modern gipsies. According to J. L. Myres, the Sigynnae of Herodotus were "a people widely spread in the Danubic basin in the 5th century B.C.," probably identical with the Sequani (*q.v.*).

SIKHS, a sect of dissenters from Brahmanical Hinduism. It originated in the Punjab, where most of the *Sikha,* "disciples," are still to be found. Although the fetters of Brahmanism have long been firmly riveted on India, attempts to loosen them date back to Buddhism (*q.v.*) and were renewed by many religious and social reformers from whom Sikhism borrowed ideas and even devotional hymns. Such were Jaidev, composer of the *Gīta Govind* (translated by Edwin Arnold), who *c.* A.D. 1100 taught that Yoga (*q.v.*) was worthless in comparison with God's worship in thought, word and deed; Rāmānand, at the close of the 14th century, freed his followers from caste restrictions; a little later Kabīr (b. 1398) denounced idolatry and ritualism. Nearly a century later, in 1469, was born Nānak, the first founder of Sikhism, contemporary with Luther. His name means "he who was born at the home of his mother's parents," and it lay at Talwandi, near Lahore. Of a Kshatri family (the Kshatriya had once been formidable spiritual rivals of the Brahmans) a curious, but hardly contemporary, Sikh account of his descent makes him a reincarnation of the king of the Videhas, Janaka the great patron of the Kshatrya *Upanishads* (*q.v.*). The tradition may contain a grain of truth. As a young man he must have seen something of Sultān Sikandar Lodi's (1489–1517) measures against Hinduism.

Early Period.—Nānak's faith was sternly monotheistic. He taught the worthlessness of religious vestments, of ostentatious prayer and penance, pilgrimages and fanes. He declared that all men had a right to search for knowledge of God, irrespective of caste. He was a quietist, and though we have no authentic biography of him, we may conjecture that his life and doctrines did not expose him to persecution, and we hear nothing of any efforts to suppress his teaching. He was employed by a Muslim, and was married, leaving on his death in 1533 two sons, Sri Chand and Lakhmi Das, both Hindu names. Nānak, however, had designated as his successor in his spiritual mission the Gurū-ship, another Kshatri, Lehna, who took the name of Angad. (Angada was a lesser legendary hero of the Epic age.) To Gurū Angad is due the inception of the *Granth* ("book") *Sāhib* ("holy"), in which he embodied what he had learnt from Gurū Nānak, adding devotional reflections of his own. To mark the sacred character of the work, he is said to have invented Gurmukhi, the "Gurū's tongue," the peculiar script of the Sikhs, by modifications of the Shārada alphabet. Dying in 1552, Angad in turn excluded his sons and designated the Kshatri Amār Dās as his successor. The reforms of this Gurū were important, including the separation of the Udāsi order, founded by Nānak's own son Sri Chand, from the laity, denunciation of Sati, and the stressing of Nānak's attitude to caste by making all his Sikhs eat together. He also divided the country covered by his missioners into 22 sees. Dying in 1574, Amār Dās bestowed the Gurū-ship on his servant and son-in-law Jetha, under the name of Rām Dās.

To him is due the foundation of the golden temple built at Amritsar in 1579 on a site granted him by the emperor Akbar, whose policy aimed at welding all the creeds of India into one. Rām Dās taught no new doctrines but is still much revered. He died in 1581.

So far, the Gurūs had aimed at continuing the Gurū-ship by designation, not at setting up a hereditary spiritual dynasty. But after Rām Dās the eastern tendency, so marked in Islam, to regard saintship as vested in a saint's physical descendants asserted itself. Still Rām Dās selected his third son, Arjan Dev (*Arjuna* was a legendary, semi-divine hero of the Epics; *Deva* was a title borne by an old Rajput dynasty of Jammū), to follow him as Gurū, though the Sikhs regarded Pirthi Chand as so entitled by right of primogeniture and the latter would probably have made good his claim to inherit the Gurū-ship but for his exactions. Arjan was induced to insist on his right, though he had meekly surrendered his father's turban, the symbol of temporal rulership, to Pirthi Chand. He established a rude fiscal system appointing collectors of offerings. Gurū Arjan enlarged the *Granth,* half of which is due to him, and is said to have been arraigned before Akbar for setting up a new divinity, but the eclectic emperor naturally acquitted him. Arjan, however, made a fatal mistake in aiding Prince Khusrū, a rebel against his father Jahāngīr, with a modest sum of money. Possibly this act was dictated by a belief that Khusrū would continue Akbar's tolerant policy, but it may have been a forced loan.

Jahāngīr punished it with a fine of two lakhs of rupees, which Arjan was unable or unwilling to pay and so he was, it is said, tortured to death in 1606. To his son Har Govind, who succeeded him without contest he left a behest to maintain his throne by arms. Gurū Har Govind was installed with turban and necklace only but added an aigrette to the one and for the other substituted a sword-belt. The Gurū-ship was now launched on a new adventure—the foundation of a militant sacred dynasty. The Gurū founded the first Sikh stronghold, enlisted horse and foot, and encouraged his disciples to eat flesh to improve their physique.

After 12 years' imprisonment in the fortress of Gwalior Har Govind obtained his freedom, probably by paying the fine imposed on Arjan. This imprisonment must have preceded his military activities. By them he was enabled to resist Shāh Jahān (1627–66) and claimed three victories over the imperial troops. But he died in 1645 in a remote valley of the lower Himalayas at Kiratpur on the upper Sutlej, which indicates that he had found it safer than Amritsar. Shāh Jahān, who had destroyed many Hindu temples, appears to have taken no special measures against the Sikhs. Har Govind's grandson, Har Rai, who succeeded him, was undoubtedly a supporter of the unfortunate Dārā Shikoh, who had the *Upanishads* partly done into Persian and professed mystical Sūfī heresies. On that prince's execution in 1659 Har Rei was summoned to Delhi but sent his elder son Rām Rai instead, and on his death two years later Rām Rai was excluded from succeeding him as being a hostage or prisoner, his younger brother Har Kishen assuming the Gurū-ship, though still a child. His death in 1664 left the direct line extinct and the inheritance reverted to Teg Bahādur, Har Govind's second son, but he was executed by Aurangzeb in 1675 for having refused to accept Islam. His prophecy that Europeans were coming from beyond the seas to destroy the Moghul empire became the Sikh battle-cry at the siege of Delhi in 1857.

Middle Period.—The tenth and last Gurū was his son, Govind Rai, who took the affix *Singh,* "lion," in lieu of Rai and remodelled the Sikh organization which he renamed Khālsa, "pure." He made the Sikh initiation (*pahul*) a rite of admittance into a militant order. In that rite, with a two-edged dagger (*khanda*) sugar is stirred up in water, which the novice drinks and with which he is lustrated five times. He then utters the Sikh war-cry

vowing adherence to the Sikhs' tenets. Thenceforth he must wear the five k's, the *kes,* unshorn hair, the *kachh,* drawers reaching only to the knee, the *kara,* iron bangle, the *kirpan,* sword (or *khanda,* small dagger) and *khanga* or hair comb. Of these the first four have soldierly uses, the long hair rolled round steel rings serving as a helmet and so on. But they have also a spiritual meaning, *e.g.,* the *kachh* symbolizing self restraint, the bangle obedience, and the comb purity of mind. The use of flesh and liquor is permitted as to a warrior, but tobacco as a narcotic is prohibited. Govind Singh also instituted the *karā parshād,* a kind of communion at which flour mixed with butter and sugar is eaten by all castes together.

Govind Singh waged an active defensive against the Moghul power but his levies were dispersed and his two sons put to death by the governor of Sirhind. On Aurangzeb's death, however, he aided Bahādur Shad, but in 1708 he was assassinated at Nander in the Deccan. Sonless and mistrustful of Banda Bairāgi, who claimed to be the eleventh Gurū, Govind Singh declared the line of Gurūs extinct and the Gurū-ship vested in the *Granth Sahib* as God's representative on earth. Sikhism was thenceforth to be a militant theocracy, but it soon formed a mass of military bands under Sirdārs ("chiefs"). The earlier military organization of the Sikhs is obscure. Banda seems to have formed an almost regular army, but after gaining notable successes against the Moghuls, sacking Sirhind and compelling the allegiance of the Hindu hill-rājās who had generally refused to submit to the Gurūs, he had to cede Amritsar to the true Singhs, the Tat Khālsa, elect of the elect, and was finally executed in 1716. His death left the Sikhs leaderless, but they were strong enough to extort grants of land from Farrukhsiar and formed two armies, a veteran and a younger. The latter comprised five companies, including the militant order of *shahīds,* which carried its forays in Rājpūtāna. On the Punjab, thus distracted, fell Nādir Shāh's invasion of 1738–39. Its last great Moghul governor, Adīna Beg, recovered part of the province, but on his death in 1758 the Sikhs mastered the central and north-east Punjab. They now appear as better organized. Besides the Shahīds, three new orders were formed with eight *misls* or confederacies. Under Jassa Singh (elected head of the Ahluwālia *misl; bādshā* ["monarch"], to his own followers, and by caste a potter on the earlier Sikh coins) there materialized as it were a cabinet of *gurūs,* the *gurū matta* "sacred council," convened by the Akālis or the *granthis* about 1762 at Amritsar. South of the Sutlej the reversion to kingship was accelerated when Ālā Singh of Patiāla leased the province of Sirhind from Ahmad Shāh with the title of king (rājā) of kings, and the lessor's retreat from the Punjab left the Sikhs its masters from the Jamna to the Indus in 1767. But in 1808 Ranjīt Singh suppressed the confederacy which bore the standard of the Khālsa; and the dissensions of the other *misls* enabled him, then merely the chief of the territorial confederacy, to absorb the rest, conquer Kashmīr and Peshāwar, subdue the hill states and set up a hereditary monarchy, though he still minted Sikh coins and upheld Sikhism as the state religion. But he appointed Mohammedan *qāzīs* and *muftis* ("judges and law-officers"), and protected Muslim states like Maler Kotla and many institutions of that creed, which had befriended Sikhs from time to time.

Later Period.—The history of Sikhism in the 19th century belongs rather to the history of the Punjab (*see* INDIA, *History*), but the Sikh sub-sects and orders were mostly maintained. The differences with Hinduism tended, however, to be suppressed. Thus the Akālis lost ground, though the Kūkas remained staunch to their extremist tenets, with diminished numbers. Sects like the Sanwal-Shāhis, followers of a disciple of Gurū Nānak, are all but confined to the south-west Punjab, while the Sewapanthis are still more restricted to the Sindh Sāgar Doāb. The Hindālīs forfeited their once influential position by throwing in their lot with Ahmad Shāh Abdāli and are now known as Narinjani or worshippers of the Bright One (God). The Nirankāris, a modern sect, revived Nānak's teaching though they respect later Gurūs also. The older orders became Sikh castes, like the Rāmgarhias, whose founder was a carpenter and which is now the Sikh carpenter caste; as the Sikh Kallāls or Nebs (potters) style themselves Ahluwālia. Every confederacy worked out its own destiny, tending to form hereditary chiefships and divide the villages it had occupied among its members as if they were private lands. To a certain extent the mutiny revived Sikhism by stimulating anti-Muslim feeling, and this recrudescence probably saved it from becoming a mere collection of more or less Hinduized sects in which the Nānak-panthis would have absorbed the Khālsa or sect of Gurū Govind Singh. But the revival was militarist rather than religious. The sectarian institutions decayed. Little was added to religious literature. In a sense the *Granth* became the Gurū, receiving divine honours, for example at Conjeeveram, in the south, where it became the object of a fire sacrifice. The book of common prayer was the *Panjgranthi,* including five poems from the *Granth,* three of which have to be recited daily by the Khālsa Sikhs; yet Sikh ascetics used to make pilgrimages to Hindu temples. The Khālsa college at Amritsar was, however, founded, and there too the chief Khālsa Dīwān had his headquarters. It made grants to various schools, including some 30 for girls. Local societies, Singh Sabha, were established throughout the Punjab and even beyond it.

There was very little innovation in the religious sphere, but Sikhism was still alive awaiting a stimulus to arouse its latent power. This came to it from education, the general awakening of India, and the mal-administration of the sectarian shrines and temples.

Laity.—When Sikhism revived, all its divisions were equally resuscitated. A notable example of this was furnished by the Kūkas ("shouters"), who professed to be ethically strict followers of Govind Singh but observed such secrecy that they were debited with the degrading practices so often ascribed to such sects. The Kūka insignia, a high straight turban and a knotted necklace or rosary of wool, hint at an originally military asceticism and possibly at some connection with Banda Bairāgi, but their significance has never been disclosed. Supposed to be hostile to British rule, the Kūkas were certainly anti-Muslim, especially resenting the slaughter of kine, carefully planning the assassination of Mohammedan butchers and once organizing, in 1872, an armed rising which took the shape of a raid into the Muslim state of Maler Kotla. Owing to the drastic action of the district officer of Ludhiāna who executed over 100 mutineers by artillery the rising speedily collapsed, but severe as was the method of its suppression, it had undoubtedly excited the Sikh population and a less decisive one might in the end have resulted in more bloodshed. On the other hand the fanatical Akālis only revived as a body of harmless eccentrics practising their rites at Sikh gatherings, and not taken seriously by any other Sikh body. The Udāsi order became hardly distinguishable from a Hindu religious sect and was even regarded as Vaishnava.

The Nirmalas were not quite re-Hinduized but the general tendency of the Sikh laity was towards emergence into Brahmanism. Only the more ardent followers of Govind Singh preserved their distinctive tenets, dress, and protestant, anti-Brahmanical attitude. Thus ended the first phase of the Sikh revival. The second phase was greatly fostered if not initiated by the formation of the Imperial Service troops. The Sikh recruits in the Phulkian states, south of the Sutlej, had often neglected to take the *pahul.* They were encouraged to do so by their British inspecting officers, and the military spirit of Sikhism was enhanced. With its revival came an awakened interest in other things. The Sikhs, even the stricter elements, had acquiesced in the decay of their religious institutions. In 1863 the British Government had by statute divested itself of all administrative control over religious endowments, but had provided no machinery to assume its functions. The Sikh orders had no written constitutions. Such an order as the Udāsi was in theory celibate. It proceeded to permit its members to marry, to found families of great respectability and influence, who were accepted as owners of the religious shrines and wealthy refectories, and administered them as private properties—on the Brahmanical model. But Brahmanism allows no lay interference with Brahman property.

Orders.—The humbler village fanes were equally appropriated by their incumbents, who naturally favoured the fatal principle of

hereditary rights in them. The Kūka headship became a kind of dynasty. The Akālis alone retained celibacy, but even the Nirmalas failed to enforce it rigidly. But celibate or not, no order evolved any definite system of selecting its heads. The powers of the abbots, of the chapter and of the congregation were undefined. If, then, the glebe was alienated by a dissolute incumbent, or endowments mis-spent by incompetent abbots, the sole remedy for the laity was a suit in the courts, which begged the whole question of the layman's right to ask for relief by treating the priestly rights in the shrine as a matter of custom—of custom recently created by priestly malfeasance. Ignoring the fundamental doctrines of Sikhism in general and of its orders in particular, the courts proceeded to give legal recognition to the vested interests of the carnal heirs of spiritual offices in their benefices. This led to grave unrest among the Sikhs. Even the administration of the Khālsa college, founded under British auspices, had to be remodelled. The golden temple at Amritsar, being a purely religious foundation, was, however, beyond Government control. Internal dissensions made its problems difficult of solution. Its governing body had long been divided, one party permitting its walls to be adorned with Hindu mythological pictures, another condemning them as incompatible with Sikh monotheism. The Sikhs at a mass meeting accepted a provisional council, only in part nominated by Government, to draw up a scheme of management. But it failed to function. In 1920 the Mahātma Gandhi intervened, suggesting the appointment of the Shiromani Gurūdwāra Parbandhak committee for the management of shrines in general. This body proceeded at once to the high-handed seizure of places of worship, including the golden temple itself. It also reorganized the Akālis, recruiting them with lawless *jathas,* gangs of turbulent elements not all furnished by the Sikhs. It called on the Udāsi *mahant* or "abbot" of Gurū Nānak's birthplace, Nānkāna, to reform his institution. In defence of his property the Gurū enlisted Muslim mercenaries and so exacerbated Sikh feeling. A body of 130 Sikhs seized the sanctuary but were massacred to a man. Equally lawless seizures of shrines ensued. At Gurū kā Bāgh, the "Gurū's Garden," the Akālis captured the Gurūdwāra or fane of the Gurū, but the *mahant* held its house and lands. The committee took steps to seize some of the latter as appurtenant to the shrine, but the law was here successfully vindicated and no fewer than 5,000 Akālis arrested. In reprisal, the Akāli order threw off a new and more militant offshoot in the Babbar ("lion") Akālis dedicated to the murder of village officials and others loyal to Government but in their isolation beyond its effectual protection. The tract between the Sutlej and Biās rivers was terrorized by Akāli and other lawless gangs, marked men being openly assassinated and property indiscriminately plundered. Soldiery alone secured a semblance of order. Yet in 1923, when communal riots between Hindus and Muslims broke out at Amritsar the Akālis aided authority to maintain order. In 1924, however, the shrines committee espoused the cause of the misguided Mahárája of Nābha, who abdicated after levying private war on the sister Sikh state of Patiāla, and at Jaitoke a meeting of the new ruler's opponents had to be dispersed. The Akālis came to the rising, but their peaceful purpose was merely the perpetual recitation of the *Granth* for the restoration of the ex-Rājā. Unfortunately they were reinforced by a huge mob which attacked the State forces. It was beaten off with a loss of 50 men, including 21 killed and only three or four Akālis fell. In 1925 the Sikh Gurūdwāra and Shrines bill became law. It set up legal machinery for the control of Sikh endowments, and if it is alleged to be unjust to the Sikh orders, it must be pleaded that the failure of those orders, even of the Udāsis, to organize their own self-discipline and protect the rights of the Sikh congregations made it a necessity. The disruptions in the Udāsi order made it impossible to give legal embodiment to it or to anyone of its branches.

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SIKH WARS, two Indian campaigns fought between the Sikhs and the British, which resulted in the conquest and annexation of the Punjab (*see* Punjab).

FIRST SIKH WAR (1845–46)

The first Sikh War, or Sutlej campaign, was brought about by the insubordination of the Sikh army, which after the death of Ranjit Singh became uncontrollable and on Dec. 11, 1845, crossed the Sutlej, and virtually declared war upon the British. The British authorities had foreseen the outbreak, and had massed sufficient troops at Ferozepore, Ludhiana and Umballa to protect the frontier, but not to offer provocation. So complete were the preparations for advance that on the 12th, the day after the Sikhs crossed the Sutlej, Sir Hugh Gough, the commander-in-chief, marched 16m. with the Umballa force to Rajpura; on the 13th the governor-general, Sir Henry Hardinge, declared war, and by the 18th the whole army had marched 150m. to Moodkee, in order to protect Ferozepore from the Sikh attack. The Sikh army is referred to for brevity as "the Sikhs," but it was composed of Sikhs, Punjabi Muslims and Hindus, as are the present Sikh regiments of the Indian army. Gurkha, Hindostani and Afghan mercenaries were also found in the ranks.

Wearied with their long march, the British troops were enjoying a rest, when the news came in that the Sikhs were advancing to battle at four o'clock in the afternoon. The British had some 10,000 men, and the Sikhs are estimated by some authorities as low as 10,000 infantry with 2,000 cavalry and 22 guns. The battle opened with an artillery duel, in which the British guns, though inferior in weight, soon silenced the enemy, the 3rd Light Dragoons delivered a brilliant charge, and the infantry drove the enemy from position after position with great slaughter and the loss of seventeen guns. The victory was complete, but the fall of night prevented it from being followed up, and caused some of the native regiments to fire into each other in the confusion.

Ferozeshah.—After the battle of Moodkee Hardinge volunteered to serve as second in command under Gough, a step which caused some confusion in the ensuing battle. At 4 A.M. on Dec. 21 the British advanced from Moodkee to attack the Sikh entrenched camp under the command of Lal Singh at Ferozeshah, orders having been sent to Sir John Littler, in command at Ferozepore, to join the main British force. At 11 A.M. the British were in front of the Sikh position, but Littler though on his way had not yet arrived. Gough wished to attack while there was plenty of daylight; but Hardinge re-asserted his civil authority as governor-general, and forbade the attack until the junction with Littler was effected. The army then marched on to meet Littler and the battle did not begin until between 3.30 and 4 P.M. The engagement opened with an artillery duel, in which the British failed to gain the mastery over the Sikhs, owing to the light weight of the British ordnance. The infantry, therefore, advanced to the attack; but the Sikh muskets were as good as the British, and fighting behind entrenchments they were a most formidable foe. Littler's attack was repulsed, the 62nd Regiment losing heavily in officers and men, while the sepoys failed to support the European regiments. But the Moodkee force, undaunted, stormed and captured the entrenchment, though the different brigades and regiments lost position and became mixed up together in the darkness. The army then passed the night on the Sikh position, while the Sikhs prowled round keeping up an incessant fire. In the morning the British found that they had captured seventy-three pieces of cannon and were masters of the whole field; but at that moment a fresh Sikh army, under Tej Singh, came up to the assistance of the scattered forces of Lal Singh. The British were exhausted with their sleepless night, the native troops were shaken, and a determined attack by this fresh army might have won the day; but Tej Singh, after a half-hearted attack, which was repulsed, marched away, whether from cowardice, incapacity or treason, and left the British masters of the position.

Aliwal.—After the battle of Ferozeshah the Sikhs retired behind the Sutlej, but early in January they again raided across the river near Ludhiana, and Sir Harry Smith was detached to pro-

tect that city. On Jan. 21 he was approaching Ludhiana when he found the Sikhs under Runjoor Singh in an entrenched position flanking his line of march at Budhowal. He passed on without fighting a general action, but suffered considerable loss in men and baggage. After receiving reinforcements Sir Harry again advanced from Ludhiana and attacked the Sikhs at Aliwal on Jan. 28. An attack upon the Sikh left near the village of Aliwal gave him the key of the position, and a brilliant charge by the 16th Lancers, which broke the Sikh square, completed their demoralization. The Sikhs fled in confusion, losing sixty-seven guns, and by this battle were expelled from the south side of the Sutlej.

Sobraon.—Ever since Ferozeshah Gough had been waiting to receive reinforcements, and on Feb. 7, his siege train arrived, while on the following day Sir Harry Smith's force returned to camp. On Feb. 10 Gough attacked the Sikhs, who occupied a strong entrenched position in a bend of the Sutlej. After two hours cannonading, the infantry attack commenced at 9 A.M. The advance of the first brigade was not immediately successful but the second brigade following on carried the entrenchments. The cavalry then charged down the Sikh lines from right to left and completed the victory. The Sikhs, with the river behind them, suffered terrible carnage, and are computed to have lost 10,000 men and 67 guns. The British losses throughout the campaign were considerably heavier than was usual in Indian warfare; but this was partly due to the fact that the Sikhs were the best natural fighters in India, and partly to the lack of energy of the Hindostani sepoys. After the battle of Sobraon the British advanced to Lahore, where the treaty of Lahore was signed on March 11.

SECOND SIKH WAR—PUNJAB CAMPAIGN 1848–49

For two years after the battle of Sobraon the Punjab remained a British protectorate, with Sir Henry Lawrence as resident; but the Sikhs were unconvinced of their military inferiority, the Rani Jindan and her ministers were constantly intriguing to recover their power, and a further trial of strength was inevitable. The outbreak came at Multan, where on April 20, 1848, the troops of the Dewan Mulraj broke out and attacked two British officers, Mr. Vans Agnew and Lieutenant Anderson, eventually murdering them. On hearing of the incident, Lieut. Herbert Edwardes, who was Lawrence's assistant in the Derajat, advanced upon Multan with a force of levies drawn from the Pathan tribes of the frontier; but he was not strong enough to do more than keep the enemy in check until Multan was invested by a Bombay column under General Whish. In the meantime Edwardes wished for an immediate British advance upon Multan; but Lord Gough, as he had now become, decided on a cold season campaign, on the ground that, if the Sikh government at Lahore joined in the rising, the British would require all their available strength to suppress it. Multan was invested on Aug. 18 by Whish in conjunction with the Sikh general Shere Singh; but during the course of the siege Shere Singh deserted and joined the rebels, thus turning the rising into a national war. The siege of Multan was temporarily abandoned, but was resumed in November, when Gough's main advance had begun, and Mulraj surrendered on Jan. 22. In the meantime Gough had collected his army and stores, and on Nov. 9, crossed the Sutlej.

Chillianwalla.—On Nov. 22 there was a cavalry skirmish at Ramnagar, in which General Cureton and Colonel Havelock were killed. For a month after this Gough remained inactive, waiting to be reinforced by Whish from Multan; but at last he decided to advance without Whish, and fought the battle of Chillianwalla on Jan. 13, 1849. Gough had intended to encamp for the night; but the Sikh guns opening fire revealed the fact that their army had advanced out of its intrenchments, and Gough decided to seize the opportunity and attack at once. An hour's artillery duel showed that the Sikhs had the advantage both in position and guns, and the infantry advance commenced at three o'clock in the afternoon. The battle resulted in great loss to the European regiments, the 24th losing all its officers in a few minutes, while the total loss in killed and wounded amounted to 2,338; but when darkness fell the British were in possession of the whole of the Sikh line. Gough subsequently retired to the village of Chillianwalla, and the Sikhs returned and carried off their guns. After the battle Gough received an ovation from his troops, but his losses were thought excessive by the public in England and the directors of the East India Company, and Sir Charles Napier was appointed to supersede him. Before, however, the latter had time to reach India, the crowning victory of Gujrat had been fought and won.

Gujrat.—After the fall of Multan Whish marched to join Gough, and the junction of the two armies was effected on Feb. 18. In the meantime the Sikhs had withdrawn from their strong intrenchments at Russool, owing to want of provisions, and marched to Gujrat, which Gough considered a favourable position for attacking them. By a series of short marches he prepared the way for his "last and best battle." In this engagement, for the first time in either of the Sikh wars, the British had the superiority in artillery, in addition to a picked force of 24,000 men. The battle began on the morning of Feb. 21 with two and a half hours' artillery fire, which was overwhelmingly in favour of the British. At 11.30 A.M. Gough ordered a general advance covered by the artillery; and an hour and a half later the British were in possession of the town of Gujrat, of the Sikh camp and of the enemy's artillery and baggage, and the cavalry were in full pursuit on both flanks. In this battle the British only lost 96 killed and 700 wounded, while the Sikh loss was enormous, in addition to 67 guns. This decisive victory ended the war. On March 12, the Sikh leaders surrendered at discretion, and the Punjab was annexed to British India.

See Sir Charles Gough and A. D. Innes, *The Sikhs and the Sikh Wars* (1897); R. S. Rait, *Life and Campaigns of Viscount Gough* (1903).

SI KIANG, a river of south China, rising in the plateau of Yunnan, on land over 6,000 ft. above sea-level. The headwaters flow first of all southward and then turn northward, the southern boundary of Kwei Chow. In this section of the course it is generally known as Pa-ta-ho. The river next forms the boundary between the provinces of Kwei Chow and Kwang Si, for some distance being known in sections as the Hung Shui. It flows now through the much dissected and contorted ancient land mass of south-eastern China. Opposite Szengen the river has fallen slightly below 600 ft. above sea-level. Later it receives the Lung Kiang on the left bank. The river in this section is known as the Wu-ni-kiang, and later as the Si Kiang. Near Sünchow the Yu Kiang enters on the right. This tributary also rises in Yunnan, and has followed a course similar to that of the upper Si Kiang. The course of the main river to the neighbourhood of Sünchow has been a very rapid one, but from here to the sea, in spite of subsequent gorges and rapids, its course is more suitable to navigation. At Wuchow the Kwei Kiang enters from the left. After Chaoking the river splits up into a number of streams and forms a great delta. The Pe Kiang enters near the head of the delta. The northern section of the delta streams, on which Canton stands, is known as the Canton river or Chu Kiang. From Canton southwards a large inlet reaches to the sea. The Tung Kiang, a north bank tributary, also drains into the delta region. The entire length of the Si Kiang may be estimated at 1,250 miles. It is navigable in flood time for vessels drawing 16 ft. to Wuchow, and at ordinary times for vessels drawing 6 ft. or more to the same city. Light craft use the river as far as Hsing-i-fu.

The Si Kiang is the great commercial highway in south China, and in one way or other links Hongkong, Canton, Macao, Chaoking and Wuchow with the interior.

SIKKIM, a protected State of India, situated in the eastern Himalaya. Area 2,818 sq. miles. The country is a mass of mountains and consists of part of the main chain of the Himalayas and of ranges projecting southwards and gradually lessening in height. On the west the Singalila range divides Sikkim from Nepal, the chief pass into which is Chiabhanjan-la (10,320 ft.). On the east the Chola range forms the boundary with Tibet, the chief passes being the Natu-la and Jelep-la, both over 14,000 ft. Between these two ranges the country is split up into mountain ridges and a succession of deep valleys, which in the south are only 1,000 ft. above sea-level. The highest peaks are Kin-

chinjunga (28,146 ft.), Siniolchu, or D.2 (22,520 ft.), Kinchinjhau (22,509 ft.) and Chomiomo (22,385 ft.). The line of perpetual snow lies at about 17,000 feet. Between 12,000 and 15,000 ft. there are occasional plateaux, with some small lakes, *e.g.*, at Changur, to which cattle are driven for grazing in the summer. Forests cover the mountain slopes from 9,000 to 12,000 ft. and lower down give place to cultivation. From 6,500 to 4,500 ft. the slopes have been completely denuded and brought under cultivation, crops of maize, millets and pulses being raised. At lower levels the slopes are terraced and rice is grown wherever irrigation is possible. The chief river is the Tista, which is formed by the confluence of the Lachen and Lachung in the north of Sikkim. The valleys drained by these two affluents are broader and more open than those in the south into which the steep sides of the mountains descend abruptly, forming narrow gorges. The capital is at Gangtok. As is natural in a country with elevations varying from 1,000 to over 28,000 ft., every variety of climate and vegetation, sub-tropical, temperate and arctic, is encountered. The rainfall is heavy, as the mountains are exposed to the moisture-laden monsoon winds blowing up from the Bay of Bengal and averages 137 in. a year at Gangtok. The exuberance of the flora may be imagined when it is considered that the flowering plants comprise some 4,000 species of rhododendron. Butterflies abound and comprise about 600 species. Among mammals, the most interesting are the snow leopard, the cat-bear, the musk deer and two species of goat antelope.

The population numbers (1921) 81,721, of whom the majority are Nepalese by origin or actual birthplace. The other races are chiefly Bhotias of Tibetan extraction (11,580) and Lepchas (9,021). The Lepchas, whose own name for themselves is Rongpa, *i.e.*, the people of the valleys or ravines, are believed to be the earliest inhabitants of Sikkim and to be of Indo-Chinese origin. As their name implies, they are chiefly denizens of the warmer valleys. A peaceful, simple people, they have been replaced at higher levels by the more industrious and pushing Nepalese, who are a hardy race of cultivators. The Bhotias are mainly graziers, who make their homes at higher elevations. Buddhism, the State religion, is professed by one-third of the inhabitants, chiefly the Bhotias and Lepchas, for most of the Nepalese are Hindus. There are a number of Buddhist monasteries picturesquely placed on the summits and shoulders of the hills, of which the most important is at Pemionchi. The Buddhism prevalent is of the lamaistic type found in Tibet. The population is essentially agricultural, each family living in a homestead on its own land; and there are no close clusters of houses that can be dignified with the name of village except round a few market places and in the Lachen and Lachung valleys.

History.—The ruling family is Tibetan, and claims descent from one of the Gyalpos or princelings of eastern Tibet. Their ancestors found their way to Lhasa and, in 1641, overcame the Lepcha chiefs of Sikkim. One of them established his government and introduced Buddhist Lamaism as a State religion. Till the end of the 18th century Sikkim was practically a dependency of Tibet, where its ruler was designated Governor of Sikkim.

British relations with Sikkim began in 1816, when the Tarai or submontane portion of Sikkim (now included in Darjeeling), which had been occupied by the Nepalese, was restored to the raja by the treaty concluded at the end of the Nepalese War. In 1839 the site of Darjeeling was ceded to the British for use as a sanatorium. In 1849 the British resumed the whole of the Tarai and the outer hills, as punishment for repeated insults and injuries culminating in the imprisonment of Dr. Campbell, superintendent of Darjeeling, and Sir Joseph Hooker, when travelling in Sikkim. In 1861 the despatch of a British force was required to impose a treaty defining good relations. The maharaja, however, refused to carry out his obligations and persisted in living in Tibet; his administration was neglected, his subjects oppressed, and a force of Tibetan soldiers was allowed, and even encouraged, to erect a fort in Sikkim territory. The Government was forced in 1888, to send an expedition, which drove the Tibetans back over the Jelep pass. A convention was then concluded with China in 1890, whereby the British protectorate over Sikkim was acknowledged and the boundary of the State defined; to this was added a supplemental agreement relating to trade and domestic matters, which was signed in 1893. A British political officer was appointed to assist the maharaja in the administration with a Durbar or Council composed of the chief civil officers and lamas. The maharaja refused to co-operate and tried to flee to Tibet through Nepal, where he was stopped by the Nepalese and made over to the British. He then resided as a State prisoner near Kurseong in the Darjeeling district and died in 1914. The present maharaja, Sir Tashi Namgyal, K.C.I.E., who succeeded in 1914, was invested with full ruling powers in 1918.

See Hooker, *Himalayan Journal* (1854); *Gazetteer of Sikkim* (Calcutta, 1894); L. A. Waddell, *Among the Himalayas* (1898); D. W. Freshfield, *Round Kangchenjunga* (1903); J. Claude White, *Sikkim and Bhutan* (1909); Earl of Ronaldshay, *Lands of the Thunderbolt* (1923).

SILAGE: *see* ENSILAGE.

SILAS (*fl.* A.D. 50), early Christian prophet and missionary, was the companion of St. Paul on the second journey, when he took the place formerly held by Barnabas. The tour included S. Galatia, Troas, Philippi (where he was imprisoned), Thessalonica and Beroea, where Silas was left with Timothy, though he afterwards rejoined Paul at Corinth. He is in all probability the Silvanus[1] who is associated with Paul in the letters to the Thessalonians, mentioned again in 2 Cor. i. 19, and the bearer and amanuensis of 1 Peter (*see* v. 12). It is possible, indeed, that he has an even closer connection with this letter, and some scholars (*e.g.*, R. Scott in *The Pauline Epistles*, 1909) are inclined to give him a prominent place among the writers of the New Testament. He was of Jewish birth and probably also a Roman citizen.

SILAY, a municipality (with administration centre and 9 *barrios* or districts) of the province of Occidental Negros, Island of Negroes, Philippine Islands, on the north-west coast, about 10 m. N. of Bacolod, the provincial capital. Pop. (1918) 23,328.

SILCHESTER, a parish in the north of Hampshire, England, about 10 m. S. of Reading, containing the site of the Romano-British town Calleva Atrebatum. The site was completely excavated between 1889 and 1909 and the whole plan of the ancient town within the walls recovered; unfortunately the excavators had to abandon their task before the suburbs, cemeteries and whatever else may lie outside the walls have been examined. The results are published in *Archaeologia*, the official organ of the London Society of Antiquaries. (*See* BRITAIN: *Roman.*) As the excavations proceeded, the areas excavated were covered in again, but the ruins of the town hall, which have been famous since the 12th century, still remain.

SILENT TRADE: *see* TRADE, PRIMITIVE.

SILENUS, in mythology, the son of Hermes (or Pan) and a nymph. The companion and nurse of Dionysus, he often appeared in art and in satyr-plays in the god's train. He now and then emerged into cult, and a story, variously located in Asia Minor or Macedonia, showed King Midas as catching one (there were presumably many Silenuses, SILENOI, old satyrs, *q.v.*) by making him drunk, and as being instructed by him on the woes of human life. In art he generally appears as a little pot-bellied old man, with a snub nose and a bald head, riding on an ass and supported by satyrs; or he is depicted lying asleep on his wine-skin, which he sometimes bestrides. A more dignified type is the Vatican statue of Silenus carrying the infant Dionysus, and the marble group from the villa Borghese in the Louvre.

See Preller-Robert, *Griechische Mythologie* (1894), pp. 729–35; Roscher's *Lexikon* (s.v.).

SILESIA, the name of a district in the East of Europe, the greater part of which is included in the German republic and is known as German Silesia. A smaller part, called Austrian Silesia, was included in the empire of Austria Hungary.

German Silesia, a province of Prussia, is bounded by Brandenburg, Grenzmarke, Poland, Czechoslovakia, and the republic and province of Saxony. Besides the bulk of the old duchy of Silesia, it includes the countship of Glatz, a fragment of the Neumark, and part of Upper Lusatia, taken from the kingdom of Saxony.

[1]For the abbreviation, *cf.* Lucas, Prisca (=Priscilla); Sopater (=Sosipater).

in 1815. The province, which has an area of 14,022 sq.m. and is the largest in Prussia, is divided into three governmental districts, those of Liegnitz and Breslau comprising lower Silesia, and of Oppeln taking in the greater part of mountainous Silesia. By the Treaty of Versailles it was decreed that 122 sq.m. of territory in Upper Silesia, with a population of 48,446, should be ceded to Czechoslovakia. In nearly all the other districts of Upper Silesia it was ordained that a plebiscite should be taken as to whether they should remain German or become Polish. The plebiscite was taken in 1921, and, though the total majority was for Germany, many districts had Polish majorities; this led to difficulties and the question was referred to a commission of the council of the League of Nations. According to the findings of this commission 1,241 sq.m., with a population of 892,457, were assigned to Poland. The new boundary cut across a homogeneous industrial area, and, in order to alleviate economic distress, certain stipulations were made whereby the internal commerce of the area could be carried on very much as before. In 1925 the population of Lower Silesia was 2,988,541, of Upper Silesia 1,-299,144, giving a density per sq.m. of 304 and 368 respectively. In Lower Silesia two-thirds of the population is Protestant, in Upper Silesia the great majority is Roman Catholic.

Physiographically the province falls into three parts. Along its south-western border we have the Sudetic range, its ridge presenting an almost unbroken line, everywhere over 1,500 ft. high, and rising to over 5,000 ft. in the Riesen Gebirge. This range is composed of Archaean and Primary rocks, the latter of which have, in places, coal-bearing strata. The south-eastern and eastern boundaries are drawn along the Tarnowitz Plateau and its north-westward extension; this plateau is formed of secondary rocks, but in the south there are carboniferous outcrops. Between these two sets of heights lies Silesia proper, a depression watered by the Oder and its tributaries, and covered with recent deposits, among which fairly large stretches of loess are notable. The average January temperature is about 30° F; July 70° F, but the figures vary greatly at different altitudes. On the lowlands the annual rainfall is just over 20 in., but it is much higher on the hills.

The mines and the good agricultural land attracted German settlers up the Oder in the middle ages, and the land became essentially German, but there are traces of the older Wendish population still to be found among the inhabitants. In the plain, especially on the loess, there is rich agricultural land, and the chief crops are wheat, oats, hops, sugar-beet and fruit. To the north of the Oder the land is poorer, heath and scrubby pine-woods, and here the potato, rye and flax are the agricultural staples. The same is true of the Lusatian region. In earlier times Silesia was famed for its sheep, and wool, flax and an abundance of water led to the establishment of a textile industry. Later cotton was introduced and water-power was replaced by steam produced by coal from the neighbouring mines. At Görlitz and Schweidnitz woollens are manufactured, at Hirschberg and Neustadt linen, at Glatz and Reichenbach cotton, and at Schmiedeberg carpets and plush. Several of these towns also manufacture glass and porcelain. At Waldenburg coal is mined, and there are ironworks; the manufacture of machinery is carried on in many Silesian towns.

The slopes of the Sudetes are covered with fine pine forests and here we have manufactures dependent on a good supply of wood; *e.g.*, paper, toys and matches. The plain, with its soft rocks, is supplied with building material from the quarries of the Sudetes. Above the tree line are the summer pastures of large herds of cattle. It is only the smaller share of the great industrial region of the south-east that has remained to Germany, but Silesia is still important for its coal mines, and its iron-, lead- and zinc-smelting works. Along the Sudetes at various places there are mineral springs.

The main line of communication is the railway that runs from Sagan via Liegnitz and Breslau to Oppeln, where it branches, sending one arm to Beuthen in the industrial south-east, and the other via Ratibor, the upper Oder and the March valleys towards Vienna. This main line throws off a number of branches north-eastward to Poland. Another line runs roughly parallel to it from Hoyerswerden to Ratibor passing through a number of industrial towns. It is linked with the main line at numerous points. The Sudetes are crossed by three important railways, from Görlitz, from Waldenburg and from Glatz. The Oder is navigable nearly throughout the province, *i.e.*, from Kosel, whence the Klodnitz canal enables barges to tap the industrial region around Gleiwitz and Hindenburg. The bigger cities in the plains have varied manufactures, and Breslau is the commercial as well as the political capital. For administrative purposes the province is divided into 14 city and 57 rural circles.

HISTORY

Early Period.—From the evidence of place-names, it appears as though the population of Silesia was at one time Celtic; but when its historical records begin with its incorporation into the new kingdom of Poland (*c.* A.D. 1000), we find it populated by Slavonic tribes, one of which, deriving its name from the mountain Zlenz, gave Silesia its name. On the death of Boleslaw III. of Poland (1138), his dominions were partitioned, and Silesia was constituted a separate principality, which in 1163 was divided into the *ducatus Zlesie* and the *ducatus Opoliensis,* these again disintegrating during the succeeding centuries into ever smaller units. By the end of the 14th century, Silesia consisted of 18 principalities: Breslau, Brieg, Glogau, Jauer, Liegnitz, Münsterberg, Oels, Schweidnitz and Steinau in Lower Silesia; Beuthen, Falkenberg, Kosel, Neisse, Oppeln, Ratibor, Strehlitz, Teschen and Troppau in the upper district. As members of the Piast house and *principes Poloniae,* the Silesian dukes remained outside the German empire; but as from the first they adopted the policy of inviting German settlers to fill their vacant land, and founding towns which enjoyed German law, their lands soon became virtually German. The result was much material prosperity; forest and swamp lands were reclaimed; the weaving and mining industries acquired great importance and Breslau (which was refounded *c.* 1250 as a German town) became a large market for the wares of the East and the West.

At the beginning of the 14th century the Silesian dukes exchanged their nominal allegiance to Poland for allegiance to Bohemia, becoming members of the Empire; and as some of the Piast dynasties died out, their lands were appropriated as crown land by the Kings of Bohemia. The earlier Bohemian overlords justified their intrusion by their vigorous administrative and other reforms; the cities in particular enjoyed greatly increased material prosperity and political importance. Later, however, the Bohemian connection involved Silesia in the Hussite wars. In 1420 Silesia supported Sigismund against the Bohemian rebels, whom it regarded as dangerous to the German nationality, but suffered in consequence a series of devastating invasions (1425–35) which permanently weakened the German element. Had the Hussite, George Podiebrad, who was accepted by most of the Silesian dynasties, but fiercely repudiated by the burghers of Breslau, retained the Bohemian throne which he mounted in 1457, the Slavonic element might have regained the upper hand; but he was replaced by Matthias Corvinus, whom Silesia readily recognised as overlord. Corvinus' reforms, although effective, were financially exacting, and under his successor Vladislav the Silesians exacted concessions which gave them virtual autonomy.

The estates of Silesia accepted the accession of Ferdinand I. of Habsburg without demur (Dec. 5, 1526), but under their new dynasty they soon lost almost all their old rights, and the land gradually passed to the Crown as the old dynasties became extinct. After an uneventful period, the land was almost ruined by the Thirty Years' War (1618–48) in which Silesia, which was almost wholly Protestant, had joined with the rebellious Bohemians. It was punished less severely than Bohemia, but for years was the battlefield of contending armies, and overrun by lawless mercenaries. Three quarters of the population lost their lives, and trade and industry were brought to a standstill. Owing to the permanent diversion of trade routes, and the disregard by the Habsburgs of their undertakings towards their Protestant subjects, recovery was slow, although the representatives of Charles XII. of Sweden secured for the Silesians some religious liberty,

and the emperor Charles VI. tried to stimulate trade with Austria.

In 1740 Frederick II. of Prussia laid claim to the former Duchies of Liegnitz, Brieg, Jägerndorf and Wohlau, on the strength of a testamentary disposition made in 1537 and later annulled. He occupied Lower Silesia, which Maria Theresa was forced to yield him in 1741, and in 1742 extorted from Austria the whole remainder of Silesia except the districts of Troppau, Teschen and Jägerndorf. Maria Theresa's tenacious endeavour to recover her lost province proved unsuccessful, although in the Seven Years' War (*q.v.*) she was near success.

Austrian Silesia.—The history of Austrian Silesia is shortly told. It was combined with Moravia until 1849, when it was created a separate Crownland. In 1918 the Germans of Silesia claimed the right of self-determination, but their country was attributed to Czechoslovakia. The frontiers of Teschen (*q.v.*), which was disputed by Czechs and Poles, had to be drawn by the Allied Powers. By the law of 1927, the old Austrian Silesia became a federal province of the Czechoslovak State.

Prussian Silesia.—Prussian Silesia, on annexation, was reorganized completely. The old local institutions were abolished, and the country became an integral part of Prussia. Frederick II., who visited it yearly and appointed a special Minister for Silesia, introduced many important reforms and laid the foundations for its industrial development, in particular reviving the old mining and weaving industries. In 1815 Silesia was enlarged by a part of Lusatia, and henceforward developed very rapidly with the increasing importance of coal. It became highly industrialized, large mining areas and industrial towns, the latter with an almost wholly German population, alternating with agricultural districts inhabited by Polish peasantry.

THE PARTITION OF UPPER SILESIA

On the re-creation of the Polish State in 1918 the question of the attribution of Upper Silesia, with its great mineral wealth and mixed population of 2,280,902, became one of great importance. It was decided and provided by Article 88 of the Treaty of Versailles (1919) that the inhabitants of Upper Silesia should be called upon to decide by plebiscite whether they would belong to Germany or Poland (except in the purely German districts of Falkenberg, Grotthau, Neisse, part of Neustadt and Hultschin), the supreme authority in the area meanwhile being vested in an Inter-Allied commission consisting of one representative of France, Great Britain and Italy respectively. On Feb. 1, 1920, Allied troops occupied the plebiscitary district; local German officials were subordinated to the Inter-Allied authorities, and the German police replaced by a special polling police, composed half of German-speaking and half of Polish-speaking inhabitants.

The Plebiscites.—On the whole, the collaboration of the Inter-Allied control and the German officials proved satisfactory. Both the Poles (under Korfanty) and the Germans opened an active canvassing campaign; and the Poles, after previous excesses, attempted on Aug. 19, 1920, to seize the country by force, and order was not restored for several weeks. The Polish terrorism revived when the date of the plebiscite was announced for March 20, 1921, reaching a climax before the plebiscite, and recommencing after it. Bands, chiefly recruited from Congress Poland, usurped authority. The poll showed 717,122 votes for Germany and 483,514 for Poland. In 664 districts there was a German, in 597 a Polish majority. Practically all the towns voted for Germany. There was a Polish majority in the administrative districts of Rybnik, Pless, Beuthen, Tarnowitz and Gross-Strehlitz. The Inter-Allied Commission proved unable to agree on the allocation of the disputed regions, the French representative (who had from the first been accused of tacitly supporting the Poles) wishing to allot the whole of southern and eastern Upper Silesia to the Poles, while the British and Italian representatives wished to apportion the industrial region to Germany. Protracted diplomatic negotiations between Paris, London and Rome led to no result. At the end of April a report became current that the Council of Ambassadors had given only the districts of Rybnik and Pless to Poland; whereupon in May, Korfanty, at the head of a force armed and reinforced from Poland, occupied the whole south-eastern part of Upper Silesia, nominated himself dictator of these districts, took over the administration, and treated even the Allied officials so curtly that they were obliged to vacate the regions occupied by the Poles, except the larger towns. A further Polish advance was prevented, after severe fighting, by the German defence force, composed of Upper Silesians and volunteers from other parts of the Reich, under Gen. Hofer.

After fruitless attempts to negotiate with Korfanty, the Allies dispatched reinforcements of French and British troops to Upper Silesia. Lengthy negotiations were carried on with the German defence force, and British troops had, by June 20, re-occupied the larger towns, the Poles commanding the rural districts. Korfanty now lost control over his bands, which plundered the villages; work in many mines and ironworks stopped and the industrial district suffered severe losses.

THE DECISION OF THE LEAGUE OF NATIONS

After prolonged and open disagreement between the Allied Powers, France wishing to assign the whole industrial region to Poland, Great Britain to leave all except the south-east corner, with Pless and Rybnik, to Germany, it was decided, Italy and Japan supporting the British view, to entrust the decision to a commission of the Council of the League of Nations. This commission was ultimately constituted by the representatives of Japan (chairman), Brazil, China, Spain and Belgium. An award, published on Oct. 20, 1921, assigned to Poland at least 75% of the aggregate material wealth of the country. In order to guarantee the continuity of the economic life of the region during a provisional period of readjustment, and to provide for the protection of minorities, the commission recommended that a general convention be concluded between Germany and Poland, so as to place Upper Silesia under a special régime during the transitional period, and that an advisory "Upper Silesian Mixed Commission" should be set up, together with an arbitral tribunal for settling private disputes occasioned by the temporary measures.

The provisional or transitional period was to be 15 years. During that period: (1) Railway and tramway systems, privately owned or municipal, to continue under the terms of their concessions, and the German State railways to be put under a joint system of operation. Railway rates to be uniform; the State insurance of employees in the Silesian railway system to be undertaken by that system; a single accounts office to be set up for the whole system; expenses of new construction to be charged to a separate account, and borne by the State in whose territory it was carried out; the working capital for operation to be lent by the German State, and interest charged to the account of this system; profits or deficits to be divided between the two countries in proportion to the length of line and amount of traffic belonging to each. (2) The German mark was to be the only legal unit of currency, and Poland was to recognize the rights of the Reichsbank for a period not exceeding 15 years, but by agreement the two Governments might modify this arrangement earlier. (3) While the German monetary system was maintained in the Polish zone, the postal, telegraph and telephone charges should be in German currency. (4) The customs frontier should coincide with the political frontier, and the German and Polish customs law should apply, with certain exceptions.

For six months incoming goods from other countries, on which German or Polish duties had been paid previously to the partition, should cross the frontier without duty. For 15 years, natural products originating or coming from one of the two zones of the plebiscite area, and destined for consumption in the other, should cross the frontier free of duty. For six months, raw, half-manufactured and unfinished products of industrial establishments in one zone, destined for industrial establishments in the other, should cross free of duty; and this should continue for 15 years when the products, as finished, were intended for free importation into the country of origin. Natural or manufactured products originating in the Polish zone should, on importation into the German customs territory, be exempt from duty for three years from the date of the frontier-delineation. As regards export, the two countries should facilitate for 15 years the export of such pro-

ducts as were indispensable for industry in either zone. (5) Poland was to permit, for 15 years, the exportation to Germany of the products of the coal-mines in the Polish zone, and Germany similarly to Poland in respect of the mines in the German zone. (6) For the 15 years, any inhabitant regularly domiciled or occupied in the plebiscite area should receive a "circulation permit," free of payment, enabling him to cross the frontier without other formalities. (7) Generally, the two countries should respect private rights.

A German-Polish conference met at Geneva on Nov. 23, 1921, and a detailed convention was signed on May 15, 1922. On the whole, the industrial provisions suggested by the League worked unexpectedly smoothly. The prosperity of Polish Silesia was greatly furthered by the British coal strike of 1926. On the German side there was a tendency to transfer capital from Silesia to the Ruhr. A curious difficulty arose when the three-year duty-free period expired, owing to the world glut of coal. Germany was anxious to stop the free imports at the earliest date, while Poland wished for their continuance. This difference was a major obstacle to the conclusion of a German-Polish commercial treaty. An appeal by the German Government to the Permanent Court of International Justice on May 15, 1925, against Polish action in expropriating a nitrate factory at Chorzow, and certain landed estates, resulted in a decision by the Court generally in favour of Germany (May 25, 1926).

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SILESIA, a province of Czechoslovakia, covering an area of 1,708 sq.m., stretches along the north-eastern flank of the Jeseník Mts. across the lowland of the Upper Oder to the northern slopes of the Jablunkovské hory (Lysá hora—4,346 ft.). A tongue of Moravia along the right bank of the Oder almost cuts it into two parts. Owing to its mountainous character and its slopes toward the north and north-east Silesia has a severe climate (Opava, 920 ft., Jan. 27·5° F, July 65·5° F), with a large seasonal range of temperature, and an annual rainfall of 20 to 30 ins., with a summer maximum. North-west of the Oder valley the surface formation is Carboniferous passing to eruptive rocks, but, in the valley and to the south-east, recent deposits, including loess, offer greater scope to agriculture. In the former region forestry, dairy-farming and sheep breeding together with the growth of fodder plants are typical, while in the latter cereals, fruit and poultry are the principal products. But Silesia is chiefly noted for its mineral wealth consisting of coal, iron-ore, lead, marble and slate. The foundation of its great and varied industrial activity is the coal of the Moravská Ostrava—Karvinná basin, the largest field in Czechoslovakia, giving a rich coking variety much of which goes to the large iron and steel foundries of Vítkovice nearby. Engineering and metallurgic industries concentrate on Moravská-Ostrava, the manufacture of agricultural machinery at Opava and Krnov and textiles, particularly woollen goods, at Krnov and Andělská Hora. Other industrial activities are chemicals (Vitkovice and Moravská-Ostrava), brewing and distilling.

In 1921 the population numbered 672,268, of whom 39·3% were German, 13·5% Poles and 46·3% Czechoslovaks. According to religion 84% were Roman Catholics, 9·6% Evangelicals, 2% Jewish and 3·6% belonged to the Czechoslovak church. A large measure of provincial autonomy is granted to the province which is counted with Moravia (*q.v.*), for purposes of representation in the national parliament.

See also Czechoslovakia; Moravia; and H. Cloos, *Der Gebirgsbau von Schlesien* (Berlin, 1922), and A. Fillunger, *Das Relief des Steinkohlengebirges von Mähr-Ostrau* (Vienna, 1903).

SILESIAN WARS, the name given to the contests between Austria and Prussia for the possession of Silesia. The first (1740–42) and second (1744–45) wars formed a part of the great European struggle called the War of the Austrian Succession (*q.v.*), and the third war (1756–62) similarly a part of the Seven Years' War (*q.v.*).

SILHOUETTE, ÉTIENNE DE (1709–1767), controller-general of France, was born at Limoges on July 5, 1709. He travelled extensively while still a young man and attracted attention by English translations, historical writings, and studies on the financial system of England. Successively councillor to the parlement of Metz, secretary to the duke of Orleans, member of the commission on delimitation of Franco-British interests in Acadia (1749), and royal commissioner in the Indies Company, he was named controller-general through the influence of the marquise de Pompadour on March 4, 1759. The court at first reposed a blind confidence in him, but, when he proposed a land-tax on the estates of the nobles and the reduction of pensions, a storm of opposition broke on the unfortunate minister. In allusion to the sacrifices which he demanded of the nobles, even the conversion of their table plate into money, *silhouette* became the popular word for a figure reduced to simplest form. Silhouette was driven from office in 1759 and withdrew to Brie-sur-Marne. He died on Jan. 20, 1767.

For a list of his writings *see* Quérard, *France littéraire*, ix. 138. A *Testament politique*, published under his name in 1772, is apocryphal. *See* J. P. Clement and A. Lemoine, *M. de Silhouette* (Paris, 1872); M. Guillaumat-Vallet, *Le Contrôleur-Genéral Silhouette et ses reformes en matière financière* (1914).

SILHOUETTE, the shadow outline of an object, usually a profile, obtained by projecting the shadow on to a sheet of white paper, tracing in the outline and afterwards filling in with a dark colour. About 1750 it became popular to have profile portraits cut out of black paper with scissors and mounted.

SILICA, in chemistry, the name ordinarily given to amorphous silicon dioxide, SiO_2. This chemical compound is widely and most abundantly distributed in nature, both in the free state and in combination with metallic oxides, constituting about 60% of the solid crust of the earth. Free silica constitutes the greater part of sand and sandy rocks; when fairly pure it occurs in the large crystals which we know as quartz (*q.v.*), and which, when coloured, form the gem-stones amethyst, cairngorm, cat's-eye and jasper. Tridymite (*q.v.*) is a rarer form, crystallographically different from quartz, and cristobalite is still rarer. Amorphous forms also occur: chalcedony (*q.v.*), and its coloured modifications agate, carnelian, onyx and sard, together with opal (*qq.v.*) are examples. Amorphous silica can be obtained from a silicate (a compound of silica and a metallic oxide) by fusing the finely powdered mineral with sodium carbonate, decomposing the sodium silicate thus formed with hydrochloric acid, evaporating to dryness to convert the colloidal silicic acid into insoluble silica, and removing the soluble chlorides by washing with hot water. On drying, the silica is obtained as a soft white amorphous powder, insoluble in water and in all acids except hydrofluoric; it dissolves in hot solutions of the caustic alkalis and to a less extent in alkali carbonates. It melts at 1,710° C, and in the electric furnace it may be distilled, the vapours condensing to a bluish-white powder. The melting point is not that of amorphous silica or ordinary quartz, for above 870° C this is unstable and is converted to tridymite; this in turn becomes unstable above 1,470° C, being then converted into cristobalite, and it is this form which is stable at the melting point. Under the very high pressures prevailing during the crystallization of igneous rocks, however, the limit of stability of quartz would be greatly raised, since its density (2·65) is greater than that of tridymite (2·3), and this probably accounts for the comparative rarity of the latter in spite of the rocks having crystallized at above 1,000° C. On the crystal structure of these forms of silica *see* Sir W. H. Bragg and R. E. Gibbs, *Proc. Roy. Soc.*, 1925–26; R. W G. Wyckoff, *Amer. J. Sci.*, 1925.

Quartz which has been heated above 575° etches differently from ordinary quartz and is therefore called β-quartz, the un-

heated variety being α. Since quartz crystals have no plane or centre of symmetry, they can exist in two forms which rotate the plane of polarization of light in opposite directions and are related to one another as an object and its image.

Silicates.—These compounds are to be regarded as salts of silicic acid, or combinations of silicon dioxide and metallic basic oxides; they are of great importance since they constitute the commonest rock-forming and many other minerals, and occur in every petrographical species. The parent acid, silicic acid, was obtained by T. Graham by dialysing a solution of hydrochloric acid to which sodium silicate had been added, a colloidal silicic acid being retained in the dialyser. This solution may be concentrated until it contains about 14% of silica by open boiling, and this solution on evaporation in a vacuum gives a transparent mass of metasilicic acid of approximate composition, H_2SiO_3. The colloidal solution is a tasteless liquid having a slight acid reaction; it gradually changes to a clear transparent jelly, which afterwards shrinks on drying. This coagulation is brought about very quickly by salts, especially those of multivalent metals. (*See* COLLOIDS.) The natural silicates may be regarded as falling into five classes, viz., orthosilicates, derived from $Si(OH)_4$; metasilicates, from $SiO(OH)_2$, disilicates, from $Si_2O_3(OH)_2$; trisilicates, from $Si_3O_5(OH)_2$; and basic silicates. These acids may be regarded as derived by the partial dehydration of the ortho-acid. Another classification is given in METALLURGY; a list of mineral silicates is given in MINERALOGY, and for the synthetical production of these compounds, *see* also PETROLOGY.

Certain naturally occurring silicates, *e.g.*, kaolin, and specially prepared amorphous silica, have the power of absorbing colouring matters from oils and thus improving their appearance.

Solutions of sodium silicate containing excess of silica ($SiO_2:Na_2O>1$) are used as adhesives and possess great advantages over ordinary adhesives in certain cases, *e.g.*, sticking paper to metals.

SILICON, a non-metallic chemical element. It is not found in the uncombined condition, but in combination with other elements it is, with the exception of oxygen, the most widely distributed and abundant of all the elements. It is found in the form of oxide (silica), either anhydrous or hydrated, as quartz, flint, sand, chalcedony, tridymite, opal, etc., but occurs chiefly in the form of silicates of aluminium, magnesium, iron, and the alkali and alkaline-earth metals, forming the chief constituent of various clays, soils and rocks. It has also been found as a constituent of various parts of plants and has been recognized in the stars. The element (symbol Si, atomic number 14, atomic weight 28·06, isotopes 28, 29, 30) exists in two forms, one amorphous, the other crystalline. The older methods used for the preparation of the amorphous form, namely the decomposition of silicon halides or silicofluorides by the alkali metals, or of silica by magnesium, give an impure product, but if a small proportion of magnesia is added in the last case, the product is of about 96% purity. The crystalline form may be prepared by heating potassium silicofluoride with aluminium, by heating silica with magnesium in the presence of zinc, or by volatilizing the amorphous variety from an electric furnace. A somewhat impure silicon (containing 90–98% of the element) is made by heating coke and sand in an electric furnace, the coke being present in insufficient quantity to form carborundum (*q.v.*), or by heating silica and carborundum similarly. The crystalline solid has specific gravity about 2·4, and the amorphous about 2·35; the melting points are about 1,450° C.

Amorphous silicon is a brown powder, the crystalline variety being grey, but differing according to the method of preparation. The specific heat varies with the temperature, from 0·136 at −39° C to 0·2029 at 232° C. Silicon is attacked rapidly by fluorine at ordinary temperature, and by chlorine when heated in a current of the gas. It undergoes a slight superficial oxidation when heated in oxygen. It combines directly with many metals on heating, whilst others merely dissolve it. It decomposes ammonia at a red heat, liberating hydrogen and yielding a compound containing silicon and nitrogen. It reduces many non-metallic oxides. It is only soluble in a mixture of hydrofluoric and nitric acids or in solutions of the caustic alkalis, in the latter case yielding hydrogen and a silicate:

$$Si+2KHO+H_2O=K_2SiO_3+2H_2,$$

a reaction which has been utilized for the large-scale production of this gas for military balloons. On fusion with alkaline carbonates and hydroxides it undergoes oxidation to silica which dissolves in excess of alkali yielding alkaline silicates.

Hydrides.—When hydrochloric acid reacts with magnesium silicide (produced by heating together two parts of magnesium and one part of silica), a spontaneously inflammable mixture of hydrogen and various hydrides of silicon is formed. By condensing the latter in liquid air and fractionating the resulting solid, A. Stock and his collaborators have obtained four "silanes" in a state of purity: (1) SiH_4, monosilane or silicomethane, m.p. −185° C, b.p. −42°, is a colourless gas which is very stable at the ordinary temperature and not spontaneously inflammable. (2) Si_2H_6, disilane or silicoethane, m.p. −132·5°, b.p. −15°, is stable at ordinary temperatures but decomposes below 300° and inflames in air; it reacts vigorously even with carbon tetrachloride, forming hydrogen chloride, silicon and carbon. (3) Si_3H_8, trisilane or silicopropane, m.p. −117°, b.p. 53°, is somewhat unstable at ordinary temperatures. (4) Si_4H_{10}, tetrasilane, m.p. −93·5°, b.p. 80–90°, is still more unstable. All the silanes reduce silver and copper salts, and they react with caustic alkalis to give a quantitative yield of hydrogen and silicate, *e.g.*, $Si_2H_6+4NaOH+2H_2O=2Na_2SiO_3+7H_2$. By direct reaction with bromine, or, better, by reaction with hydrogen bromide in the presence of aluminium bromide, they give a series of compounds in which the hydrogen is replaced successively by bromine, and these in turn react with water to give oxy-compounds; *e.g.*, bromo-monosilane yields disiloxane; $2SiH_3Br+H_2O=2HBr+(SiH_3)_2O$; and dibromosilane gives siloxane, SiH_2O, which polymerises rapidly to $(SiH_2O)_n$. For further details of these and related compounds, the works of A. Stock (*Berichte*, 1916 *et seq.*) should be consulted.

Only one oxide of silicon, namely the dioxide or silica, is definitely known (*see* SILICA) although SiO has been described.

Halides.—*Silicon fluoride,* SiF_4, is formed when silicon is brought into contact with fluorine; or by decomposing a mixture of acid potassium fluoride and silica, or of calcium fluoride and silica with concentrated sulphuric acid. It is a colourless, strongly fuming gas with suffocating smell and solidifies at −97° C. It is decomposed with great violence when heated in contact with either sodium or potassium. It combines directly with ammonia to form the compound $SiF_4{\cdot}2NH_3$, and is absorbed by dry boric acid and by many metallic oxides. Water decomposes it into silicofluoric acid and silicic acid: $3SiF_4+3H_2O=2H_2SiF_6+H_2SiO_3$, hydrogen fluoride being an intermediate product. It combines directly with acetone and with various amines.

Silicon fluoroform, $SiHF_3$, obtained by O. Ruff and Curt Albert by decomposing titanium fluoride with silicochloroform in sealed vessels at 100–120° C, is a colourless gas which may be condensed to a liquid boiling at −80·2° C (melting point about −110° C). It is very unstable, decomposing slowly, even at ordinary temperatures, into hydrogen, silicon fluoride and silicon:

$$4SiHF_3=2H_2+3SiF_4+Si.$$

It burns with a pale-blue flame forming silicon fluoride, silicofluoric acid and silicic acid. It is decomposed readily by water, alcohol and ether, yielding respectively silicofluoric acid, H_2SiF_6, ethyl orthosilicate, $Si(OC_2H_5)_4$, and ethyl orthosilicoformate, $SiH(OC_2H_5)_3$.

Silicofluoric or hydrofluosilicic acid, H_2SiF_6, is obtained as shown above, and also by the action of sulphuric acid on barium silicofluoride, or by absorbing silicon fluoride in aqueous hydrofluoric acid. The concentrated solution deposits a hydrated form, $H_2SiF_6{\cdot}2H_2O$. The anhydrous acid is not known, since on further heating alone or in aqueous solution it gradually decomposes into silicon fluoride and hydrofluoric acid.

Silicon chloride, $SiCl_4$, was prepared by J. J. Berzelius by the action of chlorine on silicon, and is also obtained when an intimate mixture of silica and carbon (or sulphur) is heated in a stream of chlorine and the products of reaction fractionated. It

is a very stable colourless liquid which boils at 58° C. Oxygen attacks it only at very high temperatures. When heated with the alkali and alkaline earth metals it yields silicon and the corresponding metallic chlorides. Water decomposes it into hydrochloric and silicic acids. It combines directly with ammonia gas to form $SiCl_4 \cdot 6NH_3$, and it also serves as the starting point for the preparation of numerous organic derivatives of silicon. By the action of acetylacetone on silicon tetrachloride a complex siliconium chloride $Si(C_5H_7O_2)_3Cl$ is produced, which gives rise to well-defined series of double salts such as $Si(C_5H_7O_2)_3AuCl_4$, $Si(C_5H_7O_2)_3FeCl_4$, and $[Si(C_5H_7O_2)_3]_2PtCl_6$. Silicon hexachloride, Si_2Cl_6, is formed when silicon chloride vapour is passed over strongly heated silicon; or by the action of chlorine or mercuric chloride on the corresponding iodo-compound. It is a colourless fuming liquid which boils at 146–148° C. It is decomposed by water, to give silico-oxalic acid, $Si_2O_4H_2$. *Silicochloroform*, $SiHCl_3$, is formed by heating crystallized silicon in hydrochloric acid gas at a temperature below red heat, or by the action of hydrochloric acid gas on copper silicide, the products being condensed by liquid air and afterwards fractionated. It is a colourless liquid which boils at 33° C. It fumes in air and burns with a green flame. It is decomposed by cold water with the formation of silicoformic anhydride, $H_2Si_2O_3$. Higher chlorides up to Si_6Cl_{14} are known.

The bromo-compounds resemble the corresponding chloro-compounds.

Silicon tetraiodide, SiI_4, is formed by passing iodine vapour mixed with carbon dioxide over strongly-heated silicon; the iodo-compound condenses in the colder portion of the apparatus and is purified by shaking with carbon bisulphide and with mercury. It crystallizes in octahedra which melt at 120·5° C and boil at 290° C. It is decomposed by alcohol:

$$SiI_4+2C_2H_5OH=SiO_2+2C_2H_5I+2HI.$$

The *hexaiodide*, Si_2I_6, obtained by heating the tetraiodide with finely divided silver to 300° C, crystallizes in hexagonal prisms which exhibit double refraction; it is soluble in carbon bisulphide, and is decomposed by water and also by heat, in the latter case yielding the tetraiodide and the di-iodide, Si_2I_4, an orange solid not soluble in carbon bisulphide. *Silicoiodoform*, $SiHI_3$, is formed, together with silicon tetraiodide, by the action of hydrogen and hydriodic acid on silicon. It is also obtained by the action of hydriodic acid on siliconitrogen hydride suspended in carbon disulphide, or by the action of a benzene solution of hydriodic acid on trianilino-silicon hydride:

$$SiH(NHC_6H_5)_3+6HI=SiHI_3+3C_6H_5NH_2 \cdot HI.$$

It is a colourless, strongly refracting liquid, which boils at about 220° C with slight decomposition.

Siliconitrogen hydride, SiNH, is a white powder formed with silicon amide when ammonia gas (diluted with hydrogen) is brought into contact with the vapour of silicochloroform at −10° C. *Trianilino-silicon hydride*, $SiH(NHC_6H_5)_3$, is obtained by the action of aniline on a benzene solution of silicon chloroform. *Silicon amide*, $Si(NH_2)_4$, is obtained as a white amorphous unstable solid by the action of liquid ammonia on silicon chloride. It is readily decomposed by water:

$$Si(NH_2)_4+2H_2O=4NH_3+SiO_2.$$

Above 0° C it decomposes thus; $Si(NH_2)_4 - 2NH_3+Si(NH)_2$.

Silicon sulphide, SiS_2, is formed by heating amorphous silicon with sulphur; it crystallizes in needles which rapidly decompose when exposed to moist air. By heating crystallized silicon with boron in the electric furnace, H. Moissan and A. Stock obtained two borides, SiB_3 and SiB_6, as stable crystalline solids.

Organic Derivatives of Silicon.—The organic derivatives of silicon resemble the corresponding carbon compounds except in so far that the silicon atom is not capable of combining with itself to form a complex chain to the same extent as the carbon atom. Many of the earlier-known silicon alkyl compounds were isolated by Friedel and Crafts and by Ladenburg, the method adopted consisting in the interaction of the zinc alkyl compounds with silicon halides or esters of silicic acids:

$$SiCl_4+2Zn(C_2H_5)_2=2ZnCl_2+Si(C_2H_5)_4.$$

The greatest advances have taken place with the application of the Grignard reagent (*q.v.*):

$$C_2H_5MgBr+SiCl_4 \rightarrow C_2H_5SiCl_3+MgBrPh \rightarrow$$
$$Ph(C_2H_5)SiCl_2+MgBrC_3H_7 \rightarrow Ph(C_2H_5)(C_3H_7)SiCl,$$

and by similar means F. S. Kipping (1907) was able to prepare phenylbenzylethylpropylsilicane $(C_6H_5)(C_7H_7)(C_2H_5)(C_3H_7)Si$, which he converted to sulphobenzylethylpropylsilicyl oxide, $(SO_3H \cdot C_6H_4 \cdot CH_2 \cdot SiEtPr)_2O$, and this was resolved into its *d*- and *l*- forms. (*See* STEREOCHEMISTRY.)

Silicon tetramethyl, $Si(CH_3)_4$ (tetramethyl silicane), and silicon tetraethyl, $Si(C_2H_5)_4$, are both liquids. *Triethyl silicol*, $(C_2H_5)_3Si \cdot OH$, is a true alcohol. *Silicon tetraphenyl*, $Si(C_6H_5)_4$, a solid melting at 231° C, is obtained by the action of chlorobenzene on silicon tetrachloride in the presence of sodium (Fittig's reaction). *Silicomesoxalic acid*, $HO \cdot OSi \cdot Si(OH)_2 \cdot SiO \cdot OH$, formed by the action of moist air on octachloro-trisilane, Si_3Cl_8, is very unstable, and hot water decomposes it with evolution of hydrogen and formation of silicic acid. *Silicobenzoic acid*, $C_6H_5 \cdot SiO \cdot OH$, results from the action of dilute aqueous ammonia on phenyl silicon chloride, $SiPhCl_3$ (obtained from magnesium phenyl bromide and silicon tetrachloride). It is a colourless solid which melts at 92° C. For organic derivatives of silicon *see* F. S. Kipping (*Journ. Chem. Soc.*, 1907 *et seq.*).

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SILICON CARBIDE is one of the small class of solid compounds containing only non-metallic elements. It does not occur in nature, but was discovered accidentally in 1871 by Acheson, who gave it the name carborundum (*q.v.*). On account of its extreme hardness (next to diamond on Mohs's scale), its abrasive value was soon recognized, and it remains the first in importance, as it was the first in time, of commercially produced artificial abrasives (*q.v.*). It often appears as greenish, bluish, or brownish translucent or opaque crystals, but is generally seen as a greyish-brown powder, being of most industrial use in this form. Chemically it has the composition SiC (hardness, 9; sp.gr. 3·2). Its crystal structure is the same as that of the diamond, only with alternate carbon atoms replaced by silicon atoms. This fact is doubtless connected with its extreme hardness.

Silicon carbide is made by heating a mixture of 35% coke (C), 53% sand (SiO_2), 10% sawdust and 2% salt (NaCl). The furnace is rectangular, about 30 ft. long, 10 ft. wide, and 10 ft. high; and the electrodes are bundles of thick carbon rods passing through thick brick walls at the ends of the furnace. The space between the carbons of the electrodes is packed tightly with graphite, the charge of coke, sand, sawdust and salt is filled in up to the level of the centre of the electrodes, and a trench is made in it to hold small coke running longitudinally from one pole to the other. A further charge is then added and heaped up above the level of the top of the furnace. The brick walls are separated from the charge by a thickness of fine coke. An alternating current of about 6,000 amperes at 230 volts is switched on, and as the resistance diminishes, the current is regulated so as to be kept at 20,000 amperes and 75 volts. After about 48 hours the current is stopped, and after a day's cooling the furnace is carefully unpacked, and a layer of some 18 in. of nearly pure crystallized silicon carbide is found, together with layers of graphite and of partially converted material. Special precautions are required in starting and stopping the current (some thousands of kilowatts). The substance produced by this process resists the action of even the strongest acids, and the action of air or of sulphur at high temperatures. The crude product can therefore be treated with hot sulphuric acid to purify it.

Silicon carbide forms a more or less porous crystalline mass, which shows some well-defined hexagonal plates. Although harder than artificial corundum, it is less tough and has a different fracture. The properties of silicon carbide make it the most efficient abrasive for working on materials of low tensile strength such as cast iron, copper, aluminium, marble, granite and pearl. Carborundum paper, made like emery paper, is now largely used

in place of garnet paper in American shoe factories, and finds a market in other directions as well. It is also used in the form of grinding wheels, and coated cloth, and as loose grains. Silicon carbide is also extensively used in the manufacture of high temperature refractories. The amorphous carbide, which was at first a waste product, has been tried, it is reported with success, as a lining for steel furnaces, since it is said not to be affected by iron or iron oxide at a white heat.

See F. B. Jacobs, *The Abrasive Handbook* (1928).

SILICON STEEL. Invented by Sir Robert Hadfield in 1889, this alloy is a most important member of the family of steel alloys, and led to the perfection of what is termed low hysteresis steel, so largely used in the manufacture of generators, transformers, and other electrical apparatus. It should be explained that the term hysteresis is applied to the tendency of magnetic materials to remain in any magnetic state which already exists. This leads to considerable loss of energy when the magnetic state is changed. Silicon steel is superior to iron itself in magnetic qualities, and improves in that respect with use. Therefore it makes an ideal core for electrical transformers, and its use saves millions of tons of coal every year.

Silicon steel is made by heating steel containing 2½% to 4% of silicon to a temperature of about 1,000° Centigrade. It is then cooled, reheated to about 800°C., and cooled again. Hadfield made the first electrical transformer employing his silicon steel as recently as 1903. (*See* STEEL [ALLOYS].)

SILISTRA, the chief town of the department of Durostor in Rumania and the see of an archbishop, situated on a low-lying peninsula projecting into the Danube, 81 m. below Ruschuk. Pop. (1928) 17,600. The town was formerly a fortress of great strength, occupying the north-east corner of the famous quadrilateral (Ruschuk, Silistra, Shumen, Varna), but its fortifications were demolished in accordance with the Berlin Treaty (1878). In the town is a large subterranean cavern, the *Houmbata,* which served as refuge for its inhabitants during frequent bombardments. The principal trade is in cereals; wine and wood are also exported. The town also contains saw mills. It is surrounded by fine vineyards, some 30 kinds of grapes being cultivated, and tobacco is grown. Apiculture is extensively practised and there are large market-gardens in the neighbourhood. The soil of the department is fertile, but lacking in water; the inhabitants have excavated large receptacles in which rain-water is stored. A considerable area is still covered with forest, to which the region owes its name of Deli Orman ("the wild wood"); there are extensive tracts of pasturage, but cattle-rearing declined in 1880–1910. A large cattle-fair, lasting three days, is held in May.

Silistra was the Durostorum of the Romans, the Δρίστρα of the Greeks. It was one of the most important towns of Moesia Inferior and was successively the headquarters of the legio I. (Italica) and the legio XI. (Claudia). It was defended by the Bulgarian tsar Simeon (*q.v.*) against the Magyars and Greeks in 893. From 967-971 it was held by the Russian prince Sviatoslav, whom the Byzantine emperor Nicephorus Phocas had summoned to his assistance. It was then held successively by the Byzantines, Petchenegs, Byzantines again, and Bulgars, till captured in 1388 by the Turks. A few years later it seems to have been in the possession of the Walachian prince Mircea, but in 1416 it passed finally into the hands of the Turks. Silistra flourished under Ottoman rule; Hajji Khalifa describes it as the most important of all the Danubian towns; a Greek metropolitan was installed here with five bishops under his control and a settlement of Ragusan merchants kept alive its commercial interests. In the Russo-Turkish wars of the nineteenth century it played a most important part. It was assigned to Bulgaria in 1878, and to Rumania, after the second Balkan War, in 1913.

SILIUS ITALICUS, in full TITUS CATIUS SILIUS ITALICUS (A.D. 25 or 26–101), Latin epic poet. His birthplace is unknown. He was a renowned forensic orator, and got a bad name under Nero by acting as prosecuting counsel in the "trials" of Nero's victims. He was consul in the year of Nero's death (68), and is mentioned by Tacitus as having been one of two witnesses who were present at the conferences between Vitellius and Flavius Sabinus, the elder brother of Vespasian, when the legions from the East were marching rapidly on the capital. The life of Silius after his consulship is well depicted by the younger Pliny:—"He conducted himself wisely and courteously as the friend of the luxurious and cruel Vitellius; he won repute by his proconsulship of Asia, and obliterated by the praiseworthy use he made of his leisure the stain he had incurred through his active exertions in former days. In dignity and contentment, avoiding power and therefore hostility, he outlived the Flavian dynasty, keeping to a private station after his governorship of Asia." Silius was a great student and patron of literature and art, and a passionate collector. His heroes were Cicero and Virgil; he possessed Cicero's villa at Tusculum, and the estate in Campania where he spent his years of retirement contained Virgil's tomb. He imitated Virgil in writing an epic, and Cicero in passing much of his time in philosophic conversation, especially with Epictetus. Stricken at the end of his life with an incurable tumour he followed Stoic practice in starving himself to death, keeping a serene and cheerful spirit to the end.

Whether Silius committed to writing his philosophic dialogues or not, we cannot say. Chance has preserved to us his epic poem entitled *Punica,* in 17 books, and comprising some 14,000 lines. In choosing the Second Punic War for his subject, Silius had, we know, many predecessors, as he doubtless had many followers. In justice to Silius and Lucan, it should be observed that the mythologic poet had a far easier task than the historic. In a well-known passage Petronius pointedly describes the difficulties of the historic theme. A poet, he said, who should take upon him the vast subject of the civil wars would break down beneath the burden unless he were "full of learning," since he would have not merely to record facts, which the historians did much better, but must possess an unshackled genius, to which full course must be given by the use of digressions, by bringing divine beings on to the stage, and by giving generally a mythologic tinge to the subject. The Latin laws of the historic epic were fixed by Ennius, and were still binding when Claudian wrote. They were never seriously infringed except by Lucan.

To seize the moments in the history, however unimportant, which were capable of picturesque treatment; to pass over all events, however important, which could not readily be rendered into heroics; to stuff out the somewhat modern heroes to something like Homeric proportions; to subject all their movements to the passions and caprices of the Olympians; to ransack the poetry of the past for incidents and similes on which a slightly new face might be put; to foist in by well-worn artifices episodes, however strange to the subject, taken from the mythologic or historic glories of Rome and Greece,—all this Silius knew how to do. He did it all with the languid grace of the inveterate connoisseur, and with a simplicity foreign to his time, which sprang in part from cultivated taste and horror of the venturesome word, and in part from the subdued tone of a life which had come through the reigns of Caligula, Nero and Domitian. The more threadbare the theme, and the more worn the machinery, the greater the need of genius. Two of the most rigid requirements of the ancient epic were abundant similes and abundant single combats.

No writer has ever been more correctly and more uniformly judged by contemporaries and by posterity alike. Only the shameless flatterer, Martial, ventured to call his friend a poet as great as Virgil. But the younger Pliny gently says that he wrote poems with greater diligence than talent, and that, when according to the fashion of the time, he recited them to his friends, "he sometimes found out what men really thought of them." Nor has he been more admired in modern times, since Poggio discovered him. Yet, by the purity of his taste and his Latin in an age when taste was fast becoming vicious and Latin corrupt, by his presentation to us of a type of a thousand vanished Latin epics, and by the historic aspects of his subject, Silius merits better treatment from scholars than he has received. The general reader he can hardly interest again.

The raw material of the *Punica,* which covers 17 books, was supplied in the main by the third decade of Livy, though Silius

may have consulted other historians of the Hannibalic war. Such facts as are used are generally presented with their actual circumstances unchanged, and in their historic sequence. The general plan of the epic follows that of the *Iliad* and the *Aeneid*. Its theme is conceived as a duel between two mighty nations, with parallel dissensions among the gods. Scipio and Hannibal are the two great heroes who take the place of Achilles and Hector on the one hand and of Aeneas and Turnus on the other, while the minor figures are all painted with Virgilian or Homeric pigments. Hannibal, however, who at the outset is clearly designed as an incarnation of cruelty and treachery, clearly forces his greatness on the poet during the course of the book, while Scipio is never anything but a cardboard Achilles. The best drawn of the minor characters are Fabius Cunctator, an evident copy of Lucan's Cato, and Paullus, the consul killed at Cannae, who fights, hates and dies like a genuine man. All the well-known episodes of Homer and Virgil are there; Hannibal has a wonderful shield and Scipio a revelation of the greatness of Rome. The descriptions of the numerous battles are made up in the main, according to epic rule, of single combats—wearisome sometimes in Homer, wearisome oftener in Virgil, painfully wearisome in Silius. The different component parts of the poem are on the whole fairly well knit together, and the transitions are not often needlessly abrupt; yet occasionally incidents and episodes are introduced with all the irrelevancy of the modern novel. The interposition of the gods is, however, usually managed with dignity and appropriateness.

As to diction and detail, we miss, in general, power rather than taste. The metre runs on with correct smooth monotony, with something always of the Virgilian sweetness, though attenuated, but nothing of the Virgilian variety and strength. The dead level of literary execution is seldom broken by a rise into the region of genuine pathos and beauty, or by a descent into the ludicrous or the repellent. There are few absurdities, but the restraining force is trained perception and not a native sense of humour, which, ever present in Homer, not entirely absent in Virgil, and sometimes finding grim expression in Lucan, fails Silius entirely. The address of Anna, Dido's sister, to Juno compels a smile. Though deified on her sister's death, and for a good many centuries already an inhabitant of heaven, Anna meets Juno for the first time on the outbreak of the *Second* Punic War, and deprecates the anger of the queen of heaven for having deserted the Carthaginians and attached herself to the Roman cause. Hannibal's parting address to his child is also comical: he recognizes in the "heavy wailing" of the year-old babe "the seeds of rages like his own." But Silius might have been forgiven for a thousand more weaknesses than he has if in but a few things he had shown strength. The grandest scenes in the history before him fail to lift him up; his treatment, for example, of Hannibal's Alpine passage falls immensely below Lucan's vigorous delineation of Cato's far less stirring march across the African deserts.

But in the very weaknesses of Silius we may discern merit. He at least does not try to conceal defects of substance by contorted rhetorical conceits and feebly forcible exaggerations. In his ideal of what Latin expression should be he comes near to his contemporary Quintilian, and resolutely holds aloof from the tenor of his age. Perhaps his want of success with the men of his time was not wholly due to his faults. His self-control rarely fails him; it stands the test of the horrors of war, and of Venus working her will on Hannibal at Capua. Only a few passages here and there betray the true silver Latin extravagance. In the avoidance of rhetorical artifice and epigrammatic antithesis Silius stands in marked contrast to Lucan, yet at times he can write with point. Regarded merely as a poet he may not deserve high praise; but, as he is a unique specimen and probably the best of a once numerous class, the preservation of his poem among the remains of Latin Literature is a fortunate accident.

The poem was discovered in a ms., possibly at Constance by Poggio, in 1416 or 1417; from this now lost ms. all existing mss., which belong entirely to the 15th century, are derived. A valuable ms. of the 8th or 9th century, found at Cologne by L. Carrion in the latter part of the 16th century, disappeared soon after its discovery. Two *editiones principes* appeared at Rome in 1471; the principal editions since have been those of Heinsius (1600), Drakenborch (1717), Ernesti (Leipzig, 1791) and L. Bauer (1890). The *Punica* is included in the second edition of the *Corpus poëtarum Latinorum* (1905). A useful *variorum* edition is that of Lemaire (Paris, 1823). Recent writing on Silius is generally in the form of separate articles or small pamphlets; but *see* H. E. Butler, *Post-Augustan Poetry* (1909), chap. x. For his life, the authorities are Pliny, III., 7; Tac., *Hist.* III. 65. Martial, *passim.*

SILK, ARTIFICIAL, or RAYON. A textile, of which cellulose is the principal raw material, designed to resemble natural silk. The method of preparing artificial silk filaments is always first to get the filament-forming substance into solution or colloidal suspension in a liquid medium, then to force this solution or suspension through an orifice and, finally, to "set" or solidify the viscous filament thus produced, either by evaporating away the liquid with a current of dry air (dry process) or by making use of a coagulating or setting bath into which the filament exudes from the orifice and there solidifies (wet process). The former dry process is similar, in principle, to the spinning processes of silk worms and spiders, the idea of copying which was suggested by R. A. F. de Réaumur in 1734 and by Robert Hooke (*Micrographia*) in 1664.

Cellulose is now always the primary raw material and appears likely to remain the only one (*see* CELLULOSE). Many others, however, have been tried: the silk fibroin of waste silk itself has been used, but the amount of this raw material is, of course, quite insufficient and the insect does the same work better than the factory. Casein, gelatine, egg albumen, agar agar, carragheen and glass are also among the materials that have been seriously considered, but not one of them gives a product as useful as that obtained by the mercerising of cotton, originated by John Mercer in 1844 and perfected by H. A. Lowe in 1889; hence they have not been employed industrially.

The age of artificial silk really begins with Comte Hilaire de Chardonnet (1839–1924) who, as pointed out by C. F. Cross, was a student at the École Polytechnique under Pasteur at the time when his momentous investigations into silk-worm disease culminated; and without any doubt this was the source of the inspiration that started Chardonnet on his life work. After 30 years of effort he took out his first patent for collodion, nitro— or Chardonnet silk in 1884–85. In the meantime, however, the development of electric lighting had interested Swan, Crookes, Robertson, Weston, Swinburne, Wynne, and Powell, and others in improving the production of suitable carbon filaments for incandescent electric lamps. Their particular problem was to get cellulose into a condition that would allow of its being squirted through a hole in a plate and, ultimately, to carbonize the filament thus obtained, which could then be sealed into a bulb: in this purpose they either used strong solutions of zinc chloride or of Schweizer's reagent (cuprammonium hydroxide) in which to dissolve or disperse cotton wool or they dissolved nitrocellulose in alcohol-ether or glacial acetic acid. J. W. Swan on Dec. 4, 1884, produced a fabric which he described as "artificial silk" and this is the first recorded use of the designation; it was a collodion material and in the following July he described also his method of denitrifying it with ammonium sulphide, which is still the method used. But there were great technical difficulties in adapting these early methods to the factory scale, and the costs of production were higher than the cost of real silk. The development of artificial silk on an extensive industrial scale began with the discovery of viscose by C. F. Cross and E. J. Bevan in 1892 and the invention of the Topham spinning box in 1900 by C. F. Topham, who with C. H. Stearn had taken up the spinning problem with Cross & Bevan; and it is the low costs of the viscose process and the perfection of the Topham box as a spinner that have, technically, made artificial silk the success it is. By 1910 viscose silk had made a strong start with 20% of the world's output; by 1927 it accounted for 84% of a total output of at least 280 million pounds.

The Four Industrial Processes.—There are four industrial processes in operation, namely, (*a*) Chardonnet, collodion or nitro-silk, (*b*) cuprammonium silk, (*c*) viscose silk, (*d*) acetate silk. The silk obtained by the first three processes is regenerated or reverted cellulose; the silk of the fourth process is an acetate-ester compound of cellulose or, more correctly, a mixture of ace-

tate-esters. All of them, therefore, use cellulose as the primary raw material.

Since the cellulose has to be dissolved or dispersed in a fluid medium, it is obvious that the length of the fibre is of no importance whatever and, theoretically, any sort of cellulose might therefore be used; actually, however, it is a fact derived from experience that high quality in the final product is greatly dependent upon special quality in the raw material. Two, and only two, sorts of raw material are of any account, namely, cotton linters and high grade bisulphite wood pulp.

Cotton Linters.—In the process of ginning, the short seed hairs or staples of the ripe cotton seed capsule are separated from the longer staples, as being not worth spinning for the cotton industries; these short staples are known as linters. The market price of linters is (1927) about 5d. a pound. The quantity available is approximately $\frac{1}{15}$ of the total output of raw cotton or, say, 400,000 tons (1927); the nitro-cellulose industries (explosives, Chardonnet silk, lacquers, films, plastic masses, etc.), consume about 70,000 tons a year; cuprammonium, viscose and acetate silks use a further quantity at present impossible to estimate with any degree of precision but which may be also about 70,000 tons. It is evident, however, that the supply of this raw material is likely to be adequate to all demands for as long as can be foreseen. The crude linters are purified with appropriate machinery, by freeing them from seeds, husks and other mechanical admixture, then by boiling them 2–4 hours at 100°–120°C. with 2–5% alkali solution (NaOH or Na_2CO_3); they are then washed free of alkali and bleached with bleaching powder solution (2–6% of active chlorine being usually consumed); and, finally, well washed and dried. This material is very pure cellulose and it is characterized chemically as being 95% or more of alkali-resistant or alpha-cellulose; that is to say, when it is treated with 17·5% sodium hydroxide (mercerising solution), under standard conditions, approximately 95% remains undissolved.

Sulphite Wood Pulp.—The viscose industry, almost exclusively, and the cuprammonium process to a considerable extent use wood pulp as the primary raw material; the quantity thus consumed (1927) is about 130,000 tons which is less than 2% of the world's total output of pulp, and it is obvious, therefore, that the artificial silk industries are never likely to have any difficulty in obtaining all the wood pulp required and that these industries will never be the cause of any serious increase of the world's wood consumption.

Of the processes in use for preparing pulp from wood only the bisulphite process is used to prepare pulp intended for viscose, and spruce (*Picea excelsa*) is the usual wood used; all experience has shown that other pulps are not so good for the purpose. But it has to be a special grade, specially prepared, and its price is £2–£5 a ton above that of ordinary bisulphite pulps. This special grade of pulp is characterized by a high content of alkali-resistant or alpha-cellulose, approximating to 90% of the dry weight, and it should contain no more than 1–2% of beta-cellulose, *i.e.*, cellulose soluble in alkali and reprecipitated by acetic acid, under standard conditions; the remainder of the cellulose (gamma-cellulose) is soluble in alkali and not reprecipitated by acetic acid. The ash content must also be not more than 0·3%; it would otherwise be likely to cause obstruction of the minute orifices of the spinnerettes, when the spinning stage is reached, by precipitation of calcium salts. The ether-soluble (resin) constituents should not exceed 0·6% and the so-called "copper number" (*i.e.*, the percentage of cuprous copper, proportional to the percentage of oxy- and hydro-cellulose present, formed by reaction with a standard alkaline solution of cupric sulphate), should not exceed 2–3. Finally the state or condition of aggregation of the cellulose fibre is of importance because some pulps react easily with sodium hydroxide (mercerising) solution in the first stage of the factory process, whereas other pulps, in spite of favourable chemical composition as determined by laboratory analysis, do not; constant, uniform quality in this respect is essential and the requirements of different factories vary to some extent and give the pulp maker some difficult problems accordingly. But the pulp maker has, on the whole, attained a high level of perfection though his process is still based on empirical practice mainly.

The other raw materials required are ordinary products of the heavy chemical industries, but they must be of high grade purity. An abundant supply of pure, soft water is absolutely essential; it must be softened, if necessary, and filtered; the quantity required daily in gallons approximates to 0·5×(lb. of annual output), *i.e.*, a factory producing 2,000,000 lb. annually will consume about 1,000,000 gallons a day.

Chardonnet, Nitro- or Collodion Silk.—For the artificial silk industry a product consisting mainly of a mixture of esters with a nitrogen content approximating to 10–11·5%, known as collodion, and soluble in alcohol-ether is most suitable and, in practice, it is commonly prepared by nitrating purified, oven-dried cotton linters with a mixture approximating to 17–19% water, 60% sulphuric acid, and 20–23% nitric acid.

The cotton is immersed in about 45–80 times its own weight of the mixture, this large quantity of liquid being used with the object of ensuring uniform nitration of the cotton. In practice the nitration is regulated within the temperature limits 20–40°C. because a lower yield and lower quality of product—correlated with degradation of the cellulose—is obtained if the temperature is allowed to rise freely. In these circumstances the time required for the nitration is usually about 1–2 hours. It is worthy of notice that wood-pulp cellulose, containing no more than 90% of alpha or undegraded cellulose to 10% of degraded, semi-celluloses on the dry weight, does not give a good collodion silk because the nitration process, even when carefully controlled, degrades some of the cellulose; and if there is already present an initial proportion of degradation products, as there is in even the best pulp, the final product is, of course, proportionately more degraded. And all experience proves that high quality in every cellulose product, whether prepared by nitration or by other treatment, is always correlated with a high proportion of undegraded cellulose. Hence, cotton linters are used in preference to wood pulp.

After completion of the nitration, the surplus acid is removed by squeezing out the nitrated cotton in presses and by centrifuging; the recovered acid is worked up and used again or sold for other industries, *e.g.*, superphosphate. The washing of the nitrated cotton is commonly done with cold and with hot water and it is also broken into shreds in a bronze breaker or hollander (iron being attacked by the acid residues present). Before the final washing, the nitro-cotton may be bleached, if necessary, with bleaching powder solution and finally it is dried in special drying chambers with a current of warm air at about 40–45°C., vacuum drying being also sometimes employed.

The nitro-cellulose thus obtained has retained much of the appearance of the original cotton; its specific gravity is very similar; it is less hygroscopic than cotton, and it is soluble in alcohol-ether and in acetone. If the nitration has not been properly controlled there may be traces of unnitrated cellulose present; the ash content should be no higher than that of the original cellulose and it will probably contain a trace of sulphur, present as sulphate, attributable to the formation of a trace of sulphate-ester in the nitration process. Acids saponify the nitro-cellulose to give the whole of the cellulose, considerably degraded, as a fine powder; with alkalies, also, saponification proceeds progressively, with ultimate production of degraded cellulose.

Spinning.—The nitro-cellulose is dissolved in a mixture of, usually, two of alcohol to three of ether to make a 20–30% solution for spinning; other solvents have been tried, such as acetone, acetic acid, etc., but without real success. For dissolving the nitro-cellulose, kneaders and revolving cylinders are used and a clear solution of the strength required is obtained in about eight hours; it is filtered and passed into tinned steel or tinned copper storage tanks, where air bubbles are removed by vacuum and the viscosity gradually increases to a point at which it is suitable for spinning. Both "dry" spinning and "wet" spinning are in use, but the former method appears to be now more usual.

In "dry" spinning the alcohol-ether solvent is evaporated and the filament, on issuing from the orifice of the spinnerette, dried by a current of warm air. The air, laden with alcohol and ether vapours, is then passed through condensing towers with the object

of recovering the alcohol and ether; but success in this is imperfect and the losses account for much of the rather high costs of this process as compared with those of the viscose process. It will be readily understood that it is technically by no means easy to condense, with high efficiency, the vapour of a low boiling liquid like ether when diluted with the large volume of air necessary to make the drying of the filament effective in the short distance between the orifice and the spool on to which it has to be reeled.

In "wet" spinning, on the other hand, which was Chardonnet's original method and which is still in use, the filament issues from the orifice of the spinnerette into a setting bath containing water in which it is immersed and which coagulates the nitro-cellulose and dissolves the alcohol-ether solvent. In this "wet" process nitro-cellulose solutions of lower concentrations and lower viscosities can be used and this allows filtration and spinning pressures to be lower; also it allows the so-called "stretch spinning" process to be used in which the filament, on issuing from the orifice of the spinnerette, is stretched and drawn out to a smaller diameter; the alcohol and ether can be also very easily recovered, by distillation, from the setting bath. But, in spite of such advantages, dry spinning gives the larger output per unit; this gives it the ultimate economic advantage and hence it has been gradually superseding the wet spinning process.

Denitration.—Nitro-cellulose is both inflammable and explosive, and therefore it is necessary to remove the nitro-groups from the spun nitro-cellulose and, thereby, to convert it back to cellulose. A great many reagents have been tried for this purpose but none has any advantages over the original sodium, ammonium or calcium sulphide solution first used by Swan in 1885 and universally used to-day. These sulphide baths have little or no adverse effect on the strength of the filaments and they are very cheap; denitration is carried to the point at which a small residue of about 0·05–0·1% of nitrogen remains in the filaments. The reactions involved are complicated and no satisfactory method of recovering the sulphur and nitrogen has been found; but the denitrated filament, in feel and in appearance, is undoubtedly one of the nearest approaches to real silk yet attained and that is the real reason of the early success of this process and of the continued and increasing demand for Chardonnet silk. In 1910 the output of this silk was about 2½ million pounds and 48% of the total output; in 1927 it was about 8·5 million pounds and 3% of the total output; thus it has maintained a satisfactory growth in competition with the stupendous growth of the viscose silk output.

Cuprammonium Silk.—The cuprammonium process was patented by Depeisses in 1890, shortly before his death; but others took it up and it was developed at first in France, later in Germany and in England, and brought to a high level of technical perfection. It was developed with the object of establishing a more economical process than the nitro-cellulose process, especially by avoiding the use of the heavily excise-taxed alcohol and ether; but the position it has attained and which it holds is mainly due to its suitability for the "stretch-spinning" process, which allows of the production of a filament of extreme fineness and high quality that also dyes very well.

This process, in fact, gives a product which is perhaps the nearest approach there is to real silk and which has always appealed to the more exacting consumers. The output of this silk, which was about 2 million pounds in 1910 and about 36% of the total output, had increased to about 16 million pounds in 1927, about 6% of the total output; its future no doubt depends to some extent upon the possibility of improving the qualities of viscose silk, more particularly in respect of fineness of filament and in feel, appearance and strength.

In this process the cellulose raw material and the chemicals must be of highest grade and purity. On the Continent bleached cotton linters and in Great Britain bleached wood pulp are generally used; it was said that linters gave a higher textile strength in the finished product but it has been established that wood pulp gives a product in every respect at least as good as that obtained from linters and with the advantage of the lower price. E. Schweizer in 1857 discovered that the deep blue solution obtained by dissolving copper hydroxide in ammonia, called "Schweizer's Reagent," dissolves or disperses cellulose, from which it can be precipitated by solutions of acids, alkalies, certain salts, glycerine, sugar and other substances. The process generally in use was as follows:—the cellulose was cut, broken and beaten with water in a collander and then filtered off, centrifuged and added moist to the Schweizer reagent. This reagent was usually prepared as follows:—copper turnings and 25% ammonia solution are mixed in a tower, through which cooled air is circulated; the mixture is cooled by a cold water jacket so that the temperature does not rise above 5°C., otherwise some of the ammonia will be oxidized and less cellulose will dissolve in the resulting solution (containing some ammonium nitrite thus formed); in 18–24 hours the copper will have dissolved and its concentration is then increased by adding to it a strong solution of copper sulphate to which an equivalent quantity of sodium hydroxide solution is finally added. This procedure is, in practice, found to give the highest attainable concentration and to be capable of taking up as much as 12–13% of cellulose or more. It is found that the cellulose dissolves or disperses in this reagent more quickly and gives a higher concentration, when the temperature is kept down, by cooling, to 10°C.

Latterly, the more usual procedure has been to treat the cellulose with 17% sodium hydroxide (mercerising) solution, whereby so-called alkali-cellulose, such as is used in the viscose process, is obtained; after being squeezed dry and torn into crumbs it is then immersed in saturated, cold copper sulphate solution, which causes copper hydroxide to be precipitated within the mass of the cellulose and with which it is thus most intimately incorporated; the surplus copper sulphate solution is then squeezed out and the mass is immersed in strong ammonia solution, in which it dissolves or disperses rapidly to give a high concentration of cellulose. This procedure is evidently a definite advance on its predecessors.

It is customary to add up to 2% of cane sugar, glucose or tartaric acid to the spinning solution, which gives a more favourable sheen to the finished product and also, apparently, diminishes the degradation of the cellulose. The spinning solution is filtered through a nickel or unrustable steel, fine mesh screen and submitted to evacuation for the removal of air bubbles and surplus ammonia. It is then spun by the "stretch spinning" process, for which it is especially suitable, into a setting bath of water at 35° C. to which small additions of acids, alkalies, sugar, etc., are sometimes made and from which the air is partially removed by heating, evacuating and cooling, so that air bubbles may not get occluded in and "set" with the filament. The setting quality of the water is due to the gradual removal of the ammonia by diffusion into and solution in the water, and the cellulose can be thus very gradually thrown out and congealed.

In the "stretch spinning" process, as its name implies, the filament is submitted to stretching during this gradual coagulation; and considerable extension, with corresponding diminution of diameter, thus ensues, with the result that even when a spinnerette with comparatively large orifices is employed the finest filaments can be spun, surpassing natural silk in fineness. The spun product obtained is treated with 1% hydrochloric acid solution at 40–50° C. to remove copper residues and then well washed until there is not the faintest trace of surplus acid remaining, the presence of which, ultimately, would greatly diminish the strength, by formation of hydro-cellulose. Many attempts have been made to recover the ammonia and copper waste products, but with comparatively small success, in respect of cost; they are greatly diluted in the setting bath and that, of course, is the main difficulty. The copper is usually recovered by electrolysis; the ammonia is usually run to waste. The Bemberg Co. of Barmen, which has played a leading part in perfecting this process, has recently patented a method of recovering the ammonia by precipitating it with magnesium phosphate, which forms an insoluble double magnesium ammonium phosphate from which the ammonia can be easily recovered.

Viscose Silk.—The viscose reaction was patented by C. F. Cross and E. J. Bevan in 1892, and in 1927 it provided a world's output of about 235 million pounds and 84% of the total output.

Bisulphite wood pulp cellulose most usually, and cotton linters to a small extent, are used for this process; the bleached cellulose is first treated with 17% (mercerising) sodium hydroxide solution for two hours, the surplus solution is then squeezed out and the resultant alkali-cellulose is torn into crumbs, which are matured for 24 hours or more in a closed vessel; 60 parts of carbon bisulphide per 100 parts of air-dry cellulose are then added and the cellulose crumbs gradually swell and become deep-orange coloured and gelatinous in three to four hours' time. After the further addition of an appropriate quantity of sodium hydroxide solution and water a viscous solution or dispersion called viscose, of 7% strength or more, is obtained, which is allowed to "ripen" for a variable period, usually one to two days, until its viscosity has diminished, so that it has become suitable for spinning. All these details must be standardized empirically to ensure uniformity of final product and there are minor variations of procedure related to minor variations of conditions, including quality of raw materials and other factors; this is an industry in which experienced scientific control is essential at every step. The viscose is filtered and spun by the wet process, from spinnerettes immersed in a "setting" bath containing, *e.g.*, a solution of sulphuric acid and sodium sulphate, which congeals the filament and throws out some free sulphur, a portion of which remains in the filament, from which it has to be removed. The yarns produced are washed with water and marseille soap, dried, reeled into skeins and immersed in a bath of three to four parts of sodium sulphide per 1,000 water at 70°C. for about 20 minutes, which dissolves out the sulphur; then, after being washed, the yarns are immersed in a very weak bleaching solution and in a very weak acid solution; the yarns, now pure white, are washed, immersed in a weak bath of sodium bisulphite solution (to destroy residual bleach), washed, immersed in very dilute acetic acid solution and again washed and dried; finally, washed with soap (which improves the feel) and carefully dried and conditioned so as to contain up to 10% moisture.

Every step of this remarkable process has been scrutinized and, in the course of its history, modifications have been suggested and tried, almost infinite in number, most of which are of little more than academic interest. For example, all sorts of substances have been suggested as advantageous additions, in modification of the "setting bath"; sugar, glycerine, lactic acid, citric acid, tartaric acid and so on, and some are commonly used to-day, *e.g.*, sugar and glycerine, which appear to have a favourable influence on the coagulation and improve the feel of the final product. The influence of variations of composition of the "setting bath" in relation to its effects on the cross section of the filament have been studied in great detail and especially by A. Herzog (*Leipziger Monatsschrift f. Textilindustrien*, Bd. 9, 1926). The ideal cross section for a filament is the nearest attainable approximation to a circle, with close, minutely serrated edge (like a circular saw with minute teeth); this particular section is the most favourable for uniform light reflection from the surface and, hence, the most even colour effect after dyeing; and it is, of course, also the section that will give the greatest tensile strength. This section is greatly modified by variations of concentration in the "setting" bath; thus a solution of 12% sulphuric acid and about 1–8% sodium sulphate will give a very favourable cross section, from 8–16% sodium sulphate not quite so good, and 16–32% a very badly distorted cross section; 10–12% sulphuric acid alone gives a good cross section, as does also 20% ammonium chloride, but with an edge not so favourably serrated; and so on. These facts determine the composition and concentrations of the "setting" baths used. In general terms it is true, not only of viscose but of the other artificial silks too, that the form of the cross section is related to the composition of the substance of the filament, the manner of its coagulation, including the actual composition of the setting bath, and other variable factors; so that the microscopic examination of cross sections will often give much information of composition, quality, and origin.

The changes that occur in the so-called "ripening" of viscose have been the subject of much study, and much remains to be done before it can be said to be well understood. The sodium xanthogenate or xanthate (viscose) formed, is certainly a monoester derivative of cellulose which is in the form of a colloidal, emulsoid dispersion in sodium hydroxide solution. After formation, the viscosity diminishes and, after a day or two, reaches a level at which it remains for some days before it increases again, until a final setting to a coagulated mass of hydrated cellulose, with elimination of a watery solution containing sulphur compounds. These changes are retarded and the keeping quality of the viscose increased, within limits, by increasing the excess of sodium hydroxide present; the addition of salts, of course, as in the "setting" bath, has the opposite effect as does also rise of temperature. This sequence of changes is known in other emulsoid colloids, too, and is designated "synaeresis." In the first stage of diminution of viscosity there is a diminution of particle size (increase of dispersion) and in the later stages an increase of particle size with an increase of viscosity and final coagulation. This later stage has been described also, in terms of chemistry, as an increase of the C_6-unit of the cellulose molecule first to the C_{12}-unit and then to the C_{24}-unit, for each OCSSNa-unit of the sodium-ester group. Depending on these facts there is at least one method of determining the degree of "ripeness" of viscose which is of value in the factory. The principle of the method is that the addition of a definite quantity of a coagulating salt solution will coagulate the viscose slowly if the ripening has not progressed very far and rapidly if it has progressed far; the time taken for coagulation, under standard conditions, is thus a measure of the degree of ripeness.

The waste liquors of the viscose industry contain acids, sulphur compounds and alkali mostly, in considerable dilution and, being of low initial cost, they are not worth recovering. They are apt to be a noxious trade effluent, the disposal of which is one of the first factors for consideration in selecting the site for a factory. The 17% mercerising sodium hydroxide solution, pressed out from the pulp in the first stage of preparing viscose, contains hemicelluloses, resin, etc., and therefore cannot be used again and no process of regenerating it or recovering the soda economically has been successful. But the cheapness of the substances used in this process makes it possible to ignore the value of the waste products and that is the great economic advantage this process has over the others.

Acetate Silk.—Cellulose was acetylated by Schutzenbugen in 1865, and Franchimont in 1879 discovered the advantage of adding a catalyst to hasten the action. C. F. Cross and E. J. Bevan patented the first feasible industrial process in 1895. They acetylated cellulose with acetyl chloride in presence of magnesium or zinc acetate, as catalyst. In the meantime, however, the other silk processes were being developed industrially with considerable success and it was really the World War which brought the acetate process into industrial prominence. During the War a large factory for the manufacture of cellulose acetate as dope for aircraft, for which it is valuable because of its low inflammability and its shrunk-finish effect on the wing-fabric, was erected at Spondon, Derbyshire, at a cost of 7¾ millions sterling; at the end of the War this installation was turned to use for the manufacture of artificial silk by the acetate process. Simultaneously the earlier difficulties of dyeing acetate silk were overcome about 1920 and improvements were made in the process for recovering the acetone, used as solvent in the process of dry spinning the acetate. By 1927 the output of acetate silk amounted to about 20 million pounds and about 7% of the world's total output. It has been thought by some that ultimately it may largely displace viscose silk, though there is no obvious sign of this.

Cellulose acetate is prepared by treating cotton linters containing about 5% moisture, with not less than three times their weight of acetic anhydride, with a suitable quantity of glacial acetic acid, as diluent, and with about 10% of sulphuric acid, as catalyst. During the first hour or so the temperature should not be allowed to rise above 25°C and it is best that it should be much lower; thereafter the temperature is raised and eventually the whole of the cellulose dissolves or disperses in the fluid. Industrially, samples are taken from time to time during the warming and dissolving process, and they are put into

water which throws out the acetate; this acetate is filtered, washed, and its solubility in acetone tested. When the solubility of a sample is satisfactory the warming up process is stopped and the crude product is thrown into water which precipitates the acetate as a white fibrous mass; it is filtered, washed, dried, and merchandized in that form. It dissolves or disperses in acetone to give a fluid of good spinning quality. This is the acetate known industrially as the "secondary" acetate, and it gives about 55–58% of acetic acid on saponification. The so-called "primary" acetate which gives up to 62·5% acetic acid on saponification, and is therefore the tri-acetate, is obtained by continuing the warming-up stage of dissolving or dispersing the cellulose, after acetylation, until it has ceased to be acetone-soluble and has become chloroform-soluble; it may be transformed back into the acetone-soluble, chloroform-insoluble, "secondary" acetate by partial saponification with 95% acetic acid at 40°–50°C. and especially in presence of a small amount of sulphuric acid as catalyst. The "secondary" acetate used for spinning is therefore evidently a mixture of acetate esters.

Dry spinning is the spinning process always used, and the recovery of the acetone vapours has been perfected to a very high efficiency; it is said that 90% and more of the acetone can be recovered by employing methods involving refrigeration and absorption by charcoal. In the acetate process the acetic anhydride and acetic acid are of course more expensive than the caustic soda and carbon bisulphide of the viscose process and the cotton linters more expensive than wood pulp; the acetic anhydride and the acid are practically irrecoverable; the acetone is, however, almost completely recovered. On the other hand, some of the acetic anhydride adds on to the cellulose in forming the ester, the yield of which is consequently about 30% greater than the weight of the original cotton linters; finally, any material spoilt in the spinning process, or later, can be merely re-dissolved and spun again, so that ultimate losses are reduced to the absolute minimum. Therefore the final cost of acetate silk is perhaps not so very much higher than that of viscose silk and is possibly no more than about twice as much.

The acetate process gives a very beautiful product, much less absorbent of moisture than any of the other artificial silks or real silk. This is sometimes spoken of as an advantage, but it is perhaps a doubtful one; for it is a special merit of wool and silk, as clothing, that they can absorb as much as 30% or more of moisture without becoming damp to the feel. In this respect, the other artificial silks have something of the same sort of advantage over acetate silk. Cellulose acetate is also an excellent electrical insulator and is now used a great deal for this purpose both as a wrapping, as real silk is used, and also as a lacquer; it also transmits ultra violet light better than, *e.g.*, glass and is therefore used as film for this special purpose.

Plant and Machinery.—The manufacture of artificial silk, as far as the production of the filaments, is a chemical industry, and the plant and machinery are therefore very much like that of other chemical industries. But every material has its own special qualities and properties requiring special adjustments and, therefore, though boiling kiers, bleaching apparatus, extractors, dryers, filter presses, shredders, mixers, agitators, washers, etc., are similar to those used in other industries they have some minor modifications of detail and arrangement which have been evolved in accordance with the demands of experience in this as in every other industry. The same is true of the textile processes of winding, skeining, weaving, knitting, dyeing, and finishing generally; ordinary textile processes, though the same in principle, have had to be adjusted to the special qualities and properties of artificial silk, and, in particular, the textile operative has to be trained to handle the material with the special care it demands.

The spinning processes are peculiar to this industry; they are of great interest and worthy of special description. As mentioned already there are two methods, namely, dry spinning and wet spinning, the essential difference of principle of which is as their names imply; in the former, the filament which exudes from the orifice of the spinnerette is solidified or dried by a current of warm, dry air, whereas in the latter the filament is solidified, congealed, or set by immersion in an appropriate solution which coagulates it.

Dry Spinning.—Dry spinning is the method employed in the collodion-silk and acetate-silk processes; the alcohol-ether solvent and the acetone solvent, respectively, are evaporated and the filament dried by a current of dry air, as will be readily understood from the scheme of one form of apparatus shown in fig. 1. The solution to be spun is ejected from the container, through the orifices of the spinnerette as a bundle of separate filaments which are dried by a counter current of warm, dry air passing upwards and carrying the vapours of the solvent away through the outlet; the filaments converge on passing round the pulley wheel, which is coupled with the winder, on to which the yarn is wound; the number of filaments in the yarn is, of course, determined by the number of orifices in the spinnerette. By a modification of this apparatus the filaments can be stretched so that from relatively large orifices relatively fine filaments may be produced; by another modification the parallel filaments can be twisted or this can be done on a separate machine, such as is used for twisting natural silk filaments into yarns. It is also possible to employ a vacuum to make evaporation the more effective, and gases, such as sulphurous acid and carbonic acid, have been also added to the current of air, though apparently with no very conspicuous advantage. It will be noticed that in this process the spinning is downwards; this is necessitated by the obvious advantage of using warm air, which of course circulates upwards, *i.e.*, in counter direction, and of allowing the air, when fresh, dry, and therefore most effective, to come first into contact with the almost dry portions of the filaments, which it thus dries under conditions of greatest advantage.

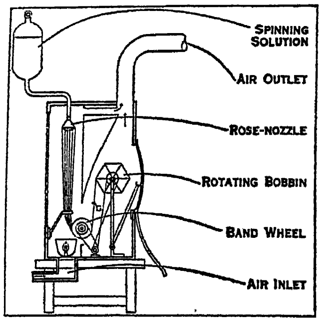

FIG. 1.—DRY SPINNING

Wet Spinning: Bobbin Spinning.—The principle of this method is illustrated in plan in fig. 2. The spinning solution is driven by a pump through a filter and the spinnerette orifices as filaments, into a setting bath, from which they are wound on to the bobbin, which also rotates in a setting bath. The filaments, as yet parallel, have to be subsequently twisted on a separate machine, such as is used for twisting natural silk; this disadvantage has led to the gradual and almost complete supersession of this method by the pot or centrifugal spinning box method due to C. F. Topham (1900), which was once very correctly described by C. F. Cross, of whom he was the colleague and coworker, as "a comprehensive solution of the main difficulties which had been encountered and a radical development of the industrial outlook in respect of mass production." The textile world has long marked the Topham box as a work of genius.

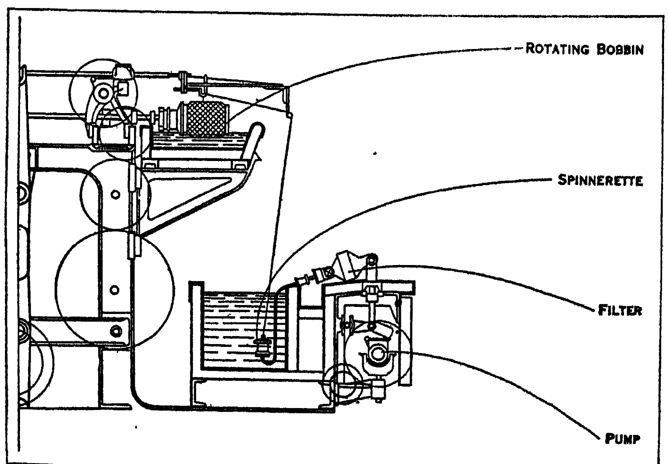

FIG. 2.—BOBBIN SPINNING

Topham Centrifugal Box Spinning.—This method is illustrated in fig. 3. The spinning solution is forced by a pump through a filter and the spinnerette orifices as filaments, into a setting bath, from which they are carried over the roller through a funnel, which is given an up and down motion by the reciprocating mechanism and thence into the Topham box, which is rotated at a high speed by a driving mechanism, electric or otherwise. Thus the filaments, spun into a yarn, are piled into a "cake" and, very important, given a much desired twist in the process of piling, the amount of which depends upon the speed of the delivery of the thread and of the revolving pot.

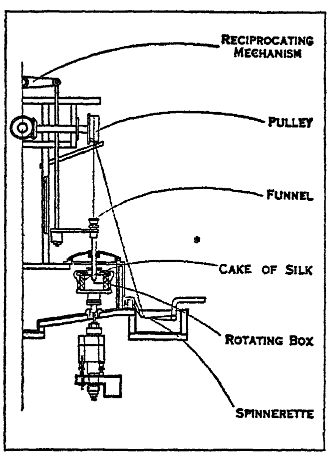

FIG. 3.—TOPHAM CENTRIFUGAL BOX SPINNING

Stretch-Spinning.—A modification of the bobbin and centrifugal box spinning methods allows of stretch-spinning, which originated in an observation due to W. P. Dreaper and H. K. Tompkins (1897), who noticed that stretching during coagulation much increased the sheen of the product. The stretch-spinning process now used, especially for the spinning of cuprammonium silk, was first developed by Thiele in 1901 from an earlier process due to Lehner in 1890. The principle of the method is illustrated in fig. 4. The filaments issuing from the spinnerette orifices pass through the funnel and, from its lower end, over the roller whence they pass to a winding mechanism. The setting fluid, water, circulates up to the level of the spinnerette and gradual coagulation accompanies the gradual diffusion and absorption

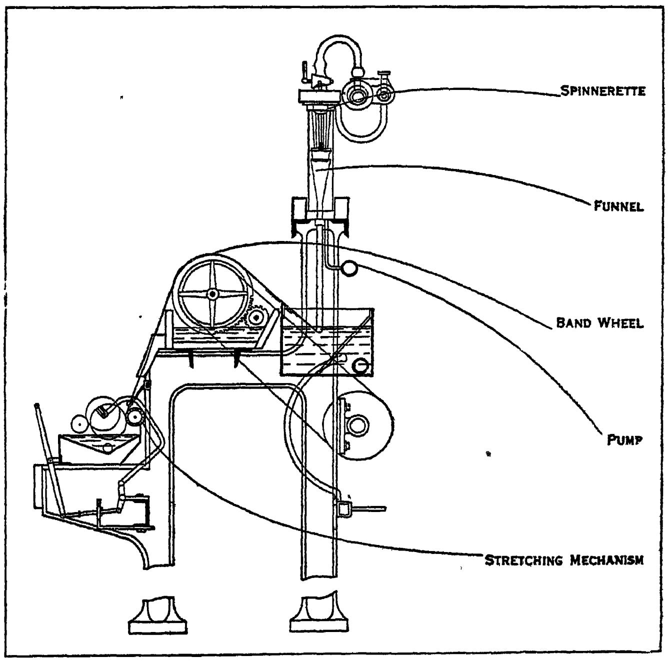

FIG. 4.—STRETCH SPINNING

of the ammonia from the exuding filament into the water; all the time this gradual coagulation is proceeding the filaments are moving towards the winding mechanism, which is pulling and stretching them, and they are thus drawn out to a very small diameter, which may even surpass that of natural silk. This process, most successfully applied to cuprammonium silk, has given it a special quality that is much esteemed by the more exacting consumers. It is, however, also possible to make viscose filaments as fine as natural silk and without employing stretch-spinners; the special advantage of stretch-spinning is to that extent of less importance than it was formerly.

Properties of Silks.—The products obtained from the collodion, cuprammonium and viscose processes, being all of them reverted or regenerated cellulose, are very similar in qualities and properties; the acetate is an ester, or mixture of esters, formed by addition of acetyl radicles to the cellulose molecules, and its qualities and properties are therefore differentiated. The apparent specific gravity of the three former is very close to that of ordinary cellulose (1·58), namely, about 1·52; that of the acetate is 1·33 and that of real silk 1·40. The qualities that are of outstanding interest and importance are the strength and elasticity; and especially by comparison with real silk. The following comparative figures show how much superior real silk still is and especially when wet; acetate silk is very little absorbent of moisture and is therefore not strictly comparable, but approximately it is nearly as strong wet as dry, though when dry it is not so strong as the other silks. It will be noticed that natural silk is about as strong wet as it is dry, and of great elasticity.

Class.	Denier.	Breaking strain, grams.		Extension %.	
		Dry.	Wet.	Dry.	Wet.
Collodion	5·0	9·6	5·1	13·0	8·9
Cuprammonium . . .	5·0	9·2	4·8	12·9	15·1
Viscose	5·0	12·1	6·0	15·1	12·2
Acetate	5·0	7·9	6·7	31·2	26·7
Silk	1·27	7·8	7·3	14·7	32·7

The artificial silks are not very elastic; that is to say that, after being stretched, they do not recover their original dimensions if the stretch is very much, and it has been well said that for half its breaking strain it acts like elastic and thereafter like perished rubber. The textile mill must adjust its methods accordingly, as also must the ultimate consumer.

Tendencies of the Industry.—In 1927 the viscose process dominated the situation by reason of the cheapness of the raw materials and because of viscose silk's good dyeing and finishing qualities. Much has been done to improve the lustre, which can be made very similar to that of real silk. Among the most interesting and promising of modified treatments is the Lilienfeld process (1926), according to which a coagulating bath containing more than 55% sulphuric acid gives filaments from viscose which have a tensile strength surpassing that of any other artificial thread and, in some cases, approaching or surpassing that of even cotton or real silk, and with the further advantage of resistance to alkalies and soap. The viscose process is so highly developed that it can easily produce filaments as fine as those of real silk, and demand and production are actually tending in the direction of very fine spinning.

The output of artificial silk in pounds weight has increased greatly since the World War; the increase in actual spinning is of course relatively much greater because the filament-denier is now much lower. The improvements have given increased strength, softer feel, and more silk-like appearance. Hollow filaments can be produced, and the best method appears to be by projecting the viscose containing a small proportion of added soluble carbonate into the usual acid setting bath with the addition of some other salts, such as zinc or magnesium sulphate, the action of which appears to be favourable; the action of the acid is evidently to form a gas bubble (carbon dioxide) in the filament which is elongated with the filament. These hollow fibres are very pliable and they have the "scroop" or rustle of real silk.

Artificial silk is produced in large and ever increasing quantities; its applications are probably still in their infancy and the limits of their future possibilities cannot be foreseen. Its use in combination with other textile materials has necessitated modified methods of weaving, dyeing, finishing, etc., which, in turn, have reacted on some of the related industries the main requirement of which, in general terms, is that the filaments and yarns must be free, in every stage of manufacture, to run smoothly, evenly and without jerks, because the elastic limits are not so favourable as

they are in natural fibres. Lubricants used in the textile industries with natural fibres, *e.g.*, sperm oil, white curd soap, olive oil and neat's-foot oil, mineral oil, compounded oil (mineral and vegetable), and soluble oils, are used also with artificial silks, and sizing materials such as starch, dextrine, gum tragacanth, and gelatin are similarly used. But loading and weighting materials are never employed, and this is a notable difference—by comparison with the natural silk industries particularly.

It is not unlikely that the greatest future use of artificial silk will be in combination with the natural fibres; there are already signs that this is possible. Thus, in combination with natural silk, and especially with the less expensive grades, the greater strength of the natural silk is a definite gain. Similarly, favourable combinations with cotton, especially mercerised cotton, and with wool are in ever increasing demand. The additional strength is important; the soft feel and absorbent quality of artificial silk are very advantageous for such uses as underclothing; and it is a curious fact that so far from competing with wool, for this use, artificial silk has in combination with it actually made wool more popular. For brocades and furnishings, generally, artificial silk on cotton warps and backings gives a favourable combination of beauty and strength. Admixtures with linen are just coming into use (1927).

For these purposes of admixture with other fibres, the so-called "staple fibre" is now in great demand. Each natural fibre has its own peculiar average staple length, whereas the artificial silk filament is, of course, of infinite length; therefore for spinning in admixture with natural fibres artificial silk is cut up into short length staples or "staple fibre." In this way 75% of staple fibre is now commonly spun into yarn with 25% cotton, wool or silk; carding instead of combing is the process employed and counts up to 80 threads per inch appear to be most in demand; many fabrics are equal in appearance to the loveliest that can be produced from pure natural silk and not far short in strength and weaving quality. Valuable effects are also obtained by skilful applications of dyeing principles; thus whereas the artificial silks (excepting acetate) react to dyes very much as cotton does, their reactions are different from those of silk and wool. Hence mixtures of artificial silk and natural silk (or wool) can be either dyed in the single or by cross dyeing and thus twist and marl effects can be obtained; the mixture is dyed for the artificial silk and the natural silk (or wool) remains undyed.

Acetate silk has presented some dyeing problems peculiar to itself which formerly greatly handicapped its use but which have been solved in a satisfactory way; the difficulty was that it would not take up dyes by the ordinary methods in use and the only method available was to treat it with alkali, to regenerate cellulose, whereby the special quality of the acetate was wholly sacrificed. There is now a large range of dyes available and the previous methods of dyeing have been entirely abandoned.

Related to the artificial silk industries are the manufacture of artificial wool and artificial horse hair, sheets, films, and tissues and plastic masses. The solutions used for spinning artificial silk from spinnerettes with, *e.g.*, 50 or more minute orifices, may be, of course, also spun from spinnerettes with one or more larger orifices and artificial horse-hair may be thus produced; or ribbon strips may be similarly made. The spinnerettes with fine orifices for artificial silk are usually made from alloys of gold, platinum and palladium, and glass is also used to some small extent; for spinning horse-hair and ribbons glass spinnerettes are employed.

These spinning solutions may be also made into sheets, films and tissues. Thus nitro-cellulose, frequently mixed with camphor and pigments, is made into celluloid sheets and moulded articles and also into photographic and cinema (inflammable) film; cellulose acetate is made into (non-inflammable) cinema film; viscose into a thin tissue known as cellophane, used as a food wrapper, and into film caps, often pigmented, much in use as a closure for bottles, especially by pharmacists, for which they are well suited because their great shrinkage during drying gives a very tight closure. Nitro-cellulose, mixed with softeners and pigments and dissolved in butyl or amyl acetate, is much used as a lacquer for motor car bodies and other high class out-door work; cellulose acetate similarly dissolved is the dope used for the wing fabric of aircraft, to which it gives a shrunk water-proof finish and for which the nitrate, being very inflammable, would be unsuitable.

Hitherto, the esters are the only derivatives of cellulose that have come into use in industry. Any derivative that can be brought into solution or dispersion would be usable in similar manner, and the ethers, especially, of which a very large number are known already and known to have valuable intrinsic qualities, could and would be used if they could be made at competitive prices. But the cost of preparing ethers is a good deal higher than the cost of preparing esters, though it is quite possible that some day there will be cheaper methods available. (*See* also CELLULOSE; SILK FABRICS, ARTIFICIAL.)

Statistics of Artificial Silk Production

World's output Millions of lb.			Output by countries. Millions of lb.			
			1924.	1925.	1926.	1927.
1892	·031	United States	38·7	51·0	63·0	74·0
1902	5	Great Britain	25·5	27·0	25·5	38·8
1912	20	Germany	23·7	26·0	26·0	30·0
1914	25	Italy	18·5	25·0	35·0	39·0
1919	40	France	12·3	14·0	17·5	24·0
1920	56	Belgium	8·9	10·0	13·0	16·0
1921	65	Holland	3·4	9·0	10·0	14·5
1922	79·5	Switzerland	4·0	6·0	8·5	43·7
1923	97	Other countries	6·1	6·0	36·5	
1924	141					
1925	174					
1926	235	Total	141·0	174·0	235·0	280·0
1927	280					

Percentage by processes 1927

Viscose...87 Cuprammonium.. 3·5 Acetate.. 4·5 Nitro. .5·0

Textiles whole world. Tons 1927

Cotton...5,900,000 Wool...1,300,000 Flax.. 450,000
Art silk...125,000 Silk...39,000

Production, consumption, exports and imports of artificial silk yarns in principal countries in 1926

	Production.	Exports.	Imports.	Consumption.
	lb.	lb.	lb.	lb.
United States	63,400,000	..	10,125,000	73,525,000
Great Britain	25,487,551	5,425,496	1,799,980	21,862,035
Germany	26,000,000	8,200,000	10,100,000	27,900,000
Italy	35,000,000	20,000,000	1,750,000	16,750,000
France	17,500,000	2,396,680	2,167,660	17,270,980
Belgium	13,000,000	7,000,000	900,000	6,900,000
Holland	14,500,000	12,000,000	..	2,500,000
Japan	6,500,000	..	3,500,000	10,000,000

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SILK AND SERICULTURE. Silk is a fibrous substance produced by many insects, principally in the form of a cocoon or covering within which the creatures are enclosed and protected during the period of their principal transformations; the webs and nests, etc., formed by spiders are also of silk. But the fibres used for manufacturing purposes are exclusively produced by the mulberry silk-moth of China, *Bombyx mori,* and a few other moths closely allied to that insect.

History.—According to native record the silk industry has existed in China from a very remote period. The empress, known as the lady of Si-ling, wife of a famous emperor, Huang-ti (2640 B.C.), encouraged the cultivation of the mulberry tree, the rearing of the worms and the reeling of silk. This empress is said to have devoted herself personally to the care of silkworms, and she is by the Chinese credited with the invention of the loom. A voluminous ancient literature testi-

fies to the antiquity and the importance of Chinese sericulture, and to the attention bestowed on it by royal and noble families. The Chinese guarded the secrets of their valuable art with vigilant jealousy; and there is no doubt that many centuries passed before the culture spread beyond the country of its origin. Through Korea a knowledge of the silkworm and its produce reached Japan, but not before the early part of the 3rd century. One of the most ancient books of Japanese history, the *Nihongi,* states that towards A.D. 300 some Koreans were sent from Japan to China to engage competent people to teach the arts of weaving and preparing silk goods. They brought with them four Chinese girls, who instructed the court and the people in the art of plain and figured weaving; and to the honour of these pioneer silk weavers a temple was erected in the province of Settsu. Great efforts were made to encourage the industry, which from that period grew into one of national importance. At a period probably a little later knowledge of the working of silk travelled westward. According to a tradition the eggs of the insect and the seed of the mulberry tree were carried to India by a Chinese princess concealed in the lining of her head dress. The fact that sericulture was in India first established in the valley of the Brahmaputra and in the tract lying between that river and the Ganges renders it probable that it was introduced overland from the Chinese empire. References in Sanskrit literature indicate however that a silk industry existed in India at about 1000 or possibly 4000 B.C. From the Ganges valley the silkworm was slowly carried westward and spread in Khotan, Persia and Central Asia.

The first notice of the silkworm in Western literature occurs in Aristotle, *Hist. anim.* v. 19 (17), 11 (6), where he speaks of "a great worm which has horns and so differs from others. At its first metamorphosis it produces a caterpillar, then a bombylius and lastly a chrysalis—all these changes taking place within six months. From this animal women separate and reel off the cocoons and afterwards spin them. It is said that this was first spun in the island of Cos by Pamphile, daughter of Plates." But long before this time raw silk must have begun to be imported at Cos, where it was woven into a gauzy tissue, the famous *Coa vestis,* which revealed rather than clothed the form.

Towards the beginning of the Christian era raw silk began to form an important and costly item among the prized products of the East which came to Rome. The silken textures which at first found their way to Rome were necessarily of enormous cost, and their use by men was deemed a piece of effeminate luxury. From an anecdote of Aurelian, who neither used silk himself nor would allow his wife to possess a single silken garment, we learn that silk was worth its weight in gold. Notwithstanding its price and the restraints otherwise put on the use of silk the trade grew. Under Justinian a monopoly of the trade and manufacture was reserved to the emperor, and looms, worked by women, were set up within the imperial palace at Constantinople. Justinian also endeavoured, through the Christian prince of Abyssinia, to divert the trade from the Persian route along which silk was then brought into the east of Europe. In this he failed, but two Persian monks who had long resided in China, and there learned the whole art and mystery of silkworm rearing, arrived at Constantinople and imparted their knowledge to the emperor. By him they were induced to return to China and attempt to bring to Europe the material necessary for the cultivation of silk, which they effected by concealing the eggs of the silkworm in a hollow cane. From the precious contents of that bamboo tube, brought to Constantinople about the year 550, were produced all the races and varieties of silkworm which stocked and supplied the Western world for more than twelve hundred years.

The silkworm took kindly to its Western home and flourished, and the silken textures of Byzantium became famous. At a later period the conquering Saracens obtained a mastery over the trade, and by them it was spread both east and west—the textures becoming meantime impressed with the patterns and colours peculiar to that people. They established the trade in the thriving towns of Asia Minor, and they planted it as far west as Sicily, as Sicilian silks of the 12th century with Saracenic patterns still testify. Ordericus Vitalis, who died in the first half of the 12th century, mentions that the bishop of St. Evroul, in Normandy, brought with him from Apulia in southern Italy several large pieces of silk, out of the finest of which four copes were made for his cathedral chanters. The cultivation and manufacture spread northwards to Florence, Milan, Genoa and Venice—all towns which became famous for silken textures in mediaeval times. In 1480 silk weaving was begun under Louis XI. at Tours, and in 1520 Francis I. brought from Milan silkworm eggs, which were reared in the Rhone valley. But it cannot be said that these industries were firmly established before Colbert in the 17th century encouraged the planting of the mulberry by premiums, and otherwise stimulated local efforts.

Into England silk manufacture was introduced during the reign of Henry VI.; but the first serious impulse to manufactures of that class was due to the immigration in 1585 of a large body of skilled Flemish weavers who fled from the Low Countries in consequence of the struggle with Spain then devastating their land. Precisely one hundred years later religious troubles gave the most effective impetus to the silk-trade of England, when the revocation of the Edict of Nantes sent simultaneously to Switzerland, Germany and England a vast body of the most skilled artisans of France, who planted in these countries silk-weaving colonies which are to this day the principal rivals of the French manufacturers. The bulk of the French Protestant weavers settled at Spitalfields, London—an incorporation of silk workers having been there formed in 1629. James I. used many efforts to encourage the planting of the mulberry and the rearing of silkworms both at home and in the colonies. Up to the year 1718 England depended on the thrown silks of Europe for manufacturing purposes, but in that year Lombe of Derby, disguised as a common workman, and obtaining entrance as such into one of the Italian throwing mills, made drawings of the machinery used for this process. On his return, subsidized by the government, he built and worked, on the banks of the Derwent, the first English throwing mill. In 1825 a public company was formed and incorporated under the name of the British, Irish and Colonial Silk Company, with a capital of £1,000,000, principally with the view of introducing sericulture into Ireland, but it was a complete failure, and the rearing of the silkworm cannot be said ever to have become a branch of British industry.

In 1522 Cortes appointed officials to introduce sericulture into New Spain (Mexico), and mulberry trees were then planted and eggs were brought from Spain. The Mexican adventure is mentioned by Acosta, but all trace of the culture had died out before the end of the century. In 1609 James I. attempted to reinstate the silkworm on the American continent, but his first effort failed through shipwreck. An effort made in 1619 obtained greater success, and, the materials being present, the Virginian settlers were strongly urged to devote attention to the profitable industry of silk cultivation. Sericulture was enjoined under penalties by statute; it was encouraged by bounties and rewards; and its prosecution was stimulated by rhapsodical rhymes like the following:

> Where Wormes and Food doe naturally abound
> A gallant Silken Trade must there be found.
> Virginia excels the World in both—
> Envie nor malice can gaine say this troth!

In the prospectus of Law's great *Compagnie des Indes Occidentales* the cultivation of silk occupies a place among the glowing attractions which allured so many to disaster. Onward till the period of the War of Independence bounties and other rewards for the rearing of worms and silk filature continued to be offered; and when the war broke out Benjamin Franklin and others were engaged in establishing a filature at Philadelphia. With the resumption of peaceful enterprise, the stimulus of bounties was again applied—first by Connecticut in 1783; and such efforts have been continued sporadically down almost to the present day. Bounties were last offered by the state of California in 1865–1866, but the state law was soon repealed, and an attempt to obtain state encouragement again in 1872 was defeated. About 1838 a speculative mania for the cultivation of silk developed itself with remarkable severity in America. It was caused principally through the

representations of Samuel Whitmarsh as to the suitability of the South Sea island mulberry (*Morus multicaulis*) for feeding silkworms; and so intense was the excitement that plants and crops of all kinds were displaced to make room for plantations of *M. multicaulis*. In Pennsylvania as much as $300,000 changed hands for plants in one week and frequently the young trees were sold two and three times over within a few days at ever-advancing prices. Plants of a year's growth reached the ridiculous price of $1 each at the height of the fever, which, however, did not last long, for in 1839 the speculation collapsed; the famous *M. multicaulis* was found to be no golden tree, and the costly plantations were uprooted. These endeavours to stimulate by artificial means have in scarcely any instance resulted in permanent success. In truth, raw silk can only be profitably brought to the market where there is abundant and very cheap labour—the fact that China, Japan, Bengal, Piedmont and the Levant are the principal producing localities making this plain.

The Silkworm.—The mulberry-feeding moth, *Bombyx mori*, which is the principal source of silk, belongs to the *Bombycidae*, a family of *Lepidoptera* in which are embraced some of the largest and most handsome moths. *B. mori* is itself an inconspicuous moth, of an ashy white colour, with a body in the case of the male not ½ in. in length, the female being a little longer and stouter. Its wings are short and weak; the fore pair are falcate, and the hind pair do not reach to the end of the body. The larva which is hairless, is of an ashy grey or cream colour, attains to a length of from 3 to 3½ in., and is slender in comparison with many of its allies. The second thoracic ring is humped, and there is a spine-like horn or protuberance at the tail. The common silkworm produces only one generation during the year where the seasons are defined, *e.g.*, Europe and the Near East; in Japan, the largest silk-producing country of the world, the race of silkworm is bivoltine, *i.e.*, reproduction takes place twice annually, while in parts of India and China reproduction is almost continuous and the races cultivated are called multivoltine; but the quality of the silk is in inverse ratio to the number of hatchings. The silkworm's natural food is the foliage of mulberry trees.

The silk glands or vessels consist of two long thick-walled sacs running along the sides of the body, which open by a common orifice—the spinneret or seripositor—on the under lip of the larva. As the larva approaches maturity these vessels become gorged with a clear viscous fluid, which, upon being exposed to the air immediately hardens to a solid mass. Advantage is taken of this peculiarity to prepare from fully developed larvae silkworm gut used for casting lines in rod-fishing, and for numerous other purposes where lightness, tenacity, flexibility and strength are essential. The larvae are killed and hardened by steeping some hours in strong acetic acid; the silk glands are then separated from the bodies, and the viscous fluid drawn out to the condition of a fine uniform line, which is stretched between pins at the extremity of a board. The board is then exposed to the sunlight till the lines dry and harden into the condition of gut. The preparation of gut is, however, merely an unimportant collateral manufacture. When the larva is fully mature, and ready to change into the pupa condition, it proceeds to spin its cocoon, in which operation it ejects from both glands simultaneously a continuous and reelable thread of 800 to 1,200 yd. in length, moving its head round in regular order continuously for three days or thereabouts. The thread so ejected forms the cocoon, and consists of filaments seriposited from two separate glands. Two other glands, named after their discoverer the glands of Filippi, secrete a glutinous or resinous substance, which is believed to serve the double purpose of helping the thin viscous threads through the spinneret and causing the two filaments to adhere when brought into contact with the atmosphere.

Under the microscope cocoon silk presents the appearance of a somewhat flattened combination of two filaments placed side by side, being on an average $\frac{1}{1,200}$ in. in thickness. The cocoons are white or yellow in colour, oviform in shape, and often with a constriction in the middle. According to race, etc., they vary considerably in size and weight, but on an average they measure from an inch to an inch and a half in length, and from half an inch to an inch in diameter. They form hard, firm and compact shells with some straggling flossy filaments on the exterior, and the interior layers are so closely and densely agglutinated as to constitute a parchment-like mass which resists all attempts at unwinding. The whole cocoon with its enclosed pupa weighs from 15 grains for the smaller races to about 50 grains for the breeds which spin large cocoons. From 10 to 12 days after the completion of the cocoon the enclosed insect is ready to escape; it moistens one end of its self-made prison, thereby enabling itself to push aside the fibres and make an opening by which the perfect moth comes forth. The sexes almost immediately couple; the female in from four to six days lays her eggs, numbering 500 and upwards; and, with that the life cycle of the moth being complete, both sexes soon die.

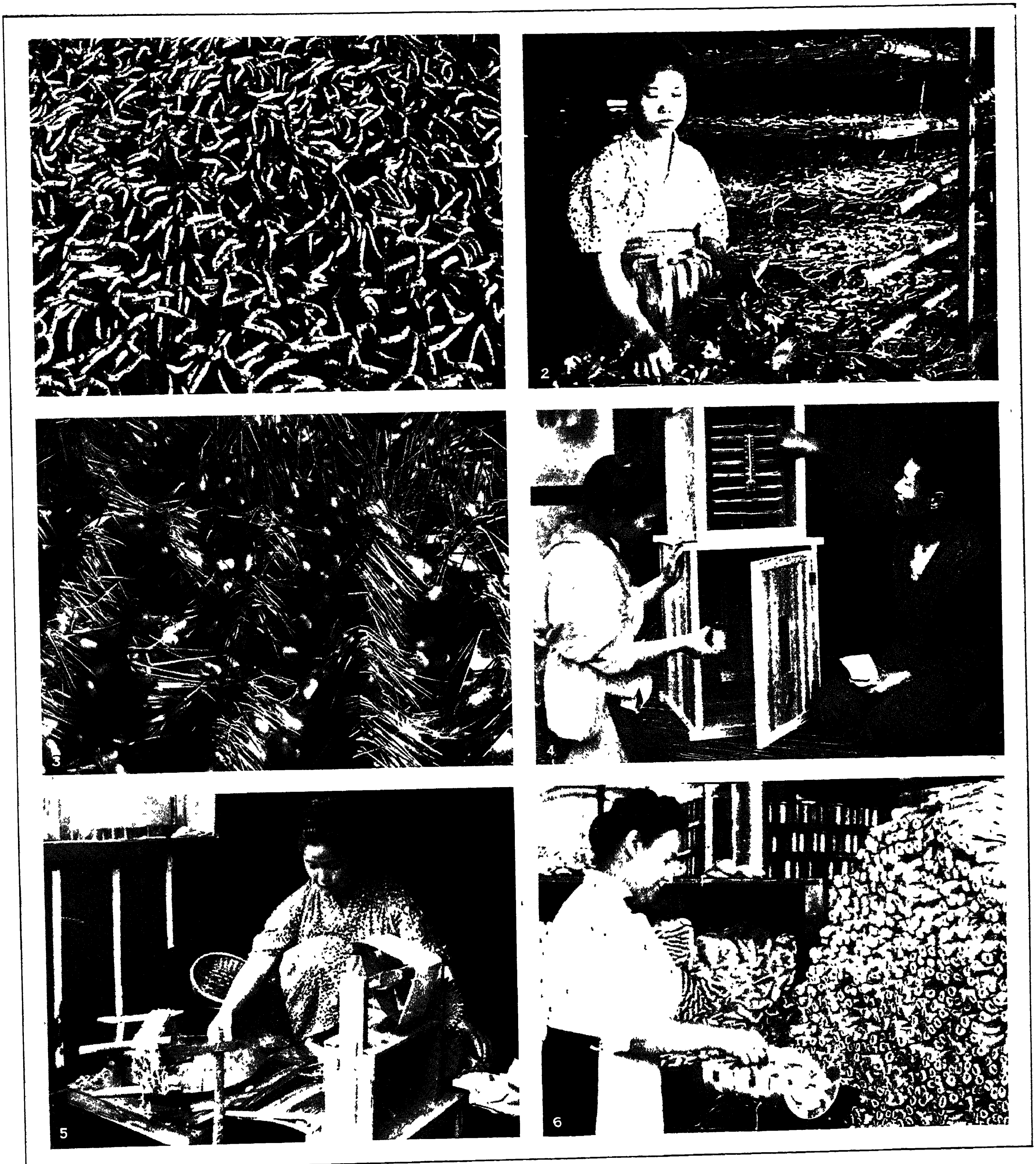
SERICULTURE

The art of sericulture concerns itself with the rearing of silkworms under artificial or domesticated conditions, their feeding, the formation of cocoons, the securing of these before they are injured and pierced by the moths, and the maturing of a sufficient number of moths to supply eggs for the cultivation of the following year. The first essential is a stock of mulberry trees adequate to feed the worms in their larval stage. The leaves preferred in Europe are those of the white-fruited mulberry, *Morus alba*, but there are numerous other species which appear to be equally suitable. The soil in which the mulberry grows, and the age and condition of the trees, are important factors in the success of silkworm cultivation; and it has been too often proved that the mulberry will grow in situations where, from the nature of the leaf the trees put forth and from other circumstances, silkworms cannot be profitably reared. An elevated position with dry, friable, well-drained soil produces the best quality of leaves. Throughout the East the species of mulberry cultivated are numerous, but, as these trees have been grown for special purposes at least for three thousand years, they show the complex variations peculiar to most cultivated plants.

Incubation and Rearing of Worms.—The eggs of the silkworm, called "silk-seed" (Fr. *graines*), are hatched out at the period when the mulberry buds are breaking into leaf. The hatching is natural where the climate is uniformly hot, but in countries where the silkworm has been introduced, artificial heat has to be applied to the eggs. In many parts this is done by the primitive fashion of imparting to the seed the necessary heat by contact with the human body, but this gives an irregular and unduly protracted hatching. Simple incubators are now in use which make incubation regular, and the eggs all hatch out together, which is a great advantage from the point of view of economical feeding later on. The eggs are very minute—about 100 weighing a grain; and a vast number of hatched worms may at first be kept in a small space; but as the worms grow and require more and more leaves, the caterpillars require quickly increasing and ample space. The seed is distributed in perforated boxes to rearers, as it requires air all through the period of preservation until the worms are hatched. The boxes are opened and the seed is evenly spread on trays which are placed into the incubator; the lamp of the incubator is lit and the temperature is brought to 65° F. This is gradually increased daily by about 2° until it reaches 77°, at which temperature hatching takes place. The trays are withdrawn from the incubator and perforated paper or open-mesh gauze is spread over the minute worms; mulberry leaves, now young and very tender, are finely chopped and spread over the paper or gauze; the little worms wriggle up through the holes and begin feeding. The temperature of the room in which they are placed should be maintained at 77°. In more progressive countries, a special rearing house (Fr. *mag-*

BY COURTESY OF THE CORTICELLI SILK CO.

FIG. 1.—MULBERRY LEAVES, THE FAVOURITE FOOD OF SILKWORMS



PHOTOGRAPHS, KEYSTONE VIEW COMPANY

CULTURE OF SILKWORMS

1. Tray filled with thousands of worms of the silk producing type. Their eggs, called "silk seed," are hatched out at the period when the mulberry buds are breaking into leaf
2. Feeding mulberry leaves to silkworms. Leaves must be green but slightly wilted. During the final feeding, lasting about ten days, each worm consumes 20 times his own weight of the leaves
3. Silkworm cocoons in their nests. These nests consist of "brushes" of scrub oak or of some other many branched shrub placed vertically in the centre of the shelves where the worms have hitherto spent their lives. A worm indicates readiness to spin a cocoon by raising the forepart of the body and writhing slowly from side to side
4. Silkworm eggs being carefully placed in an incubator. An even heat is maintained starting at 65° F and raised 2° each day until 77° is reached at which temperature hatching takes place
5. Reeling the raw silk from the cocoon. Great care is taken not to break delicate thread
6. Weighing and sorting raw silk before it is sent away for spinning

nanerie) is allocated to the rearing of silkworms; it may be used for other purposes during the remainder of the year provided it is swept clean, disinfected and lime-washed ready for the reception of the worms. In more backward places, the dwelling of the peasant rearer is utilized, but the same scrupulous disinfection and cleanliness should be observed, though this is often neglected with unfortunate effects on the worms and the rearer. The place set apart for rearing should be well-ventilated, but not necessarily well lit, indeed, it should be capable of shading the worms from the direct rays of the sun, which are detrimental to them.

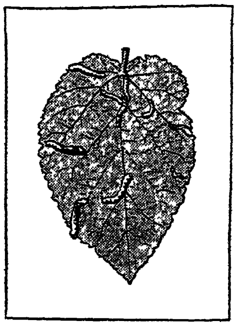


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FIG. 2.—SILKWORMS SIX AND TEN DAYS OLD FEEDING ON A MULBERRY LEAF

Though there are many methods of keeping the worms during feeding, the best is probably to erect shelves about three feet wide in the centre of the room so that there is a walking space between them and the walls all round and gangways intersecting them. These shelves are constructed by means of light scantling from the floor to the ceiling with cross-pieces at intervals of two feet, the lowest being two feet above the floor. Over the frame-work thus created is laid large-mesh wire netting which, in this way, provides a series of shelves each two feet high. Paper is spread over the wire and the worms are placed on this; the worms increase in size with astonishing rapidity and they are given more and more space in conformity with their growth. No less remarkable is their growing voracity. After three or four days they are sufficiently grown to be able to consume whole young leaves, and from this time onwards their powers of consumption run parallel with the maturity of the mulberry. The feeding lasts about 42 days, but during that time the worm passes through four periods of sleep lasting 24 hours each; some races have only three periods of sleep, but these are rare. During this sleeping period the skin of the worm cracks and when the creature wakes up it is able to shed the old skin and continue with the new one. The importance of the regularity of hatching out now becomes apparent. The worms hatched out on the same day all sleep at the same time, and during the sleep do not require nourishment. If, however, the hatching out is irregular, sleeping and active hungry worms are mixed up, with the risk either of a waste of mulberry leaf or of malnutrition of the active worms. Worms will not touch faded leaves; the latter must be green but very slightly wilted. The sleeping periods occur on the sixth, twelfth, eighteenth and twenty-sixth day after hatching. After the fourth sleep, the worms start their great and final feed, lasting for ten days during which period they consume about twenty times their own weight of leaves.

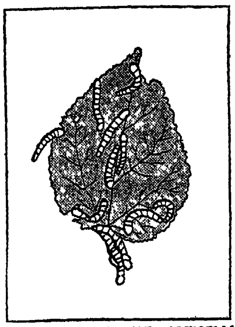

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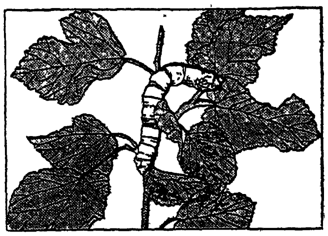
FIG. 3.—WORMS ABOUT 18 DAYS OLD

Laurent de l'Arbousset showed in 1905 that 1 oz. of seed of 30 grammes producing 30,000 to 35,000 silkworms (30,000 may be depended upon to reach the cocoon stage) will give a harvest of 130 to 140 lb. fresh cocoons and ultimate yield of about 12 lb. raw silk properly reeled. The amount of nourishment required for this rearing is as follows:—hatching to first moult, about 9 lb. of leaves of tender growth, equal to 40 to 45 lb. ripe leaves; first to second moult, 24 lb., representing 100 lb. ripe leaves; second to third moult, 80 lb., representing 240 lb. ripe leaves; third to fourth moult, 236 lb., representing 472 lb. ripe leaves; fourth moult to mounting, 1,430 lb., representing 1,540 lb. ripe leaves, totalling to about one ton of ripe leaves for a complete rearing. The growth of the worms during their larval stage is stated by Count Dandolo to be as follows: the small, black, newly hatched worm weighs about one-hundredth of a grain, and is about one-twelfth of an inch long; when it has reached its full growth, the large white worm weighs about ten grains, and is more than three inches long. Or, in tabular form:

	Weight per 100	Size in Lines
Worms newly hatched	1 gr.	1
After 1st moult	15 „	4
„ 2nd „	94 „	6
„ 3rd „	400 „	12
„ 4th „	1,628 „	20
Greatest weight and size	9,500 „	40

The Cocoons.—The worms show that they are ready to spin their cocoons by raising the forepart of the body and waving it slowly from side to side. Provision is now made for the structure on which they can spin. This consists of "bushes" of scrub-oak or other many-branched shrub which are placed vertically in the centre of the shelves on which the worms have hitherto spent their lives. Obedient to the dictates of nature, the worms, now replete with glutinous fibre, mount up into the bushes and proceed to spin the cocoons around themselves. If they are overcrowded there is the danger of two worms combining to spin one cocoon; this latter is practically useless for making silk as the combined threads are inextricably mixed up and the cocoon is incapable of being reeled into fine silk. After eight days, the bushes are removed from the shelves and the cocoons are picked off them. The importance of an even incubation is again demonstrated here, for if the hatch-out were irregular some worms would be ready to spin before others and the rearer would run the risk of taking down the bushes before all the worms had completed their spinning, resulting in some cocoons of inferior quality. On the other hand, the rearer dare not wait more than eight days, otherwise the chrysalis would complete its transformation and change into a moth which, in emerging from the cocoon, would cut through the silk fibres and destroy it for reeling purposes and thus render it practically valueless.

With the exception of those selected for reproduction of eggs, the cocoons are now treated so as to preserve them intact for reeling. The chrysalis must be killed without damage to the cocoon. The worm spins the cocoon with one continuous thread in a manner forming the figure 8, therefore the cutting of the cocoon at one end to allow the moth to escape means the cutting of the one continuous thread into many thousands of short ones and naturally makes it impossible to unwind ("reeling silk" is only another way of saying "unwinding cocoons"). The method adopted for killing the chrysalides—is that of suffocation. Leaving cocoons exposed to the hot sun will suffocate the chrysalides, but it also hardens the gum in the thread, making unwinding difficult and wasteful, and withdraws to a certain extent the colour from yellow cocoons. Another method is suffocation by steam. The cocoons are placed in shallow drawers in a cupboard which is constructed over a common washing copper. The bottoms of the drawers are constructed so as to allow of steam percolating through them. A fire is lit below the cauldron, which is filled with water, and steam is generated. The cocoons remain in the steam from eight to ten minutes and the chrysalis is suffocated. The cocoons are then spread lightly on canvas beds, sheltered from the sun, but where air can circulate freely. They remain on the beds from six weeks to two months, during which time they require to be turned over twice daily to prevent heating and the dead chrysalis gradually dries up without becoming putrid. In this method there is the risk of either keeping the cocoons in the steam too long and damaging the fibre, rendering the thread brittle, or not keeping them long enough so that the chrysalis, which has marvellous powers of recovery, will complete its metamorphosis and the moth will cut through after all. The safest and most practical method is suffocation by hot air. *Séchoirs*, or dryers, are constructed to take a large quantity of cocoons at one charge, and air is fanned through a steam-coiled chamber rendering it about 200° F. The hot air circulates by



BY COURTESY OF THE CORTICELLI SILK CO.

FIG. 4.—A SILKWORM, ALMOST FULL GROWN, FEEDING

means of channels through the chambers containing the cocoons, and the chrysalis is suffocated and all moisture in it dried up in one process of twelve hours' duration. The cocoons are put into sacks and stored without fear of deterioration. Exposure to air and wind, which also means exposure to dust and dirt, is unnecessary, and the colour of the silk when the cocoons are reeled is richer, while the water used in the reeling keeps clean.

Selection of Eggs for Reproduction.—The promiscuous production of eggs for the following crop by the rearers is strongly to be discouraged and in many countries it is absolutely prohibited, because of the great risk of propagating diseases to which the silkworm is prone. Reproduction, if a virile and healthy race of worm is to be preserved, must be under the supervision of experts. These experts choose rearers who are known to be extremely adept at cocoon-raising and give them specially selected eggs, each separate laying of which has been microscopically examined for the presence of disease. These eggs are known as "cellular seed." The experts pay periodical visits to the *magnanerie* during the rearing to examine the condition of the worms and take away any of doubtful appearance for microscopic examination. If the rearing is entirely successful and no trace of disease is found, the cocoons are taken to the "seed station," where they are examined. Ill-formed or imperfect cocoons are sent to be stifled and the selected ones are threaded together into long ropes and suspended from the ceiling to within a foot of the floor. In due course the moths emerge from the cocoons, mating takes place and the female is placed in a small linen bag, about 2 in. square, which has been washed and disinfected; the mouth is tied up and these bags are strung together and suspended from the ceiling of another room. The female lays its eggs in the bag and dies. The males, after two or three matings, are destroyed. This part of the process is carried on until the cocoon crop is at an end. The ratio of reproduction is about 250 to 1, so the seed stations require about 1,000 lb. of cocoons for seed for a crop of 25,000 lb. of cocoons the next season.

BY COURTESY OF THE CORTICELLI SILK CO.
FIG. 5.—A SILKWORM MOTH EMERGING FROM ITS COCOON (FRONT VIEW)

As soon as the mating is over, work is begun on the microscoping of the seed which has been laid. In the case of selection for cellular seed, each bag is emptied of its contents, the seed is washed in water to free it from the remains of the dead female and a few seeds are crushed and placed on a slide for examination. If the microscope tells no tale of disease, that particular laying is passed. If traces of disease are found, the bag and its contents are burnt. In the case of seed not to be used for reproduction but only to be distributed for producing cocoons for silk, called industrial seed, each rearing is kept separate and the contents of all the bags of one rearing are emptied out together. This heap of seed is washed as before, is well mixed and half a dozen samples are taken, crushed and examined as before. If disease is detected, further samples are taken to determine the extent of it. If not more than 5% of disease is apparent, the rearing passes; if more, it is entirely destroyed. In this way all the eggs are gradually cleared through the microscoping room, a further washing takes place and, after the seed is dry, it is done up in small gauze bags in weights of 1 oz., ½ oz., and ¼ oz. These, in turn, are placed in perforated cardboard boxes and are ready for distribution to rearers the following season, the cellular seed being kept separate for selected rearers for a further cycle of reproduction.

BY COURTESY OF THE CORTICELLI SILK CO.
FIG. 6.—SILKWORM MOTH EMERGING FROM ITS COCOON (SIDE VIEW)

The expert's task is not finished with the production of sound and healthy seed. He is also concerned with the cross-breeding of different varieties with a view to a higher yield of silk in the cocoons for reeling, to creating hardier races for different conditions of climate, to improving the cocoons of one part of the world by crossing the moths with those from another—an endless succession of problems for the propagation of sericulture in general.

DISEASES

That the silkworm is subject to many serious diseases is only to be expected of a creature which for upwards of 4,000 years has been propagated under purely artificial conditions, and these most frequently of a very insanitary nature, and where not the healthy life of the insect, but the amount of silk it could be made to yield, was the object of the cultivator. Among the most fatal and disastrous of these diseases with which the cultivator had long to grapple was "muscardine," a malady due to the development of a fungus, *Botrytis bassiana*, in the body of the caterpillar. The disease is peculiarly contagious and infectious, owing to the development of the fungus through the skin, whence spores are freed, which, coming in contact with healthy caterpillars, fasten on them and germinate inwards, giving off corpuscles within the body of the insect. Muscardine, however, has not been epidemic for many years.

The Pebrine Epidemic.—About the year 1853 anxious attention began to be given in France to the ravages of a disease among silkworms. This disease, which at a later period became known as *pebrine*—a name given to it by de Quatrefages, one of its many investigators—had first been noticed in France at Cavaillon in the valley of the Durance near Avignon. Pebrine manifests itself by dark spots in the skin of the larvae; the eggs do not hatch out, or hatch imperfectly; the worms are weak, stunted and unequal in growth, languid in movement, fastidious in feeding; many perish before coming to maturity; if they spin a cocoon it is soft and loose, and moths when developed are feeble and inactive. When sufficient vitality remains to produce a second generation it shows in increased intensity the feebleness of the preceding. The disease is thus hereditary, but in addition it is virulently infectious and contagious. From 1850 onwards French cultivators were compelled, in order to keep up their silk supply, to import graine from uninfected districts. The area of infection increased rapidly, and with that the demand for healthy graine correspondingly expanded, while the supply had to be drawn from increasingly remote and contracted regions. Partly supported by imported eggs, the production of silk in France was maintained, and in 1853 reached its maximum of 26,000,000 kilos of cocoons, valued at 117,000,000 francs. From that period, notwithstanding the importation at great cost of foreign graine, reaching in some years to 60,000 kilos, the production of silk fell off rapidly. In 1865 it touched its lowest weight of about 4,000,000 kilos. In 1867 de Quatrefages estimated the loss suffered by France in the 13 years following 1853, from decreased production of silk and price paid to foreign cultivators for graine, to be not less than one milliard of francs. In the case of Italy, where the disease showed itself later but even more disastrously, affecting a much more extended industry, the loss in 10 years de Quatrefages stated at two milliards. A loss of £120,000,000 sterling within 13 years, falling on a limited area, and on one class within these two countries, constituted indeed a calamity on a national scale, calling for national effort to contend with its devastating action. The malady, moreover, spread eastward, and, although it was found to be less fatal in Oriental countries than in Europe, the sources of healthy graine became fewer and fewer, till only Japan was left as an uninfected source of European graine supply.

A scourge which so seriously menaced the very existence of the silkworm in the world necessarily attracted a great amount of attention. As early as 1849 Guérin Méneville observed in the blood of diseased silkworms certain vibratory corpuscles, but neither did he nor the Italian Filippi, who studied them later, connect them distinctly with the disease. The corpuscles were first accurately described by Cornalia, whence they are spoken of as the corpuscles of Cornalia. The French Academy charged de Quatrefages, Decaisne and Péligot with the study of the disease, and they issued two elaborate reports—*Études sur les maladies actuelles des vers à soie* (1859) and *Nouvelles Recherches sur les maladies actuelles des vers à soie* (1860); but the suggestions

they were able to offer had not the effect of stopping the march of the disease. In 1865 Pasteur undertook a Government commission for the investigation of the malady. Attention had been previously directed to the corpuscles of Cornalia, and it had been found, not only that they occurred in the blood, but that they gorged the whole tissues of the insect, and their presence in the eggs themselves could be microscopically demonstrated. Pasteur established (1) that the corpuscles are the special characteristic of the disease, and that these invariably manifest themselves, if not in earlier stages, then in the mature moths; (2) that the corpuscles are parasites, and not only the sign but the cause of the disease; and (3) that the disease manifests itself by heredity, by contagion with diseased worms, and by the eating of leaves on which corpuscles are spread. In this connection he established the very important practical conclusion that worms which contract the disease during their own life-cycle retain sufficient vitality to feed, develop and spin their cocoon, although the next generation is invariably infected and shows the disease in its most virulent and fatal form. This fact, however, enabled the cultivator to know with assurance whether the worms on which he bestowed his labour would yield him a harvest of silk. He had only to examine the bodies of the moths yielding his graine: if they were free from disease then a crop was sure; if they were infected the education would assuredly fail.

Pasteur brought out the fact that the malady had existed from remote periods and in many unsuspected localities. He found corpuscles in Japanese cocoons and in many specimens which had been preserved for lengthened periods in public collections. Thus he came to the conclusion that the malady had been inherent in many successive generations of the silkworm, and that the epidemic condition was only an exaggeration of a normal state brought about by the method of cultivation and production of graine pursued. The cure proposed by Pasteur was simply to take care that the stock whence graine was obtained should be healthy, and the offspring would then be healthy also. Small educations reared apart from the ordinary magnanerie, for the production of graine alone, were recommended. At intervals of five days after spinning their cocoons specimens were to be opened and the chrysalides examined microscopically for corpuscles. Should none have appeared till towards the period of transformation and escape of the moths, the eggs subsequently hatched out might be depended on to yield a fair crop of silk; should the moths prove perfectly free from corpuscles after depositing their eggs the next generation would certainly live well through the larval stage. For special treatment towards the regeneration of an infected race, the most robust worms were to be selected, and the moths issuing from the cocoons were to be coupled in numbered cells, where the female was to be confined till she deposited her eggs. The bodies of both male and female were to be examined for corpuscles, and the eggs of those found absolutely free from taint were preserved for similar "cellular" treatment in the following year. By this laborious and painstaking method it has been found possible to re-establish a healthy stock of valuable races from previously highly-infected breeds. The rearing of worms in small educations under special supervision has been found to be a most effective means of combating pebrine. In the same way the rearing of worms for graine in the open air, and under natural conditions as far as possible, has proved equally valuable towards the development of a hardy, vigorous and untainted stock. The open-air education was originally proposed by Chavannes of Lausanne, and largely carried out in the canton of Vaud by Roland, who reared his worms on mulberry trees enclosed within "manchons" or cages of wire gauze and canvas. The insects appeared quickly to revert to natural conditions; the moths brought out in open air were strongly marked, lively and active, and eggs left on the trees stood the severity of the winter well, and hatched out successfully in the following season. Roland's experience demonstrated that not cold but heat is the agent which saps the constitution of the silkworm and makes it a ready prey to disease.

Other Diseases.—*Grasserie* is another form of disease incidental to the silkworm. It often appears before or after the first moult, but it is only after the fourth that it appears in a more developed form. The worm attacked presents the following symptoms: the skin is distended as if swollen, is rather thin and shiny, and the body of the worm seems to have increased, that is, it suffers from fatness, or is *engraissé*, hence its name. The disease is characterized by the decomposition of the blood; in fact it is really a form of dropsy. The blood loses its transparency and becomes milky, its volume increases so that the skin cannot hold it, and it escapes through the pores. This disease is more accidental than contagious and rarely takes very dangerous proportions. If the attack comes on a short time before maturity, the worms are able to spin a cocoon of a feeble character, but worms with this disease never change into chrysalides, but always die in the cocoon before transformation can take place. The causes which produce it are not well known, but it is generally attributable to currents of cold and damp air, to the use of wet leaves in feeding, and to sudden changes of temperature.

Another cause of serious loss to the rearers is occasioned by *flacherie*, a disease well known from the earliest times. Pasteur showed that the origin of the disease proceeded from microscopic organisms called ferments and vitrios. One has only to ferment a certain quantity of mulberry leaves, chop them up and squeeze them, and so obtain a liquid, to find in it millions of ferments and vitrios. It invariably occurs during the most active period of feeding, three or four days after the fourth moult up to the rising, and generally appears after a meal of coarse leaves, obtained from mulberries pruned the same year and growing in damp soil. It can also occur from the feeding of damp leaves, *e.g.*, leaves wetted by rain, to the worms or from leaves too freshly plucked and not allowed to wilt slightly. *Flacherie* is an intestinal disease of the cholera species and therefore contagious. The definite course is not occasioned so much from the ferments which exist in the leaves themselves, but from an arrest of the digestive process which allows the rapid multiplication of the former in the intestines. Good ventilation is indispensable to allow the worm to give out by transpiration the great quantity of water that it absorbs with the leaf. If this exhalation is stopped or lessened the digestion in its turn is also stopped, the leaf remains longer than usual in the intestines, the microbes multiply, invading the whole body, and this brings about sudden death. The true remedies consist in the avoidance of the fermentation of the leaves by careless gathering, transport or packing, in proper hygienic care in ventilation and in maintaining a proper degree of dryness in the atmosphere in rainy weather, and in the use of quicklime to facilitate the transpiration of the silkworms.

WILD SILKS

The ravages of pebrine and other diseases had the effect of attracting prominent attention to the numerous other insects, allies of the mulberry silkworm, which spin serviceable cocoons. It had been previously pointed out by Captain Hutton, who devoted great attention to the silk question as it affects the East Indies, that at least six species of *Bombyx*, differing from *B. mori*, but also mulberry-feeding, are more or less domesticated in India. These include *B. textor*, the boropooloo of Bengal, a large species having one generation yearly and producing a soft flossy cocoon; the Chinese monthly worm, *B. sinensis*, having several generations, and making a small cocoon; and the Madrasi worm of Bengal (*B. croesi*), the Dassee or Desi worm of Bengal (*B. fortunatus*) and *B. arracanensis*, the Burmese worm—all of which yield several generations in the year and form reelable cocoons. Besides these there are many other mulberry-feeding *Bombycidae* in the East, principally belonging to the genera *Theophila* and *Ocinara*, the cocoons of which have not attracted cultivators. The moths yielding wild silks which have obtained most attention belong to the extensive and handsome family *Saturnidae*. The most important of the species at the present time is the Chinese tussur or tasar worm, *Antheraea pernyi*, which is an oak-feeding species, native of Mongolia, from which is derived the greater part of the so-called tussur silk now imported into Europe. Closely allied to this is the Indian tussur moth, *Antheraea mylitta*, found throughout the whole of India feeding on the bher tree, *Zizyphus jujuba*, and also on many other plants. It yields a large compact cocoon of a silvery grey colour, which Sir Thomas Wardle of Leek, who

devoted a great amount of attention to the wild-silk question, succeeded in reeling. Next in promising qualities is the muga or moonga worm of Assam, *Antheraea assama,* a species to some extent domesticated in its native country.

The yama-mai worm of Japan, *Antheraea* (*Samia*) *yama-mai,* an oak-feeder, is a race of considerable importance in Japan, where it was said to be jealously guarded against foreigners. Its eggs were first sent to Europe by Duchêne du Bellecourt, French consul-general in Japan in 1861; but early in March following they hatched out, when no leaves on which the larvae would feed were to be found. In April a single worm got oak-buds, on which it throve, and ultimately spun a cocoon whence a female moth issued, from which Guérin Méneville named and described the species. A further supply of eggs was secretly obtained by a Dutch physician Pompe van Meedervoort in 1863, and, as it was now known that the worm was an oak-feeder, and would thrive on the leaves of European oaks, great results were anticipated from the cultivation of the yama-mai. These expectations, however, for various reasons, have been disappointed. The moths hatch out at a period when oak leaves are not ready for their feeding, and the silk is by no means of a quality to compare with that of the common mulberry worm. The mezankoorie moth of the Assamese, *Antheraea mezankooria,* yields a valuable cocoon, as does also the Atlas moth, *Attacus atlas,* which has an omnivorous larva found throughout India, Ceylon, Burmah, China and Java. The Cynthia moth, *Attacus cynthia,* is domesticated as a source of silk in certain provinces of China, where it feeds on the *Ailanthus glandulosa.* The eria or arrindi moth of Bengal and Assam, *Attacus ricini,* which feeds on the castor-oil plant, yields seven generations yearly, forming loose flossy orange-red and sometimes white cocoons. The ailanthus silkworm of Europe is a hybrid between *A. cynthia* and *A. ricini,* first obtained by Guérin Méneville, and now spread through many silk-growing regions. These are only a few of the moths from which silks of various usefulness can be produced; but none of these presents qualities, saving perhaps cheapness alone, which can put them in competition with common silk.

A wild silk which has entered the market since the beginning of the 20th century is Anaphe. It is found in West and East Africa. The worms combine to make large nests of cocoons with a strong outer protecting covering, tough as parchment. A peculiar and unpleasant quality of this species is the presence of hairs of a somewhat poisonous nature which bring out a rash on the skin when the nests are handled. Chemical treatment before handling has eliminated this trouble, but progress with the utilization of this silk is slow. It first began to attract attention in Germany in 1913 but its experimental stage was held up until 1920. At first, the outer cover was thrown away and the internal cocoons were treated, but it has since been found that the outer cover is the more valuable and the internal cocoons hardly worth the trouble of working. Natives use the nests for the manufacture of their blankets but its economic usefulness in Europe has still to be proved (1928). The systematic planting of the bush on which the Anaphe worm feeds would also be indicated if there is to be a constant and cheaper supply of this material.

PHYSICAL AND CHEMICAL PROPERTIES OF SILK

Common cocoons (*Bombyx mori*) enclosing chrysalides weigh each from 0·4 to 2 grams, *i.e.,* there are from 300 to 600 to the pound, for small breeds, and 270 to 300 for large breeds. About one-sixth of this weight is silk and of that one-half can be reeled, the remainder which cannot be reeled consisting of surface floss or blaze and the husk of the chrysalis. It is therefore difficult to estimate the total length of thread produced by the silkworm or even that of the portion reeled, which varies in length and thickness according to the condition and robustness of the cocoon and may be 500 metres in some breeds and in others 900 to 1,200 metres. Under favourable conditions 11 kilograms of fresh cocoons may give 1 kilogram of raw silk for commerce and about the same quantity of waste silk for spinning. The thread is usually thicker and stronger towards the middle of the reeled portion than at the extremities. The mean diameter of the cocoon thread or bave which is composed of two filaments of different specimens of mulberry silk was found at the Lyons laboratory to vary from 0·00180 to 0·0033 cm.; the bave of wild silks from 0·0030 to 0·0070 cm. The denier or weight in grams of 9,000 metres (*see* SILK MANUFACTURE) of the bave of mulberry silk varies from 1·8 to 3·8, and that of the bave of the Anthers (wild silks) from 3 to 8 deniers.

The raw silk fibre (*see* FIBRES) consists essentially of two cores of *fibroin* cemented together and covered with *sericin* or silk albumen, besides small quantities of waxy and colouring matters. The ultimate filaments of fibroin, which constitute about 70 to 80% of dry, raw mulberry silk have in bulk, after removal of the gum, the characteristic soft white appearance and pearly lustre of pure silk. Under the microscope the filaments appear smooth and rod-like and, when examined by polarized light, show the colours given by doubly refracting substances; their cross-section is roughly triangular (maximum diameter, 0·0023 to 0·0014 cm.; minimum diameter, 0·0018 to 0·0009 cm.). The filaments have great tensile strength (3 to 5×10^9 dynes per sq.cm.) extending considerably before breaking, and show true elastic effects under limited stresses (Young's modulus, 0·4 to $0{\cdot}8 \times 10^{11}$ and rigidity, $0{\cdot}2 \times 10^{11}$ dynes per sq.cm. under ordinary conditions). Their density is about 1·3, refractive index, 1·5 and specific heat, 0·3 calories per gram. The low electrical conductivity of fibroin, utilized in the employment of silk for electrical insulation, may cause a troublesome electrical excitation of the fibres during manufacturing processes in a dry atmosphere. Its thermal conductivity also is low. Under ordinary atmospheric conditions fibroin contains about 11% of its dry weight of hygroscopic moisture which may be removed by heating it at 105° C. It is insoluble but swells slightly in water, alcohol, benzene and other organic liquids.

Fibroin is an amphoteric colloid and belongs to the chemical class of proteins; the formula $C_{15}H_{23}N_5O_6$ sometimes assigned to it should be taken to be no more than an approximate expression of its elementary composition. The X-ray method of examination indicates the possible presence in fibroin of a crystalline constituent, and there is some chemical evidence that fibroin is chemically heterogenous. It dissolves in the cold in concentrated solutions of the mineral acids or of the caustic alkalies, and in an ammoniacal solution of copper oxide; from all these solutions it may be reprecipitated in a more or less altered form when the solution is neutralized, but, owing to more far-reaching changes, not after long standing. When heated, fibroin melts and burns giving a smell of burnt feathers which serves to distinguish it from the vegetable fibres, including artificial silk. It may be distinguished from wool by its microscopical appearance and by chemical tests. The ultimate filaments of the wild silks are thicker and more ribbon-shaped than those of mulberry silk and exhibit longitudinal striations along which the filaments tend to split into fibrillae under any mechanical or chemical action; the fibroin of the wild silks possesses properties similar to those of mulberry fibroin but is more resistant to chemical action. Sericin, also a protein, is more active chemically than fibroin, from which it may be separated by the solvent action of hot water, best under pressure, or of acid or alkaline solutions. Its hot aqueous solution gelatinizes on cooling. Its elementary composition is similar to that of fibroin but it contains more oxygen; like fibroin it may be chemically heterogenous. The colouring matter of yellow silk is probably *carotene* or a related substance.

Since 1916 a committee of experts has been sitting at the Imperial Institute to study the possibilities of sericulture in all parts of the Empire. Through its efforts the filature was erected in Cyprus, and it is following with practical advice the experimental work being carried on in a dozen other countries under the British flag. *See* SILK TRADE for a further study of the development of sericulture.

The U.S. Department of Agriculture, with appropriations made by Congress, conducted extensive experiments in sericulture. It was shown that cocoons of excellent quality can be produced in the many localities in the United States where the white mulberry tree grows well, but the conclusion reached by

the Department was that under the then existing economic conditions the raising of silk could not be made commercially successful.

BIBLIOGRAPHY.—L. Duran, *Raw Silk* (1913); R. C. Rawlley, *Economics of the Silk Industry* (1919); E. Brinckmeier, *Der Seidenbau* (4th ed., 1922). *See* also *Rapports du Laboratoire d'Etudes de la Soie, Lyon.* (N. BR.; F. WA.; W. S. DE.)

SILK FABRICS, ARTIFICIAL. Except in the production of knitted and lace goods, as well as a small variety of woven luxury fabrics of the most delicate texture, artificial silk is of such a character that it may only be employed successfully when in combination with threads produced from the natural textile fibres, in order to constitute a foundation texture of sufficient stability according to the specific use for which the fabric is intended. It should be realized, therefore, that the special function of artificial silk (so far as the textile industry is concerned) is that of embellishing and enriching textile fabrics of any description that permit of decorative treatment.

Artificial silk may be employed in conjunction with cotton in any combination. Also, the warp and weft may be interwoven in order to develop any desired textural or woven effect from the simplest and most elementary weaves. Fabrics may also be produced either as simple or compound structures and decorated with simple figuring. Again, artificial silk threads either of the same colour or any number of different colours may be introduced in place of the ordinary warp and weft threads, or as extra threads of warp and weft, in order to produce simple or variegated stripes.

Special Precaution in Preparing Textile Designs.—In the development of brocade or "float" figuring with artificial silk, great care should be taken, when preparing an applied design for the card-cutter, to ensure thorough interlacement of the threads, and also to avoid floats of inordinate length. This precaution is especially necessary for fabrics that are subject to wear or friction, as, owing to the multi-filament structure of artificial silk threads, the fine filaments are easily caught up and broken. As a general rule, the decorative features of a woven fabric may be developed with much greater success with the warp than with the weft series of threads, for the practical reason that, during the operation of weaving, the warp threads are under much more complete control and tension than the weft. Consequently, the warp series of threads lie much straighter and firmer in the fabric, and thus produce a more perfectly flat and even surface than can be obtained by employing weft for figuring purposes. Moreover, not only does the greater tension of the warp threads tend to effect a better distribution of the fine filaments composing those threads, and thus ensure a more complete "covering" of the weft, but the additional tension (by keeping the threads straight) also increases their power of reflection, which enhances their lustre. Further, the employment of warp, instead of weft (whenever the choice of these alternatives is quite optional and solely for decorative effect, as distinct from technical and practical considerations) is a more economical policy from the manufacturers' point of view, besides incurring a smaller percentage of waste material.

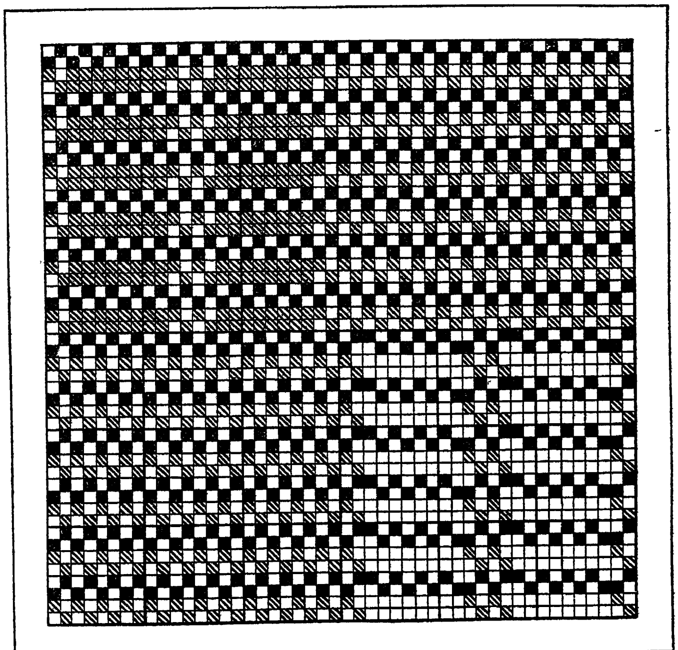


FIG. 1.—APPLIED DESIGN FOR CHENILLE VOILE FABRIC, A DRESS FABRIC CONSISTING OF A VOILE FOUNDATION INTERWOVEN WITH VELVET OR PLUSH PILE OF ARTIFICIAL SILK

The black squares indicate warp threads raised over picks of cotton weft, and the shaded squares, the warp raised over picks of artificial silk weft

Multi-colour Effects of Cross-Dyeing.—Another method of embellishing textile fabrics with artificial silk in combination with other textile materials is by what is known as "cross-dyeing," whereby two or more distinctly different hues and tones of colour may be produced in the same fabric by submitting it to a single dye-bath. This interesting phenomenon results entirely from the different chemical and physical properties of artificial silk and of the natural fibres. Hence, certain types of fibres react, on being submitted to the same dye-bath, in a manner quite different from that of other types, and thus assume different hues, according to the particular types of fibres employed, and their different affinity for dyestuffs.

Staple Artificial Silk Fibres.—Other uses to which artificial silk is applied in combination with cotton, wool and even natural silk, and one that offers ample scope in every section of the textile industry, is to cut the filaments of artificial silk into definite staple lengths and blend these with the fibres of cotton, wool or waste silk, respectively, to be spun together to produce "union" or "mixture" yarns.

Chenille Voile.—The various stages in the construction of this fabric is indicated by a portion of an applied or "working" design on point paper, in fig. 1, in which black squares indicate warp threads raised over picks of cotton weft, while the shaded squares show the warp raised over picks of artificial silk weft. After the cloth is woven, the ribs of floating artificial silk weft are "cut" up the centre in order to sever the floats of weft, which immediately assume a more or less vertical position, and thus constitute the tufts of cut velvet or plush pile, after the manner of forming the ribs of pile in corduroy and velvet cord fabrics (*see* FUSTIAN FABRICS). "Chenille voile" fabrics are sometimes woven with plain ribs or cords of pile, uniformly, and afterwards embellished with printed designs in one, or more than one, colour.

Embossed Plush Pile Fabrics.—The charming decorative qualities of artificial silk are displayed to their greatest perfection in so-called "embossed" plush or velvet pile figuring developed on a delicate texture of natural silk georgette and which was at one time very popular. This example is embellished with a design developed with a rich plush-pile figuring of artificial silk and subsequently printed with an effective colour scheme, displaying the artistic ability of the designer in conjunction with the handicraft skill of the weaver. The georgette foundation texture of this lovely dress material is produced from spun silk yarn with a high degree of twist, and with both the warp and weft threads twisted in "reverse" direction, *i.e.*, "twist-way" and "weft-way" respectively, in order to develop the peculiar, crimped tissue which is a distinctive characteristic of voile and georgette textures. The artificial silk pile figuring warp threads and the spun silk ground warp threads are drawn through the shedding harness and reed in pairs, with a "two-and-two" end disposition, uniformly. The ground warp threads of spun silk are disposed in the order of one thread spun with a "right-hand" twist (or "twist-way"), and one with a "left-hand" twist (or "weft-way"), in alternate succession, uniformly; while the ground picks of spun silk weft are inserted with three picks of weft spun "twist-way," and three spun "weft-way," uniformly.

Embossed plush pile fabrics of this character are produced in a "double-plush" loom of a special type in which two distinct fabrics are woven together simultaneously, face to face, with the figuring pile warp threads passing vertically between the upper and lower foundation textures which are severed automatically (whilst in the loom) during the operation of weaving. When not

required for figuring purposes, the figuring warp threads are floated quite loosely as surplus yarn on the back of their respective foundation fabrics, from which they are afterwards brushed away as waste material. This method of pile weaving necessitates the winding of the plush figuring warp threads on to separate flanged bobbins that are supported in a bobbin-creel frame, whereas the foundation warp threads are wound on to an ordinary warp beam.

See H. Nisbet, F.T.I., *Grammar of Textile Design* (3rd ed., 1927); a practical treatise on the principles of woven fabric structures, with a chapter on "The Decorative Value of Artificial Silk in Textile Fabrics." (H. N.)

SILK MANUFACTURE. In discussing silk manufacture, it is necessary to distinguish between reeled silk and spun or waste silk. The former embraces a range of operations peculiar to silk, dealing as they do with continuous fibres of great length, whereas in the spun silk industry the raw materials are treated by methods analogous to those followed in the treatment of other fibres (*see* WEAVING). It is only floss, injured and unreelable cocoons, the husks of reeled cocoons, and other waste from reeling, with certain wild silks, which are treated by spun silk process, and the silk thereby produced loses much of the beauty, strength and brilliance which are characteristic of the manufactures from reeled silk.

Filature or Reeling.—When the cocoons have been gathered and the chrysalids they contain have been stifled, they are sorted into qualities for reeling. Doubles (cocoons made by two worms in conjunction), pierced cocoons and any from other causes rendered unreelable are put aside for the spun silk manufacture. During the gathering from the rearers of "fresh" cocoons, *i.e.*, while the chrysalids are alive, a certain amount of crushing occurs, which smashes the chrysalis and naturally saturates the cocoon with its fluid. One cocoon thus crushed may be the cause of staining several others. Also, there are partly reelable cocoons made by unhealthy worms. A black fluid is exuded from some of these cocoons, which, in turn, stain all the cocoons in their vicinity. Worms which have been ill fed make cocoons of a weak thread. The sorting is done by hand, and the cocoons separated into four qualities, (*a*) cocoons which are perfectly clean and firm, (*b*) cocoons which are otherwise good but which have been stained by crushed cocoons, (*c*) weak cocoons, and (*d*) cocoons crushed and badly stained from within. The (*c*) and (*d*) qualities, which form but a small proportion of the whole, are reeled as quickly as possible, for they are liable, if kept in store, to attack from an insect fly which bores a minute hole about the size of a pinhead through them and renders them unsuitable for reeling. The (*b*) quality, which forms about 20% of the whole, is also susceptible to the insect, but to a much smaller degree, so these are worked next, leaving the (*a*) quality for the remainder of the year's work. This assortment is of great consequence for the success of the reeling operations, as uniformity of quality and evenness and regularity of fibre are the most valuable features in raw silk. The object of reeling is to bring together the filaments (Fr. *bave*) from two or more (generally five or six, but sometimes up to 20) cocoons, and to form them into one continuous, uniform and regular strand, which constitutes the "raw silk" of commerce. To do this, the natural gum of the cocoons which holds the filaments together must be softened, the ends of the filaments must be caught, and means must be taken to unwind and lay these filaments together, so as to form a simple uniform rounded strand of raw silk. This reeling process is generally carried out by female labour; it is extremely delicate but by no means hard work. The establishment in which it is done is called a filature, and may consist of anything from 20 to 300 reeling basins. Each reeler is issued with a given weight of cocoons, and the worker who prepares them for the reeler places a quantity of them in a round deep basin with water kept at a certain level automatically and heated to boiling point by a steam coil in the bottom. A circular bass broom made to fit exactly over the basin is shut down on the soaking cocoons (which float on the surface of the water) so that the ends of the bass just touch the tops of the cocoons. The broom is set to work in a circular motion first one way and then the other by machinery until the ends of the broom have caught the outside fluff and the actual filament (*maître brin*) is found. The worker pulls up the broom, disengages the hank of fluff from the bass from which now depends the filament of each cocoon separately. She catches up the cocoons from the water by means of a strainer and passes it over to the reeler. The latter empties the cocoons into her basin, which also contains water kept at a level automatically and heated by a steam coil to 180° to 200° F. She then "makes her threads."

Filatures are constructed to enable four, six and eight skeins to be reeled by one reeler at a time. The reeler takes the filaments of, say, six cocoons and makes one thread of them by twisting them together; this combined thread is passed through an apparatus about 2 in. above the water level, upwards about 18 in. round a tiny glass conducting reel, then downwards round a similar glass reel and upwards again until the thread crosses itself. Here it is twisted round itself many times and is then taken through a glass conducting hook above the reeler's head, passed through a porcelain slit and finally attached to the reel on which the skein is to be wound. The process is repeated until the four, six or eight threads, each consisting of the threads of six cocoons, are attached to the reels. The reels are set revolving by means of a control lever ready at the reeler's hand, and as the reels revolve, they pull the threads; if eight skeins are being reeled, the 48 cocoons which go to make the eight threads all begin to turn about in the water as they unwind themselves in response to the pulling of the reels. When each thread is in motion, it travels through the apparatus with a minute hole, which prevents to a great extent any imperfection in the thread getting through, then through the twist on itself, then round the two glass conducting reels, then through the twist on itself for the second time and thence to the porcelain slit just in front of the reel, and finally on to the reel itself. The porcelain slit has a short cross motion of about 1½ in. which spreads the skein evenly over the surface of the reel. The twist on itself given to the thread is most important for it performs two functions; it rounds, smooths and condenses the six separate filaments into one strand, and as the surface of the filaments is gummy and adhesive, the threads are agglutinated into a compact single fibre of raw silk. The twist also expels from the thread all the moisture on it from the water in the basin in the form of spray and it reaches the reel practically dry. A silk thread made up of the filaments of six cocoons is scarcely visible, and yet it can easily stand the strain imposed on it by this twist on itself which is as long as six inches. A good silk should stretch about one-third of its own length before reaching breaking point. During the reeling process, the cocoons, of course, give off all their silk in a short time and breaks continually occur, so the reeler has to watch the unwinding cocoons carefully and directly she detects a cocoon that is motionless, she supplies the thread of another from a reserve which she keeps ready. The apparatus through which the thread is originally passed has a little disc attached to it which revolves rapidly. The reeler places the filament of the new cocoon across her extended first and second fingers, she advances her fingers to the disc, one above and one below, the disc cuts the filament and whirls it round the others which absorb it, and the new cocoon begins unwinding. A break of one filament in a thread of six will be rectified by a first-class reeler before half a yard of thread has gone through. All cocoons whose filaments break before they are finished are returned to have their filaments found again by a second brushing.

As soon as the cocoons issued to the reeler are finished, the silk is removed from the reels and taken to the silk room. It is weighed and a ratio to the quantity of cocoons used is found. The value of silk permits of no unnecessary waste and this control is important. The skeins are then examined for any defects. These consist of small knobs on the thread like pinheads, or a very coarse piece 3 or 4 in. long due to a cocoon not unwinding evenly. The knobs are picked off, the coarse pieces removed and clean thread is inserted in their place. The skeins are twisted up and packed into a bale.

Silk Waste.—The outer covering or fluff which is brushed off the cocoons in finding the filaments is a valuable waste used by silk spinners. Its trade name is knubs (Fr. *frisons*). A thin film of silk is left round the chrysalis when reeling is completed. The chrysalids with this film are boiled up in a vat and stirred with beaters which tear the film off. This is a low grade waste also used by spinners. The chrysalids are dried and form a valuable manure. Thus nothing is lost.

Throwing.—Raw silk, being still too fine and delicate for ordinary use, next undergoes a series of operations called throwing, the object of which is to twist and double it into more substantial yarn. The first operation of the silk throwster is winding. He receives the raw silk in hanks as it is taken from the reel of the filature, and putting it on a light reel of a similar construction, called the swifts, he winds it on bobbins with a rapid reciprocating motion, so as to lay the fibre in diagonal lines. These bobbins are then in general taken to the first spinning frame, and there the single strands receive their first twist, which rounds them, and prevents the compound fibre from splitting up and separating when, by the subsequent scouring operations, the gum is removed which presently binds them into one. Next follows the operation of cleaning, in which the silk is simply reeled from one bobbin to another, but on its way it passes through a slit which is sufficiently wide to pass the filament but stops the motion when a thick lump or nib is presented. In the doubling, which is the next process, two or more filaments are wound together side by side on the same reel, preparatory to their being twisted or thrown into one yarn. Bobbins to the number of strands which are to be twisted into one are mounted in a creel on the doubling frame, and the strands are passed over smooth rods of glass or metal through a reciprocating guide to the bobbin on which they are wound. Each separate strand passes through the eye of a faller, which, should the fibre break, falls down and instantly stops the machine, thus effectually calling attention to the fact that a thread has failed. The spinning or throwing which follows is done on a frame with upright spindles and flyers, the yarn as it is twisted being drawn forward through guides and wound on revolving bobbins with a reciprocating motion. From these bobbins the silk is reeled into hanks of definite length for the market. Numerous attempts have been made to simplify the silk-throwing by combining two or more operations on one machine, but not as yet with much success.

According to the qualities of raw silk used and the throwing operations undergone the principal classes of thrown silk are—(1) "singles," which consist of a single strand of twisted raw silk made up of the filaments of eight to ten cocoons; (2) tram or weft thread, consisting of two or three strands of raw silk not twisted before doubling and only lightly spun (this is soft, flossy and comparatively weak); (3) organzine, the thread used for warps, made from two and rarely three twisted strands spun in the direction contrary to that in which they are separately twisted. Silks for sewing and embroidery belong to a different class from those intended for weaving, and thread-makers throw their raw silks in a manner peculiar to themselves.

Numbering of Silk.—Silk is graded for thickness of thread like cotton, but instead of the size being termed "counts" it is measured in "deniers." The French denier weighs one-twentieth part of a gramme. The basis for raw and thrown silk adopted by the permanent committee of the Paris international congress of 1900 was a fixed length and a variable weight, the standard of length being 450 metres and the weight the "denier." Thus, a manufacturer gives an order for a bale of silk of 13–15 deniers. By this is meant that a thread is required of which 450 metres measured off will weigh between 13 and 15 deniers. Silk is reeled as fine as 8–10 deniers and as coarse as 28–30 deniers—for some purposes even 38–40 deniers. A silk cocoon has a filament of three deniers in its early stages of unwinding, two and a half deniers in the middle and two deniers at the end, so in order to arrive at a size of 13–15 deniers it is required to reel a thread of two new, two half-reeled and two nearly finished cocoons. During the reeling tests are carried out to see that the size is properly maintained. A reel is taken away from the reeler and carried to the testing room, where a winding machine measures off 450 metres from the reeled silk. This silk is put on the balances and if it weighs 14 deniers it is perfect, if 13 or 15 deniers it is good, if 12 or 16 deniers it is passable, but if it weighs 11 or 17 deniers it is bad and the reeler has been reeling a thread with less or more than the six cocoons combined.

Conditioning.—Silk in the ordinary dry condition usually contains about 10 per cent of hygroscopic moisture, the exact amount depending on the relative humidity of the atmosphere with which it is in contact. As it is largely sold by weight it becomes necessary to ascertain its condition in respect of absorbed water, and for that purpose official conditioning houses are established in all the considerable centres of silk trade. In these the silk is tested or conditioned, and a certificate of weight issued in accordance with the results. The silk is for four hours exposed to a dry heat of 230° F, and immediately thereafter weighed. To the weight 11% is added as the normal proportion of water held by the fibre.

Scouring.—Up to this point the silk fibre continues to be comparatively lustreless, stiff and harsh from the coating of albuminous matter (gum or *grès*) on its surface. As a preliminary to many subsequent processes it is therefore necessary to remove the gum by boiling off, scouring or *décreusage*. Silk is usually boiled-off in a solution of 30 per cent of its own weight of neutral soap dissolved in sufficient pure water to give a one per cent solution. The hanks of raw silk hung on a wooden rod are immersed in this solution which is maintained at a temperature just below the boiling point, the hanks being turned round to expose all parts equally to the solvent action of the hot solution. After one hour the silk is removed, centrifuged, then treated similarly in a second bath with half the quantity of soap. It is finally rinsed and dried in a hydro-extractor. According to the amount of gum to be boiled off the soap solutions are made strong or weak; but care has to be exercised not to overdo the scouring, whereby loss of strength, substance and lustre would result. The perfect scouring of silks removes from 20 to 27 per cent of their weight, according to the character of the silk and the amount of soap or oil used in the working. Scouring renders all common silks, whether white or yellow in the raw, a brilliant pearly white, with a delicate soft flossy texture, from the fact that the fibres which were agglutinated in reeling, being now degummed, are separated from each other and show their individual tenuity in the yarn. Silks to be finished white are at this point bleached by exposure in a closed chamber to the fumes of sulphurous acid, and at the close of the process the hanks are washed in pure cold water to remove all traces of the acid. Instead of "sulphuring" a dilute solution of hydrogen peroxide containing sodium silicate may be used for bleaching. Much thrown silk is woven or knitted without having been boiled-off, the gum being then usually removed from the woven or knitted fabric (piece-degumming).

Weighting.—The weighting of silk, which is by no means universal, and which when practised is confined usually to certain classes of goods, is facilitated by the ease with which silk absorbs various metallic salts and organic substances.

In tin weighting, the silk yarn or cloth, usually degummed, is soaked in an aqueous solution of stannic chloride and then washed exhaustively with water when hydrated stannic oxide is precipitated in the fibre; if the weighted silk is now soaked in a solution of sodium phosphate the stannic oxide present in the fibre is rendered insoluble in the solution of stannic chloride and so, with each repetition of the same series of operations, a further quantity of stannic oxide is fixed by the silk which may be treated finally with a solution of sodium silicate. The compounds of tin are fixed permanently in the fibre, unless against chemical treatment, and the weighted silk may be washed or dyed like unweighted silk from which it differs little in outward appearance. The mineral matter, besides adding weight, makes the fibres somewhat thicker, thus increasing their covering power and allowing cheaper goods to be made of weighted than of unweighted silk; on that account and because weighted silk garments drape well, the practice is held by many to be justified. By the removal of the gum,

raw silk loses about one quarter of its weight; if the original weight is restored by the addition of mineral matter to the degummed silk, the silk is said to be weighted "to par"; heavier weightings are described as so much per cent "above par." The weighting does not usually exceed 50% above par. The strength of the fibre remains unimpaired after weighting but weighted silk is more sensitive to the action of light than unweighted silk.

In black weighting the silk is treated with salts of iron and logwood or tannins such as extracts of sumac, divi-divi, chestnut, catechu from the Areca or Acacia and gambier from the Uncaria. The silk is frequently "bottomed" with Prussian blue or tin weighted, before being black weighted with various combinations of the above materials. Black weighted silk is highly resistant to the deteriorating action of sunlight.

Dyeing.—Silk may be dyed with acid, basic or direct cotton colours or with vat or mordant dyes; but acid dyes are still the most commonly used. The application to silk of vat dyes which are necessary for many very fast shades requires special care because of the sensitiveness of the fibre to the alkaline solutions which must be used with these dyes.

Although tussur and other silks from wild moths are readily dyed, the dyeing is apt to be uneven; and as these wild silks are usually of a fawn or brown colour which is not readily bleached it is difficult to dye them successfully with light or brilliant colours. Pioneers in this field were Sir Thomas Wardle and Tessié du Motay who made use of potassium permanganate to bleach the fawn colour of tussur; this reagent tends, however, to destroy the fibre itself and gentler means of oxidation, such as, a dilute solution of hydrogen peroxide made slightly alkaline with sodium silicate, are now employed to bleach tussur to a fairly pale ground.

THE SPINNING OF "SILK WASTE"

The term *silk waste* includes all kinds of raw silk which may be unwindable, and therefore unsuited to the throwing process. Before the introduction of machinery applicable to the spinning of silk waste, the refuse from cocoon reeling, and also from silk winding, which is now used in producing spun silk fabrics, hosiery, etc., was nearly all destroyed as being useless, with the exception of that which could be hand-combed and spun by means of the distaff and spinning wheel, a method which is still practised by some of the peasantry in India and other Eastern countries.

The supply of waste silk is drawn from the following sources: (1) The silkworm, when commencing to spin, emits a lustreless and uneven thread with which it suspends itself from the twigs and leaves of the tree upon which it has been feeding, or from straws provided for it by attendants in the worm-rearing establishments: this first thread is unreelable, and, moreover, is often mixed with straw, leaves and twigs. (2) The outside layers of the true cocoon are too coarse and uneven for reeling; and as the worm completes its task of spinning, the thread becomes finer and weaker, so both the extreme outside and inside layers are put aside as waste. (3) Pierced cocoons—*i.e.*, those from which the moth of the silkworm has emerged—and damaged cocoons. (4) During the process of reeling from the cocoon the silk often breaks; and both in finding a true and reelable thread, and in joining the ends, there is unavoidable waste. (5) Raw silk skeins are often re-reeled; and in this process part has to be discarded: this being known to the trade as gum-waste. The same term—gum-waste—is applied to "waste" made in the various processes of silk throwing; but manufacturers using threads known technically as organzines and trams call the surplus "manufacturer's waste." Finally we have the uncultivated varieties of silks known as "wild silks," the chief of which is tussur. The different qualities of "waste," of which there are many, vary in colour from a rich yellow to a creamy white; the chief producing countries being China, Japan, India, Italy, France and the countries in the Near East; and the best-known qualities are: steam wastes, from Canton; knubs, from China and from Italy and other Western countries; frisons, from various sources; wadding and blaze, Shanghai; China, Hangchow, and Nankin buttons; Indian and Szechuen wastes; punjum, the most lustrous of wastes; China curlies; Japan wastes, known by such terms as kikai, ostue, etc.; French, Swiss, Italian, China, Piedmont, Milan, etc. There are yellow wastes from Italy, and many more far too numerous to mention.

A silk "throwster" receives his silk in skein form, the thread of which consists of a number of silk fibres wound together to make a certain diameter, the separate fibres having actually been spun by the worm, and this fibre may measure anything from 500 to 1,000 yd. in length. The silk-waste spinner receives his silk in quite a different form: merely the raw material, packed in bales of various sizes and weights, the contents being a much-tangled mass of all lengths of fibre mixed with much foreign matter, such as ends of straws, twigs, leaves, worms and chrysalids. It is the spinner's business to straighten out these fibres, with the aid of machinery, and then to so join them that they become a thread, which is known as spun silk.

There are two distinct kinds of spun silk—one called "schappe" and the other "spun silk" or "discharged spun silk." All silk produced by the worm is composed of two substances—fibroin, the true thread, and sericin, which is a hard, gummy coating of the "fibroin." Before the silk can be manipulated by machinery to any advantage, the gum coating must be removed, really dissolved and washed away—and according to the method used in achieving this operation the result is either a "schappe" or a "discharged yarn." The former, "schapping," is the French, Italian and Swiss method, from which the silk when finished is neither so bright nor so good in colour as the "discharged silk"; but it is very clean and level, and for some purposes absolutely essential, as, for instance, in velvet manufacture.

Schapping.—The method is as follows: If waste silk is piled in a heap in a damp, warm place, and kept moist and warm, the gum will in a few days' time begin to ferment and loosen, and can then be washed off, leaving the true thread soft and supple; but the smell caused by the fermentation is so offensive that it cannot be practised in or near towns. Therefore schappe spinners place their degumming plant in the hills, near or on a stream of pure water. The waste silk is put into large kilns and covered with hot water (temperature 170° F). These are then hermetically closed, and left for a few hours for the gum to ferment and loosen. When thoroughly softened—the time occupied depending on the heat of the water and nature of the silk—the contents of the kiln are taken out and placed into vats of hot water, and allowed to soak there for some time. Thence the silk is taken to a washing machine, and the loosened gum thoroughly washed away. The silk is then partly dried in a hydro-extractor, and afterwards put in rooms heated by steam-pipes, where the drying is completed.

"Discharging" is the method generally used by the English, and results in a silk having brilliance and purity of colour. In this process the silk waste is put into strong, open-meshed cotton bags, made to hold (in accordance with the wish of individual spinners) from 1 lb. to 5 lb. in weight. When about 100 lb. of silk has been bagged, the whole is placed in a large wooden tub and covered with boiling water in which 12 to 20 lb. of white curd soap has previously been dissolved. In this the silk is boiled from one to two hours, then taken out and put through a hydro-extractor to remove the dirty gummy solution. Afterwards it is put into another tub of soapy liquor, and boiled from one to one and a half hours. It is then once more hydro-extracted, and finally taken to a stove and dried. "Discharged silk" must be *entirely free* from gum when finished, whereas "schappe" contains a percentage of gum—sometimes as much as 20%.

From this stage both classes of silk receive much the same treatment, differing widely in detail in different mills and districts.

The "degummed silk," after it is dried, is allowed to absorb a certain amount of moisture, and thus it becomes soft and pliable to the touch, and properly conditioned for working by machinery.

When the waste contains any large percentage of worm or chrysalis, it is taken to a "cocoon beater," a machine which has a large revolving disk on which the silk is put, and while revolving slowly is beaten by a leather whip or flail, which loosens the silk and knocks out the wormy matter. After the beating, the silk presents a more loose appearance, but is still tangled and mixed in length of fibre. The object of the spinner at this point is to

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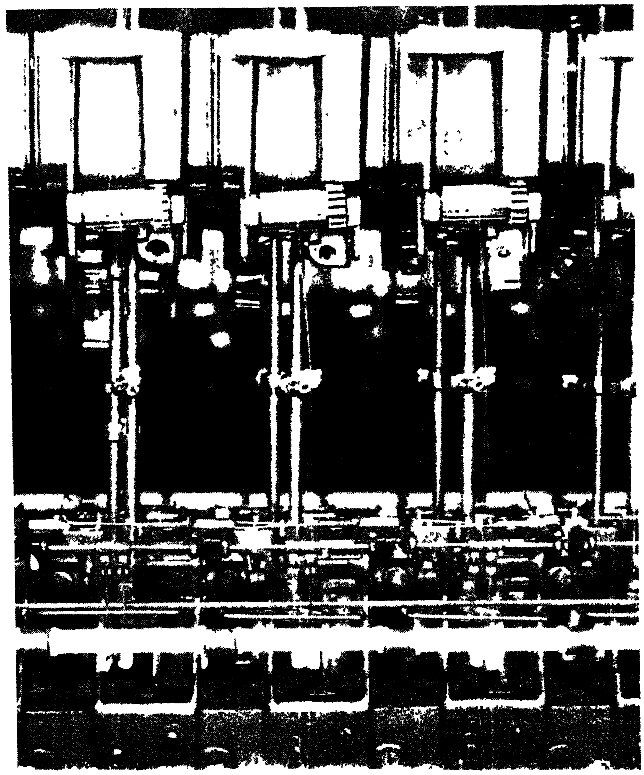

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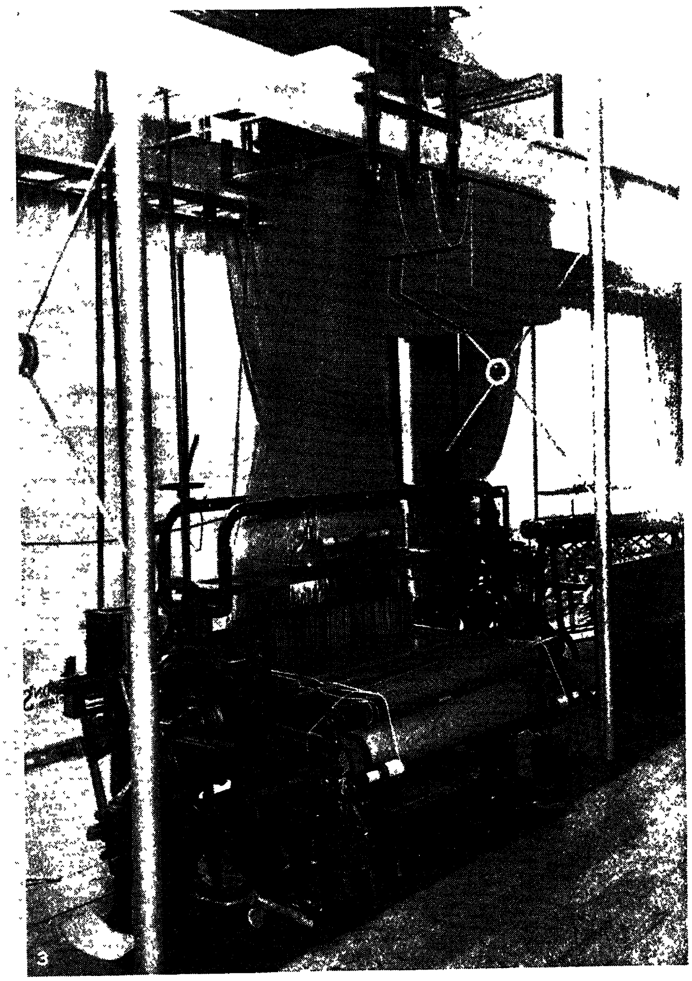

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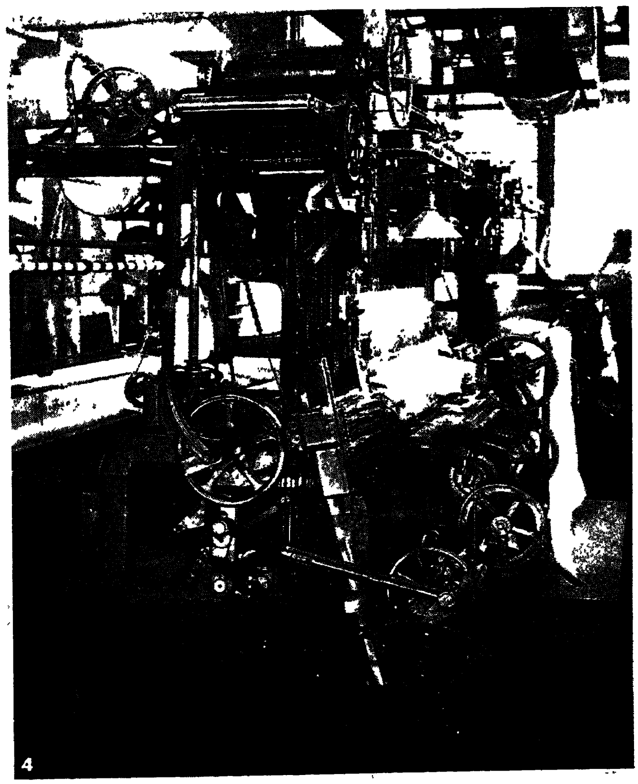

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SILK MANUFACTURING MACHINERY

1. Winding silk on bobbins, rapid reciprocating motion used to lay fibre in diagonal lines
2. Throwing or spinning the silk. Frame pictured has upright spindles and flyers. As yarn is twisted it also is drawn forward through guides and wound on revolving bobbins. From the bobbins silk is reeled into hanks of definite length for the market
3. Weaving silk Sebastian brocade on Jacquard loom, woven pattern in material determined and controlled by Jacquard cards hanging from above
4. Modern power loom with motion conveyed to all working parts from a main shaft. Healds control all warps in plain or printed goods

straighten out the tangles and lumps, and to lay the fibres parallel: the first machine to assist in this process being known as an opening machine, and the second as a filling engine.

Opening and Filling.—The silk to be opened is placed on a latticed sheet or feeder, and thus slowly conveyed to a series of rollers or porcupines (rollers set with rows of projecting steel pins), which hold the silk firmly while presenting it to the action of a large receiving drum, covered with a sheet of vulcanized rubber, set all over with fine steel teeth. As the drum revolves at a good speed, the silk is drawn by the steel teeth through the porcupines into the drum in more or less straight and parallel fibres. When the teeth are full the machine is stopped, and the silk stripped off the drum, then presenting a sheet-like appearance technically known as a "lap." The lap is taken to the filling engine, which is similar in construction and appearance to the opener as far as the feeding arrangements are concerned, but the drum, in place of being entirely covered with fine steel teeth, is spaced at intervals of from 5 to 10 in. with rows of coarser straight teeth, each row set parallel with the axle of the machine. The silk drawn by the rows of teeth on the drum through the porcupine rollers (or porcupine sheets in some cases) covers the whole of the drum, hooked at certain intervals round the teeth; and when a sufficient weight is on the machine, it is stopped, and an attendant cuts, with a knife, the silk along the back of each row of teeth, thus leaving a fringe of silk hooked on the pins or teeth. This fringe of silk is placed by the attendant between two hinged boards, and whilst held firmly in these boards (called book-boards) is pulled off the machine, and is called a "strip"; the part which has been hooked round the teeth is called the "face," and the other portion the "tail." By these means the silk has been opened, straightened and then cut into a certain length, the fibres now being fairly laid parallel and ready for the next operation, known as silk dressing.

Silk Dressing.—This is the process equivalent to combing in the wool industry. Its purpose is to sort out the different lengths of fibre, and to clear such fibres of their nibs and noils. There are two well-known principles of dressing: one known as "flat frame," giving good results with discharged silk, and the other known as "circular frame" dressing, suitable for schappes.

The flat dressing frame is a box or frame holding a certain number of book-boards from the filling engine, which boards when full of silk are screwed tightly together in the frame. The frame is capable of being raised into contact with travelling combs, affixed to an endless belt placed round two metal rollers about 6 ft. apart. The attendant allows the silk to enter gradually into close contact with the combs, which comb through the silk in exactly the same manner as a lady combs her tresses. In a circular frame the silk is clamped between boards, and these are fixed on a large drum. This drum revolves slowly, and in its revolution conveys the fringes of silk past two quickly running smaller combing drums. These combing drums being covered with fine steel teeth penetrate their combs through the fringes of silk depending from the large drum, thus combing through the silk. In each machine the object is the same. First the filled silk is placed into a holding receptacle, clamped fast, and presented to combing teeth. These teeth retain a certain proportion of shorter fibre and rough places and tangled portions of silk, which are taken off the combs in a book-board or wrapped round a stick and again presented to the combs. This fibre again yields combings which will also be combed, and so on for five or six times until the combings are too short, and are taken from the machine and known as "noils." The productions from these several combings are known as "drafts" and are of different lengths: the product of the filled silk first placed in the dressing frame being the longest fibre and of course the most valuable.

The flat frame is the most gentle in its usage of the silk, but is most costly in labour; whilst the circular frame, being more severe in its action, is not suitable for the thoroughly degummed silks, but on the other hand is best for silks containing much wormy matter, because the silk hanging down into the combing teeth is thoroughly cleansed of such foreign matter, which is deposited under the machine. This method also has the advantage of being cheaper in cost of labour. Recently a machine has been invented giving the same results as the circular frame: the silk descends from boxes into combs, and at the same time has the gentle action of the flat frame. The cost of the operations is as cheap as the circular frame, therefore the machine combines the advantages of each of its predecessors.

Noils.—The noils resulting from the dressing operations are sometimes combed, the comb used being similar to those used in the cotton trade. The resulting sliver is used by silk spinners who make a speciality of spinning short fibres, and the exhaust noils are bought by those who spin them up into "noil yarns" on the same principle as wool. The yarns are chiefly used by manufacturers of powder bags. The noils are also in great demand for mixing with wool to make fancy effects in wool cloths for the dress goods trade.

Drafts.—The drafts from the dressing frame are valued in accordance with their length of fibre, the longest being known as A or 1st drafts and so on:—

	1st drafts	2nd drafts	3rd drafts	4th drafts	5th drafts	6th drafts
or as quality	A	B	C	D	Shorts	

Each draft may be worked into a quality of its own, and by such means the most level yarns are obtained. But occasionally one or more drafts are mixed together, when price is the determining factor.

Processes Peculiar to Silk Spinning Industry.—The foregoing processes are all peculiar to the silk waste trade, no other fibre having to go through such processes, nor needing such machinery. In the first stages of the spun-silk industry, the silk was dressed before boiling the gum out; the resulting drafts were cut into lengths of one or two inches. The silk was then boiled and afterwards beaten, scutched, carded, drawn, spun, folded, etc., in exactly the same way as fine cotton. Short fibre silks are still put through cards and treated like cotton; but the value of silk is in its lustre, elasticity and strength, which characteristics are obtained by keeping fibres as long as possible. Therefore, when gill drawing machinery was invented, the cutting of silk into short fibres ceased, and long silks are now prepared for spinning in what is known as "long spinning process." Following the process of dressing, the drafts have to go through a series of machines known as preparing machines: the object being to piece up the lengths of fibre, and to prepare the silk for spinning.

Preparing or Drawing Machinery.—A faller or gill drawing machine consists of a long feeding sheet which conveys silk to a pair of rollers (back rollers). These rollers present the silk to a set of fallers (steel bars into which are fixed fine steel pins), which carry forward the silk to another pair of rollers, which draw the silk through the pins of the fallers and present it to the rollers in a continuous way, thus forming a ribbon of silk called a "sliver." The fallers are travelled forwards by means of screws, and when at the end of the screw are dropped automatically into the thread of a receiving screw fixed below, which carries the fallers back to their starting point to be raised by cams into the top pair of screws thus to repeat their journey.

Silk Spreader.—This is the first of the series of drawing machines. The drafts from the dressing frame are made into little parcels of a few ounces in weight, and given to the spreader, who opens out the silk and spreads it thinly and evenly on to the feeding sheet, placing a small portion of the silk only on the sheet. Another portion is opened out and placed tail end to the first portion; and these operations are repeated until the requisite weight is spread. During this time the silk has been conveyed through the fallers and into a large receiving drum about 3 ft. in diameter, the silk being wrapped thinly and evenly all round the circumference of the drum. When the agreed-on weight is on the drum, the silk is drawn across the face of the drum parallel with its axle, and pulled off in form of a sheet, and is called a lap. This lap is thin, but presents the fibres of silk now joined and overlapped in a continuous form, the length measured by the circumference of the drum. This lap is sometimes re-spread to make it more even, and at other times taken

to a drawing machine which delivers in a sliver form. This sliver is taken through a series of four other drawing machines called "four head drawing box." Eight or more slivers are put behind the first drawing head, conveyed through the fallers and made into one sliver in front of the machine. This sliver is put up behind the second drawing; eight or more ends together run through the second head again into one sliver; and so on through the third and fourth heads of drawing. All these doublings of the sliver and re-drawing are for the purpose of getting each fibre to lie parallel and to make the sliver of an equal weight over every yard of its length. From the last head of drawing the sliver is taken to a machine known as a gill rover. This is a drawing machine fitted with fallers through which the sliver is drawn, but the end from the front roller is wound on to a bobbin. The machine is fitted with 20 to 40 of these bobbins placed side by side, and its product is known as "slubbing roving," it being now a soft, thick thread of silk, measuring usually either 840 or 1,260 yd. to 1 lb. weight. Hitherto all the drawing has been by rollers and fallers, but in the next machine the drawing is done by rollers only.

Dandy Roving Frame.—This is a frame built with forty or more spindles. Two or three slubbing rovings are put up behind the machine opposite each spindle; each end is guided separately into back rollers and thence between smaller rollers, known as carrier rollers, to the front rollers. The back rollers revolve slowly, the front rollers quickly, thus drawing the rovings out into a thinner size or count. The product is wound on to the bobbin by means of flyer and spindle, and is known as dandied or fine roving, and is then ready for the spinning frame.

Spinning.—The spinning is done by exactly the same methods as cotton or worsted, viz., either mules, ring frames, cap or flyer frames, the choice of machine being determined by the size or count of yarn intended to be produced.

Twisting and Doubling.—If a 2-fold or 3-fold yarn is needed, then two or more ends of the spun thread are wound together and afterwards conveyed to the twisting frame for the purpose of putting the needed twist in the yarn necessary for weaving or other requirements. This process is exactly the same as in the cotton or worsted industry, ring or flyer frames being used as desired.

Weft Yarns.—These are taken straight from the spinning frame, wound on to a long paper tube and so delivered to the manufacturer ready to place in the loom shuttle.

Folded Yarns are hairy after being spun and folded, and in addition sometimes contain nibs and rough places. The fibre and nibs have to be cleaned off by means of a gassing machine so constructed that the end of silk (silk yarn) is frictioned to throw off the nibs, and at the same time is run very rapidly through a gas flame a sufficient number of times to burn off the hairy and fibrous matter without injuring the main thread. The yarn is now ready for reeling into skeins or for warping, both of which operations are common to all the textile yarns. It may be washed or dyed just as required, either in hank or in warp.

Growth of Industry and Uses of Spun Silk.—As will have been gathered, spun silk is pure silk just as much as that used by the throwster. The spinning industry has not decreased in England. The number of mills has decreased, but machinery now runs so much more quickly than formerly that more yarn is being spun on fewer spindles. The American spinning industry has more than doubled its output since 1914 under a protective tariff of some 35%. The Continental spinners have increased, but are developing into huge syndicates, all working on the schappe principle. The three chief syndicates, one each in Italy, France and Switzerland, work very much together, practically ruling the prices for yarns and raw materials.

Spun silks are used largely for silk linings, hosieries, sewing threads, elastic webbing, lace, plush and many other purposes, such as mufflers, dress goods and blouse silks; also for mixing with other fibres in form of stripes in the weaving of various fabrics, or to be used in what are known as mixed goods, *i.e.*, a warp of silk and weft of some other fibre or weft of silk and a warp of cotton or other fibre. The article known as tussur spun is prepared in exactly the same manner as other spun silks, but its chief use is to make an imitation of sealskin known commercially as silk seal.

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(N. Br.; W. S. De.; A. Mel.)

SILK TRADE. The area suitable for sericulture stretches in a broad belt between 25° and 48° of latitude right across Europe and Asia. It is China and Japan which produce 85·5 per cent. of the world's supply of raw natural silk as the following table, taken from the League of Nations Report for 1927 (C.E.I. 24, page 6), indicates.

Production 1925			World percentage
Western Europe		Kilogrammes	
Spain	100,000		
France	265,000	4,740,000	11·7
Italy	4,380,000		
Eastern Europe and the Levant		1,065,000	2·6
The Far East			
India and Indo-China	90,000		
China	8,120,000	34,055,000	85·5
Japan	25,845,000		
Approx.		39,860,000	..

The above figures show the quantity of silk available for western manufacturers, but the actual production of both China and Japan is far higher, the figures shown being merely those of the exports of raw silk from these two countries. The home consumption of China is estimated as at least 55% of her total production, being mostly worked upon hand looms, whilst in the case of Japan, about 30% is used at home, and so the above figure represents only 45% of the total output of China and 70% of that of Japan. Moreover, in the case of the latter country much of the raw material is worked up by modern machinery whose products are subsequently sold in competition with European silk manufactures.

It is believed therefore that the actual world production of raw silk is not less than 58,000,000 kg., worth approximately £175,000,000 or $830,000,000, whereas the commercial supply available for European and American manufacturers is only 39–40,000,000 kilogrammes.

In 1875, western Europe produced about 46% of the world's commercial supplies of natural silk, but by 1925 it was barely 12%. In that year the value of the commercial crop was £120,-000,000. It will thus be seen that without reducing shipments of raw silk to Europe and America, China and Japan have an ample supply of raw silk with which to produce increasing quantities of silk manufactures and sell them in competition with the products of western manufacturers. One factor must be noted and that is that despite the impoverishment of Europe by the World War and the increasing output of artificial silk, the demand for natural silk products has steadily increased during the last ten years, and so has the total production of raw silk. The demand is due in part to the present fashions, and in particular for silk hosiery of all types, and in part to the increasing use of silk mixed with other textile yarns in all manner of products.

Consumption of Silk Goods.—Although it is not possible to give accurate figures of the world's output of finished silk goods, a very fair picture will be obtained from a study of the statistics of consumption. According to *The Economic Forces of the World* issued by the Dresdener bank of Berlin in 1927, the world consumption of raw silk in 1913 was 29,250,000 kg. Of this France used 17·3%, Germany 13·7, Italy 5·5 and all Europe together took 39·9 per cent. Of the remainder the United States consumed 40·3%, China 9·9 and Japan 6.8. By 1925 the world

total had risen to 46,350,000 kg. and the United States had increased her lead to 61·7%, France had sunk to 13·1% and Germany to 4·5%. The consumption of the rest of Europe had also decreased so that the total was only 21·1%, while in Asia Japan was the only exception, her consumption having risen to 9·7 per cent.

Number of Looms.—In the 20th century two tendencies have been most noticeable: the first is the gradual replacement of the handloom by the mechanical loom and the second is the steadily increasing importance of the United States as a manufacturer of silk goods. The consumption figures have already shown this tendency but the figures of the number of looms are even more striking. So far as the hand looms are concerned, in 1913 Europe owned 29,300 out of a total of 69,300 or 42·4%, practically all the rest being Japanese, for although China and India used handlooms their products hardly competed commercially, being almost exclusively used at home.

By 1925 the European handlooms had sunk to 23,400, while in Japan the number had remained stationary. Of the European handlooms more than half belong to France.

The real future of the silk industry rests, however, with the mechanical loom and here the progress has been marked. In 1913 Europe owned 152,800 out of a world total of 244,800 or, in other words, 62·4 per cent. The United States owned 84,000 or 34·3% and Japan 8,000 or 3·3 per cent. By 1925 the world total had increased to 268,100, of which the United States owned no less than 102,000, while those belonging to European countries had only increased to 154,100 as compared with the increase in Japan to 12,000. Therefore in that year Europe owned only 57·5% of the total as compared with 62·4% in 1913, whereas the United States owns 38% and Japan 4·5 per cent.

Commerce in Silk.—Lyons is still the headquarters of the silk trade in France, Krefeld in Germany, Genoa in Italy, Zurich in Switzerland and Macclesfield in England, although there are many other places where particular lines are made and distributed.

In 1927 Great Britain imported raw silk worth £1,831,600 and articles manufactured worth £16,190,000 and only exported goods worth £2,427,000. India purchased abroad silk goods worth 4,71,54,193 rupees, of which raw silk and waste represented 1,37,94,765 rupees and only exported 40,12,400, of which 35,01,000 rupees represented raw silk. It is clear, therefore, that as yet she plays but a small part in the production and distribution of manufactured silk goods. China on the other hand imports but little silk, whereas she supplies approximately 22 per cent of the total commercial crop. The value of her total silk exports in 1926 was 191,675,975 Haikwan taels. This total included silk piece goods worth 21,364,100 Haikwan taels and shows that, despite her primitive methods, she is able to sell large quantities of finished goods, a fact which suggests that as she changes to the mechanical loom she will tend to become a more serious competitor both of Europe and the United States. Japan has already progressed a fair way along the road on which China is only just embarking. Handlooms still play an important part in the production of the goods she sells abroad, but it is her mechanical looms which are increasing. That she is now an important factor in the silk trade may be demonstrated by the fact that in 1926 her exports of tissues were five times as great as those of Great Britain. In 1927 her silk imports were trifling and consisted almost entirely of cocoons and wild silk, but her exports were large and included such items as raw silk worth 740,611,000 yen and tissues 139,615,000 yen. Heavy imports of raw silk in America show that the trade consists in producing finished goods for the home market whereas her imports of finished goods are small and only exceed her exports by a trifling amount. Thus in 1927 the United States imported raw silk worth $390,365,000 and fabrics worth $17,862,000, while her exports were worth $15,298,000.

In Europe France is the chief centre of the silk trade. She imported in 1927 raw silk worth 1,678,180,000 francs, weighing 120,486,000 kilogs., spun silk and thread worth 46,443,000 francs and tissues worth 100,238,000 francs and exported raw silk, spun silk and thread, etc., worth 720,495,000 francs and manufactured goods worth 3,233,511,000. We must remember, however, that in that year the mean rate of exchange for the franc was 123·87 francs to the £. Of the remaining European countries the most important are Italy and Germany. In 1927 the former imported manufactured silk goods worth 393,270,000 lire, of which 63,000,000 represented cocoons and 130,872,000 thrown silk. Of her exports the most important items were thrown silk 803,293,000 lire, and doubled and twisted 645,629,000 and she sold waste silk worth 179,000,000 and tissues worth 943,370,000 lire.

Germany suffered severely during the post-war crisis and is only gradually recovering her former position. In considering her statistics we must remember that they include artificial silk, which should be excluded but cannot be disentangled. The gold mark in 1927 was worth 11·74d., in which year she imported approximately 200,000,000 marks worth of raw and thrown silk, yarn and tissues and exported 258,800,000 marks worth, of which only 4,111,000 was classified as raw and thrown. Her two chief items were tissues and hosiery, which between them accounted for nearly four-fifths of her exports. (J. S. M. W.)

SILL, EDWARD ROWLAND (1841–1887), American poet and educationist, of Puritan ancestry, was born at Windsor (Conn.), April 29, 1841. Early orphaned, he drifted through college, recognized as a genius, but out of sympathy with the Puritanic atmosphere and academic formalism of Yale at the period. After his graduation in 1861, he had difficulty in finding his proper niche. He spent five years in California, working in a post-office, on a ranch, and in a bank, and for a time studying medicine and law. On his return to the East, he entered the Harvard Divinity school, but felt that he could not conform to church dogmas and tried newspaper work in Brooklyn, where he "didn't suit, wasn't suited, and quit." After a brief experience of teaching in a rural school, he was, from 1869 until 1871, principal of the high school and superintendent of the grades in Cuyahoga Falls, Ohio, the home of his "best uncle," his wife's father. Thereafter he taught at the Oakland (Calif.) high school, and he was professor of English in the University of California, at Berkeley, from 1874 to 1882. The remainder of his life was devoted to literary work at Cuyahoga Falls. He died unexpectedly, after a minor operation, at Cleveland, Ohio, Feb. 27, 1887. Sill was devoted to music, and had some talent in painting. Of an unusually sensitive temperament, he liked best to work in seclusion, and much of his work in the *Atlantic* and other magazines appeared anonymously in "The Contributors' Club" or under a pseudonym. The reception of his first book, *The Hermitage and Other Poems* (1868), was disappointing; and although *The Venus of Milo and Other Poems* (1883) was privately printed as a farewell to his California friends, he published no other book during his lifetime. His best poems, such as "The Fool's Prayer" and "Opportunity," gave him a place among the minor poets of America, which might have been higher but for his early death.

A memorial volume was privately printed by Sill's friends in 1887. *See* the biographical sketches in *The Poetical Works of Edward Rowland Sill* (1906), and in his collected *Prose* (1900); also *Edward Rowland Sill, His Life and Work* (1915), by W. B. Parker.

SILL (O.Eng. *syl*, Mid. E. *sylle*, selle; the word appears in Icel. *syll*, *svill*, Swed. *syll*, and Dan. *syld*, and in German, as *Schwelle*; Skeat refers to the Teutonic root *swal-*, swell, the word meaning the rise or swell formed by a beam at a threshold; the Lat. *solea*, from which comes Fr. *seuil*, gives Eng. "sole," also sometimes used for "sill"), the horizontal base of a door or window-frame. A technical distinction is made between the inner or wooden base of the window-frame and the stone base on which it rests—the latter being called the sill of the window, and the former that of its frame.

SILL, in geology, an intrusive mass of igneous rock which consolidated beneath the surface and has a large horizontal extent in comparison with its thickness. In north-eastern England there is a great mass of this kind known as the Whin Sill. "Whin" designates hard, tough, dark coloured rocks often of igneous origin, and the Whin Sill is a mass of dolerite or, more strictly, quartz-dolerite. Its most striking character is the great distance over which it can be traced. It starts not far north of Kirkby Stephen

(Westmorland) and describes a great curve with its convexity towards the west, till it ends on the sea-shore at Bamborough, not far south of Berwick-on-Tweed. It has been pierced in a deep boring at Crook, in Durham. The length of the outcrop is about 80 m., but in places it is covered with superficial deposits or may be actually discontinuous. The rocks in which it lies belong to the Carboniferous Limestone series, and the sill is probably one of the manifestations of the volcanic activity which occurred during the later part of the Carboniferous period.

The Hudson Palisades.—The great Palisade trap of the Hudson river, which is an almost exact parallel to the Whin Sill, is an enormous sheet of igneous rock exposed among the Triassic beds of New Jersey and New York. It has an outcrop which is about 100 m. long; its thickness is said to be in places 800 ft., though usually not above 200 to 300 ft. Like the Whin Sill the rock is a quartz-dolerite occasionally passing into olivine-dolerite, especially near its edges. The Palisade dolerite is compact, non-vesicular and non-porphyritic as a rule. It follows the bedding planes of the sedimentary rocks into which it was injected, but breaks across them locally and produces a considerable amount of contact alteration. These great sheets of igneous rock intruded into cold and nearly horizontal strata must have solidified very gradually. Their edges are fine-grained owing to their having been rapidly chilled, and the whole mass is usually divided by joints into vertical columns, which are narrower and more numerous at top and base and broader in the centre. Where exposed by denudation the rocks, owing to this system of jointing, tend to present a nearly vertical, mural escarpment which seems to consist of polygonal pillars.

Sills of Scotland and Ireland.—In the Tertiary volcanic district of the west of Scotland and north Ireland, including Skye, Mull and Antrim, innumerable sills occur and intrusive sheets build up a great part of the geological succession. They are for the most part olivine-basalts and dolerites, and while some of them are nearly horizontal, others are inclined. Among the lavas of the basaltic plateaus there is great abundance of sills, which are so numerous, so thin and so nearly concordant to the bedding of the effusive rocks that there is great difficulty in distinguishing them. As a rule, however, they are more perfectly columnar, more coarsely crystalline and less vesicular than the igneous rocks which consolidated at the surface. These sills are harder and more resistant than the tuffs and vesicular lavas, and on the hill slopes their presence is often indicated by small vertical steps, while on the cliff faces their columnar jointing is often very conspicuous.

Modern Volcanic Sills.—On modern volcanoes intrusive sheets are seldom visible except where erosion has cut deep valleys into the mountains and exposed their interior structure. This is the case, for example, in Ireland, Teneriffe, Somma and Etna and in the volcanic islands of the West Indies. In their origin the deep-seated injections escape notice; many of them in fact belong to a period when superficial forms of volcanic action have ceased and the orifices of the craters have been obstructed by ashes or plugged by hard crystalline rock. But in the volcanoes of the Sandwich islands the craters are filled at times with liquid basalt which suddenly escapes, without the appearance of any lava at the surface. The molten rock, in such a case, must have found a passage underground, following some bedding plane or fissure, and giving rise to a dike or sill among the older lavas or in the sedimentary rocks beneath. Many of the great sills, however, may have been connected with no actual volcanoes, and may represent great supplies of igneous magma which rose from beneath but never actually reached the earth's surface.

Sills and Dikes.—The connection between sills and dikes is very close; both of them are of subterranean consolidation, but the dikes occupy vertical or highly inclined fissures, while the sills have a marked tendency to a horizontal position. Accordingly we find that sills are most common in stratified rocks, igneous or sedimentary. Very frequently sills give rise to dikes, and in other cases dikes spread out in a horizontal direction and become sills. It is often of considerable importance to distinguish between sills and lavas, but this may be by no means easy. Lavas indicate that volcanic action was going on contemporaneously with the deposit of the beds among which they occur. Sills, on the other hand, show only that at some subsequent period there was liquid magma working its way to the surface.

SILLIMAN, BENJAMIN (1779–1864), American chemist and geologist, was born on Aug. 8, 1779, at Trumbull (then called North Stratford), Connecticut. Entering Yale college in 1792, he graduated in 1796, and in 1802 was appointed professor of chemistry and mineralogy, a position which he retained till 1853. Not only was he a popular and successful teacher of chemistry, mineralogy and geology in the college for half a century, but he also did much to improve and extend its educational resources, especially in regard to its mineralogical collections, the Trumbull gallery, the Medical institution and the Sheffield Scientific school. Outside Yale he was well known as one of the few men in America who could hold the attention of a popular audience with a scientific lecture. His original investigations were neither numerous nor important, and his name is best known to scientific men as the founder, and from 1818 to 1838 the sole editor, of the *American Journal of Science and Arts*—often called *Silliman's Journal*—one of the foremost American scientific serials. He died at New Haven (Conn.) on Nov. 24, 1864.

SILLIMANITE, a rock-forming mineral of composition Al_2SiO_5, crystallizing in the rhombic system. Sillimanite has the same percentage of chemical composition as andalusite (*q.v.*) and kyanite (*q.v.*) but differs from these in crystalline form and physical properties. The crystal habit is that of long slender prisms, often aggregated together to form fibrous or compact masses (hence its alternative name, fibrolite), but terminal faces are very rare. The mineral possesses a perfect cleavage parallel to 010, and an irregular cross parting parallel to 001 is usually observed in thin slices under the microscope.

The pure mineral is white, but coloured varieties are pleochroic, the colour being ascribed to Fe_2O_3 or TiO_2. Rare sapphire-blue crystals of gem quality from the Burma ruby mines have yielded good faceted stones.

Sillimanite is stable at all temperatures below 1,545° C, at which temperature it dissociates into the compound $3Al_2O_3 \cdot 2SiO_2$ (mullite) (*q.v.*) and a silica-rich liquid. It is doubtful whether sillimanite has yet been artificially prepared. Sillimanite is essentially a mineral of the crystalline schists and hornfelses, being especially characteristic of highly metamorphosed argillaceous sediments. As such it is commonly found in the thermal aureoles of igneous intrusions and in areas of crystalline schists of the highest grade of metamorphism. Cordierite, corundum, spinel and potash felspar are common associated minerals. (C. E. T.)

SILO: *see* ENSILAGE.

SILURES. These were a powerful and warlike tribe in ancient Britain, occupying approximately the counties of Monmouth, Brecon, and Glamorgan. They made a fierce resistance to the Roman conquest about A.D. 48, but a legionary fortress (Isca Silurum, Caerleon) was planted in their midst and by A.D. 78 they were overcome. Their town Venta Silurum (Caerwent, 6 m. W. of Chepstow) became romanized. Its massive Roman walls survive, and excavations have revealed a town hall and market square, a temple, baths, amphitheatre, etc.

SILURIAN SYSTEM, a term variously used in geology; as originally defined by Murchison in 1835 it included the rocks developed on the borders of England and Wales, a region formerly inhabited by the Silures; now used in Britain in a restricted sense to denote rocks lying between the Ordovician system below and the Old Red Sandstone or Devonian system above. There is no complete agreement as to the exact horizon at which the lower and upper limits of the system should be drawn. The upper limit of the Ashgillian has yet to be defined accurately in those areas where sedimentation proceeded continuously from Ordovician to Silurian time; and opinion is somewhat divided as to the upward limitation of the system, on the one hand on account of the physical conditions attending deposition where the Old Red Sandstone facies succeeds, and on the other from the difficulty of putting a definite boundary where there is a gradual passage, owing to continuous sedimentation under the open sea conditions that usher

in the Devonian facies.

As is the case with the rocks of the ORDOVICIAN system the strata belonging to the SILURIAN system may be divided into several contemporaneous facies or types of deposit controlled by different physical conditions; four main facies can be recognized:

1. TERRESTRIAL: only known in America.
2. SHALLOW WATER:
   (a) areas of heavy sedimentation, *i.e.*, littoral areas.
   (b) areas of average sedimentation, sandstones and mudstones.
   (c) clean sea areas of reef formation and shell-bank growth.
3. DEEPER WATER GRAPTOLITE SHALES.
4. VOLCANIC: mainly in Australia and America.

Again, as in the Ordovician Period, the deposits belonging to the shallow water facies may pass into each other laterally, *i.e.*, in a direction parallel to the original shore line, whilst in a direction at right angles to this shore line they pass into the deeper water Graptolite Shales, and as this transition often takes place gradually, the shallower water beds being replaced stage by stage, the contemporaneity of the two is placed beyond doubt.

Life.—The life of the SILURIAN PERIOD, though somewhat similar in general aspect to that of the ORDOVICIAN, presents a definite advance in type, and more classes of organisms play a prominent part.

It may be said to be characterized:—

(a) By the rise of the spine-bearing brachiopods (e.g., *Atrypa, Meristina*) and the great development of those with a definite internal skeleton (*Pentamerus*). The Silurian is pre-eminently the age of brachiopods.

(b) by the abundance of trilobites, though as these have passed their zenith there are but few new genera, and these of no great importance.

(c) by the predominance of the uniserial scandent graptolites (*Monograptus*).

Other noteworthy features are:—

(d) the rise in importance of the mollusca as a whole, especially the *Cephalopods*, the earliest *Ammonoid* making its appearance.

(e) the incoming late in the period of the first vertebrates (fish).

(f) the increased importance of corals and crinoids, especially as rock-builders.

(g) the abundance towards the close of crustaceans of *Eurypterus* type.

The shallow water fauna is predominantly a brachiopod-trilobite fauna, characterized by mutations of *Pentamerus* (including the subgenera *Barrandella, Conchidium, Sieberella*, etc.), though in some places it is less prominent than *Stropheodonta*, and in the higher beds *Rhynchonella* (*Camarotaechia*) and *Chonetes* predominate. In the cleaner waters, which seem to have occupied wide areas, there seems to have been considerable reef-building,

Table Showing Characteristic Facies of Development of the Silurian (Gotlandian) in Classic Areas

British Isles: Shelly		British Isles: Graptolitic		Scandinavia: Shelly (Gotland)	Scandinavia: Graptolitic (Skåne)	Bohemia: Shelly	Bohemia: Graptolitic	Estonia and Livonia		N. America
*Ledbury or Temeside Shales	Downtonian								Cayugan	
*Downton Sandstones				Ascoceras Lst.				Upper Osel Lst.		Manlous Lst.
				Megalonus Lst.						Rondout
Upper Ludlow				Ostracod Lst.			F1			Cobleskill Lst.
				Sphaerocodium Lst.						Salina Beds with rock salt and gypsum
						Crinoid zone				
	Salopian					Brachiopod zone	E2			
Aymestry Lst.			Flags	Dayia Lst.	Colonus	Cephalopod zone				
Lower Ludlow		Lower Ludlow			Shales					Guelph Lst.
Wenlock Lst.				Marlsand Lst.			E1γ	Lower Osel Lst.	Niagaran	
					Cyrtograptus Shales					
Wenlock Shale		Wenlock Shale	Denbigh				E1β			Lockport Dolomite
Woolhope Lst.										
										Rochester Shale
Upper Llandovery	Valentian	Tarannon-Gala or Browgill	Stockdale Shales	Up. Stricklandinia Marl						Clinton Beds
				Pentamerus Lst. (Dalarne)	Rastrites Shales			Pentamerus Beds	Oswegan	
Middle Llandovery		Birkhill or Skelgill Shales					E1α			Medina Sandstone
				Quartzite						
Lower Llandovery				Phacops elliptifrons (Dalarne)						Oneida Conglom. and Queenstown Shales

*Included by some in O.R.S.

Table Showing Development and Succession of the Silurian Rocks in Classic British Areas

Welsh Borderland: Murchison	Welsh Borderland	Welsh Borderland: Lapworth	N. Wales	Lake District	S. Scotland: Moffat		S. Scotland: Girvan
Ludlow	*Ledbury or Temeside Shales	Downtonian				Daily Series	
	*Downton Sandstones						
	Upper Ludlow			Kirkby Moor Flags			Downtonian of Lanarkshire Pentland Hills
	Aymestry Lst.	Salopian		Bannisdale Slates			
				Coniston Grits	Raebury Castle Beds		
	Lower Ludlow		Denbigh				
Wenlock	Wenlock Lst. (of Wenlock Edge)			Coldwell Beds			
			Grits		Riccarton Beds		Blair and Straiton Beds
	Wenlock Shale						
				Brathay Flags			
			Flags				
	Woolhop Lst.						
Llandovery	Upper Llandovery	Valentian			Gala Grits	Newlands Series	Drumyork Flags
			Valentian beds	Stockdale Shales			Bargany Group
							Penkill Group
	Middle Llandovery						
					Birkhill Shales		
							Camregan Group
	Lower Llandovery						Saugh Hill Group
							Mulloch Hill Group

*Included by some in O.R.S.

not only by corals but by other classes of organisms such as bryozoa, crinoids and stromatoporoids. Brachiopods also, together with other organisms, gave rise to considerable shell-banks of limestone.

The fossils of commonest occurrence are:—

Trilobites	*Phacops Sensu lato, Calymene, Encrinurus, Acidaspis, Lichas, Cheirurus, Homolonotus, Illaenus, Arethusina, Proetus, Sphaerexochus.*
Brachiopods	*Pentamerus Sensu lato, Stricklandinia, Meristina, Stropheodonta, Atrypa Coelospira, Plectambonites, Leptaena, Camarotaechia, Wilsonia, Dayia, Chonetes, Dalmanella, Whitfieldella.*
Corals	*Halysites, Heliolites, Favosites, Acervularia, Omphyma, Palaeocyclus, Goniophyllum, Syringopora.*
Cystids	*Lepadocrinus, Prunocystis, Schizocystis.*
Crinoids	*Cyathocrinus, Crotalocrinus, Taxocrinus, Periechocrinus.*
Crustaceans	*Eurypterus, Pterygotus, Slimonia.*
Cephalopods	*Orthoceras, Gomphoceras, Trochoceras, Phragmoceras, Ascoceras.*
Lamellibranchs	*Orthonota, Cardiola, Aviculopecten, Pterinaea, Modiolopsis, Grammysia.*

In the Graptolitic facies Monograpti predominate throughout; in the earlier beds they have either simple cells or cells with a slight degree of sinuosity, but they then tend to show a development into a lobe or hook on the one hand, or to isolation of the cells from each other on the other; thus the lobed cell and the isolated cell are characteristic of the Valentian, the hooked cell of the lower part of the Salopian, and the return to simple form the upper part of the Salopian. In general, graptolites are rare above the Salopian, but some have been recorded from Bohemia from beds of Downtonian age.

Distribution.—Rocks of Silurian age are found in many lands all over the world; they occur in Europe in the British Isles, Scandinavia, Estonia, Livonia, Russia, France, Belgium, Germany, Poland, Bohemia, Spain, Elba and Sardinia; in Asia, in Siberia, China, the Himalayas and in the Shan States; in N. and S. America; in N. Africa and in Australia.

Europe.—With the exception of those occurring in E. Scandinavia, Estonia, Livonia and Russia, the beds in Europe have been in general highly folded by earth movements, but even so may be grouped according to their facies of deposit; they seem to have occupied much the same areas as those of the Ordovician, and it is clear from the study of the rocks accumulating throughout the period in the N.W. geosyncline, that the stresses were in operation that were eventually to culminate in the elevation of the Caledonian-Scandinavian mountain system, for the shore lines of the gulf are continually shifting their position, and as a result intra-formational conglomerates are frequently found, and there is a marked tendency for succeeding beds to overlap; moreover, oscillations of the shore line gave origin to a widespread continental shelf with its island festoon affording ideal conditions for the reef-building by corals and other organisms, or for the formation of shell-banks made up largely of the remains of one class of organism. Outside the geosyncline also clean sea limestone reefs or graptolite shales are of widespread occurrence. The island of Gotland may be taken as typifying the former, the development in Skåne or Bohemia as characteristic of the latter facies of deposit.

The British Isles.—The general instability of the shore lines of the geosyncline is admirably illustrated by the rock succession in S. Scotland on the one hand and the Welsh borderland on the other; in S. Scotland the shore line moved more or less steadily towards the S.E., so that deeper water beds are continually being overlaid by those of shallower water type. In the Welsh borderland the oscillations were far more irregular; sometimes the sea transgressed with overlap and unconformity upon the eastern shore line, at others there was a retrogressive movement when the shore line advanced so that there is great variety in different places, not only in the sediments found, but also in the completeness of the succession. One fact remains constant, namely, that

when far enough away from the shore line, these variable deposits all tend to pass into graptolite shales until the area of the gulf has become so shallow that the shallow water facies occupies the whole.

Scandinavia.—Skåne alone possesses a complete series of beds of Silurian age; for the greater part these belong to the graptolite shale facies, but include shallower water beds towards the top: over much of the remainder of the country the strata of this period are found in the table-topped hills capped by dolerite in which only a part of the succession is found.

America.—The Silurian rocks of America are not exposed so extensively as were those of Ordovician age; at present little is known about their character in the west, the best known successions being found in the east and centre, though they are also known in the north; in the eastern region the succession is of interest, as a volcanic facies occurs in addition to those of shallow and deeper water type and in many respects, apart from the volcanic rocks, the succession resembles that of the British Isles; the central region contains the classic development exposed in the Niagaran Gorge (*see* table); the rocks are thickest in the Appalachian region, and thin away towards the interior where the series tends to be incomplete as the result of unconformity or overlap. There is a very general absence of rocks of Lower Valentian age. In the north the development, which includes islands in the Arctic archipelago, consists very largely of coral limestones.

Australia.—Strata of Silurian age appear to be restricted wholly to the east part of the continent, being found only in Queensland, New South Wales, Victoria and Tasmania, where they have been considered as originating in Schuchert's "Tasmanian geosyncline." They are mainly of interest as affording evidence of submarine volcanic activity during the period, this being most conspicuously displayed in New South Wales; apart from this, records indicate the occurrence of the common facies of deposition. In Tasmania the rocks are mainly of shallow water type, and in Victoria where they have been considerably affected by earth movement, they are distinguished by the development of fringing reefs of coral limestone. Graptolite shales with characteristic *Monograpti* have also been recorded.

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SILVA, ANTONIO JOSÉ DA (1705–1739), Portuguese dramatist, was born at Rio de Janeiro, Brazil, but came to Portugal with his parents at the age of eight. The parents belonged to a French family which had emigrated to escape the Inquisition. Antonio was sent to study at Coimbra, and, while still a student, was arrested with his mother. Both were tortured, but Antonio abjured his errors, and his mother figured as a penitent in an *auto-da-fé.* He completed his studies and joined his father in practice as an advocate at Lisbon. He married a cousin whose parents had been burnt by the Inquisition, while she also had been exiled for her religion. On Oct. 5, 1739, husband and wife were imprisoned for "judaizing," having been denounced by the Inquisition. On Oct. 18 Antonio was strangled, and his body burnt in an *auto-da-fé;* on that same day one of his popular operettas was given at a Lisbon theatre.

His dramatic works, which were produced at the Bairro Alto theatre between 1733 and 1738, include the following comedies, all played by marionettes:—*D. Quixote* (1733), *Esopaida* (1734), *Os Encantos de Medea* (1735), *Amphitrião* (May 1736), *Labyrintho de Creta* (November 1736), *Guerras do Alecrim e Mangerona* (carnival of 1737), *As Variedades de Proteo* (May 1737) and *Precipicio de Faetonte* (1738). Slight as these sketches are, they show considerable dramatic talent and an Aristophanic wit. The characters are well drawn and the dialogue full of comic strength, the scenes knit together and the plot skilfully worked out. Moreover Silva possessed a knowledge of stagecraft, and, if he had lived, he might have emancipated the drama in Portugal from its dependence on foreign writers; but the triple licence of the Palace, the Ordinary and the Inquisition, which a play required, crippled spontaneity and freedom. Even so, he showed some boldness in exposing types of the prevailing charlatanism and follies, though his liberty of speech is far less than that of Gil Vicente (*q.v.*). His comedies give a truthful and interesting picture of 18th century society, especially his best comedy, the *Alecrim e Mangerona,* in which he treats of the *fidalgo pobre,* a type fixed by Gil Vicente and Francisco Manoel de Mello (*q.v.*).

Bibliography.—His plays were published in the first two volumes of a collection entitled *Theatro comico portuguez,* which went through at least five editions in the 18th century, while the *Alecrim e Mangerona* appeared separately in some seven editions. This comedy and the *D. Quixote* have been reprinted in a critical edition with a life of Silva by Dr. Mendes dos Remedios (Coimbra, 1905). Ferdinand Denis, in his *Chefs-d'oeuvre du théâtre portugais* (pp. 365–496, Paris, 1823), prints liberal extracts, with a French translation, from the *Vida de D. Quixote.*

See Dr. Theophilo Braga, *Historia do theatro portuguez; a baixa comedia e a opera* (Oporto, 1871); F. Wolf, *Dom Antonio José da Silva* (Vienna, 1860); Ernest David, *Les Opéras du juif Antonio José da Silva, 1705–1739* (Paris, 1880); Oliveira Lima, *Aspectos de litteratura colonial Brazileira* (Leipzig, 1896); *Jewish Encyclopedia,* vol. xi. p. 341; G. A. Kohnt, "Bibliography of Works relating to Antonio José da Silva and Bibliography of Don Antonio's Compositions" in the *Publ. Am. Jew. Hist. Soc.* No. 4, p. 181; idem, "Martyrs of the Inquisition in South America," ib. p. 135; M. Grünwald, "José da Silva" in *Monatsschrift* (1880), xxix. p. 241.

SILVANUS (Lat. *silva,* wood), a deity or spirit of the woodland bordering on clearings. Thus he is partly wild and partly civilized, and reflects the experience of the earliest settlers in Italy; hence his later identification with foreign deities felt to be not wholly hostile. Accordingly Horace writes of the "horridi dumeta Silvani" (*Odes,* iii. 29) but he also calls him "tutor finium" (*Epod.,* ii. 22) and Virgil "arvorum pecorisque deus" (*Aen.* viii. 600). A writer on land measurement (*Script. gromatici,* i. 302) tells us that each holding had three Silvani—*domesticus* (of the holding itself), *agrestis* (of the wilder pasture-land) and *orientalis* (of the boundaries). Although much worshipped, he never made his way into the towns, but is almost the only Roman deity who from first to last retained the same perfectly intelligible rustic character. His double nature as deity of woodland and cultivated land is seen well in the artistic representations of him; he carries a young tree in one hand, a pruning-hook in the other.

See Wissowa, *Gesammelte Abhandlungen* (1904, p. 78 foll.).

SILVER, a metal known from very early times and, on account of its comparative scarcity, brilliant white colour, and resistance to atmospheric oxidation, has long been used for articles of value—coins, ornaments and jewellery. Silver (symbol Ag, atomic number 47, atomic weight 107·88) was called Luna or Diana by the alchemists, who assigned to it the symbol of the crescent moon; the term lunar caustic is still in general use for silver nitrate.

Silver is very widely diffused throughout nature as is shown by spectrum analysis; it is always present in sea water in minute amounts, an estimate of the total amount present being 2,000,000 tons. Silver is sometimes found native—usually in only small quantities, though occasionally masses of several hundredweights have been discovered.

Gold is almost invariably found associated with silver. The principal ores of silver are the sulphides, and to a lesser extent it is found combined with tellurium, selenium, arsenic and antimony. Galena, PbS, always contains silver and most of the metal produced in Europe comes from this source.

Physical Properties.—Silver in the massive state is the whitest of all metals, has a perfect metallic lustre, and is the most malle-

able and ductile of all metals except gold: one gram of the pure metal can be drawn out into wire considerably more than one mile long, and it can be beaten into leaves of a thickness of 0·00025 mm. Hammering or rolling hardens the metal considerably, but the malleability is restored by annealing at a dull red heat. Pure silver is somewhat harder than gold but softer than copper; it is too soft in the pure state for use as coinage or jewellery, and for these purposes it is best hardened by alloying it with a small percentage of copper which neither affects its colour appreciably nor renders it brittle. The specific gravity of silver varies considerably according to the previous method of treatment, the density of different samples varying from 9·87 to 10·55, whereas the density of silver precipitated from solution by ferrous sulphate is 10·62. A mean value of 10·5 may be taken as fairly correct. The specific heat of silver is about 0·56 and its coefficient of linear expansion between 0° and 100° C is about 0·0000194, but this increases rapidly at higher temperatures.

Silver is by far the best conductor of heat and electricity. According to the law of Wiedemann and Franz, the ratio of heat-conductivity to electrical-conductivity of good conducting metals is constant at the same temperature. Taking the thermal conductivity of silver as standard (100), the thermal conductivities of other metals are as follows:

Ag	Cu	Au	Zn	Sn	Fe	Pt	Pb	Bi
100	73·6	53·2	19·0	14·5	11·6	8·4	8·1	1·8

The melting point of silver is 960·5° C, and its boiling point under atmospheric pressure is about 2,000° C. It gives rise to a blue vapour which on dilution in the atmosphere appears bright green. Its vapour density has been determined at a temperature above its boiling point, and the molecule thereby found to be monatomic. In the molten state silver has the property of "occluding" about 20 times its volume of oxygen. This oxygen is not in a state of chemical combination and is violently ejected on cooling to near the solidifying point, producing a phenomenon known as the "spitting" of silver. The absorption of oxygen from the air can be prevented by covering the surface either with powdered charcoal or with some non-oxidising flux.

Chemical Properties.—Silver does not combine directly with oxygen, nor does it decompose water or steam at any temperature; it is, however, oxidized by ozone which becomes converted into ordinary oxygen without alteration in volume. The ordinary blackening or discoloration of silver is invariably caused by sulphur, either in the free state or in compounds other than oxides. This stain is black silver sulphide, Ag_2S.

Silver dissolves readily in nitric acid, either strong or dilute, producing the nitrate, $AgNO_3$, with evolution of nitric oxide; it is also readily soluble in hot strong sulphuric acid, silver sulphate, Ag_2SO_4, being produced with evolution of sulphur dioxide. Hydrochloric acid acts superficially on silver, but further action is stopped by the coating of silver chloride produced. Hydriodic acid dissolves silver readily, producing the iodide but hydrofluoric acid is without action on it. Silver combines readily with the free halogens.

"Molecular" Silver.—Silver can be obtained in a finely divided, very reactive state as a greyish powder either by precipitation of a solution by a reducing agent, such as ferrous sulphate, or by bringing a piece of a more electro-positive metal such as iron or zinc into contact with a silver halide below faintly acidified water. This active form of the metal is usually dried at a low temperature after thorough washing, and is frequently used in organic synthesis for removing halogen elements from alkyl compounds with duplication of the organic radical.

Colloidal silver may be produced by precipitating a solution of silver nitrate with various organic substances such as tartrates, citrates, tannin, etc. The precipitates vary greatly in colour, and after washing become soluble in pure water. A brown colloidal solution of silver may also be obtained by passing an electric arc between silver terminals under pure water.

Silver in any form acts catalytically upon solutions of hydrogen peroxide; a steady stream of oxygen flows from the points of contact and finally complete decomposition results.

Chemically Pure Silver.—In exact determinations of the atomic weights (*q.v.*) of elements (halogens, etc.), it is frequently necessary to obtain silver in the purest possible state and a great deal of work has been done to this end. For a long time the most satisfactory process was the reduction of a solution of silver nitrate by means of ammonium sulphite, but this process, due to J. S. Stas, has been superseded by that of Richards and Wells (1905), which is carried out as follows: A solution of recrystallized silver nitrate is precipitated by hydrochloric acid and the resulting chloride thoroughly washed. This chloride is then placed in a silver dish and reduced to metallic silver with pure invert sugar and caustic soda. The reduced silver is fused on a block of lime in the reducing flame of a blowpipe, and thereby brought to 99·999% purity; this is made the anode and cathode of a cell, the electrolyte being a solution of silver nitrate prepared from some of the same purified silver. On electrolysis a crystalline powder of electrolytic silver is formed, and is thoroughly washed, dried and fused in a lime boat contained in a tube through which a current of hydrogen is circulated. The small bars of silver after scrubbing and washing with dilute nitric acid, ammonia and water are dried *in vacuo* at about 400°.

Alloys.—Silver alloys readily with most metals, but in many cases the alloys are of little practical value; thus arsenic, antimony, bismuth, tin and zinc produce very brittle alloys which are quite unsuitable for further working. Copper on the other hand increases its hardness, toughness and fusibility, and such alloys are therefore almost exclusively used for coinage and jewellery. The proportion of silver in alloys is stated in terms of its "fineness" which means parts of silver in 1,000 parts of the alloy. Thus the British coinage till 1920 was of a fineness of 925 or 92·5% silver and 7·5% copper, and was well adapted to its purpose, but the silver currency was then lowered to a fineness of 500, and other metals besides copper, especially nickel, were introduced. This alloy is much less satisfactory than that of the old standard for, apart from its unsatisfactory working properties, it is much more readily discoloured.

Silver is sometimes alloyed with gold and with the platinum metals, with which it produces alloys which can be worked satisfactorily. Thus the sovereigns formerly minted in Australia were of 22-carat quality, containing 8·33% silver instead of copper, and thus having a lighter colour; and a dental alloy of 50% silver-platinum was at one time in general use.

Compounds of Silver.—Several oxides of silver have been reported from time to time. A suboxide, Ag_4O, has been stated to exist by several observers, but their results have not been generally accepted. The best characterized oxide is the compound Ag_2O, argentic oxide, which is the base of all the more stable salts of silver. It is produced by precipitating a solution of silver nitrate by an alkaline or alkaline-earth hydroxide, as a blackish powder which can be crystallized from solutions of ammonia, forming violet crystals. This oxide is appreciably soluble in water (1 part in 300) giving a solution which turns red litmus blue, and which precipitates most of the heavy metals as hydroxides. This oxide is a strong base and forms stable salts with acids. It begins to decompose into its elements at 250°.

Silver peroxide, AgO or Ag_2O_2, is formed by the electrolysis of silver solutions under certain conditions, or by the action of potassium permanganate upon argentic oxide. That formed by electrolysis is generally found combined with some of the silver salt forming the electrolyte, and compounds such as Ag_7NO_{11} and $Ag_{14}S_2O_{24}$ are said to have been produced. Higher oxides of silver have been reported but not confirmed.

Halogen Compounds.—Silver combines with all the halogens to form definite and very stable compounds. Silver chloride, $AgCl$, is found native in the mineral horn-silver or cerargyrite; mixed with clay, it is called butter-milk ore by the German miners. It is obtained as a precipitate by the action of hydrochloric acid or any soluble chloride upon a solution of silver. It forms a white curdy precipitate which rapidly darkens on exposure to light, and this reaction is the basis of nearly all the processes used in photography (*q.v.*). Silver chloride is nearly insoluble in pure water and in dilute nitric acid (1 part in 50,000). It is, however, much

more soluble in concentrated solutions of hydrochloric acid and metallic chlorides, although, on dilution, most of the silver chloride is often precipitated. Silver chloride dissolves readily in ammonia and evaporation of the solution yields rhombic crystals of the composition $2AgCl,3NH_3$. It is also easily soluble in solutions of sodium thiosulphate and potassium cyanide. Silver chloride melts at about 455° C to a yellow transparent liquid, which, on cooling, solidifies to a colourless horny mass. It is easily reduced to metallic silver (1) by contact under acidulated water with certain metals (zinc, iron, etc.), an equivalent of which dissolves as chloride; (2) by fusion with alkaline hydroxides, carbonates or cyanides; (3) by heating in a stream of hydrogen or coal gas; or (4) by digesting alkaline solutions with grape sugar or other reducing agents.

Silver bromide, AgBr, found native in the mineral bromargyrite in Chile and Mexico, is obtained as a yellowish-white precipitate by the addition of a soluble bromide to a silver solution. It resembles the chloride in most of its properties but is less soluble in ammonia. It melts at about 425° C, and is even more sensitive to light than the chloride, although its change in colour is less noticeable. Certain minerals, chiefly found in Chile, consist of variable mixtures of AgCl and AgBr; they are embolite, megabromite and microbromite. Silver iodide, AgI, found native in the mineral iodargyrite or iodyrite, is produced by precipitating a silver solution with any soluble iodide or by acting upon the metal with hydriodic acid or iodine. It forms a yellow powder, practically insoluble in water, acids, or ammonia, but soluble in strong hydriodic acid, sodium thiosulphate, or strong solutions of potassium iodide, forming in the last case a double iodide, $KAgI_2$. Silver iodide is dimorphous; at ordinary temperatures it is hexagonal and deep yellow, but at 146° C it changes to a cubic, light yellow form. Like the chloride and bromide, it is partly decomposed by light, but without apparent change of colour as it requires a developer to demonstrate the change. Silver iodide melts at 552° C, and after resolidifying it shows the anomalous behaviour of expansion on cooling.

Silver fluoride, AgF, produced by dissolving the oxide in hydrofluoric acid, is soluble in water, the solution possessing an alkaline reaction; it crystallizes with one molecule of water and is unacted on by light.

Other Compounds.—Silver nitrate, $AgNO_3$, by far the most important compound of silver, is almost always produced by dissolving the metal in somewhat diluted nitric acid and crystallizes on evaporation of the solution as anhydrous, colourless, rhombic plates. Silver nitrate is exceedingly soluble in water, dissolving in less than half its own weight at ordinary temperatures; at 100° C one part of water dissolves more than eleven parts of the nitrate; it is also soluble in alcohol and ether. Silver nitrate melts at 209° C and decomposes quantitatively above 320° C into silver nitrite, $AgNO_2$, and oxygen. When pure, it is not decomposed by light, but in the presence of organic matter blackening takes place. Either in the solid state or in solution it stains the skin black, and a dilute solution in ether is sometimes used as a hair-dye. The nitrate cannot be used as the basis of a marking-ink for linen, since the strong acid liberated when the silver is deposited would corrode the fabric, and hence silver salts of various weak organic acids are used for this purpose.

Silver sulphide, Ag_2S, found native in the minerals silver glance or argentite, is formed by direct union of its elements or by precipitating a silver solution with sulphuretted hydrogen. Silver sulphate, Ag_2SO_4, is produced by dissolving the metal in hot concentrated sulphuric acid, sulphur dioxide being given off; it can also be produced by adding strong sulphuric acid to a silver solution. It is a white crystalline substance sparingly soluble in water, but dissolving in ammonia to give $2NH_3,Ag_2SO_4$.

Silver selenide, Ag_2Se, occurs in nature in the double selenides naumannite, $PbSeAg_2Se$, and eukairite, Cu_2SeAg_2Se. Silver telluride, Ag_2Te, occurs in the mineral hessite. Fulminating silver, which must not be confused with silver fulminate, is a black, exceedingly explosive powder, first obtained by Berthollet in 1788 by the action of strong ammonia upon silver oxide. When dry it is exceedingly unstable, as merely touching it with a feather is sufficient to cause violent detonation. It is probably variable in composition as the formulae Ag_3N and $AgNH_2$ have been assigned to it by different observers. Silver fulminate, $Ag_2C_2N_2O_2$, produced by the action of alcohol on a solution of silver nitrate containing free nitric acid, forms a grey crystalline powder. Silver azide, AgN_3, the silver salt of hydrazoic acid, HN_3, is formed by precipitating a silver solution with a soluble azide or by the interaction of silver nitrate and hydrazine sulphate. It is a white curdy precipitate physically resembling silver chloride. The two last compounds are used as detonators for high explosives.

Silver cyanide, AgCN, formed by the addition of a soluble cyanide to a silver solution, is a white curdy precipitate, soluble in excess of alkali cyanide or in ammonia. On ignition it is decomposed into silver, cyanogen and paracyanogen, and can be thus distinguished from the chloride which it resembles in many respects. It is, however, not decomposed on exposure to light.

Certain silver salts yield stable co-ordinative compounds with ethylenethiocarbamide (etu), the complex chloride [Ag,3etu]Cl is readily soluble in water, and not affected by light; two complex nitrates are known, one sparingly soluble $[Ag_2,3etu](NO_3)_2$, and the other readily soluble $[Ag,4etu]NO_3$ (Morgan and Burstall, 1928).

Bivalent Silver.—In the foregoing silver salts the metal is invariably present in the univalent condition. A co-ordinative compound of bivalent silver has, however, been described by Barbieri, 1912; which has the constitution $[Ag, 4Py]S_2O_8$, that is argentic persulphate with four molecules of pyridine of crystallization; it is a sparingly soluble, yellow, crystalline substance.

Further evidence of the existence of complex derivatives of bivalent silver is furnished by W. Hieber and F. Mühlbauer (1928), who employ the organic diamine, *o*-phenanthroline (pha), in preparing the brown persulphate, $[Ag, 2pha]S_2O_8$, and also the perchlorate, chlorate, nitrate and acid sulphate, $[Ag, 2pha]X_2$, where $X=ClO_4$, ClO_3, NO_3 or HSO_4.

Medicinal Use.—Two compounds of silver are in the *British Pharmacopoeia:* (1) *Argenti nitras* (U.S.A. and British Pharmacopoeia), lunar caustic, incompatible with alkalis, chlorides, acids (except nitric and acetic), potassium iodide and arsenical solutions. From the nitrate are made (*a*) *argenti nitras indurata,* toughened caustic, containing 19 parts of silver nitrate and one of potassium nitrate fused together into cylindrical rods; (*b*) *argenti nitras mitigatus,* mitigated caustic, in which one part of silver nitrate and two parts of potassium nitrate are fused together into rods or cones.

(2) *Argenti oxidum,* incompatible with chlorides, organic substances, phenol, creosote, etc., with which it forms explosive compounds.

Therapeutics.—Externally the nitrate has a limited caustic action, destroying the superficial tissues and separating the part acted on as a slough. It may be employed to destroy warts or small growths and to reduce exuberant granulations, or it may be applied to bites. In granular lids and various forms of ophthalmia, solutions of silver nitrate (2 gr. to 1 fl.oz.) are employed. A 1% solution is also used as a prophylactic for ophthalmia neonatorum.

The effect of the nitrate being both astringent and stimulating as well as bactericidal, solutions of it are used to paint indolent ulcers, and in chronic pharyngitis or laryngitis. Silver salts are most useful as an injection in sub-acute and chronic gonorrhoea; one uses either the nitrate (1–5% solution) or protargol (1% solution), which is a proteid compound containing 8% of silver; they also benefit in leucorrhoea. In pruritus of the vulva and anus, a weak solution of silver nitrate will relieve the itching, and strong solutions painted round the base of an incipient boil will abort its formation.

Internally the nitrate has been used in the treatment of gastric ulcer, in ulcerated condition of the intestine, and in chronic dysentery. For intestinal conditions it must be either given in a keratin-coated pill or injected high up into the rectum. The oxide has been given in epilepsy and chorea. Nitrate of silver is eliminated from the system very slowly and the objection to its continuous use as a drug is that silver is deposited in the

tissues causing *argyria* or chronic silver poisoning, of which the most prominent symptom is the dark slate-blue colour of the lips, cheeks, gums and later of the skin. Taken in large doses, nitrate of silver is a powerful poison, causing violent abdominal pain, vomiting and diarrhoea, with the development of gastro-enteritis. In some cases nervous symptoms and delirium supervene. The treatment consists in the use of solutions of common salt, followed by copious draughts of milk or white of egg and water, or soap in water, in order to dilute the poison and thus to protect the mucous membranes of the oesophagus and stomach. (F. E. M.)

SILVER: METALLURGY, MINING AND PRODUCTION. Silver was discovered later than gold and copper, but has been known to man from prehistoric times. Silver ornaments and decorations have been found in the royal tombs of Chaldaea, built in the fourth millenium B.C. It was in use as money probably as early as gold, and it is recorded that Abraham paid Ephron in silver for land bought as a burial place. Silver is also mentioned as money in a Chaldaean inscription of about 4500 B.C., according to Gowland. In ancient Egypt it was scarce, and in the IV. and succeeding dynasties it was more valuable than gold, but in the XVIII. dynasty trade with the eastern Mediterranean countries made silver more plentiful and cheaper than gold.

Occurrence and Distribution.—Silver is sometimes found in the metallic state ("native silver") but unlike gold it is generally combined with other elements in its ores. Horn-silver, AgCl, and embolite (a chloro-bromide), found in the oxidized portions of lodes near the surface, have been formed by the weathering of more complex compounds. At deeper levels, silver usually occurs as sulphides, arsenides and antimonides (compounds of silver with sulphur, arsenic and antimony respectively). Native silver occurs in dendritic and wire-like forms which are aggregates of minute crystals, usually cubes and octahedra belonging to the cubic system. It also occurs in thin sheets and sometimes in masses. At Kongsberg in Norway, where the mines have been worked for centuries, large masses of native silver have been found, one of which weighed 697 kilogrammes or nearly three quarters of a ton. Native silver has been found, associated with other silver ores, at Cobalt, Canada, at Broken Hill, N.S.W., and in many localities in the United States, Mexico and South America, occurring for example in the native copper of Lake Superior, but it is not an important source of production of silver.

Argentite, Ag_2S, a soft black sulphide of silver, is one of the commonest ores of silver, but complex sulphides containing antimony and arsenic are also of frequent occurrence. The most important of these as sources of silver are Stephanite, $5Ag_2S$, Sb_2S_3, iron black in colour; the ruby-silver ores, Pyrargyrite or dark red silver ore, $3Ag_2S$, Sb_2S_3 and Proustite or light red silver ore, $3Ag_2S$, As_2S_3; Dyscrasite or antimonial silver, Ag_6Sb, and Polybasite. Grey copper ore or Fahlerz, a complex mineral containing copper, iron, zinc, antimony, arsenic and sulphur, is also an important silver ore of which no two specimens agree in composition. At Cobalt, Ontario, a large proportion of the ore taken from the mines in 1907 contained thousands of ounces of silver per ton, but such rich ores are unusual, and silver ores containing as much as ½% of silver or 150 oz. per ton are generally regarded as very rich. A large part of the world's production of silver is, however, not obtained from true silver minerals but from lead, copper and zinc ores in which it is an accidental constituent. These are called argentiferous ores. Galena (lead sulphide), in particular always contains silver, in amounts ranging as a rule from 20 oz. to 200 oz. per ton, which is extracted as a by-product at a trifling cost. One result of the large yield of silver in lead and copper smelting is that its market price has not such a strongly controlling influence on the amount of production as is observable in the statistics of other metals. The amounts of lead and copper ores smelted and of silver extracted from them depend mainly on the demand for lead and copper and their market prices and not on the price of silver. About 1½ million oz. of silver are extracted annually from gold bullion and the remainder is from ores obtained by mining in rock, as there is no silver obtained by washing loose alluvial deposits. For the operations of silver mining, see MINING, METALLIFEROUS.

Extraction of Silver from Ores.—The treatment of silver ores was for centuries chiefly by amalgamation (*q.v.*) but lixiviation processes, in which the silver is dissolved and the solutions washed out of the ore, were introduced in the middle of the 19th century and passed into wide use. In one group of these processes, much used for a time in the United States, the ore was roasted with common salt in rotating cylindrical or other furnaces in order to convert the silver into chloride of silver which was then dissolved by various solutions. These solutions had little or no effect on metallic silver or on silver sulphides or complex minerals containing silver. In the Augustin process the silver chloride was dissolved in hot strong brine (common salt). It was superseded by the Patera process, in which a solution of sodium thiosulphate (commonly called hyposulphite, the "hypo" of photography) was used. In the Kiss process the leaching solution contained calcium thiosulphate and in the Russell process a double thiosulphate of sodium and copper. These processes have been replaced by the cyanide process (*q.v.*), in which a preliminary roasting is not required, or by smelting. Smelting is merely the ordinary smelting of lead ores or copper ores which contain silver, but it is often found to be the more profitable course to add true silver ores to the smelting mixture, instead of treating them separately by the cyanide process. The increased percentage of extraction by smelting compensates for the additional cost, if adequate supplies of lead or copper ore and fuel are at hand. For lead and copper smelting and the extraction of silver from the products, see LEAD, COPPER.

Refining.—Crude silver, produced by the cyanide process, or separated from lead by cupellation, or from copper or gold by electrolysis, contains small amounts of copper, gold, bismuth, lead, and other metals. When it contains a few parts of gold per thousand it is called "doré silver." Doré silver was formerly refined by boiling in sulphuric acid (*see* GOLD MINING AND METALLURGY) but more recently most of it has been treated by electrolysis. Both the Moebius and Balbach processes are used. Besides doré silver, scrap and residues of all kinds containing gold up to about one third of the total weight may be treated by electrolysis.

In the Moebius process the silver is cast into plates about 18in. long, 10in. wide and ½in. thick. Each plate is enclosed in a linen or cotton bag and a number of them are suspended in a parallel series in earthenware or porcelain vats. The plates form the anodes of an electric circuit and are supported by hooks from rods connected at one end with the positive pole of a dynamo. Cathode plates consisting of thin rolled sheets of pure silver are suspended in the vats alternately with the anodes, parallel to them and about 1¾in. distant. The electrolyte filling the vats consists of a solution containing ½–1% of silver nitrate and 1–2% of nitric acid. A current of electricity is passed from the anodes to the cathodes through the liquid, which is kept stirred. The silver, copper and some other metals are dissolved from the anodes, and pure silver is deposited on the cathodes in pulverulent and non-coherent form. The cathodes are continually cleaned by wooden scrapers moving backwards and forwards automatically and by this means are kept free from loose crystals of silver. If left undisturbed the crystals form trees which may stretch from cathode to anode and cause short circuits. The detached silver falls into canvas trays at the bottom of the tanks. In later practice glue or gelatine is added to the solution and the stirring is more vigorous, with the result that hard, compact, adherent deposits of silver are formed on the cathodes. In one form of apparatus there are rotating cylindrical cathodes, surrounded by anodes, in order to enable stronger currents to be used with more expeditious deposition.

The copper accumulates in the solution as copper nitrate and, to prevent it from being deposited on the cathodes with the silver, more nitric acid is added and the current is reduced. When the amount of copper in the liquid reaches about 5%, part of the solution is withdrawn and replaced by fresh solution of silver nitrate; otherwise copper would be deposited on the cathodes. The deposited silver is removed, washed, melted and cast into ingots which should contain over 99·9% of pure metal. The slime in the anode bags consists in great part of gold which remains undis-

solved. In the Balbach cell, the whole bottom surface of an earthenware trough is the cathode which may consist of carbon. The anodes are placed horizontally above it and are supported on perforated earthenware trays or a grill consisting of wooden rods. The trays are covered with a filter cloth to prevent the anode slime from falling through and settling on the cathode.

Alloys of Silver.—The addition of a small percentage of copper to silver lowers its melting point, prevents it from "sprouting" on solidification, and makes it harder, without sensibly impairing its malleability, altering its colour, or preventing it from taking a high polish; thus, silver-copper alloys are used for silver coin and plate. A little cadmium is often added to them to facilitate the manufacture of wares, and other metals such as antimony have been added to produce alloys which will not tarnish. The colour of silver-copper alloys remains nearly white until the copper amounts to about 45% to 50% when the alloy is pale red and as the copper is increased further the colour becomes deeper. Silver-copper alloys, like pure silver, blacken in the atmosphere of towns, from the formation of a film of sulphide of silver. They blacken also when heated to redness but the black oxide of copper thus formed can be removed from their surface by warm dilute sulphuric acid. Silver alloys with molten lead with great readiness and in all proportions, but if the melted alloy is cooled, pure lead crystallizes out and sinks in the liquid which becomes enriched until it contains 2·5% of silver, when the alloy solidifies as a whole. These properties are used in the Pattinson process (*see* LEAD). Zinc removes silver from molten lead, forming a zinc-silver compound which is lighter than lead and floats to the top with the dross and surplus zinc so that it can be skimmed off, as in Parke's process of desilverizing lead. (*See* LEAD.)

Silver is at once "wetted" by mercury when brought into contact with it at the ordinary temperature (*see* AMALGAMATION) but the interpenetration of the metals is exceedingly slow and a true solid amalgam is difficult to form. The crystalline amalgam containing 35% of silver and 65% of mercury is produced in the beautiful branching form known as *Arbor Dianae* by prolonged contact between mercury and a solution of silver and mercury nitrates. The other alloys of silver are of no industrial importance.

Production.—The most ancient silver mines of importance known to history were those in Asia Minor and on islands in the Aegean Sea. The deposits of silver-lead ore at Hissarlik in the Troad were worked probably as early as 2500 B.C. and lasted for many centuries, and the Greek mines at Laurium, also of silver-lead, were known in 1000 B.C. The Romans obtained most of their silver from Spain, but in the middle ages the supplies which had previously been plentiful became scarce, as production was small and the stocks gradually disappeared. The scarcity came to an end with the discovery of America, which has given the rest of the world a large and ever increasing supply of silver. The following estimates of production are those given in the *Annual Reports of the Director of the United States Mint.* The statistics for the period 1493–1885 were compiled by Dr. Adolf Soetbeer, and from 1886 onward the estimates were made by the United States Mint. Between 1493 and 1520 the average annual production of the world was 1,511,000 oz. troy of fine silver. The output then rose until in 1545–60 the annual average was 10,018,000 oz., but a lull followed up to about the year 1700, during which production was almost stationary. In the period 1701–10 the average was 11,432,500 oz. per annum and the production then rose gradually until in 1801–10 it was 28,747,000 oz. per annum. The Wars of Independence of the Spanish colonies of America disorganized the mining industry, and production fell so that in 1821–30 the average was only 14,807,000 oz. Thereafter the rise was almost continuous until in 1900 it was 173,591,000 oz.

The annual production of the world from mines since 1901 is given below in units of 1,000 oz. fine.

1901	173,011	1908	203,131
1902	162,763	1909	212,149
1903	167,689	1910	221,716
1904	164,195	1911	226,193
1905	172,318	1912	230,904
1906	165,054	1913	210,013
1907	184,207	1914	172,264
1915	173,000	1921	171,286
1916	180,802	1922	209,815
1917	186,125	1923	246,010
1918	203,159	1924	239,485
1919	179,850	1925	245,214
1920	174,420	1926	253,587

About two-thirds of the world's supply is derived from Mexico and the United States. The Mexican mines first sent supplies to Europe in the 16th century and during the years 1781–1800 yielded two-thirds of the world's production. After a period of less activity owing to civil war, Mexico was again the leading producer in 1924–27. The United States became a large producer about 1860, and was first among the countries during most of the next 40 years. Its production was 116,019 oz. in 1860; 1,546,920 oz. in 1861; 22,254,002 oz. in 1872 and 54,647,000 oz. in 1900, but the production is no longer increasing. Canada produced little until late in the 19th century, but South America has sent supplies to Europe since the discovery of the Potosi mines in Peru in 1533. In Europe, Germany and Spain are the most important producers. The German mines were worked in the 10th century and at the beginning of the 16th century the production was over 400,000 oz. annually. In 1905 the output was 12,535,238 oz. but declined later. In Spain the mines were neglected in the 16th century owing to the plentiful supplies from America, but production was revived in the 19th century. The output in Asia is chiefly from India and Japan. Australia became noticeable after the discoveries at Broken Hill, New South Wales, where 36,608 oz. were produced in 1885 and 7,727,877 oz. in 1890. The silver in Africa is mainly derived from the gold bullion of the Transvaal.

The production by countries is given in the *Report* of the director of the *United States Mint* for 1927 as follows, in units of 1,000 oz. fine.

	1925	1926
UNITED STATES	66,107	62,673
CANADA	20,229	22,372
MEXICO	92,885	98,291
CENTRAL AMERICA / WEST INDIES	2,701	3,499
SOUTH AMERICA	30,343	30,340
PERU	(19,917)	(21,500)
BOLIVIA	(4,347)	(5,834)
CHILE	(3,202)	(2,877)
EUROPE	11,064	11,499
GERMANY	(4,780)	(5,359)
SPAIN	(3,394)	(3,000)
GREAT BRITAIN	(32)	(41)
ASIA	12,337	12,510
INDIA	(4,855)	(5,125)
JAPAN	(4,835)	(4,776)
AUSTRALIA	10,841	11,200
NEW SOUTH WALES	(9,220)	(9,710)
AFRICA	1,419	1,202
TOTAL FOR THE WORLD	245,814	253,587

The silver produced in the world is in great part exported to India and China. The net amounts sent to these countries, taken together, averaged about 87,000,000 oz. per annum in the years 1910–24 according to the figures published by the London dealers in bullion. *The Report of the Director of the United States Mint* gives the following figures of coinages and consumption in the industries for the world.

	1925 oz. fine	1926 oz. fine
SILVER COINAGE	188,306,076	148,055,068
COINS WITHDRAWN	84,737,192	43,827,862
NET COINAGE	103,568,884	104,227,206
INDUSTRIAL CONSUMPTION (excluding the EAST)		
UNITED STATES	39,827,000	39,408,000
FRANCE	10,750,000	10,224,000
GREAT BRITAIN	8,500,000	8,000,000
OTHER COUNTRIES (incomplete)	8,513,000	6,701,000
TOTAL	67,590,000	64,333,000

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tion of the ores of silver; C. A. Stetefeldt, *Lixiviation of Silver Ores* (1890) is a technical work; W. Gowland, *Metallurgy of the Non-Ferrous Metals* (1914) contains a technical account of the metallurgy of silver; *see* also *Annual Reports of the Director of the Mint* (Washington, 1880, foll.); and B. White, *Silver: Its History and Romance* (1917), a popular treatise. (T. K. R.)

SILVER-BERRY (*Elaeagnus argentea*), a North American shrub of the oleaster family (Elaeagnaceae), found from Quebec to Hudson bay and British Columbia, south to Minnesota and Utah. It grows from 6 to 12 ft. high, with silvery-scurfy leaves and numerous fragrant flowers, pale yellow within and silvery without, borne in the leaf-axils, and round-ovoid, olive-like silvery fruit, with a mealy edible fleshy portion enclosing a grooved nut.

SILVER CITY, a town of south-western New Mexico, U.S.A., in the foothills of the Mogollon mountains, at an altitude of 6,000 ft.; the county seat of Grant county. It is on Federal highway 180 and the Santa Fe railway. Pop. (1930) 3,519. It is in a metal-mining (copper, iron and manganese) and stock-raising region and a health resort, the gateway to the Gila National Forest. Silver City was founded in 1870 on the discovery of rich deposits of silver ore that could be reduced in a mud furnace and had a wild boom period. It was the first town incorporated in New Mexico (1878).

SILVERFISH, a small active wingless insect, so called from the silvery glitter of the scales covering the body. It is less than half an inch long and is found in damp corners or amongst books and papers in houses. Although accredited with destroying paper and linen, it probably feeds only on farinaceous or saccharine substances. Scientifically it is *Lepisma saccharina* and belongs to the order Thysanura, sub-class Apterygota (*q.v.*).

SILVERIUS, pope from June 536 to March 537, successor of Pope Agapetus I., was a legitimate son of Pope Hormisdas, born before his father entered the priesthood. He was consecrated on June 8, 536, having purchased his elevation from the Gothic king Theodotus. Six months afterwards (Dec. 9) he was one of those who admitted Belisarius into the city. He opposed the restoration of the patriarch Anthimus, whom Agapetus had deposed, and thus brought upon himself the hatred of Theodora, who desired to see Vigilius made pope. He was deposed by Belisarius in March 537 on a charge of treasonable correspondence with the Goths, and degraded to the rank of monk. He went to Constantinople, and Justinian, who entertained his complaint, sent him back to Rome, but Vigilius was ultimately able to banish his rival to Pandataria, where the rest of his life was spent.

SILVER-PLATED WARE: *see* ELECTRO-PLATE MANUFACTURES.

SILVERSMITHS' AND GOLDSMITHS' WORK. Personal ornaments, utensils, vases, decorative objects, etc., made of silver or gold, with their various alloys, are generally known as silversmiths' and goldsmiths' work. The article that follows is treated historically under the following divisions: *Egyptian to Roman*, with *Jewellery* included in a separate section; *European; North and South America; Oriental Work*. (*See* also EGYPT; ART AND ARCHAEOLOGY; INDIAN AND SINHALESE ART AND ARCHAEOLOGY; ROMAN ART; BYZANTINE ART; BRONZE; IRON IN ART; DRINKING VESSELS; JEWELLERY.)

EGYPTIAN TO ROMAN

Gold, silver and their natural or artificial mixture called electrum or white gold, were worked in ancient Greece and Italy for personal ornaments, for vessels, arrows and weapons, for coinage, and for inlaid and plated decoration of baser metals. Pliny notes that gold is generally found mixed with silver, and says that when the proportion of silver amounted to one-fifth the alloy was called electrum. The source of native electrum was the river Pactolus in Lydia, whose golden sands supplied the fabulous wealth of Croesus. Aegean lands were rich in precious metals. The considerable deposits of treasure found in the earliest prehistoric strata on the site of Troy are generally assigned to the second city; they are earlier than the sixth ("Homeric") city, and are not likely to be later than 2000 B.C. The largest of them, the so-called Treasure of Priam, is a representative collection of jewels and plate. The gold ornaments were packed in a large silver cup. They consist of elaborate diadems or pectorals, six bracelets, 60 earrings or hair-rings, and nearly 9,000 beads. The Trojan vases have bold and simple forms, mostly without ornament, but some are lightly fluted. Many are wrought from single sheets of metal. The characteristic handle is a heavy rolled loop soldered or rivetted to the body. Some silver flasks with inverted cup-covers have small shoulder-studs pierced vertically for hanging. Bases are sometimes round or pointed, sometimes fitted with separate collars, but more often slightly cupped to make a low ring-foot. An odd shape in gold is an oval bowl or cup with a broad lip at each end and two large roll-handles in the middle. The oval body has Sumerian affinities, and it seems likely that Trojan arts at this time were Asiatic rather than European. Asiatic influence had indeed invaded Europe, for the oval shape occurs in the contemporary pottery of the Greek mainland and islands (Helladic and Cycladic). A plain spouted bowl of usual early Helladic shape in the Louvre is the typical specimen of goldsmith's work from pre-Mycenaean Greece, and the scarcity of precious metals points to lack of wealth as prime cause of the artistic backwardness of these regions. Silver seems to have been more plentiful in the Cyclades, but only a few simple vessels, head-bands, pins and rings survive. Conditions were different in Crete.

Minoan and Mycenaean.—A profusion of gold jewellery was found in early Minoan burials at Mochlos, three silver dagger-blades come from a communal tomb at Kumasa, and silver seals and ornaments of the same age are not uncommon. An elegant silver cup from Gournia belongs to the next epoch (Middle Minoan I., *c.* 2000 B.C.); it is unique, but numerous imitations of its cusped and carinated form in clay, and of its metallic sheen in glazed and painted decoration, prove that such vessels were common. Minoan plate and jewellery are amply represented in the wealth of the mainland tombs at Mycenae and Vaphio. The vases from Mycenae are made indifferently of silver, gold and bronze; but gold is generally reserved for drinking-cups, small phials and boxes; silver is used for jugs as well. Much of the funeral furniture is gold, notably the masks that hid the faces or adorned the coffins of the dead. It has been thought that the small gold discs, which Schliemann found in prodigious quantities (700 in one grave), were nailed on wooden coffins, but they may have been sewn on clothes. They are impressed with geometrical designs based on circular and spiral figures, stars and rosettes and natural forms such as leaves, butterflies and octopods. Smaller bossed discs bearing similar patterns may be button-covers. Models of shrines and other amulets are also made of gold. A splendid piece of plate is a silver counterpart of the black steatite libation-vase from Knossos in the form of a bull's head, with gold horns, a gold rosette on the forehead, gold-plated muzzle, ears and eyes. The gold here and in other Mycenaean plating is not laid on the silver, but on inserted copper strips. The gold cups from Mycenae are of two main types: plain curved or carinated forms related to the silverware and pottery of Troy, and embossed conical vessels of the Minoan tradition. Some of the plain pieces have handles ending in animals' heads, which bite the rim or peer into the cup. The embossed ornament consists of vertical and horizontal bands of rosettes and spiral coils, floral, foliate, marine and animal figures. The designs are beaten through the walls and are consequently visible on the insides of the vessels; but the finest examples of their class, the two gold cups from the Vaphio tomb near Sparta, have a plain gold lining which overlaps the embossed sides at the lip. The reliefs on the Vaphio cups represent men handling wild and domesticated cattle among trees in a rocky landscape. The handles show the typical Minoan form: two horizontal plates rivetted to the body at one end and joined at the other by a vertical cylinder. Steatite vases carved with similar pictorial reliefs were evidently made to imitate embossed gold. A fragment found at Palaikastro had part of its original plating attached.

Cretan and mainland tombs have produced many examples of weapons adorned with gold. Modest ornaments are gold caps on the rivets joining hilt and blade, but the whole hilt is often cased in gold. An example from Mycenae has a cylindrical grip of openwork gold flowers with lapis-lazuli in their petals and crystal

BY COURTESY OF (1) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (2) PHOTOGRAPHISCHES ATELIER DER KUNSTHISTORISCHEN SAMMLUNGEN, VIENNA

EXAMPLES OF THE GOLDSMITH'S ART BY BENVENUTO CELLINI

Above: Gold and enamel cup, known as the Rospigliosi cup, by Benvenuto Cellini (1500–71), metal-worker and sculptor of the Florentine school, at the height of the Italian Renaissance. The cup is now in the Metropolitan Museum of Art, New York

Below: Golden salt-cellar, wrought by Cellini for Francis I. of France, who was his patron during his exile in that country. Now in the Museum of Vienna

filling between them; the guard is formed by similarly inlaid dragons. The most splendid Mycenaean blades are bronze inlaid with gold, electrum, silver and niello. Here again the work is done on inserted copper plates. This kind of flat inlay seems to have been originally Egyptian. It occurs on daggers from the tomb of Queen Aah-Hotep, which are contemporary with the Mycenaean (*c.* 1600 B.C.), and it is significant that two of the Mycenae designs have Egyptian subjects, though their style is purely Minoan. These are the scenes of cats hunting ducks among papyrus-clumps beside a river in which fish are swimming. Another blade bears Minoan warriors fighting lions, and lions chasing deer. A dagger from Thera has inlaid axe-heads; one from Argos, dolphins; and fragments from the Vaphio tomb show men swimming among flying-fish. These are masterpieces of Minoan craftsmanship; in the long decadence of the Mycenaean age there seems to have been no invention, and later pieces of goldsmith's work repeat conventional forms and ornaments.

Greek and Etruscan.—The period of transition from the Bronze to the Iron Age, when Aegean external relations were violently interrupted, was not favourable either to wealth or art, and the only considerable pieces of plate that have come from Greece are the embossed and engraved silver bowls made by Phoenicians. Most of them bear elaborate pictorial designs of Egyptian or Assyrian character, and are evidently foreign to Greece; but some simpler types, decorated with rows of animals in relief or wrought in the shape of conventional flower-bowls, can hardly be distinguished from the first Hellenic products. Early Greek work is rare. A severe and elegant silver bowl in the Metropolitan Museum, New York, represents the flower-type in its finest style. It is cast and chased, and probably belongs to the 5th century B.C. Other pieces of the same age are simply moulded, and no special kind of decoration seems to have been developed for work in precious metals.

Silver vases and toilet instruments have been found beside the commoner bronze in Etruscan tombs. A chased powder-box of the 4th century is in the Metropolitan Museum, New York. The bronze reliefs of the archaic chariot in the same collection have their opulent counterparts in some hammered silver and electrum fragments in London, Munich and Perugia. The electrum details are attached with rivets.

Roman.—About the 4th century B.C. there was revived the fashion of ornamenting silver vessels with relief, and this type of work, elaborated in the Hellenistic age and particularly at Antioch and Alexandria, remained the usual mode of decoration until the end of the Roman empire. Various fabrics of moulded pottery correspond to the successive styles of metalware. A silver vase in the British Museum, bearing a frieze of chariots between floral bands, is nearly a reflex of an earthenware Calene bowl (3rd century B.C.) in the same collection. Pliny names Greek silversmiths whose work was valued highly at Rome, and laments the disappearance of the art in his own day. He must refer only to its quality, for Roman silverware has been abundantly preserved. Many rich hoards in modern collections were buried by design during the calamitous last centuries of the ancient world, and the most sumptuous, the Boscoreale treasure, was accidentally saved by the same volcanic catastrophe that destroyed Herculaneum and killed Pliny. This treasure (108 pieces) is mostly in the Louvre. A hardly inferior hoard (70 pieces) found at Hildesheim and now in the museum of Berlin, also belongs to the early empire. The acquisition and appreciation of silver plate was a sort of cult at Rome. Technical names for various kinds of reliefs were in common use (*emblemata, sigilla, crustae*), weights were recorded and compared and ostentatiously exaggerated. Large quantities of bullion came to Rome with the spoils of Greece and Asia in the 2nd century B.C., and Pliny says that even in republican times there were more than 150 silver dishes in the city of a hundredweight apiece. The Emperor Claudius had a slave who possessed a five-hundredweight dish. Weights of vessels are often marked on their bases.

Cups and jugs of Augustan style are usually covered with ornament in high relief. The subjects are very diverse: historical, mythological and mystic scenes, formal and naturalistic designs of flowers and foliage, graceful studies of animals and birds. Others have conventional fluting, petals or gadroons, Bacchic instruments and masks, embossed or engraved wreaths, gilt or inlaid with niello. Silver and niello inlay was commonly applied to bronze plates. A singular type of silver bowl (*patera clipeata*) has a central ornament in high relief or even in the round: portrait-busts are not uncommon in this place. In course of time the ornament was restricted, and later Roman plate is largely plain with narrow border-friezes, small central medallions, and handles embossed in low relief. One of the very few gold pieces that survive, a shallow bowl found at Rennes and now in the Bibliothèque Nationale of Paris, is exceedingly elaborate. It measures 25 centimetres across and weighs 1,315 grammes. The central medallion and its surrounding frieze contain scenes of a bibulous contest between Bacchus and Hercules; between these and the edge is a row of 16 gold coins each framed in a foliate wreath. The coins range from Hadrian to Caracalla. In the same collection are several examples of very large silver plates (*clipei* or *missoria*), in which the whole field is embossed with mythological or historical subjects. The largest (called the shield of Scipio) is 72 centimetres in diameter and weighs 10,300 grammes. Another bears the name of Gelimer, king of the Vandals and Alans (6th century). The "shield of Theodosius" at Madrid shows the emperor, seated between Valentinian and Arcadius among his guards, with an allegorical group in the exergue. The persistence of classical and even pagan subjects in early Christian work is well illustrated by the silver and gilt casket of Projecta, the centrepiece of the Esquiline treasure in the British Museum. It was a wedding-present; some of its many panels contain incidents in the marriage ceremony, others have groups of Venus and her attendants, and the lid bears the pious exhortation: *Secunde et Proiecta vivatis in Christo.*

Jewellery.—There is not the same break between prehistoric and classical jewellery as between other gold and silverwork and arts in general. It is true that certain types of ornament went out of fashion at various times and places, but the ancient jeweller's craft seems to have been rather cosmopolitan, and designs of common articles, earrings, bracelets and necklaces, were universal and persistent. The outstanding feature of ancient jewellery is its large display of figured surface, generally resulting in a tinsel fabric. The earliest specimens of Aegean jewels come from opposite ends of that region, Troy and Crete, and are contemporary (*c.* 2500 B.C.). The Trojan are the more elaborate but the elements are the same in both: thin wire in linked and plaited chains and coils, thin foil in petals and rosettes. The largest Trojan diadem or pectoral is made of 90 gold chains fringed with tiny scales and supporting foil-pendants. The simplest earrings are swelling hoops, simple or multiple or enriched with transverse bands. They are identical with archaic Greek types 2,000 years later. A more elaborate earring is a horizontal half-cylinder made of wire or plate with rosettes along its front upper edge and pendent discs below. This also reappears in the archaic period as the basket-earring of Etruria, doubtless an Ionian importation. Pinheads and bracelets are decorated with applied rosettes and spiral coils, and the pins are crowned with rows of little jugs. A plaited wire bracelet at Troy is reflected in a foil bracelet stamped with the same pattern at Mochlos in Crete.

This Early Minoan group contains many flower-headed pins, related on the one side to Trojan decorative rosettes, on the other to Sumerian hair ornaments. Granulation occurs on Trojan earrings, and was doubtless used at the same time in Crete, but very little jewellery has been found there, and earrings are scantily represented even in the wealth of the Mycenae shaft-graves. The swelling hoop was Mycenaean, and often had a pendent globule-cluster, which was ultimately enlarged into the semblance of a bull's head with granulated muzzle and coiled wire ears. The shaft-grave jewels are mostly diadems and hairpins, bracelets and pectorals, bead-necklaces and pendants, signet and finger-rings and plaques for decorating clothes. Thin plates cut and embossed in animal and floral forms served for all these ornaments. They are very seldom cast or wrought. Stone inlay is rare, but stone

beads are often mounted in gold, and enamel is not uncommon. European and oriental (Phoenician) elements are combined in a treasure from Aegina, now in the British Museum, which belongs to the very end of the Mycenaean age, *c.* 1000 B.C. Its designs are mainly stylized openwork figures fringed with small pendants.

In the following period diadems, bracelets and earrings were decorated by the old processes of stamping, granulation and enamelling in the new Geometric style. Archaic Greek and Italian jewellery (700–500 B.C.) was almost wholly oriental in design, Egyptian and Assyrian models of Phoenician introduction being reinforced by rich Ionian and Lydian wares. New forms in Greece and Etruria were the coiled bracelets and earrings ending in heads of lions and bulls, pomegranate, lotus and palmette pendants, winged figures of sphinxes and sirens and masks of satyrs. But the technique was unchanged. Embossed plates are the basis of the work, stamped with separate punches or hammered into dies, and finished singly or joined back to back around a plaster core. Granulation was brought to an amazing fineness, particularly in Etruria. Patterns were precisely drawn in a field of minute grains, which were fused into globules and soldered to their background in one operation. In Greek 5th century work granulation is displaced by filigree, and enamel reappears. The style of this and the next century aims at elegance and delicacy. Necklaces consist of pendent flowers and tassels in a trellis of finely plaited ropes; flower-petals are variegated with enamel. Hoops of earrings are masked with filigreed rosettes and discs, and support elaborate pendants. Victories, Cupids and doves were favoured here by Hellenistic sentiment, and a strange but quite popular Graeco-Roman type was made with pendent vases. A change of fashion at this time, doubtless under oriental influence, introduced large coloured stones, at first garnets, in the centres of designs, and the new decorative principle became dominant in Roman jewellery. The stones are cut in simple shapes and grouped in rows by colour, blue, red, green, sapphire, garnet, plasma, with pearl borders. They are usually plain, but sometimes engraved as cameos or intaglios. In the closing period, from the 3rd century A.D., gold coins of contemporary and earlier emperors were also set like gems, and the goldsmith's skill was mainly exercised upon the borders and backgrounds. These bear arcaded patterns in chased relief and open-work, a bold and heavy style which, with colour-decoration, ousted the classical figure-work, and gave its character to the jewellery of mediaeval Europe.

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EUROPEAN

During the first six centuries there existed two principal sources of production of early Christian silver vessels: the Hellenistic and the Persian. The designs consisted often of figure compositions. Antioch was an important centre for goldsmiths' work after the 4th century, and here was made, in the 4th or 5th century, the "Antioch" chalice, now privately owned in New York City. From the 10th century, church vessels, especially chalices, became more sumptuous and were occasionally enriched with enamel and gems. Among extant early silver is the Esquiline treasure, Hellenistic in character, and the Lampsacus treasure, both in the British Museum; and the sacred treasure of Luxor, 5th to 6th centuries, now at Cairo. In the Metropolitan Museum at New York is the 6th century treasure from Cyprus, probably part of the same "find" as the objects at Nicosia and in the British Museum.

Byzantine silver of the 6th century is often marked with stamps in the manner of modern plate. St. Mark's in Venice contains many precious examples of Byzantine goldsmiths' work, including the famous *pala d'oro,* fashioned in Constantinople in 976, and enlarged and modified later by Venetian and other goldsmiths. The monasteries of Mt. Athos are rich in early vessels.

Early goldsmiths' work of a sacred character comprises the 6th century gold cross of Justin II. and Sophia, in St. Peter's, Rome; three great altar-frontals; (*a*) that executed before 835 in S. Ambrogio, Milan; (*b*) that in Aix-la-Chapelle cathedral; (*c.* 1000); and (*c*) that in the Cluny museum, Paris. To these may be added the *Codex Aureus,* and the ciborium of the Emperor Arnoulf, both at Munich. Early figures of the Virgin are two of the 11th century (with later additions) in Essen cathedral and another by a goldsmith of Hildesheim. The celebrated treatise of *c.* 1100 by the monk Theophilus, of Essen, is of extraordinary interest in the history of metal working.

A highly-skilled school of metal workers and enamellers was established in the 12th and early 13th centuries on the Meuse, chief of whom was Nicholas of Verdun. By his pupil or follower, Hugo d'Oignies, are three authenticated works, including his masterpiece, the shrine of St. Eleutherius (1247) in Tournai cathedral (see *Burlington Magazine,* xxxv.; xxxix.). By Siegfroid, pupil of Nicholas of Verdun, is a superb chalice of *c.* 1230, in Borgå church, Finland. Of the same school was Godefroid de Claire, goldsmith and enameller, of Huy.

English ecclesiastical work suffered incredible destruction at the Reformation. Of the few English silver chalices one of the earliest is that of the 13th century in the British Museum. Patens are more common. Important works are William of Wykeham's crozier at Oxford, and a censer and incense boat of *c.* 1350 in the Victoria and Albert Museum.

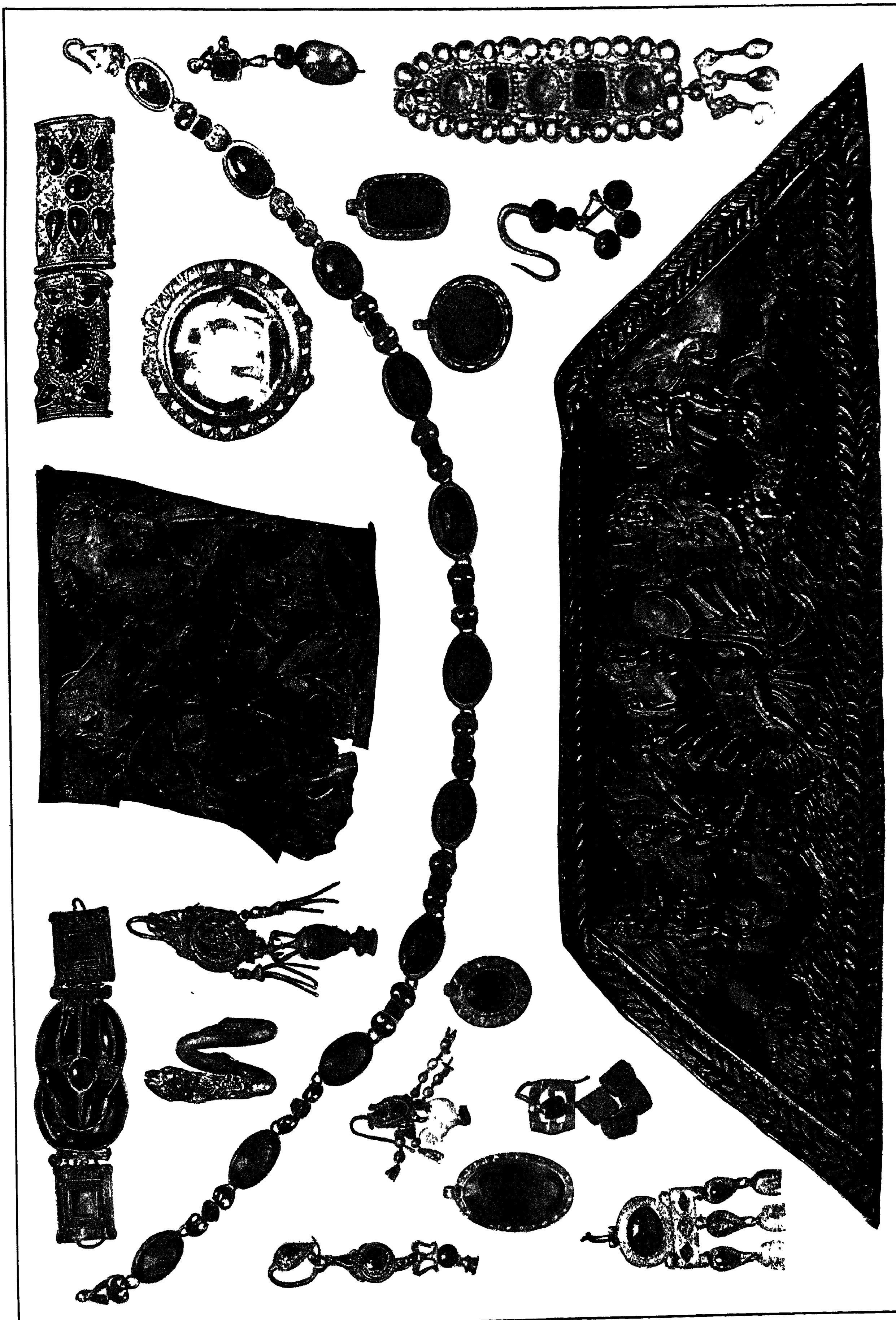
The early examples of ecclesiastical work in France include the Gourdon gold chalice and paten of the 7th century; a 9th century casket and a 10th century statuette of St. Foy, at Conques; the cross of Laon, in the Louvre (*c.* 1200); an early 13th century ciborium in Sens cathedral; a cross of the same century in Amiens cathedral; the Virgin of the abbey of Roncevaux, 14th century; and the Virgin in the Louvre (1339).

The churches of Italy abound in sacred vessels, especially from the 14th century, the early works including the 12th century altar-frontal at Città di Castello; and the chalice of 1290 by Duccio of Siena. Famous among reliquaries is the bust of St. Agatha at Catania, by Giovanni Bartolo, of Siena (1376). But more celebrated is the great reliquary of Orvieto, containing the blood-stained corporal of the Bolsena miracle, by Ugolino da Siena (*c.* 1338). Crosses include that of S. Giovanni, Florence, 1459, important for its influence upon others. Two great altar-frontals are in the cathedral of Pistoia and in S. Giovanni at Florence. Upon the latter were employed several famous artists—Antonio Pollaiuolo, Michelozzo, Verrocchio and others. The Abruzzi's greatest goldsmith, Nicola da Guardiagreli, designed the altar-frontal of Teramo (1433–48). An example of the combination of niello, enamel and silver, is the celebrated pax by Maso Finiguerra at Florence (1452). The most celebrated work of Valerio Belli (1468–1546), carver of crystal and medallist, is the crystal casket of 1532 in the Pitti palace, Florence. Caradosso, famous as a goldsmith and medallist, was the maker of a gem-set golden tiara for Julius II., known from an old coloured drawing in the British Museum, with a drawing of the gold morse executed by Cellini for Clement VII.

The early goldsmiths' work of Spain was of considerable importance. The Cross of the Angels, made in Asturias in the time of Alfonso II., and the Cross of Victory (908), both at Oviedo, are well-known. Chalices and other sacred vessels of unsurpassed richness were made in the Gothic and Renaissance periods. Under the sway of three members of the Arfe family in the 16th century several cathedrals were enriched with costly custodias (monstrances), great tower-like structures peculiar to Spain.

Early chalices were of two types with or without two handles; both lasted until the 13th century, when the two-handled form would seem to have been no longer made. The goldsmiths of the Merovingian period (420–751) were highly skilled and produced great quantities of jewellery and plate. The Carolingian period (768–814) brought a new style into the West. It used figure subjects in relief and foliated ornament, adopted from the Christian East through Italy.

Spoons are among the earliest things in silver. The Romans and Anglo-Saxons had their spoons. The earliest extant English spoon is probably the celebrated anointing spoon of the late 12th



ETRUSCAN, GREEK, HELLENISTIC AND ROMAN ORNAMENTS DATING FROM 6TH CENTURY B.C. TO A.D. 400

Greek buckle, in upper left, and beneath it an earring of gold decorated with enamel and stones of about 400 B.C. Beneath third jewel in the necklace, a Hellenistic earring of about 200 B.C.
In upper centre an Etruscan silver and gold relief with electrum plating, from Perugia. Said to be Ionic work of the 6th century B.C. In lower centre is the front panel of the lid of Projecta's bridal casket; early christian
All other objects are Roman necklace, earrings, beads and pendants, A.D. 100 to 400

or early 13th century, which was, however, re-fashioned in 1660. Early English spoons include the "Apostle" spoon, popular for 200 years from about 1450. Original sets of 13 are extremely rare, the first being dated 1536–37, and was acquired by the late J. Pierpont Morgan. Next in popularity was the seal-top spoon, made between *c.* 1510 and 1670. From about 1670 spoons in England became more common, and the patterns were copied by American silversmiths. Continental spoons are usually more ornate and are of many patterns from the 17th century. A typical German object in silver (and occasionally of gold) is a spoon, fork and toothpick combined, of the 16th and 17th centuries.

Forks of silver are rare until the 18th century. The earliest known English fork is dated 1632–33.

English Work.—In the early centuries, after the invasion of Britain, Anglo-Saxon ornamentation passed through three stages, in the use first of spiral decoration, secondly of animal ornament, and thirdly of animal ornament combined with the conventional interlacing patterns of Anglo-Saxon and Irish art, introduced in the 6th century, probably from the eastern Mediterranean. The art of the Kentish goldsmiths was particularly skilled, especially in the reign of Ethelbert (560–616). Notable examples are the famous Alfred jewel and the silver-gilt cup from Halton moor (British Museum). The beautiful Ormside bowl of copper and silver, 8th century, is also said to be Anglo-Saxon (York Museum).

Celtic craftsmen possessed an aptitude for borrowing ideas and implanting their own individuality upon them. Evidence of their skill in metal working is to be seen in their personal ornaments. The Celtic goldsmiths of Ireland in Christian times borrowed designs from the Anglo-Saxon craftsmen of Kent, but soon surpassed their Kentish masters in technical accomplishment, as may be observed in two masterpieces; the Ardagh chalice and the Tara brooch (9th and 10th centuries).

Not a vestige remains of the silver made in England during the Norman occupation. There is ample evidence of the superior merits of the English arts and crafts in mediaeval and Tudor times. The most common of English drinking vessels from *c.* 1200 to the 16th century was the mazer bowl. Two historic examples of drinking horns of the 14th century are at Oxford and Cambridge. Two unique English vessels are the Studley bowl, late 14th century, in the Victoria and Albert Museum, and the enamelled silver cup (1350–75) of the corporation of King's Lynn. England is still rich in cups, tankards and drinking vessels from the 16th century. Great standing salts were regarded with veneration, particularly in the reign of Elizabeth, when the decoration of plate was markedly under German influence. In the 16th century came the sumptuous rosewater ewers and basins.

The restoration of Charles II. in 1660 was followed by the introduction of larger and more costly vessels and by ornate decoration. Soon after 1685 the French Huguenot refugees who fled to England after the revocation of the Edict of Nantes revolutionized the decoration of English plate. Much of the early 18th century English silver is distinguished for its austere simplicity and solidity. Louis XIV. ornament was also popular, and the influence of the French rococo was strong. In the comfortable 18th century many kinds of domestic vessels were introduced or became common. The influence of Robert Adam, architect and designer, is apparent in silver between 1770 and 1790, while a little later the classical spirit was conspicuous in the silver designed by John Flaxman, the sculptor, and others. Plate of English style was made at Dublin from the 17th century, and Scottish goldsmiths wrought excellent plate from the 16th century. Silver was made in the Channel Islands in the 17th century and probably earlier.

A gild of London goldsmiths existed as early as 1180, and in 1327 it was regularly incorporated. The mark of the leopard's head (lion's face) is first mentioned in 1300, followed in 1363 by the maker's mark. In 1478 and 1544 the date-letter and lion passant respectively were introduced. Between 1697 and 1719, the figure of Britannia and the lion's head erased were in use. From 1784 the sovereign's head was marked; it was discontinued in 1890. Silver was assayed in mediaeval and later times at Norwich, York, Chester, Newcastle and Exeter. The present assay offices are London, Chester, Birmingham and Sheffield.

France.—The development of the craft in France may be followed in some measure after the death of Louis XIV., though vast quantities of silver work were melted at the Revolution. Little remains of the work of Thomas Germain, a talented 18th century goldsmith, but several notable pieces by his son, François Thomas Germain, notably at Lisbon, have survived. For the more important of these the student must, however, repair to the old imperial and royal collections at Leningrad and Lisbon, which are unequalled in France itself.

The former contains notable objects by masters of the 18th century, by Claude Ballin the younger; François Thomas Germain; Paul Charvel and Louis Lenhendrick; Robert Joseph Auguste, a prolific goldsmith; Antoine Boullier; Edmé Pierre Balzac; and Claude Augustus Aubry. Two celebrated goldsmiths of the First Empire, Biennais and Odiot, are represented by notable specimens. Henri Auguste, a talented Paris goldsmith, fled to Jamaica and died there in 1816.

The écuelle is peculiar to France and became a common vessel in the 18th century. One delightful phase of French goldsmiths' work must be mentioned, namely, the exquisite gold and enamelled boxes of the 18th century.

One of the few surviving examples of early secular plate is the gold and enamelled cup (1380) of the kings of France, in the British Museum, which is decorated with scenes from the life of St. Agnes, and is unparalleled elsewhere (Plate II., fig. 8). The cup has undergone subsequent alterations in England and Spain. One other important early French vessel is the covered beaker, made about the year 1462, now at Oriel college, Oxford. Of the few pieces of secular plate of the 16th century are the massive plain ewers with their dishes, the pair of cups and a wine bottle, all dating from 1581–82, from the chapel of the order of St. Esprit, and now in the Louvre. Here also are the unique and magnificent enamelled gold shield and morion of Charles IX. of France (1560–74). The beautiful sardonyx and gold ewer in the old Imperial collection at Vienna, sent as a gift with Cellini's golden salt, from Charles IX. to Ferdinand of Tirol, is believed to have been executed in Paris, as was the gold mounted sardonyx cup showing similar details, in the Louvre.

Italy.—Italy has great wealth in ecclesiastical goldsmiths' work but in secular silver it is singularly poor, many precious objects having been converted into bullion. One authentic work by Benvenuto Cellini alone can be mentioned: the celebrated gold salt at Vienna (Plate IV.). French designs, especially Louis XVI. styles, penetrated here as elsewhere, as in the "Turin" service at Leningrad and in the work of L. Valadini, of Rome.

Germany.—Domestic silver in Germany earlier than the second half of the 15th century is rare. In the prosperous cities of Augsburg and Nuremberg in the 16th century, the output of silver work was enormous. German Renaissance work is marked by exuberance of ornamental detail; much of it has been attributed to Italian goldsmiths, especially Benvenuto Cellini. One of the most precious German things of the period, attributed to Cellini, is the gold and enamelled Rospiglioso cup in the Altman collection in the Metropolitan Museum, New York (Plate IV.). The six members of the Jamnitzer family were prominent at Nuremberg between about 1535 and 1625.

English ornament of the Elizabethan and Jacobean periods was markedly influenced by German work. Every collection of German plate contains a preponderance of drinking vessels. A few cups of about 1590–1620 were made as "masterpieces," before admission to the gilds. Certain exclusively German cups are the giant cup (*Riesenpokal*), the double cups, the *Jungfrauenbecher* and the little ships. Other popular cups are those decorated with a large boss or lobe (*buckeln*), and the pineapple cup (*ananaspokal*), which was copied in London, in the reign of James I. The common gourd-shaped cup was also introduced into England. Certain fantastic cups were fashioned like birds and animals, figures and globes. Many are fitted with clockwork mechanism for propulsion along the table. Tankards were common from the 16th to the 18th century. The Baroque taste was

strong, as was the rococo. Designs were executed for silversmiths by Albrecht Altdorfer (*c.* 1480–1538); Peter Flötner, whose *Kunstbuch* was published in 1549; Virgil Solis (1514–62); Hans Brosamer (*fl.* 1520–54); Bernard Zan (*fl.* 1580–81); Hans Sibmacher (*fl.* 1555–95); Georg Wechter; and Paul Flindt; and the anonymous designers of the late 16th century.

Spain.—The early silversmiths' work of Spain shows many outside influences. In the second half of the 15th century artists came from Lombardy and South Germany and introduced new features in decoration. Spain is now singularly poor in early domestic silver. Some ornate shallow dishes were common in Spain and Portugal in the 16th century. For about 50 years from 1590, a small and characteristic ewer was made, mostly at Toledo. A common decoration of silver of the early 17th century are little enamelled plaques. Filigree work was popular in the 17th century. The Baroque taste prevailed in Spain and Portugal, as did the later French decoration. A notable atelier was founded in Madrid in 1778 by D. Antonio Martinez, who favoured severe classical designs.

Portugal.—In the reign of Emanuel I. (1495–1521) Portuguese work was infected by the national style in architecture, called *Arte Manuelina.* Of this style is the celebrated early 16th century gold and enamelled monstrance of Belem (in the National Museum at Lisbon), by the Lisbon goldsmith, Gil Vicente, from a design by Garcia de Rezende. Some 16th century silver and some 17th century basins are very elaborate. The influence of French decoration of the 18th century, superimposed on the national taste in decoration, is marked. English silver was copied by Portuguese silversmiths after the Methuen treaty of 1703 and in the early 19th century imitations of London marks were not infrequently stamped.

Holland.—Holland in the 17th century was rich in domestic silver. Many of the old gilds were provided with silver, some of which is in the Rijks Museum at Amsterdam. Adam van Vianen (*c.* 1555–1627) of Utrecht introduced a new decoration in silver which profoundly affected Dutch silversmiths' work for 50 years and spread to England and Germany. His brother, Paul, entered the service of the emperor Rudolph II. at Prague and there executed the superb ewer of jasper and gold, now at Vienna. Adam van Vianen, the younger, is chiefly known for his designs for silver (published 1892). Christian van Vianen visited England and made plate for Charles I. Next to the van Vianen family, the most prominent goldsmith of the 17th century was Johannes Lutma, the elder, of Amsterdam, a few of whose works are in the Rijks Museum.

Typical objects in silver are the wine-glass holder (*bekerschroef*), the windmill cup (*molenbeker*) and the *brandewijnkom,* for brandy and raisins. "Still-life" pictures of the 17th century are interesting for the silver vessels they depict. Important silver was made in most of the other old towns of Holland in the 17th and 18th centuries. French taste of the 18th century in silver and furniture spread to Holland.

Scandinavia.—Denmark and Norway are noted for the great number of silver-mounted drinking horns of the 14th and 15th centuries. Distinctive beakers and tankards were common from the 16th century. The "peg" tankard of Denmark was made by English silversmiths, mostly at York, between about 1650 and 1690. The influence of French of the 18th century and the First Empire ornament on Danish and Norwegian domestic silver is manifest, as is also in a less degree that of English designs of the 18th century.

Domestic silver was extensively wrought in Sweden in the 17th century, much of it in the German taste. The beaker and the tankard were popular. Characteristic of Swedish silversmiths is the filigree work of about 1675–1725. In Sweden as in Norway, a charming old custom is commemorated by the silver bridal crowns, preserved in churches. French decoration prevailed here as elsewhere.

The Netherlands.—Flemish pictures and illuminated manuscripts afford a glimpse of the sumptuous vessels in daily use in Flanders, including the popular beaker. The only known work by Gerard Loyet is the famous gold reliquary (1466–67), in Liége cathedral. At Antwerp, the most important centre of the goldsmiths' art in Belgium in the 16th century, was made in 1558–59 the historic "Charles V." ewer and basin (in the Louvre). Excellent plate was executed in the French style in Belgium in the 18th century.

Russia.—As early as the 14th century, Russian workers under Greek influence began to cover the figures of icons with a plate (*riza*) of silver. The most conspicuous Russian silver domestic vessel in the 16th and 17th centuries is the drinking cup (*bratina*). Many are enriched with inscriptions in highly decorative Slavonic lettering called *Vyaz,* conveying a toast or sentiment or welcome. One of the most precious (at Vienna) is of solid gold, enriched with gems and enamel, and was the gift of the tsar Michael to Vladislaus IV. (1632–48), king of Poland. Another popular vessel from the 16th to the 18th centuries was the *kovsh,* used for dispensing drinks. One of gold is in the "Green Vaults" at Dresden. The third characteristic Russian vessel is the *charka,* a small cup, generally fitted with a single handle, for drinking strong liquors or for brandy. Many are wholly of precious metal, while others are of rock crystal, ivory, coral, and amber, cornelian and other semi-precious stones, mounted in gold and richly enamelled. One other vessel is the bowl of the 17th century, decorated with painted enamel.

Hungary.—Hungarian silver has certain individual features, and shows various external influences at different periods. A conspicuous feature of ecclesiastical work, especially on chalices, is the richly coloured enamel of the second half of the 16th century and the first half of the next century, introduced probably by Venetian goldsmiths. A prosperous school of goldsmiths was established at the Transylvanian town of Nagyszeben. An important phase of Hungarian goldsmiths' work are the *garnitures de corsages* for the national costumes from the 16th century. Highly important early mediaeval treasure has been found buried in Hungary of which the most important are the 23 gold objects from Nagy-Szent-Miklos, all in the Kunsthistorisches Museum, Vienna. Some authorities ascribe them to native craftsmen and others to Caucasian work of the 9th century.

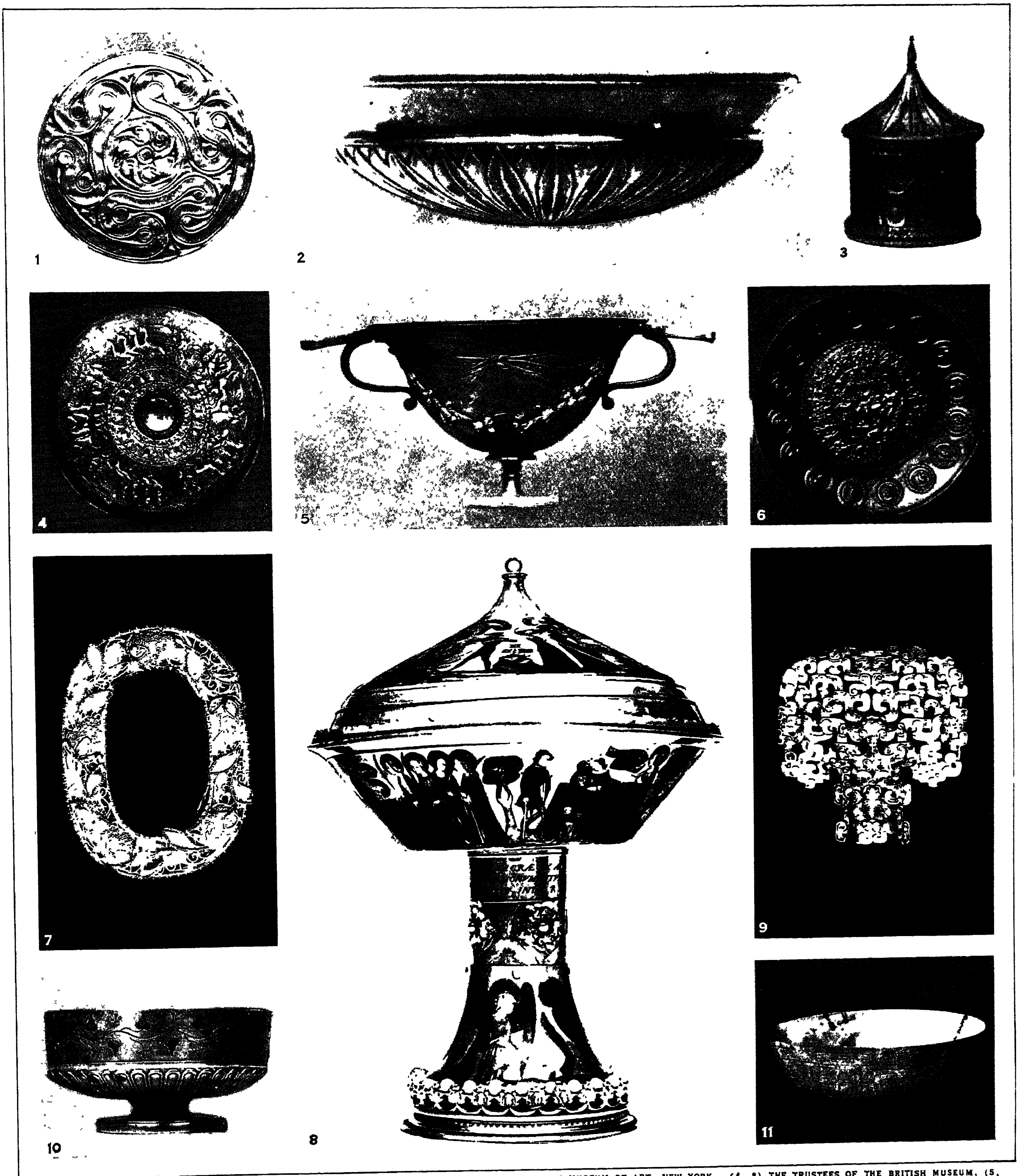
Austria.—Several towns in Austria had their goldsmiths. Vienna claims Wenzel Jamnitzer (later of Nuremberg) as one of its most celebrated goldsmiths. An earlier worker was Wolfgang Zulinger, of Wiener Neustadt, the supposed maker of the "Matthias Corvinus" cup of the 15th century, in the Rathaus there. This great cup is covered with the familiar lobes or bosses of German cups. Erhard Efferdinger of Vienna is identified by his imposing Gothic monstrance, 1524, in the church at Schattau in Moravia. Later came the well known Marx Kornblum (d. 1591).

In the 18th century the goldsmiths flourished in Vienna and were markedly under French influence. Anton Matthias Domanek (1713–79) was prominent and was the maker of the gold toilet service for Maria Theresa, at Vienna. Another was Ignaz Joseph Würth, a member of a flourishing family. An exponent of the Louis XVI. and "First Empire" styles was Ignaz Krautauer.

Poland.—Ecclesiastical vessels are the oldest relics of the goldsmiths' art in Poland. The many-sided artist, Wit Stoss (Stwosz), of Cracow, provided designs for goldsmiths at the end of the 15th century, among whom was his brother, Maciej (Matthew). Several Italian craftsmen emigrated to Poland during the early Renaissance, including Gian Jacopo Caraglio, designer, engraver, goldsmith, enameller and gem-cutter to the Polish court, 1539–60. German goldsmiths were also employed at this time. Later in the century several French goldsmiths were attracted thither. Characteristic of Poland from mediaeval times are the silver belts to be seen in early Polish portraits and the elaborate silver harness for horses.

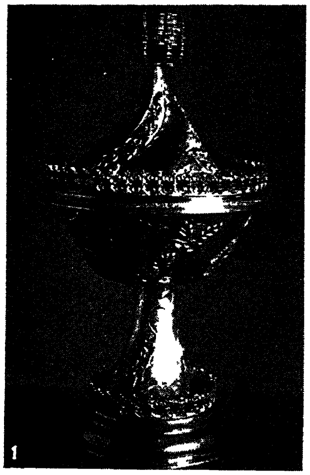
Other European Work.—Bohemian goldsmiths were much employed in the 15th and 16th centuries in the execution of ecclesiastical vessels. Rudolph II. (1552–1612) attracted talented goldsmiths to his court at Prague, among them the Dutchman, Paul van Vianen.

Prague was a centre for the fashioning of domestic vessels of great beauty from rock crystal, jasper, lapis-lazuli and other



HAND-WROUGHT GOLD AND SILVER BOWLS FROM VARIOUS COUNTRIES

1. Minoan gold ornamental disk
2. Greek silver-gilt bowl (5th century B.C.)
3. Etruscan silver-wrought powder box (4th century B.C.)
4. Greek silver bowl (3rd century B.C.)
5. Roman silver cup
6. Roman gold bowl (3rd century A.D.)
7. Gold-wrought dagger pommel (Chinese, Chow dynasty 1122–255 B.C.)
8. French gold and enamelled cup (A.D. 1380)
9. Gold head of a staff (Chinese, Chow dynasty)
10. Roman silver cup
11. Chinese silver bowl (3rd century B.C.)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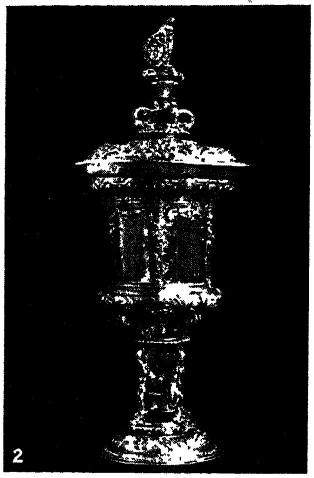
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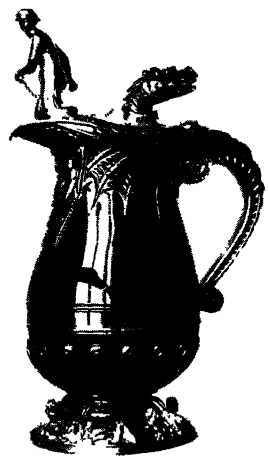
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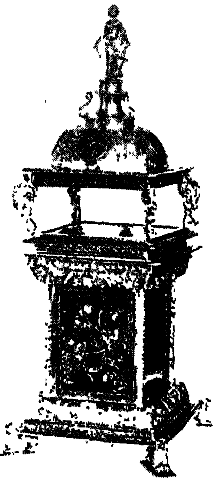
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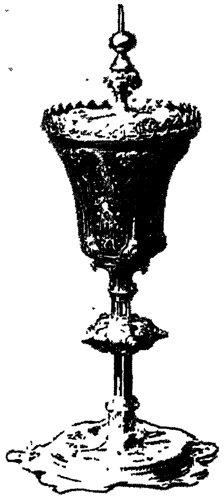
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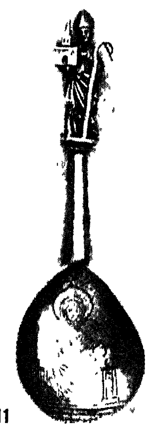
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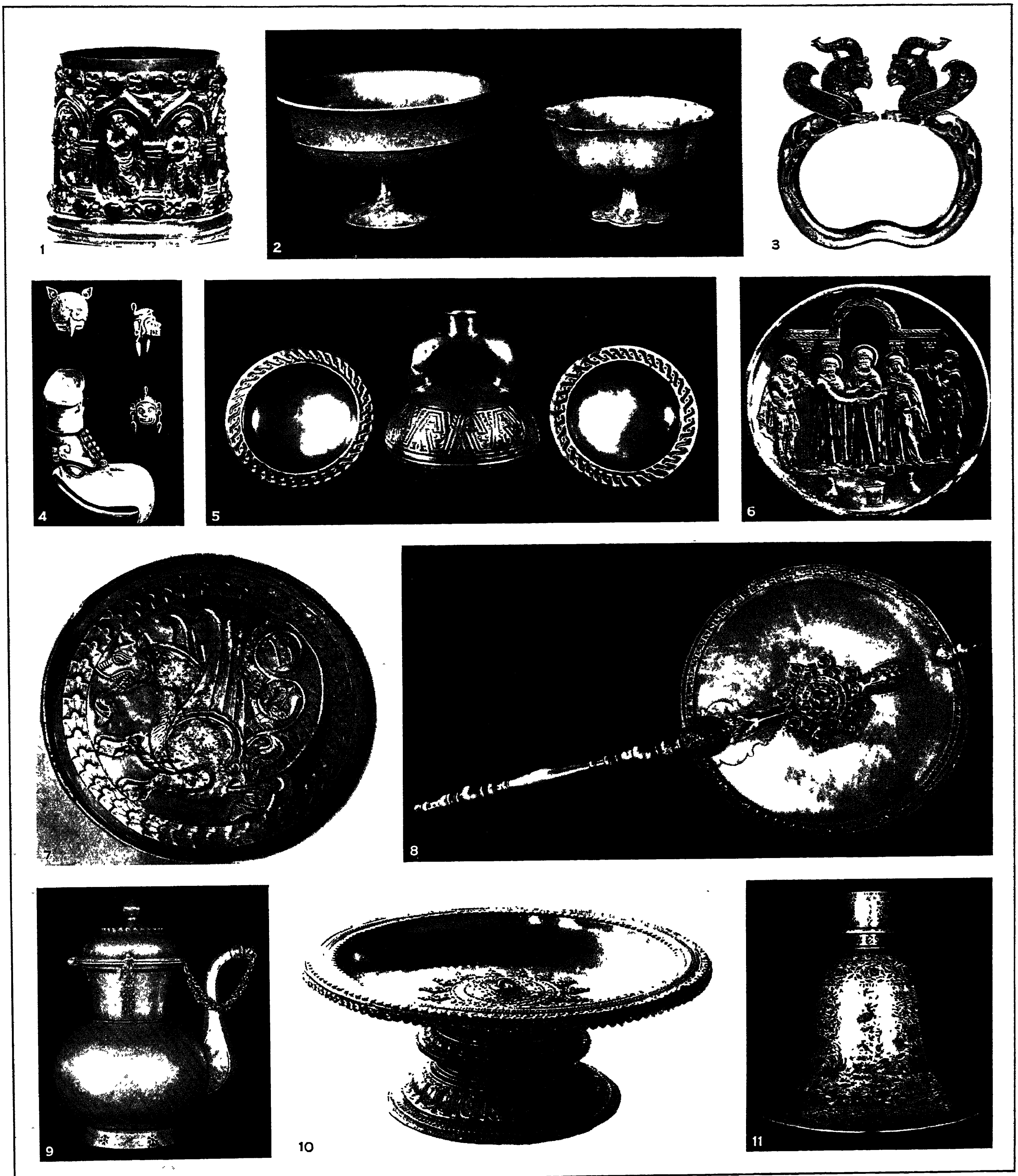
BY COURTESY OF (1) THE MASTER OF CHRIST'S COLLEGE, CAMBRIDGE, (2) THE WORSHIPFUL COMPANY OF GOLDSMITHS, (3) KUNSTHISTORISCHE SAMMLUNGEN, PHOTOGRAPHISCHES ATELIER, VIENNA, (4, 5) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (7) THE CORPORATION OF KING'S LYNN, (8) SCHLOSSMUSEUM, BERLIN, (9) THE NEWMAN CONGREGATIONAL CHURCH, EAST PROVIDENCE, R.I., (10, 11) THE METROPOLITAN MUSEUM OF ART, NEW YORK; PHOTOGRAPH, (6) G RAUDON

MEDIAEVAL SILVER AND GOLDSMITH'S WORK

1. Foundress' Cup. Silver gilt, dated 1440. Stem, bowl and cover ornamented with branches. 2. Bowes Cup, dated 1554. Note two different methods of employing crystal—in the bowl and stem. Enamel used in the coat of arms. Shows influence of South German craftsmen. 3. Jasper and gold ewer made for Emperor Rudolph II., by Paul van Vianen, a Dutch goldsmith, in 1608. 4. An English salt cellar dated 1592–3. Cover is raised above the receptacle for salt. Elaborately chased and enamelled. 5. A steeple cup of silver gilt, dated 1627–8. This type of cup believed to be an original conception of English craftsmen. 6. Silver gilt ewer with elaborate design, Antwerp, 1558–9. In the Louvre. 7. English cup, made 1350–75. Decorated with enamel figures. Believed to be one of the earliest of its type now in existence. 8. A Dutch silver ewer. Made in 1610 by Adam van Vianen. 9. Silver cup by Sanderson and Hull of Boston, Massachusetts. Bought in 1674 with legacy of Capt. Thomas Willett. Inscribed "Capt. Willett's donation to ye Ch. of Rehoboth, 1674." 10. "Banquet of the Gods," gold on lapis-lazuli slab, 16th century. Jacob Cornelisz Cobaert. 11. Silver spoon with figure of a bishop on the handle. Believed to be work of a German craftsman of the 17th or 18th century



BY COURTESY OF (1, 3, 7) THE TRUSTEES OF THE BRITISH MUSEUM, (4) THE MUSEUM OF THE AMERICAN INDIAN, HEYE FOUNDATION, (5) THE AMERICAN MUSEUM OF NATURAL HISTORY, (6) THE CURATOR OF THE CYPRUS MUSEUM, (8-11) A. K. COOMARASWAMY, (2) FROM THE GEORGE EUNORFOPOULOS COLLECTION

EARLY AND RECENT EXAMPLES OF SILVERSMITHS' AND GOLDSMITHS' HANDIWORK

1. Bimaran gold reliquary set with rubies (100 B.C.–A.D. 100)
2. Chinese silver tazza-shaped cups ornamented with floral scrolls and birds on granulated ground (8th–9th cent.)
3. Persian gold armlet (5th–4th cent. B.C.)
4. Aztec gold ornaments (about A.D. 1500)
5. Peruvian gold objects (about A.D. 1500)
6. Greek silver dish (6th cent. A.D.)
7. Sassanian silver dish with Persian bird and dragon design (3rd–6th cent.)
8. Gold fan, in the Temple of the Tooth Relic, Kandy, Ceylon, probably 18th cent.
9. Nineteenth century Punjab silver jug.
10. Eighteenth century gold tray, in the Temple of the Tooth Relic, Kandy, Ceylon
11. Eighteenth century Indian silver enamelled hookah base

semi-precious stones.

Swiss silver in form and decoration not unexpectedly was under the domination mainly of Germany. Zürich was an important centre of the goldsmiths' art. It was here that Rudolph Wyssenbach issued in 1549 his very rare pattern-book of arabesques for silversmiths. Many other Swiss towns had flourishing goldsmiths.

Silver is known to have been wrought for several centuries at Reval and Riga. Hans Ryssenberch, the elder, of Reval, was the maker of an important monstrance in 1474, now in the Hermitage museum at Leningrad. Here also was probably mounted (1551) the rare horn-shaped cup of Islamic glass, perhaps of the 14th century, also in the Hermitage. In Finland there were goldsmiths from mediaeval times.

In the monastery at Putna in Bukovina, founded shortly after 1465, are important treasures of the 15th and 16th centuries, which reveal a glimpse of art and culture in the Balkans. The Petrossa treasure of gold (found near Petrossa in Wallachia) probably made in the Balkans in the 4th or 5th century A.D., consisted originally of 22 vessels, including an elegant ewer.

NORTH AND SOUTH AMERICA

The history of silver in America begins actually with Robert Sanderson (1608–93), a London silversmith settled in Boston. John Hull (1624–83) became his partner. An example of their work is the plain cup in Newman Congregational church, East Providence, R.I., bought with the bequest in 1674 of Capt. Thomas Willett, first mayor of New York (Plate III., fig. 9). More than 150 names of silversmiths have been recorded at Boston before 1800. Colonial silver is dependent for its undoubted charm on the simplicity of its lines and graceful forms, copied for the most part in New England from contemporary English silver before 1775. Paul Revere of Boston achieved prominence for his work not because of superior technical merit but as the hero of Longfellow's poem. From the end of the 17th century the wealthy merchants of Boston acquired silver, especially tankards and porringers. The last-named vessel, not to be confused with the English vessel of this name, became common in silver and pewter in every well-ordered household. Besides Boston, there were other places in New England where silver was made, chief among them being Newport, R.I. Silversmiths settled in New York soon after the settlement by the Dutch, and much of their work is identifiable by the decoration. Important work was made at Philadelphia late in the 17th and early in the 18th centuries.

Silversmiths were working in Quebec in Canada soon after the French conquest. In the 18th century excellent work was executed by François Ranvoyze (b. 1739) and later by Laurent Amyot.

The high skill of the metal-workers of old Mexico is well known. In the American Museum of Natural History at New York (Heye Foundation) is a precious collection of gold ornaments, including a wonderful eagle's head (*quauhtli*), conferred upon certain warriors for valour in warfare. Highly skilled also were the craftsmen of Peru. The natives had little to learn from the Spanish craftsmen but new models and patterns. Silver plates and dishes for the tables of Spanish officials were hammered out by the hundred and many delightful pieces still survive in Peru and Bolivia. Stirrups, spurs and horse trappings are also common. Silver was more accessible than tin or iron to the South Americans and since alloys were not understood, it was used in pure form. One common object found in various parts of ancient America, notably Mexico, Costa Rica, Panama, Colombia, Ecuador and Peru, is the golden breast-plate in the form of a disc. The Keith collection in New York of gold work from Costa Rica and Panama is unsurpassed, and contains many beautiful amulets.

Soon after the Spanish conquest, goldsmiths from Spain emigrated to Mexico, though most of their early works have perished. Churches were richly furnished with sacred vessels, but many of these were imported from Spain. Several names of goldsmiths of the 16th, 17th and 18th centuries are recorded.

ORIENTAL WORK

The goldsmiths of the famous Achaemenid period in Persia were in an advanced state of culture, as witness the Oxus treasure of the 5th and 4th centuries B.C., in the British Museum, which with the Susa find (in the Louvre) alone presents a comprehensive group of goldsmiths' work of ancient Persia. In the same museum is some important silver of the later Sassanian dynasty. Persian silversmiths in more recent times have shown by many fine examples that they have retained their skill.

Ancient China was poor in gold. Of the T'ang dynasty (618–906), when the progress of the arts was most marked, but little goldsmiths' work has survived; it includes 15 silver vessels in the British Museum. In the great collection of Chinese art of George Eumorfopoulos are two pieces of exquisite gold jewellery: a hair-pin and an ornament, of about the 9th century A.D., and of the 9th to 11th century A.D. respectively. Two little silver cups of the 8th or 9th century A.D. (Plate V., fig. 2). A rare little gold plate, chased with flowers and foliage is of about the 12th century A.D.

Earlier than either of these are the superbly wrought gold pommel of a dagger or staffhead (Plate II., fig. 7); and the silver bowl chased with characteristic Chinese fret work, both of the Ch'in dynasty 255 B.C. to 207 B.C. (Plate II., fig. 11).

The goldsmith's craft in India is of ancient origin. Highly important is the Bīmarān gold reliquary, set with rubies (British Museum), attributed to the beginning of, or a little earlier than, the Christian era (Plate V., fig. 1). In the British Museum are a silver dish of the 3rd or 4th century A.D., decorated with a bacchanalian scene representing perhaps Kuvera, king of the Yakshas, treated in Indian style; and a silver bowl of the 7th century from northern India, embellished with medallions in low relief. Delhi was famous for its craftsmen, especially in the time of Akbar the Great, Jahāngīr, and Shah Jehan. The Indian museum at South Kensington contains a rosewater sprinkler of chased gold, enriched with champlevé enamels, probably made for Shah Jehan. Vessels and ornaments of jade, inlaid with gold and gems, are a distinct and delicate branch of art, practised at Delhi in the 17th century. A graceful vase of this kind, set with emeralds and rubies, was brought from India by the great Lord Clive with other notable specimens of Indian goldsmiths' work.

A characteristic Indian ewer, with and without a cover, in silver, copper and brass, has been used from early times for the ceremonial ratification of gifts by pouring water, and for domestic purposes. Decorated trays of silver and brass are used for offerings and for conveying gifts, but more especially for flowers to be offered in temples, as may be seen in many of the old Sīgiri paintings.

Enamelling has deservedly attained a great reputation in northern India. Enamellers from Lahore were brought by Man Singh to Jaipur in the 16th century and enamel was extensively employed in the 17th and 18th centuries here and elsewhere in gold and silver work. The craftsmen of the Punjab were renowned for their skill and Lucknow was long celebrated for its metal work, as was Chanda. At Kutch and Gujarat (Bombay Presidency) were clever goldsmiths. The metal work of the Sinhalese is of special excellence. Siamese goldsmiths executed excellent work in the 18th and 19th centuries and Turkish craftsmen have not been without skill.

In consequence of the prohibition of the use of gold and silver in ceremonial worship, there are no vessels or ornaments in these precious metals in religious use in Burma. Similarly, the use of gold or silver vessels for domestic purposes was denied to all but those of royal blood. The India museum at South Kensington contains part of the Burmese regalia of gold, and other relics. Some fine work executed at Tibet in the 17th and 18th centuries is in the Indian museum at South Kensington.

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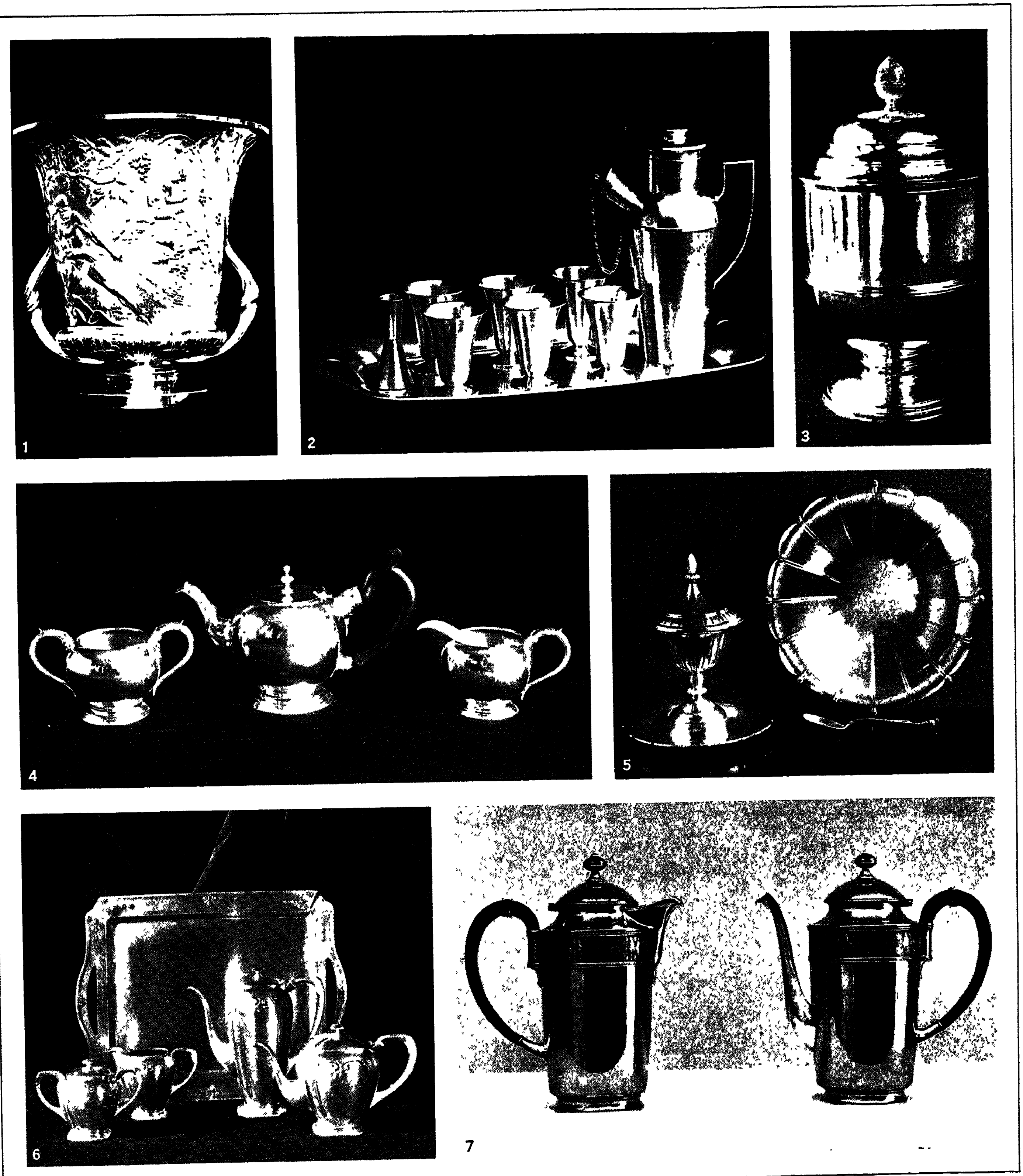
(E. A. J.)



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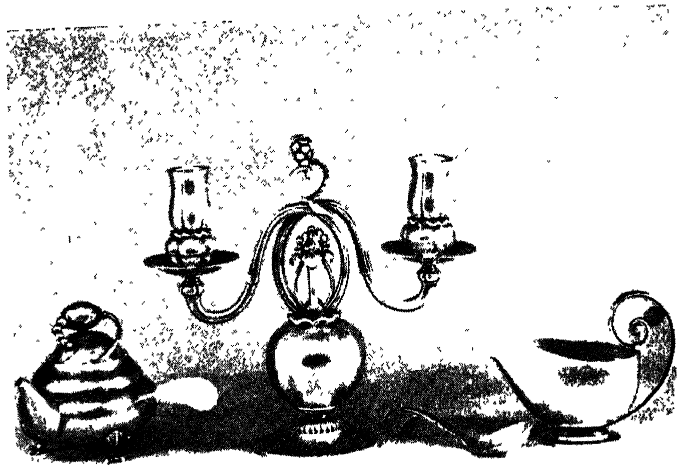
EXAMPLES OF SILVERSMITHS' WORK

1. Silver-gilt cup designed by John Flaxman, 1812 and made by Paul Storr
2. Modern cocktail set of shaker, six glasses, tray and measure
3. Sterling silver Guild cup, English and continental adaption
4. Reproduction in sterling silver of an early American teapot, sugar bowl and cream pitcher
5. Silver service of modern design ornamented with ivory or lapis-lazuli balls
6. Hand chased tea service
7. Hot water jug and coffee pot of silver with chased decorations and fibre handles and knobs

PLATE VII

SILVERSMITHS' AND GOLDSMITHS' WORK

1



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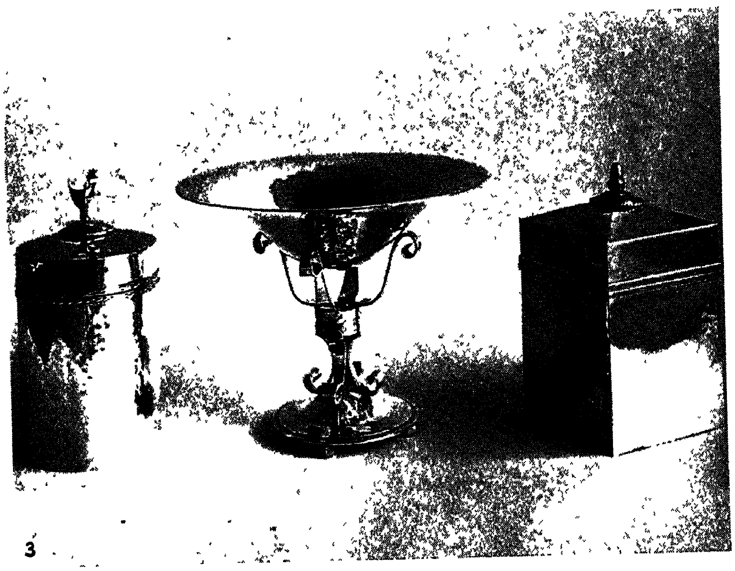

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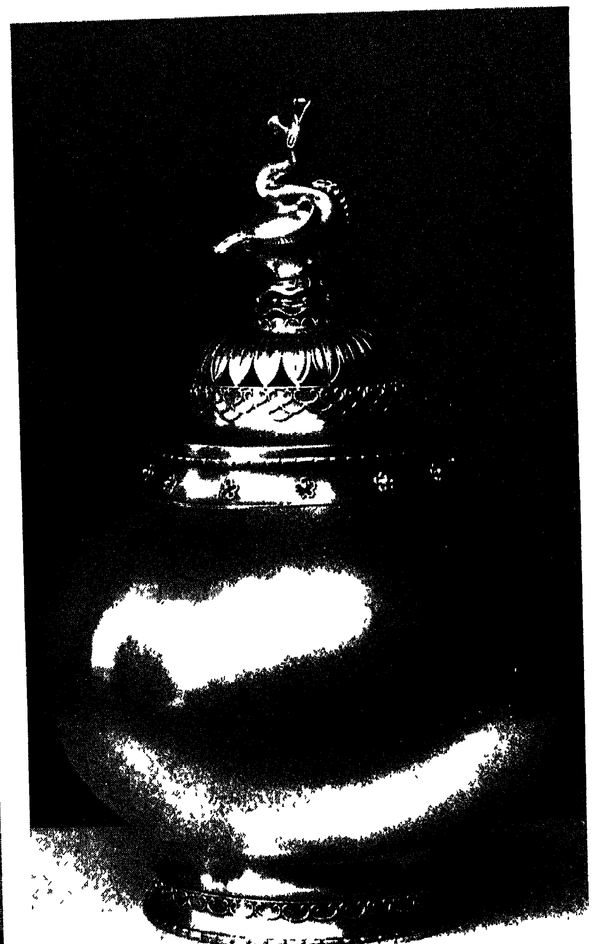

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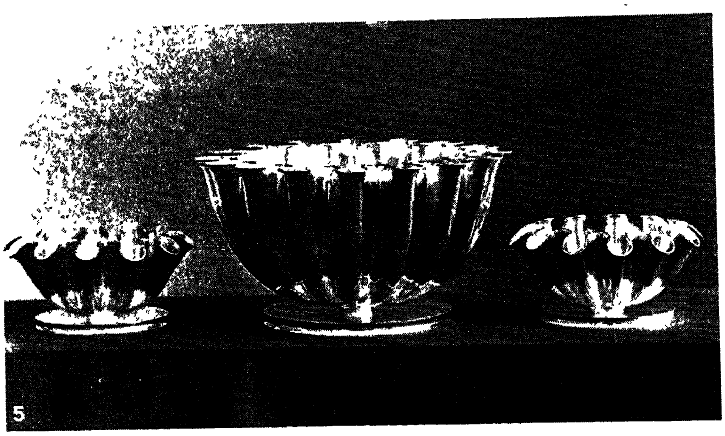


5

BY COURTESY OF (3) THE RUSSELL WORKSHOPS, LTD.

CONTEMPORARY DESIGNS IN SILVER AND OTHER METALS

1. A pitcher and two cups by Georg Jensen
2. Teapot, candelabrum, ladle and jar, the work of Georg Jensen
3. Left: Brass biscuit box with silver-plated interior. Right: Biscuit box in gilding metal, with silver-plated interior. Centre: Copper fruit dish. Group designed and made by Gordon Russell, Broadway, Worcestershire
4. Silver vase with ornamental lid, designed by Prof. Kai Gottlob and made by Evald Neilsen, Copenhagen
5. Silver bonbonnières made by A. Michelsen (Danish)

BY COURTESY OF THE GORHAM MANUFACTURING COMPANY

PROCESSES IN WORKING SILVER AND GOLD

1. Heating and alloying the silver in an American plant. The silver is placed in a crucible, mixed with other metals in the proper proportions, and melted in the furnace
2. Shaping a sheet of sterling silver. The design to be worked into the silver tray is seen on the wall in the background
3. Skilled worker in silverware plant drawing the design on a teapot preparatory to working
4. Silver chaser using the snarling iron. A snarling iron has a long beak and is used in making raised work on silverware. The worker is holding one end of the snarling iron in a vise and striking the shank with a hammer. It makes its impression on the rebound from the inside

BY COURTESY OF THE GORHAM MANUFACTURING COMPANY

DIFFERENT PROCESSES OF SILVER WORK

1. Skilled workman engraving with a graver elaborate design on a silver tray. 2. Soldering the top on a silver candlestick. 3. Erik Magnussen, noted European designer now devoting himself to development of artcrafts in America, hand-chasing a sterling silver vase. A new and modern motif is expressed in his work. 4. Stamping the Hall Mark on a finished piece of silverware. The Hall Mark is used to identify the maker of the piece and the date, and to attest to the purity of the silver

SILVER-TREE (*Leucodendron argenteum*), a South African tree, the leaves of which are covered with fine silky hairs, and are used for painting on. The tree has been nearly exterminated. There are about 70 species of the genus *Leucodendron* (family Proteaceae) all South African.

SILVESTER I., pope, bishop of Rome from Jan. 314 to Dec. 335, succeeded Melchiades and was followed by Marcus. The story of his having baptized Constantine is pure fiction, as almost contemporary evidence shows the emperor to have received this rite near Nicomedia at the hands of Eusebius, bishop of that city. The so-called *Donation of Constantine* (*q.v.*) was long ago shown to be spurious, but the document is of very considerable antiquity. It was certainly known to Pope Adrian in 778, and was inserted in the false decretals towards the middle of the next century.

SILVESTER II. (Gerbert), pope from 999 till 1003, famous under his original name of Gerbert, first as a teacher and afterwards as archbishop successively of Reims and Ravenna, was an Aquitanian by birth, and was educated at the abbey of St. Gerold in Aurillac. Here he seems to have had Gerald for his abbot and Raymond for his instructor, both of whom were among the most trusted correspondents of his later life. He visited Rome about 971 in company with his two patrons Count Borel of Barcelona and Bishop Otho of Ausona. When brought before the emperor Otto I., Gerbert admitted his skill in all branches of the quadrivium, but lamented his comparative ignorance of logic. He went to continue his studies under Adalbero at Reims, where he seems to have studied and lectured for many years, having amongst his pupils Robert, afterwards king of France, and Richer. Gerbert's fame spread over Gaul, Germany and Italy, till it roused the envy of Otric of Saxony (Octricus of Magdeburg), who, suspecting that Gerbert erred in his classification of the sciences, sent one of his own pupils to Reims as a spy, and then accused Gerbert of his error before Otto II. The emperor commanded the two scholars to appear before him at Ravenna, about Christmas 980, and the disputation lasted, we are told, a whole day. Otto II. appears to have given Gerbert the abbey of Bobbio, but the abbot found difficulty in collecting his dues, and returned to Reims as secretary to Adalbero.

According to M. Olleris's arrangement of Gerbert's letters, he was at Mantua and Rome in 985. The archbishop died on Jan. 23, 989, having, according to his secretary's account, designated Gerbert his successor. But the influence of the empress Theophana, mother of Otto III., secured the appointment for Arnulf, a bastard son of Lothair. The new prelate took the oath of fealty to Hugh Capet and persuaded Gerbert to remain with him. When Charles of Lorraine, Arnulf's uncle, and the son of Louis IV. D'Outremer, surprised Reims in the autumn of the same year, Gerbert fell into his hands and for a time continued to serve Arnulf, who had gone over to his uncle's side. He had, however, returned to his allegiance to the house of Capet before the fall of Laon placed both Arnulf and Charles at the mercy of the French king (March 991). Then followed the council of St. Basle, near Reims, at which Arnulf confessed his treason and was degraded from his office (June 17, 991). In return for his services Gerbert was elected to succeed the deposed bishop.

The episcopate of the new metropolitan was marked by a vigour and activity that were felt as far as Tours, Orleans and Paris. Meanwhile the friends of Arnulf were active in his behalf, and he is said to have been reinstated after the accession of Gregory V. In any case Gerbert seems to have left France towards the end of 995, as he was present at Otto III.'s coronation at Rome on May 21, 996. Somewhat later he became Otto's instructor in arithmetic, and had been appointed archbishop of Ravenna before May 998. Early in the next year he was elected pope (April 999), and took the title of Silvester II. Gerbert is generally credited with having fostered the splendid vision of a restored empire that now began to fill Otto's imagination.

Nor did Silvester II. confine himself to plans on a large scale. He is also found confirming his old rival Arnulf in the see of Reims; summoning Adalbero or Azelmus of Laon to Rome to answer for his crimes; judging between the archbishop of Mainz and the bishop of Hildesheim; besieging the revolted town of Cesena; flinging the count of Angoulême into prison for an offence against a bishop; confirming the privileges of Fulda abbey; granting charters to bishoprics far away on the Spanish mark; and, on the eastern borders of the empire, erecting Prague as the seat of an archbishopric for the Slavs. The genuineness of the letter to St. Stephen, king of Hungary, to whom he sent a golden crown, and whose kingdom he accepted as a fief of the Holy See, is contested. Gerbert's dreams for the advancement of church and empire were cut short by the death of Otto III., on Feb. 4, 1002, followed a year later by the death of the pope himself, May 12, 1003. He was buried in the church of St. John Lateran.

Besides being the most distinguished statesman, Gerbert was also the most accomplished scholar of his age. His pupil Richer has left us a detailed account of his system of teaching at Reims. So far as the trivium is concerned, his text-books were Victorinus's translation of Porphyry's *Isagoge*, Aristotle's *Categories*, and Cicero's *Topics* with Manlius's *Commentaries*. From dialectics he urged his pupils to the study of rhetoric; but, recognizing the necessity of a large vocabulary, he accustomed them to read Virgil, Statius, Terence, Juvenal, Horace, Persius and Lucan. More remarkable still were his methods of teaching the quadrivium. To assist his lectures on astronomy he constructed elaborate globes of the terrestrial and celestial spheres, on which the course of the planets was marked; for facilitating arithmetical and perhaps geometrical processes he constructed an abacus with 27 divisions and a thousand counters of horn. A younger contemporary speaks of his having made a wonderful clock or sundial at Magdeburg; and we know from his letters that Gerbert was accustomed to exchange his globes for mss. of those classical authors that his own library did not contain. More extraordinary still was his knowledge of music—an accomplishment which seems to have been his earliest recommendation to Otto I. Gerbert's letters contain more than one allusion to organs which he seems to have constructed, and William of Malmesbury has preserved an account of a wonderful musical instrument still to be seen in his days at Reims. The same historian tells us that Gerbert borrowed from the Arabs (Saraceni) the abacus with ciphers. (*See* NUMERALS.) Perhaps Gerbert's chief claim to the remembrance of posterity is to be found in the care and expense with which he gathered together mss. of the classical writers. His love for literature was a passion. In the turmoil of his later life he looked back with regret to his student days, and "for all his troubles philosophy was his only cure." Everywhere—at Rome, at Treves, at Moutier-en-Der, at Gerona in Spain, at Barcelona—he had friends or agents to procure him copies of the great Latin writers for Bobbio or Reims. To the abbot of Tours he writes that he is "labouring assiduously to form a library," and "throughout Italy, Germany and Lorraine (Belgica) is spending vast sums of money in the acquisition of mss." It is noteworthy, however, that Gerbert never writes for a copy of one of the Christian fathers, his aim being, seemingly, to preserve the fragments of a fast-perishing secular Latin literature.

So remarkable a character as that of Gerbert left its mark on the age, and fables soon began to cluster round his name. *See* FAUST. Towards the end of the 11th century Cardinal Benno, the opponent of Hildebrand, is said to have made him the first of a long line of magician popes. William of Malmesbury adds a love adventure at Cordova, a compact with the devil, the story of a speaking statue that foretold Gerbert's death at Jerusalem—a prophecy fulfilled, somewhat as in the case of Henry IV. of England, by his dying in the Jerusalem church of Rome—and that imaginative story of the statue with the legend "Strike here," found its way into the *Gesta Romanorum*.

Gerbert's extant works may be divided into five classes. (*a*) A collection of letters, some 230 in number, contained for the most part in an 11th-century ms. at Leiden. Other important mss. are those of the Barberini Library at Rome (late 16th century), of Middlehill (17th century), and of St. Peter's abbey, Salzburg. With the letters may be grouped the papal decrees of Gerbert when Silvester II. (*b*) The *Acta concilii Remensis ad Sanctum Basolum*, a detailed account of the proceedings and discourses at the great council of St. Basle; a shorter account of his apologetic speeches at the councils of Mouzon and

Causey; and drafts of the decrees of two or three other councils or imperial constitutions promulgated when he was archbishop of Ravenna or pope. The important works on the three above-mentioned councils are to be found in the 11th-century Leiden ms. just alluded to. (*c*) Gerbert's theological works comprise a *Sermo de informatione episcoporum* and a treatise entitled *De corpore et sanguine Domini*, both of very doubtful authenticity. (*d*) Of his philosophical works we only have one, *Libellus de rationali et ratione uti*, written at the request of Otto III. and preserved in an 11th-century ms. at Paris. (*e*) His mathematical works consist of a *Regula de abaco computi*, of which a 12th-century ms. is to be found at the Vatican; and a *Libellus de numerorum divisione* (11th- and 12th-century mss. at Rome, Montpellier and Paris), dedicated to his friend and correspondent Constantine of Fleury. A long treatise on geometry, attributed to Gerbert, is of somewhat doubtful authenticity. To these may be added a very short disquisition on the same subject addressed to Adalbold, and a similar one, on one of his own spheres, addressed to Constantine, abbot of Micy. All the writings of Gerbert are collected in the edition of A. Olleris (Clermont, 1867).

SILVESTER III. When Boniface IX. was driven from Rome early in January 1044, John, bishop of Sabina, was elected in his stead and took the title of Silvester III. Within three months Boniface returned and expelled his rival. Nearly three years later (December 1046) the council of Sutri deprived him of his bishopric and priesthood. He was then sent to a monastery, where he seems to have died.

SILVESTRE DE SACY, ANTOINE ISAAC, Baron (1758–1838), French orientalist, was born in Paris on Sept. 21, 1758. In 1781 he entered the civil service, but he retired in 1792 and lived in seclusion till in 1795 he became professor of Arabic in the newly founded school of living Eastern languages. The interval was in part devoted to the study of the religion of the Druses, which was the subject of his last and unfinished work, the *Exposé de la religion des Druzes* (2 vols., 1838). Since the death of Johann Jakob Reiske, Arabic learning had been in a backward state. In the *Grammaire arabe* (2 vols., 1st ed. 1810, 2nd ed. 1831) and the *Chrestomathie arabe* (3 vols., 1806), together with its supplement, the *Anthologie grammaticale* (1829), De Sacy supplied admirable text-books. In 1806 he became Persian professor. In 1815 he became rector of the university of Paris, and after the second restoration he was active on the commission of public instruction. With Abel Rémusat he was joint founder of the *Société asiatique*, and was inspector of oriental types at the royal printing press. De Sacy, who had been created a peer of France in 1832, died on Feb. 21, 1838.

Among his other works are his edition of Harīrī (1822, 2nd edition by Reinaud, 1847, 1855), with a selected Arabic commentary, and of the *Alfiya* (1833), and his *Calila et Dimna* (1816),—the Arabic version of that famous collection of Buddhist animal tales which has been in various forms one of the most popular books of the world; a version of Abd-Allatif, *Relation arabe sur l'Egypte*, and essays on the history of the law of property in Egypt since the Arab conquest (1805–18). To biblical criticism he contributed a memoir on the Samaritan Arabic of the Pentateuch (*Mém. Acad. des Inscr.* vol. xlix.), and editions of the Arabic and Syriac New Testaments for the British and Foreign Bible Society. Of the brilliant teachers who went out from his lecture-room may be mentioned Professor Heinrich Leberecht Fleischer (1801–88), who contributed elaborate notes and corrections to the *Grammaire arabe* (*Kleinere Schriften*, vol. i., 1885).

SILVESTRINES or **SYLVESTRINES,** an order of monks under the Benedictine rule, founded 1231 by St. Silvester Gozzolini, who in 1231 built a monastery at Montefano. The rule was the Benedictine, but as regards poverty in external things, far stricter than the Benedictine. The order was approved in 1247 by Innocent IV., and at Silvester's death in 1267 there were eleven Silvestrine monasteries. At a later date there were 56, mostly in Umbria, Tuscany and the March of Ancona. In 1907 there were nine Silvestrine houses, one in Rome, and about 60 choir monks.

See Max Heimbucher, *Orden u. Kongregationen* (1907), i. § 30; Wetzer u. Welte, *Kirchenlexicon* (ed. 2); and the *Catholic Encyclopaedia*, art. "Sylvestrines."

SILVICULTURE is the technical branch of forestry (*q.v.*) which is concerned with the establishment and maintenance of the forest. *See* Arboriculture.

SIMALUR, the northernmost island of the chain off the west coast of Sumatra, Dutch East Indies. It is about 54 miles long, and is hilly, the coasts being rocky and reef-bound. Sinabang, on a bay in the south-east, is the capital, and port, where vessels of the Royal Packet Navigation company call, giving connection with Tapa Tuan, on the Sumatran mainland: there is also a cable between Simalur and Singkep, in Achin, Sumatra. Other small places on the coast are Sibigo and Sigule; they are connected by a road. The Banyak islands, nearly 70 in number, lie south-east of Simalur. They are prolific in coco-nut palms and form a port of call, for copra, for vessels of the Royal Packet Navigation company.

SIMANCAS, a town of Spain, in the province of Valladolid; 8 m. S.W. of Valladolid, on the road to Zamora and the right bank of the river Pisuerga. Pop. (1920) 1,032. Simancas is a town of great antiquity, the Roman Septimanca, with a citadel dating from the Moorish occupation in the 9th century. In 934 it was the scene of a battle between the Moors and Christians. The citadel is now the Archivo General del Reino, to which the national archives of Spain were removed by order of Philip II. in 1563. Their transference thither was first suggested to Charles V. by Cardinal Ximenes or Cisneros (d. 1517). The extensive alterations were made by three celebrated 16th-century architects, Juan de Herrera, Alonso Berruguete and Juan Gomez de Mora; the arrangement of the papers was entrusted to Diego de Ayala. They include important private as well as state papers. The archives of the Indies were transferred in 1784 to the Lonja of Seville.

SIMBIRSK: *see* Ulianovsk.

SIMCOE, JOHN GRAVES (1752–1806), British soldier and first lieutenant-governor of Upper Canada, was born at Cotterstock, Northumberland, on Feb. 25, 1752. He entered the army, and first saw active service at Boston in 1775, remaining in America during the greater part of the Revolutionary War. His military career in America ended with the surrender of Cornwallis at Yorktown (Oct. 19, 1781). In 1791 he was appointed lieutenant-governor of the new province of Upper Canada. He reached Kingston, Upper Canada, on July 1, 1792. There the first council was assembled, the government of the new province proclaimed, and the oaths of office taken. Simcoe's ideas of colonial government were dominated by military and aristocratic conceptions quite unsuited to the pioneer conditions of Upper Canada, and there was friction with the colonists and with Lord Dorchester, the governor-general. He left Canada in September 1796. After some service in England he had been designated commander-in-chief for India to succeed Lord Lake, when he died at Exeter on Oct. 26, 1806.

See D. C. Scott, *John Graves Simcoe* (1905).

SIMEON, in the Old Testament, the name of a tribe of Israel, named after the second son of Jacob by Leah (Gen. xxix. 33). According to Gen. xxxiv., the brothers Simeon and Levi massacred the males of Shechem to avenge the violation of their sister Dinah ("judgment") by Shechem the son of Hamor. Jacob disavowed the act, and on his deathbed solemnly cursed their ferocity, condemning the two to be divided in Jacob and scattered in Israel (xlix. 5–7). Subsequently the priestly Levites are found distributed throughout Israel without portion or inheritance (Deut. xviii. 1, Josh. xiii. 14).

On the other hand, Simeon is reckoned among the N. tribes in 2 Chron. xv. 9, xxxiv. 6, but is elsewhere assigned a district in S. Palestine, the cities of which are otherwise ascribed to Judah (*cf.* Josh. xix. 1–9 with xv. 26–32). An interpolation in 1 Chron. iv. 31 states that Judah was their seat in David's time, but there is no support for this in other records (*see* 1 Sam. xxvii., xxx.). In fact, Simeon is not mentioned in the "blessing of Moses" (Deut. xxxiii., *see* S. R. Driver, *Deut.* p. 397 *seq.*), or in the stories of the "judges"; and notwithstanding references to it in the chronicler's history of the monarchy, it is not named in the earlier books of Samuel and Kings. But is Gen. xxxiv. to be taken literally? Shechem is the famous holy city, Hamor a well-known native family, Jacob talks of himself as being "few in number," and the deeds of Simeon and Levi are those of communities, not of individuals. What historical facts are thus represented, and how they are to be brought into line with the early history of Israel, are problems which have defied solution (*see* J. Skinner, *Genesis*, p. 421 *seq.*).

It is conjectured that Dinah represents a clan or group (*cf.* DAN) which settled in Shechem and was exposed to danger (*e.g.*, oppression or absorption); the tribes Simeon and Levi intervened on its behalf, the ensuing massacre was avenged by the Canaanites, and the two were broken up. These events are supposed to belong to an early stage in the invasion of Palestine by the Israelites (15th–13th century B.C.), perhaps to a preliminary settlement by the "sons" of Leah (Reuben, Simeon, Levi and Judah), previous to the entrance of the "son" of Rachel, Joseph, the "father" of Ephraim and Manasseh.

In the New Testament, (1) the seer who recognized the infant Jesus as the Redeemer; (2) an alternate form of Simon.

SIMEON (or SYMEON) **OF DURHAM** (d. after 1129), English chronicler, embraced the monastic life before the year 1083 in the monastery of Jarrow; but only made his profession at a later date, after he had removed with the rest of his community to Durham. He composed his *Historia ecclesiae Dunelmensis,* extending to the year 1096, at some date between 1104 and 1108. The original manuscript is at Durham in the library of Bishop Cosin. There are two continuations, both anonymous. The first carries the history from 1096 to the death of Ranulf Flambard (1129); the second extends from 1133 to 1144. A Cambridge ms. contains a third continuation covering the years 1141–1154. About 1129 Simeon undertook to write a *Historia regum Anglorum et Dacorum.* This begins at the point where the *Ecclesiastical History of Bede* ends. The section dealing with the years 1119–1129 is, however, an independent and practically contemporaneous narrative.

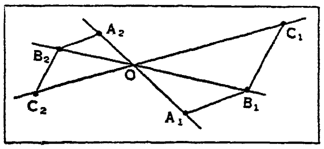
The most complete modern edition of his works is that of Thomas Arnold ("Rolls" series, 2 vols., 1882–1885). Simeon's works have been translated by J. Stevenson in his *Church Historians of England,* vol. iii. part ii. (1855).

SIMEON STYLITES, ST. (390–459), the first and most famous of the Pillar-hermits (Gr. στῦλος, pillar), was born in N. Syria. After having been expelled from a monastery for his excessive austerities, at thirty years of age he built a pillar six feet high on which he took up his abode. He made new pillars higher and higher, till after ten years he reached the height of sixty feet. On this pillar he lived for thirty years without ever descending. A railing ran round the capital of the pillar, and a ladder enabled his disciples to take him the necessaries of life. From his pillar he preached and exercised a great influence, converting numbers of heathen and taking part in ecclesiastical politics. The facts would seem incredible were they not vouched for by Theodoret, who knew him personally (*Historia religiosa,* c. 26). Moreover, Simeon had many imitators, well authenticated pillar-hermits being met with till the 16th century.

The standard work on the subject is *Les Stylites* (1895), by H. Delehaye, the Bollandist; for a summary *see* the article "Säulenheilige," in Herzog's *Realencyklopädie* (ed. 3). On Simeon *see* Th. Nöldeke's *Sketches from Eastern History* (1892), p. 210, the *Dictionary of Christian Biography* and *The Catholic Encyclopaedia.*

SIMFEROPOL, the administrative centre of the Crimean A.S.S.R., situated on the northern slopes of the Chatyr-dagh mountains in 44° 58′ N., 34° 3′ E. on the Salgar river. Simferopol grew rapidly after the railway linking it with the main Russian net was constructed. Pop. (1926) 80,719. The small fortress of Napoli erected by the ruler of Taurida about 100 B.C. existed near the town until the end of the 3rd century. Later it was a Tatar settlement Ak-mechet (Sultan Serai) the residence of the chief military commander of the khan. It was captured and burnt by the Russians in 1736. After the conquest of the Crimea by the Russians in 1784, it received its present name.

SIMILAR FIGURES. Geometric figures are said to be *similar* if they have the same shape but not necessarily the same size; *e.g.*, any two squares are similar; if they are of the same size, they are *congruent,* or *identically equal,* but they are still similar. Any two circles are similar, but not any two ellipses, for ellipses may have different shapes (*see* ELLIPSE). Solids may also be similar, as in the case of cubes or of spheres. Similarity of figures is the basis of trigonometry (*q.v.*) and of indirect measures in general. Speaking more precisely, two systems of points, $A_1, B_1, C_1, \cdots$ and $A_2, B_2, C_2, \cdots$ are said to be similar when they can be so placed that all lines A_1A_2, B_1B_2, $C_1C_2, \cdots$, joining corresponding points form a pencil whose vertex, O, divides each line into segments having a constant ratio r. In the figure here shown, the constant ratio is 2/3. Two figures are said to be similar when their systems of points are similar. The point O is called the *centre of similitude.* If $r=1$, the figures are said to be *symmetric with respect to the centre O* (*see* SYMMETRY).



SIMILAR FIGURES

SIMLA, a town and district in British India, in the Punjab. The town is the summer residence of the viceroy and staff of the supreme government, and also of the Punjab government. It is 58 m. by cart-road from the railway station of Kalka. A metre-gauge railway, 68 m. long, was opened from Kalka to Simla in 1903. The population in 1921 was 27,494, but that was only the winter population. The sanatorium of Simla occupies a spur of the lower Himalaya, running east and west for about 6 m. The ridge culminates at the east in the eminence of Jakko, in the vicinity of which bungalows are most numerous; the viceregal lodge stands on Observatory Hill. The east of the station is known as Chota Simla and the west as Boileauganj. The situation is one of great beauty; and the houses, built separately, lie at elevations between 6,600 and 8,000 ft. above sea-level. To the north, a beautiful wooded spur, branching from the main ridge, is known as Elysium. Three miles west is the cantonment of Jutogh. The minor sanatoria of Kasauli, Sabathu, Dagshai and Solon lie some distance to the south. The first European house at Simla was built in 1819, and the place was first visited by a governor-general in 1827. It has gradually become the permanent headquarters of many of the official establishments. The two chief medical institutions are the Ripon and Walker hospitals.

The DISTRICT OF SIMLA has an area of 101 sq.m., and had a population in 1921 of 45,327. The mountains of Simla and the surrounding states compose the southern outliers of the great central chain of the East Himalaya. Throughout all the hills forests of deodar abound, while rhododendrons clothe the slopes up to the limit of perpetual snow. The principal rivers are the Sutlej, Pabar, Giri, Gambhar and Sarsa.

The acquisition of the patches of territory forming the district dates from various times subsequent to the close of the Gurkha War in 1816. The Simla Hill States—which as now constituted number 27 in all—include Jubbal, Bashahr, Keonthal, Baghal and Hindur. The States of Sirmor (Nahan) and Bilaspur are under the direct control of the Government of India.

SIMMEL, GEORG (1858–1918), German philosopher and sociologist, was born in Berlin on March 1, 1858. Professor of philosophy first in Berlin (1901), then in Strasbourg (1914), Simmel was one of the first academic philosophers to apply philosophy to history and sociology. His philosophy centres round the conception of a spiritual life, various in its forms, and obedient to its own laws, whose external manifestations are to be seen in sociology and the arts. The ultimate theme of his works, which are written in a brilliant and very personal style, is nearly always the connection between life and the metaphysical general principles, revealed to the philosopher in concrete existence. He died in Strasbourg on Sept. 28, 1918.

Simmel's chief works are: *Über Sociale Differenzierung* (1890); *Einleitung in die Moralwissenschaft* (1892–93); *Philosophie des Geldes* (1900); *Kant* (1904); *Die Probleme der Geschichtsphilosophie,* 2nd ed. (1905); *Schopenhauer und Nietzsche* (1907); *Die Religion* (1907); *Philosophische Kultur* (1911); *Rembrandt* (1917); *Grundfragen der Soziologie* (1917); *Lebensanschauung* (1918). *See* W. Knevels, *Simmels Religionstheorie* (1920); N. J. Spykman, *The Social Theory of G. Simmel* (1925).

SIMMONS, EDWARD EMERSON (1852–), American artist, was born at Concord, Mass., on Oct. 27, 1852. He graduated from Harvard college in 1874, and was a pupil of Lefebvre and Boulanger in Paris, where he took a gold medal. He was awarded the prize by the Municipal Art Society of New York for a mural decorative scheme, which he carried out for the criminal courts building, later decorating the Waldorf-Astoria

hotel in New York, the library of Congress, Washington, and the capitol at St. Paul, Minn., and many other public and private buildings. He was elected to the National Institute of Arts and Letters and was one of the original members of the Ten American Painters.

SIMMS, WILLIAM GILMORE (1806–1870), American poet, novelist, dramatist and historian, was born at Charleston, S. C., April 17, 1806. His mother died in his infancy; his father, having failed in business, embarked on a series of wanderings on the border, fighting Indians and finally settling on a plantation in Mississippi. To the father's tales of wild adventure and the son's observation of frontier types on a visit to the West must be attributed some of the best features of Simms's border romances. In general, however, his life and work were shaped by the fact that he made his home in Charleston, where his grandmother had reared him. First an apprentice to a druggist, then a lawyer and an editor, largely self-educated, he received little recognition from the aristocrats of that city, in spite of his lifelong devotion to the literature of the South. He gave advice and financial help to the literary aspirants who besieged him; he contributed with little or no remuneration reams of material to the feeble southern papers and magazines, six of which he founded and conducted; but he was compelled to go to the North, where he sold the serial and book rights of most of his tales, to obtain the money and fame his own city denied him. He served in the South Carolina legislature, but lost by one vote the post of lieutenant governor. His later life was shadowed by poverty, by the burning of his home and library during the Civil War, by the defeat of the secessionist cause which he had supported and by the death of his second wife and several beloved children. Nevertheless, he remained a gallant figure, writing unceasingly until the break-down that came before his death at Charleston June 11, 1870.

Of his literary output Simms's novels are most important, ranking him next to Cooper in the depiction of frontier life. His novel of the Indians, *The Yemassee* (1835); his Revolutionary series, including *The Partisan* (1835), *Mellichampe* (1836), *Katherine Walton* (1851), *The Sword and the Distaff* (1852; published later as *Woodcraft*), *The Forayers* (1855), and *Eutaw* (1856); and his tale of the outlaws of the West, *Border Beagles* (1840), are particularly to be commended. *Beauchampe* (1842) and *Charlemont* (1856), both based on a famous Kentucky murder used by Poe and other writers, are also of interest.

As a novelist Simms's greatest weaknesses were his carelessness in technique, due to hasty composition, and his excessive use of the horrible; his chief sources of strength were his inventiveness, his vivid descriptive powers, and his bold characterization of eccentric border types. He prepared the materials for his historical romances with the care of an antiquarian and he realized the value of fiction for social history—a fact that is brought out in the best of his collections of short stories, *The Wigwam and the Cabin* (1845–46; published in Aberdeen as *Life in America*, 1858). His poems, largely of a sentimental, dreamy type, were published in two volumes in 1853, after being issued in various minor compilations. Simms's scholastic deficiencies, which he himself felt keenly, prevented his *Supplement to the Plays of William Shakespeare* (1848) from being of value save as a revelation of his tastes. His *History of South Carolina* (1840; many times republished, and still used in the public schools of the State), his other works devoted to South Carolina, and his edition of the *War Poetry of the South* (1867) reveal his loyalty to his section. Of his biographies the best probably are the lives of the Chevalier Bayard (1847) and Captain John Smith (1846), although the *Life of Francis Marion* (1844) appeared in the greatest number of editions. A revised edition of his more important works appeared in ten volumes in 1882.

W. P. Trent's *William Gilmore Simms* (1892) is an admirable biography. *See* also O. Wegelin's *List of the Separate Writings of William Gilmore Simms* (1906) and John Erskine's *Leading American Novelists* (1910).

SIMNEL, LAMBERT (fl. 1477–1534), English impostor, was probably the son of a tradesman at Oxford. He was about ten years old in 1487, and was described as a handsome youth of intelligence and good manners. In 1486, the year following the accession of Henry VII., rumours were spread by the Yorkists that the two sons of Edward IV., who had been murdered in the Tower of London, were still alive. A young Oxford priest, Richard Symonds by name, decided to put forward the boy Simnel as one of these princes. He provided him with a suitable education, but meanwhile a report having gained currency that the young earl of Warwick, son of Edward IV.'s brother George, duke of Clarence, had died in the Tower, Symonds decided that the impersonation of Warwick would be more effective. The Yorkists had many adherents in Ireland, and thither Lambert Simnel was taken by Symonds early in 1487. He gained the support of the earl of Kildare, the archbishop of Dublin, the lord chancellor and a powerful following, and was crowned as King Edward VI. in the cathedral in Dublin on May 24, 1487. Messages asking for help were sent to Margaret, duchess of Burgundy, sister of Edward IV., to Sir Thomas Broughton and other Yorkist leaders.

On Feb. 2, 1487 Henry VII. held a council at Sheen to concert measures for dealing with the conspiracy. Elizabeth Woodville, widow of Edward IV., was imprisoned in the convent of Bermondsey; and the real earl of Warwick was shown in public in the streets of London. John de la Pole, earl of Lincoln, himself a nephew of Edward IV., had probably connived at the Simnel impersonation. He now fled to Flanders, where he joined Lord Lovell, who had headed an unsuccessful Yorkist rising in 1486, and in May 1487 the two lords proceeded to Dublin, where they landed a few days before the coronation of Lambert Simnel. They were accompanied by 2,000 German soldiers under Martin Schwartz, procured by Margaret of Burgundy to support the enterprise, Margaret having recognized Simnel as her nephew. This force, together with some ill-armed Irish levies commanded by Sir Thomas Fitzgerald, landed in Lancashire on June 4. King Henry immediately marched to Nottingham, where his army was strengthened by the addition of 6,000 men. Making for the fortress of Newark, Lincoln and Sir Thomas Broughton, accompanied by Simnel, attacked the royal army near Stoke-on-Trent on June 16, 1487. After a fierce and stubborn struggle the Royalists were completely victorious, though they left 2,000 men on the field; Lincoln, Schwartz and Fitzgerald with 4,000 of their followers were killed, and Lovell and Broughton disappeared. The priest Symonds and Simnel were taken prisoners. Henry VII., recognizing that Lambert Simnel had been a tool in Yorkist hands, took him into his own service as a scullion. He was later promoted to be royal falconer, and is said to have afterwards become a servant in the household of Sir Thomas Lovell. He was still living in the year 1534.

See Bacon, *History of Henry VII.*, with notes by J. R. Lumby (1881); Bagwell, *Ireland under the Tudors* (3 vols., 1885–1890); James Gairdner, *Henry VII.* (London, 1889) and *Letters and Papers illustrative of the reigns of Richard III. and Henry VII.* ("Rolls" series, 2 vols., London, 1861–1863); *The Political History of England*, vol. v., by H. A. L. Fisher (London, 1906); and W. Busch, *England under the Tudors* (1895). For a contemporary account *see* Polydore Vergil, *Anglicae historiae*, to which all the later narratives are indebted.

SIMOCATTA[1], **THEOPHYLACT**, Byzantine historian, a native of Egypt, held an official position at Constantinople during the reign of Heraclius (610–640). He is best known as the author of a history, in eight books, of the reign of the emperor Maurice (582–602), for which period he is the best and oldest authority. The work describes the wars with the Persians, the Avars and Slavs, and the emperor's tragic end (ed. pr. by J. Pontanus, 1609; best edition by C. de Boor, 1887, with a valuable Index Graecitatis). "His want of judgment renders him diffuse in trifles and concise in the most interesting facts" (Gibbon), but his general trustworthiness is admitted. The history contains an introduction in the form of a dialogue between History and Philosophy.

Simocatta was also the author of *Physical Problems*, a work on natural history (ed. J. Ideler in *Physici et medici Graeci minores*, i. 1841); and of a collection of 85 essays in epistolatory form. The best edition is by R. Hercher in *Epistolographi Graeci* (1873). The letters were translated into Latin (1509) by Copernicus (reprinted 1873 by F. Hipler in *Spicilegium Copernicanum*).

See C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897).

SIMON, SIR JOHN (1816–1904), English surgeon and sanitary reformer, was born in London on Oct. 10, 1816. In the spring of 1844 he gained the first Astley Cooper prize by a physiological essay on the thymus gland, and the following year was elected F.R.S. Simon published many clinical surgical lectures of the greatest importance, and contributed an article on "In-

[1]Other forms of the name are Simocattos, Simocatos, Simocates.

flammation" to Holmes's *System of Surgery* which has become a classic of its kind. It was, however, on his appointment in 1848 as medical officer of health to the City of London, and afterwards to the Government, that his great abilities in sanitary science found full scope. Simon can claim priority over Cock in the operation of perineal puncture of the urethra in cases of retention from stricture. He died on July 23, 1904.

SIMON, SIR JOHN ALLSEBROOK (1873–), British politician and lawyer, the son of a Congregational minister, was born Feb. 28, 1873, at Bath, and educated at Fettes College, Edinburgh, and Wadham College, Oxford, where he was a scholar. He became president of the Union in 1896, and was subsequently elected fellow of All Souls. He went to the Bar, became Barstow Law scholar in 1898, and was called in 1899. His manifest abilities and the persuasiveness of his advocacy soon brought him to notice; he was chosen one of the counsel for the British Govt. in the arbitration on the Alaska Boundary in 1903; and he rapidly attained so considerable a practice that he was able to take silk in 1908. He had gone into politics, and was elected Liberal member for Walthamstow at the general election of 1906. At first, probably owing to his absorption in his legal work, he did not command nearly so much attention in Parliament as his Wadham contemporary and fellow-lawyer, F. E. Smith (afterwards Lord Birkenhead). But he gradually made his way, and was appointed by Asquith Solicitor-General in 1910, was knighted the same year, and became Attorney-General with a seat in the Cabinet in 1913.

On the outbreak of the war in 1914, his resignation, along with those of Lord Morley and Burns, was expected; but he finally decided to remain with his chief and the bulk of his colleagues. When the first war Coalition Government was formed, in May 1915, he was offered the lord chancellorship, but he declined the greatest prize of his profession as he preferred a political career in the Commons. Accordingly he accepted the home secretaryship, and gave up his legal practice. Early, however, in the following year, owing to his inability to accept the Government bill for compulsory military service, he resigned his office and led a fruitless opposition to the measure in the House; and then went out to the front in France as a major in the R.A.F. He subsequently resumed practice as a barrister, and immediately regained his position in the front rank of his profession. On the break between Asquith and Lloyd George in 1916, John Simon adhered to the former. He lost his seat in Parliament at the general election in Dec. 1918, but was returned for Spen Valley in 1922. On the occasion of the general strike in May 1926 John Simon argued in Parliament that the strike was not covered by the Trade Disputes Act. His speech created a deep impression. In January 1928, on appointment as chairman of the Indian Statutory Commission (*see* INDIA: *History*) Simon retired. He was made G.C.S.I. in the Birthday Honours, 1930.

SIMON, JULES FRANÇOIS (1814–1896), French statesman and philosopher, was born at Lorient on Dec. 27, 1814. His father was a linen-draper from Lorraine, who abjured Protestantism before his second marriage (of which Jules Simon was the son) with a Catholic Breton. The family name was Suisse, which Simon dropped in favour of his third prenomen. At the École Normale in Paris he came in contact with Victor Cousin, who sent him to Caen and then to Versailles to teach philosophy. He helped Cousin, without receiving any recognition, in his translations from Plato, and in 1839 became his deputy in the chair of philosophy at the Sorbonne, with the meagre salary of 83 francs per month. He also lectured on the history of philosophy at the École Normale. At this period he edited the works of Malebranche (2 vols., 1842), of Descartes (1842), Bossuet (1842) and of Arnauld (1843), and in 1844–1845 appeared the two volumes of his *Histoire de l'école d'Alexandrie.* He became a regular contributor to the *Revue des deux mondes,* and in 1847, with Amédée Jacques and Émile Saisset, founded the *Liberté de penser,* with the intention of throwing off the yoke of Cousin, but he retired when Jacques allowed the insertion of an article advocating the principles of collectivism. In 1848 he represented the Côtes-du-Nord in the National Assembly, and in 1849 entered the Council of State, but was retired on account of his republican opinions. After the *coup d'état,* which was followed by his dismissal from his professorship, he used his leisure in writing *Le Devoir* (1853), which was translated into modern Greek and Swedish, *La Religion naturelle* (1856, Eng. trans., 1887), *La Liberté de conscience* (1857), *La Liberté politique* (1859), *La Liberté civile* (1859), *L'Ouvrière* (1861), *L'École* (1864), *Le Travail* (1866), *L'Ouvrier de huit ans* (1867) and others. In 1863 he was returned to the Corps Législatif for the 8th *circonscription* of the Seine, and supported "les Cinq" in their opposition to the government.

He became minister of instruction in the government of National Defence on Sept. 5, 1870. After the capitulation of Paris in January 1871 he was sent down to Bordeaux to prevent the resistance of Gambetta to the peace. But at Bordeaux Gambetta, who had issued a proclamation excluding from the elections officials under the Empire, was all powerful. He affected to dispute Jules Simon's credentials, and issued orders for his arrest. Meanwhile Simon had found means of communication with Paris, and on Feb. 6, was reinforced by Eugène Pelletan, E. Arago and Garnier-Pagès. Gambetta resigned, and the ministry of the Interior, though nominally given to Arago to avoid the appearance of a personal issue, was really in Simon's hands. Defeated in the department of the Seine, he sat for the Marne in the National Assembly, and resumed the portfolio of education in the first cabinet of M. Thiers's presidency. He retained office until a week before the fall of Thiers in 1873.

Simon was regarded by the monarchical Right as one of the most dangerous obstacles in the way of a restoration, which he did as much as any man (except perhaps the comte de Chambord himself) to prevent, but by the extreme Left he was distrusted for his moderate views, and Gambetta never forgave his victory at Bordeaux. In 1875 he became a member of the French Academy and a life senator, and in 1876, on the resignation of M. Dufaure, was summoned to form a cabinet. He replaced antirepublican functionaries in the civil service by republicans, and held his own until May 3, 1877, when he adopted a motion carried by a large majority in the Chamber inviting the cabinet to use all means for the repression of clerical agitation. Marshal MacMahon then practically demanded his resignation. This act of the president, known as the "Seize Mai," drove him finally from office. He justified his action in submitting instead of appealing to the Chamber by his fear of providing an opportunity for a *coup d'état* on the part of the marshal.

The rejection (1880) of article 7 of Ferry's Education Act, by which the profession of teaching would have been forbidden to members of non-authorized congregations, was due to Simon's intervention. He was in fact the chief of the Left Centre opposed to the radicalism of Jules Grévy and Gambetta. He was director of the *Gaulois* from 1879 to 1881, and his influence in the country among moderate republicans was retained by his articles in the *Matin* from 1882 onwards, in the *Journal des Débats,* which he joined in 1886, and in the *Temps* from 1890.

He left accounts of some of the events in which he had participated in *Souvenirs du 4 septembre* (1874), *Le Gouvernement de M. Thiers* (2 vols., 1878), in *Mémoires des autres* (1889), *Nouveaux mémoires des autres* (1891) and *Les Derniers mémoires des autres* (1897), while his sketch of *Victor Cousin* (1887) was a further contribution to contemporary history. For his personal history the *Premiers mémoires* (1900) and *Le Soir de ma journée* (1902), edited by his son Gustave Simon, may be supplemented by Léon Séché's *Figures bretonnes, Jules Simon, sa vie, son oeuvre* (new ed., 1898), and G. Picot, *Jules Simon: notice historique* . . . (1897); also by many references to periodical literature and collected essays in Hugo P. Thieme's *Guide bibliographique de la litt. franç. de 1800 à 1906* (1907).

SIMON, RICHARD (1638–1712), French biblical critic, born at Dieppe on May 13, 1638, was educated by the Fathers of the Oratory at Dieppe and at the university of Paris. Simon entered the priesthood in 1670, and the same year wrote a pamphlet in defence of the Jews of Metz, who had been accused of having murdered a Christian child. About this time began his controversies with the Port Royalists and with the Benedictines, and his enemies sought to drive him from Paris. He was engaged at the time in superintending the printing of his *Histoire critique du Vieux Testament,* which was to be dedicated to Louis XIV.

The proof sheets were held up pending the return of the king from Flanders, and fell into the hands of the Port Royalists, who had in hand a translation into French of the Prolegomena to *Walton's Polyglott*. Simon now announced his intention of publishing an annotated edition of the Prolegomena, and actually added to the *Critical History* a translation of the last four chapters of that work, which had formed no part of his original plan. Simon's announcement prevented the appearance of the projected translation, but his enemies found the desired opportunity in the alleged heterodoxy of some of the views expressed by Simon. A decree of the council of state was obtained, and the whole impression, consisting of 1,300 copies, was seized by the police and destroyed. Simon was expelled by the Oratorians from their fellowship, and retired in 1679 to his curacy of Bolleville, Normandy. Finally the *Critical History* appeared, with Simon's name on the title page, in the year 1685, from the press of Reenier Leers in Rotterdam. Simon died at Dieppe on April 11, 1712.

The remaining works of Simon were: *Histoire critique du texte du Nouveau Testament* (1689), *Histoire critique des versions du Nouveau Testament* (1690); *Histoire critique des principaux commentateurs du Nouveau Testament* (1693), and his *Nouvelles Observations sur le texte et les versions du Nouveau Testament* (1695).

The principal authorities for the life of Simon are the life or "éloge" by his grand-nephew De la Martinière in vol. i. of the *Lettres choisies* (4 vols., 1730); *Richard Simon et son Vieux Testament*, by A. Bernus (Lausanne,, 1869); H. Margival, *Essai sur Richard Simon et la critique biblique au XVIIe siècle* (1900). For the bibliography, *see*, in addition to the various editions of Simon's works, A. Bernus, *Notice bibliographique sur Richard Simon* (Basel, 1882).

SIMON, THOMAS (*c.* 1623–1665), English medallist, was born, according to Vertue, in Yorkshire about 1623. He studied engraving under Nicholas Briot, and about 1635 received a post in connection with the mint. In 1645 he was appointed by the parliament joint chief engraver along with Edward Wade, and, having executed the great seal of the Commonwealth and dies for the coinage, he was promoted to be chief engraver to the mint and seals. He produced several fine portrait medals of Cromwell, one of which is copied from a miniature by Cooper. After the Restoration he was appointed engraver of the king's seals. On the occasion of his contest with the brothers Roettiers, who were employed by the mint in 1662, Simon produced his celebrated crown of Charles II., on the margin of which he engraved a petition to the king. This is usually considered his masterpiece. He is believed to have died of the plague in London in 1665.

A volume of *The Medals, Coins, Great Seals and other Works of Thomas Simon, engraved and described by George Vertue*, was published in 1753.

SIMON BEN YOHAI (2nd century A.D.), a Galilean Rabbi, one of the most eminent disciples of Aqiba (*q.v.*). His master was executed by Hadrian, and Simon's anti-Roman sentiments led to his own condemnation by Varus *c.* A.D. 161 (according to Graetz). He escaped this doom and dwelt for some years in a cavern. Emerging from concealment, Simon settled in Tiberias and in other Galilean cities. He acquired a reputation as a worker of miracles, and on this ground was sent to Rome as an envoy. To Simon were attributed the important legal homilies called *Sifre* and *Mekhilta* (*see* MIDRASH), and above all the *Zohar*, the Bible of the Kabbalah (*q.v.*). This latter ascription is altogether unfounded, the real author being Leon, Moses de (*q.v.*).

The fullest account of Simon's teachings is to be found in W. Bacher's *Agada der Tannaiten*, ii. pp. 70–149.

SIMONDS, FRANK HERBERT (1878–), American writer, was born in Concord, Massachusetts, April 5 1878. He graduated from Harvard University in 1900, after having seen active service in the war with Spain. He became a reporter on the New York *Tribune* in 1901, and was with the Washington bureau of that paper in 1903, and its Albany correspondent in 1904–05. He was Albany correspondent for the New York *Evening Post* in 1906–08, became an editorial writer for the *Sun* in 1908, was editor of the New York *Evening Sun* in 1913–14, and from 1915 to 1918 was associate editor of the New York *Tribune*. During the World War his brilliant articles in the American *Review of Reviews*, analysing the military and political situation from month to month, brought him a wide reputation. After the Armistice he continued to contribute articles on international politics to this review (of which he became foreign editor in 1914), to other periodicals, and to a newspaper syndicate. His books include *They Shall Not Pass* (1916), an account of Verdun; *History of the World War* (1917–20); and *How Europe Made Peace without America* (1927).

SIMONIDES (or SEMONIDES) **OF AMORGOS,** Greek iambic poet, flourished in the middle of the 7th century B.C. He was a native of Samos, and derived his surname from having founded a colony in the neighbouring island of Amorgos. According to Suïdas, besides two books of iambics, he wrote elegies, one of them a poem on the early history of the Samians. The elegy included in the fragments (85) of Simonides of Ceos is more probably by Simonides of Amorgos. We possess about thirty fragments of his iambic poems, written in clear and vigorous Ionic, satiric in type, but less personal than Archilochus. His largest fragment is an elaborate comparison of various types of women with various animals.

See Fragments in T. Bergk, *Poëtae lyrici Graeci;* separate editions by F. T. Welcker (1835), and especially by P. Malusa (1900), with exhaustive introduction, bibliography and commentary.

SIMONIDES OF CEOS (*c.* 556–469 B.C.), Greek lyric poet, was born at Iulis in the island of Ceos. During his youth he taught poetry and music in his native island, and composed paeans for the festivals of Apollo. Later he went to live at Athens, at the court of Hipparchus, the patron of literature. After the murder of Hipparchus (514), Simonides withdrew to Thessaly, where he enjoyed the patronage of the Scopadae and Aleuadae (two celebrated Thessalian families). Apparently some disaster overtook the Scopadae, which resulted in the extinction of the family. After the battle of Marathon Simonides returned to Athens, but soon left for Sicily at the invitation of Hieron, at whose court he spent the rest of his life.

His reputation as a man of learning is shown by the tradition that he introduced the distinction between the long and short vowels (ε, η, ο, ω), afterwards adopted in the Ionic alphabet which came into general use during the archonship of Eucleides (403). He was also the inventor of a system of mnemonics (Quintilian xi. 2, 11). So unbounded was his popularity that he was a power even in the political world; we are told that he reconciled Theron and Hieron on the eve of a battle between their opposing armies. He was the intimate friend of Themistocles and Pausanias the Spartan, and his poems on the war of liberation against Persia no doubt gave a powerful impulse to the national patriotism. For his poems he could command almost any price: later writers, from Aristophanes onwards, accuse him of avarice, probably not without some reason.

Of his poetry we possess two or three short elegies (Fr. 85 seems from its style and versification to belong to Simonides of Amorgos, or at least not to be the work of our poet), several epigrams and about ninety fragments of lyric poetry. The epigrams written in the usual dialect of elegy, Ionic with an epic colouring, were intended partly for public and partly for private monuments. There is strength and sublimity in the former, with a simplicity that is almost statuesque, and a complete mastery over the rhythm and forms of elegiac expression. Those on the heroes of Marathon and Thermopylae are the most celebrated. In the private epigrams there is more warmth of colour and feeling, but few of them rest on any better authority than that of the Palatine anthology. One interesting and undoubtedly genuine epigram of this class is upon Archedice, the daughter of Hippias the Peisistratid, who, "albeit her father and husband and brother and children were all princes, was not lifted up in soul to pride." The lyric fragments vary much in character and length: one is from a poem on Artemisium, celebrating those who fell at Thermopylae, with which he gained the victory over Aeschylus; another is an ode in honour of Scopas (commented on in Plato, *Protagoras*, 339 b); the rest are from odes on victors in the games, hyporchemes, dirges, hymns to the gods and other varieties. The poem on Thermopylae breathes a lofty national pride; the others are full of pathos and feeling, combined with a genial

worldliness. "It is hard," he says (Fr. 5), "to become a truly good man, perfect as a square in hands and feet and mind, fashioned without blame. Whosoever is bad, and not too wicked, knowing justice, the benefactor of cities, is a sound man. I for one will find no fault with him, for the race of fools is infinite." His most celebrated fragment is a dirge, in which Danaë, adrift with the infant Perseus on the sea in a dark and stormy night, takes comfort from the peaceful slumber of her babe. Simonides here illustrates his own saying that "poetry is vocal painting, as painting is silent poetry."

Of the many English translations of this poem, one of the best is that by J. A. Symonds in *Studies on the Greek Poets.* Fragments in T. Bergk, *Poëtae lyrici Graeci;* standard edition by F. G. Schneidewin (1835) and of the *Danaë* alone by H. L. Ahrens (1853). Other authorities are given in the exhaustive treatise of E. Cesati, *Simonide di Ceo* (1882); *see* also W. Schröter, *De Simonidis Cei melici sermone* (1906).

SIMON MAGUS. One of the most ancient and interesting rivals of early Gentile Christianity was the sect of the Simonians. Its founder was a skilful magician who had established himself in the city of Samaria just prior to its evangelization and had captivated the populace by his sorcery, so that he was generally known as "the power of God which is called great." His ascendancy was broken by the arrival in Samaria of Philip (Acts 8.5; the interpretation of this story depends somewhat on the view taken of the sources of Acts), whose novel cures and teaching attracted many converts to Christianity and ultimately won over Simon himself who was baptized with the rest. It is probable that Simon's conversion was due less to a change of heart than to a misunderstanding that baptism and the apostle's cures were evidence of a magic superior to his own, the art of which he might hope to acquire as Philip's disciple. Proof that he had carried over the mentality of his old profession into his new religion was not slow in forthcoming. When Philip was reinforced by Peter and John who supplemented baptism by the gift of the Spirit through the laying on of hands, Simon asked that he might be taught to perform this rite and to obtain power to dispense the Holy Spirit and he offered the Apostles a fee for their instruction. Peter, perceiving how slight an impression Christianity had made upon the magician's mind, rebuked him severely and pointed out that, as he had no right understanding of Christianity, he could not share in its benefits. Simon accepted the reproof and begged Peter to pray for his forgiveness.

We hear no more of Simon in Acts and might have assumed that his repentance was enduring and that he had been absorbed into the mass of Samarian Christians, if we did not have later references to him and fragments of a sectarian literature in which he figures as a god and which show that he must have withdrawn from Christianity and initiated a movement of his own in which Christian and Pagan elements were freely and curiously combined. From these later sources (Justin Martyr, Irenaeus, Epiphanius and Hippolytus), it appears that Simon's birthplace was Gitta, that he journeyed to Rome where he had some success in gaining followers under Claudius, that he was generally accompanied by a Phoenician woman named Helen, who had formerly been a prostitute but whom he associated with his own claims for divine honours, that he had a number of disciples of whom the most important were Menander and Saturninus and that he met his end through a foolish attempt to reproduce the resurrection of Jesus by allowing himself to be buried alive in the mistaken supposition that he would be able to rise again on the third day. Justin has a story that a statue was set up in Simon's honour on the Tiber with the inscription, *Simoni Deo Sancto,* but this is probably an error, as a statue answering to Justin's description and inscribed, *Semoni Sancto Deo Fidio Sacrum Sex Pompeius, S.P. F. Col. Mussianus Quinqennalis Decur Bidentalis Donum Dedit,* was unearthed on the Tiber in modern times. Semo was a local, perhaps Sabine, deity and had nothing to do with Simon, but the mistake was not an impossible one for Justin or his source to have made.

On the development of Simonian theology we are better informed than on the external history of the sect. Just what was implied in the view, current in Samaria in Simon's pre-Christian days, that he was "the power of God which is called great" is obscure and it is only a possibility that the god whose power he was thought to be was Jehovah. Evidence that he was influenced by Judaism apart from Christianity is wholly lacking. The recurrence of the phrase, "power of God," or its equivalent, in all the later accounts suggests a certain continuity and it seems probable that, even before his conversion, he advanced a theology similar to that described by Irenaeus (*Adv. haer.* 1.16.1 Harvey) but lacking the elements borrowed later from Christianity and that after his withdrawal from the church he revised this system into a parallel and rival of Christianity.

Apart from Justin's meagre statement that Simon was worshipped as the supreme God and Helen regarded as the "primary notion" emanating from him, our first satisfactory account of Simonian theology is given by Irenaeus, whose assumption that he is describing Simon's own teaching is erroneous, for he is evidently drawing from a later source in which reflections from contemporary christological speculation are unmistakable. In this system Simon is identified with the supreme God, the Father and most exalted Power from whom, before the creation of the world, a female principle emanated. This principle was his first notion through whom it occurred to him to create angels and archangels. Knowing the Father's mind, she issued from him to execute his will and made the angels and powers who, in turn, fashioned the visible world. These inferior beings were ignorant of the Father's existence but were jealous of their mother and, unwilling to be thought the offspring of another, detained her on the earth and forced her through a series of degrading incarnations. She appears in history as Helen of Troy and later as Simon's companion, Helen of Tyre, whom he came to save and who, in Simonian exegesis, is identical with the lost sheep of the parable. To rescue her and to bring salvation to men the supreme Power became incarnate and descended to earth where the angels were quarrelling for ascendancy. He came in human form, though in fact he was no man, and played the Passion in Judaea, though his sufferings were only apparent. He appears among the Jews as the Son, but also descended in Samaria as the Father and among the Gentiles as the Holy Spirit. The advent of this hitherto unknown god abrogated the precepts of the Prophets whose utterances had been inspired by the angels and designed to enslave man and obscure the truth that salvation comes not through good works but through the grace of Simon and hope in Helen and him.

The interesting features in this otherwise rather commonplace myth are the curiously Sabellian-like Trinitarian doctrine, the Iocetic theory of incarnation, and the doctrine of justification by faith or rather by hope—all of which appear to have been transferred bodily from Christianity and adapted to Simon's theology. The meaning of the Father's appearance in Samaria is obscure, but may refer to the Samaritan temple at Gerizim. It is also impossible to make out the relative importance of Jesus and Simon in the system. The Simonians evidently believed that the same divine principle was incarnate in both, but the reference to the Passion shows that they could not have confused the two historical figures. Further clarity cannot be expected as Irenaeus was not sufficiently interested or well informed to describe the doctrine of salvation in detail.

More remote from the original stock is a system preserved in a document quoted at length by Hippolytus and entitled "the Great Pronouncement" (apophasis megale). Here fragmentary survivals of the original Simonian myth serve only to cloak a philosophic system allied to Stoicism. Elaborate metaphor and fanciful exegesis do much to obscure the meaning and the affinities with other known Simonian systems are very slight. The substitution of an innate saving principle in human nature for a personal saviour is reminiscent of Saturninus, but the underlying ideas are more philosophical and myth serves only as a symbol, not as a naïve statement of fact. Still more tenuous is the connection between Irenaeus' account and a system of theology attributed to Simon in the Clementines, but this problem can be satisfactorily treated only after further research on the text and sources of that literature have been made.

Both Irenaeus and Hippolytus inform us of the liturgical practices of the Simonians. Apart from magic of various kinds, wor-

ship was paid to Simon and Helen before statues of Zeus and Athena. It was, however, customary not to mention their names but to use the titles "Lord" and "Mistress" (kyrios, kyria). Any-one violating this convention was detected as an outsider and expelled from the mysteries. (R. P. C.)

SIMON OF ST. QUENTIN (*fl.* 1247), Dominican mission-traveller and diplomatist, accompanied, and wrote the history of the Dominican embassy under Friar Ascelin or Anselm, which Pope Innocent IV. sent in 1247 to the Mongols of Armenia and Persia. Large sections of Simon's history have been preserved in Vincent of Beauvais's *Speculum historiale,* where 19 chapters are expressly said to be *ex libello fratris Simonis,* or entitled *frater Simon.* The embassy proceeded to the camp of Baiju or Bachu *Noyan* (*i.e.,* "General" Baiju, *Noyan* signifying a commander of 10,000) at *Sitiens* in Armenia, lying between the Aras river and Lake Gokcha, 59 days' journey from Acre. The papal letters were translated into Persian, and thence into Mongol, and so presented to Baiju; but the Tatars were irritated by the haughtiness of the Dominicans. The Frankish visitors were treated with contempt: for nine weeks all answer to their letters was refused. Thrice Baiju even ordered their death. At last, on July 25, 1247, they were dismissed with the *Noyan's* reply, dated July 20, which complained of the high words of the Latin envoys, and commanded the pope to come in person and submit to the Master of all the Earth (the Mongol emperor). The mission thus ended in complete failure.

See Vincent of Beauvais, *Speculum historiale,* book xxxii. (sometimes quoted as xxxi.), chaps. 26–29, 32, 34, 40–52 (*cf.* pp. 453 A-454 B in the Venice edition of 1591); besides these, several other chapters of the *Spec. hist.* probably contain material derived from Simon, *e.g.,* bk. xxxi. (otherwise xxx.), chaps. 3, 4, 7, 8, 13, 32; and bk. xxx. (otherwise xxix.), chaps. 69, 71, 74–75, 78, 80. *See* also d'Ohsson, *Histoire des Mongols,* ii. 200–201, 221–233; iii. 79 (edition of 1852); Fontana, *Monumenta Dominicana,* p. 52 (Rome, 1675); Luke Wadding, *Annales Minorum,* iii, 116–118; E. Bretschneider, *Mediaeval Researches from Eastern Asiatic Sources,* vol. i., notes 455, 494 (London, 1888); M. A. P. d'Avezac's Introduction to Carpini, pp. 404–405, 433–434, 464–465, of vol. iv. of the Paris Geog. Soc.'s *Recueil de Voyages,* etc. (Paris, 1839); W. W. Rockhill, *Rubruck,* pp. xxiv.–xxv. (London, Hakluyt Soc., 1900); C. R. Beazley, *Dawn of Modern Geography,* ii. 277, and *Carpini and Rubruquis,* 269–270.

SIMONSTOWN, a town and naval station of the British navy in South Africa on False bay, and 22½ m. by rail from Cape Town. In 1910 works were completed, which provide a tidal basin of 26 ac., with a depth of 30 ft. at L.W.O.S.T. South of this basin is a large, reclaimed area, the site of the new dockyards. The hill behind the town is fortified. Simonstown dates from the close of the 17th century, and is named after Simon van der Stel, governor of the Cape, 1679–99. Pop. (1926) 5,000, of whom 2,660 were whites. On the southern side it is developing as a seaside resort.

SIMONY, an offence, defined below, against the law of the church. The name is taken from Simon Magus (*q.v.*). In the canon law the word bears a more extended meaning than in English law. "Simony according to the canonists," says Ayliffe in his *Parergon,* "is defined to be a deliberate act or a premeditated will and desire of selling such things as are spiritual, or of anything annexed unto spirituals, by giving something of a temporal nature for the purchase thereof; or in other terms it is defined to be a commutation of a thing spiritual or annexed unto spirituals by giving something that is temporal." In the *Corpus juris canonici* the Decretum (pt. ii. cause i. quest. 3) and the Decretals (bk. v. tit. 3) deal with the subject. The offender whether *simoniacus* (one who had bought his orders) or *simoniace promotus* (one who had bought his promotion), was liable to deprivation of his benefice and deposition from orders if a secular priest,—to confinement in a stricter monastery if a regular. No distinction seems to have been drawn between the sale of an immediate and of a reversionary interest. The innocent *simoniace promotus* was, apart from dispensation, liable to the same penalties as though he were guilty. Certain matters were simoniacal by the canon law which would not be so regarded in English law, *e.g.,* the sale of tithes, the taking of a fee for confession, absolution, marriage or burial, the concealment of one in mortal sin or the reconcilement of an impenitent for the sake of gain, and the doing homage for spiritualities. So grave was the crime of simony considered that even infamous persons could accuse of it. English provincial and legatine constitutions continually assailed simony.

For the purposes of English law simony is defined by Blackstone as the corrupt presentation of any person to an ecclesiastical benefice for money, gift or reward. The offence is one of purely ecclesiastical cognizance, and not punishable by the criminal law. The penalty is forfeiture by the offender of any advantage from the simoniacal transaction, of his patronage by the patron, of his benefice by the presentee; and now by the Benefices Act 1892, a person guilty of simony is guilty of an offence for which he may be proceeded against under the Clergy Discipline Act 1892. An innocent clerk is under no disability, as he might be by the canon law. Simony may be committed in three ways—in promotion to orders, in presentation to a benefice, and in resignation of a benefice. The common law (with which the canon law is incorporated, as far as it is not contrary to the common or statute law or the prerogative of the Crown) has been considerably modified by statute. Where no statute applies to the case, the doctrines of the canon law may still be of authority. Both Edward VI. and Elizabeth promulgated statutes against simony.

The general result of the law before the Benefices Act 1898, as gathered from statutes and decisions, may be stated as follows: (1) it was not simony for a layman or spiritual person not purchasing for himself to purchase, while the church was full, an advowson or next presentation, however immediate the prospect of a vacancy; (2) it was not simony for a spiritual person to purchase for himself a life or any greater estate in an advowson, and to present himself thereto; (3) it was not simony to exchange benefices under an agreement that no payment was to be made for dilapidations on either side; (4) it was not simony to make certain assignments of patronage under the Church Building and New Parishes Acts; (5) it was simony for any person to purchase the next presentation while the church was vacant; (6) it was simony for a spiritual person to purchase for himself the next presentation, though the church be full; (7) it was simony for any person to purchase the next presentation, or in the case of purchase of an advowson the next presentation by the purchaser would be simoniacal if there was any arrangement for causing a vacancy to be made; (8) it was simony for the purchaser of an advowson while the church was vacant to present on the next presentation; (9) it was simony to exchange otherwise than *simpliciter;* no compensation in money might be made to the person receiving the less valuable benefice. The law on the subject of simony was long regarded as unsatisfactory by the authorities of the church. In 1879 a royal commission reported on the law and existing practice as to the sale, exchange and resignation of benefices. Many endeavours were made in parliament to give effect to the recommendations of the commission, but it was not until 1898 that any important change was made in the law. The Benefices Act of that year absolutely invalidated any transfer of a right of patronage unless (*a*) it is registered in the diocesan registry, (*b*) unless more than 12 months have elapsed since the last institution or admission to the benefice, and (*c*) unless "it transfers the whole interest of the transferor in the right" with certain reservations; in other words, the Act abolished the sale of next presentations, but it expressly reserved from its operation (*a*) a transmission on marriage, death or bankruptcy or otherwise by operation of law, or (*b*) a transfer on the appointment of a new trustee where no beneficial interest passes. It also substituted another form of declaration for that required under the Clerical Subscription Act 1865, and this form has been again amended by the measure of 1923 (*infra*). It abolished the sale by auction of an advowson in gross, and empowered a bishop to refuse to institute or admit a presentee to a benefice on a number of specified grounds: among others, on the ground of possible corrupt presentation through a year not having elapsed since the last transfer of the right of patronage, and constituted a new court to hear appeals against a bishop's refusal to institute. This court consists of a judge of the Supreme Court, who shall decide all questions of law and of fact,

and of the archbishop, who gives judgment. The Benefices Act 1892 has now been amended in many details by the Benefices Act 1898 Amendment Measure 1923 and the Benefices Rules 1926.

In Scotland simony is an offence both by civil and ecclesiastical law. The rules are generally those of the canon law. There are few decisions of Scottish courts on the subject. By the Act of 1584, c. 5, ministers, readers and others guilty of simony provided to benefices were to be deprived. An Act of Assembly of 1753 declares pactions simoniacal whereby a minister or probationer before presentation and as a means of obtaining it bargains not to raise a process of augmentation of stipend or demand reparation or enlargement of his manse or glebe after induction.

In the United States, there is no recognition of simony in the courts.

SIMOOM, the name usually given in the Sahara and Arabian deserts to hot, dry whirlwinds experienced in spring and summer.

SIMPLICIUS, pope from 468 to 483. During his pontificate the Western Empire was overthrown, and Italy passed into the hands of the barbarian king Odoacer. In the East, the usurpation of Basiliscus (475–476), who supported the monophysites, gave rise to many ecclesiastical troubles, which were a source of grave anxiety to the pope. The emperor Zeno, who had procured the banishment of Basiliscus, endeavoured to compound with the monophysite party; and the bishop of Constantinople, who had previously fought on the pope's side for the council of Chalcedon, abandoned Simplicius and subscribed to the *henoticon,* the conciliatory document promulgated in 482 by the emperor. Simplicius died on March 2, 483, but without settling the monophysite question.

SIMPLICIUS, a native of Cilicia, a disciple of Ammonius and of Damascius, was one of the last of the Neoplatonists. When, in A.D. 529, the school of philosophy at Athens was disendowed and the teaching of philosophy forbidden, the scholars Damascius, Simplicius, Priscianus and four others resolved in 531 or 532 to seek the protection of Chosroes, king of Persia, but within two years they returned to Greece. After his return from Persia Simplicius wrote commentaries upon Aristotle's *De coelo, Physica, De anima* and *Categoriae,* which, with a commentary upon the *Enchiridion* of Epictetus, have survived. To the student of Greek philosophy his commentaries are invaluable, as they contain many fragments of the older philosophers as well as of his immediate predecessors.

SIMPLON PASS, a pass over the Alps. Not known early save as a purely local route, the Simplon Pass rose into importance when Napoleon caused the carriage road to be built across it between 1800 and 1807. The Simplon tunnel was opened in 1906. The pass proper starts from Brig in the upper Rhône valley, 90½ m. by rail from Lausanne. From Brig it is about 14 m. to the pass (6,592 ft.), close to which is the hospice (first mentioned in 1235) in charge of Austin Canons from the Great St. Bernard. The road descends past the Swiss village of Simplon, and passes through the wonderful rock defile of Gondo before entering Italy above Iselle (28 m. from Brig). Here the road joins the railway line through the tunnel, which is 12¼ m. in length, and 2,313 ft. high, being thus both the longest and the lowest tunnel through the Alps. From Iselle it is about 11 m. by rail to Domo d'Ossola, whence the Toce or Tosa valley is followed to the Lago Maggiore (23 m.).

SIMPSON, SIR JOHN (WILLIAM) (1858–), British architect, was born on Aug. 9, 1858, educated privately, and studied at the Royal Academy. He became a fellow of the Royal Institute of British architects in 1900, and was vice-president on two occasions, and president from 1919 to 1921. His works include the school buildings of Roedean, Brighton, extensions of Haileybury, Winchester, and Lancing colleges. He has also designed a number of memorials and many private houses. He was joint architect of the National Hospital for the Paralysed and Epileptic, London, and designed the Grafton Street hospital, Liverpool.

SIMPSON, MATTHEW (1811–1884), American bishop of the Methodist Episcopal Church, was born in Cadiz (O.) on June 21, 1811. Largely self-educated, he began to practise medicine in 1833, but the same year was licensed as a preacher of the Methodist Episcopal Church. After a couple of western pastorates, in 1837 he was appointed professor of natural science in Allegheny college, Meadville; and was from 1839 until 1848 president of the newly established Indiana Asbury (now De Pauw) university, Greencastle (Ind.). He was editor of the *Western Christian Advocate,* which he made a strong temperance and anti-slavery organ, from 1848 to 1852. He was elected a bishop in May, 1852. He died on June 18, 1884, in Philadelphia. He published *A Hundred Years of Methodism* (1876) and *Lectures on Preaching* (1879), and edited a *Cyclopedia of Methodism* (1878). A volume of his *Sermons* (1885) was edited by G. R. Crooks.

See his *Life* by G. R. Crooks (1890) and E. M. Wood, *The Peerless Orator* (1909).

SIMROCK, KARL JOSEPH (1802–1876), German poet and man of letters, was born on Aug. 28, 1802, at Bonn, where his father was a music publisher. He studied law at Bonn and Berlin, and in 1823 entered the Prussian civil service, from which he was expelled in 1830 for writing a poem in praise of the French July revolution. He became lecturer and eventually (1850) professor at Bonn, where he died on July 18, 1876. Simrock established his reputation by his excellent modern rendering of the *Nibelungenlied* (1827), of the poems of Walther von der Vogelweide (1833), and other Old High German poems.

Of his republications the most popular and the most valuable were the *Deutsche Volksbücher,* of which fifty-five were printed between 1839 and 1867. His best contribution to scholarship was his *Handbuch der deutschen Mythologie* (1853–55). Simrock took a high place among students of Shakespeare by his *Quellen des Shakespeare in Novellen, Märchen und Sagen* (1831); and afterwards he translated Shakespeare's poems and a considerable number of his dramas. His *Ausgewählte Werke* were published by G. Klee (12 vols., 1907). See N. Hocker, *Karl Simrock, sein Leben und seine Werke* (1877).

SIMS, GEORGE ROBERT (1847–1922), English journalist and dramatic author, was born on Sept. 2, 1847. He was educated at Hanwell college and at Bonn, and commenced journalism in 1874 as successor to Tom Hood on *Fun.* His first play, *Crutch and Toothpick,* was produced at the Royalty Theatre in April 1879, and was followed by a number of plays of which he was author or part-author. After long runs at west end houses, many of these became stock pieces in suburban and provincial theatres. His most famous melodramas were: *The Lights of London* (Princess's theatre, September 1881), which ran for nearly a year. and *Two Little Vagabonds* (Princess's Theatre, 1896–97), and among his musical plays were *Blue-eyed Susan* (Prince of Wales's, 1892) and *The Dandy Fifth* (Birmingham, 1898). His early volumes of light verse were very popular, notably *The Dagonet Ballads* (1882), reprinted from the *Referee.* He published a book of reminiscences, *My Life,* in 1917. He died in London on Sept. 4, 1922.

SIMS, WILLIAM SOWDEN (1858–), American naval officer, was born of United States parents at Port Hope, Ont., Canada, on Oct. 15, 1858, removing in childhood to Pennsylvania. He graduated from the U.S. Naval Academy in 1880, and for eight years served on board various ships in the North Atlantic. During 1889–93 he was with the nautical school ship "Saratoga," was transferred to the Pacific station, and later to the China station. From 1897–1900 he was naval attaché to the American Embassy, at Paris and at St. Petersburg (Leningrad), but in 1900 he returned to the Pacific station. Convinced of the inadequacy of American methods of target practice, he pressed his views upon the Government, and in the end was enabled to arrange for a gunnery test and prove his claims. This resulted in his being made inspector of target practice in the bureau of navigation, where he served seven years (1902–09). In 1907 he was made commander and appointed naval *aide* to President Roosevelt, and in 1909 he became commander of the battleship "Minnesota." During a visit of the Atlantic fleet to England in 1910, Commander Sims caused a stir at a dinner at the Guildhall, London, where he said: "Speaking for myself, I believe that if the time ever comes when the British empire is menaced by an external enemy you may count upon every man, every drop of

blood, every ship and every dollar of your kindred across the sea." A semi-official protest against this utterance was made at Washington by the German Government, but the incident ended in a severe reprimand from the President of the United States.

In 1911 Sims was promoted captain, and for two years was a member of the class of the Naval War college, Newport, Rhode Island. During 1913–15 he was in command of the Atlantic torpedo flotilla, and in 1916 in command of the battleship "Nevada." In Jan. 1917 he returned to Newport as president of the Naval War college. When America entered the World War in April 1917 he was chosen to command the American naval forces in European waters. In Jan. he had been promoted rear admiral, and in May he was given the temporary rank of vice admiral. On the conclusion of the war he relinquished command of the fleet, and in Feb. 1919 resumed his position as president of the Naval War college. In 1920 he made a formal report to the U.S. Navy Department charging it with serious errors in the conduct of naval operations during the war. He has published, in collaboration with Burton J. Hendrick, *The Victory at Sea* (1920).

SIMSON, WILLIAM (1800–1847), Scottish portrait, landscape and subject painter, was born at Dundee in 1800. He studied under Andrew Wilson at the Trustees' Academy, Edinburgh, and his early landscape and marine subjects found a ready sale. He next turned his attention to figure painting, and in 1830 was elected a member of the Scottish Academy. On the proceeds of his portrait-painting, he spent three years in Italy, and on his return in 1838 settled in London, where he died on Aug. 29, 1847. Simson is greatest as a landscapist; his "Solway Moss—Sunset," exhibited in the Royal Scottish Academy of 1831 and now in the National Gallery, Edinburgh, ranks as one of the finest examples of the early Scottish school of landscape.

His subject pictures include the "Twelfth of August" (1829), the "Highland Deerstalker" (1830); and among later works the "Camaldolese monk showing relics," "Cimabue and Giotto," the "Dutch Family," and "Columbus and his Child."

SIN is the name given to moral evil, when regarded from the point of view of religion, as distinguished from that of civic law or that of ethics. The Christian's ideal is to do all things as unto the Lord; and he looks upon his shortcomings as offences against a divinely given law or as grieving the Holy Spirit. But if this aspect of sin, or the religious associations with which moral evil is tinged, be of high significance for religious life, the nature of sin as moral evil correlated with responsibility and guilt, is fundamentally a question for ethics and psychology. That "sin is lawlessness," even when the law transgressed is regarded as divine, is a description which needs amplification, in order to fulfil the requirements of theological doctrine.

Of the several conditions of accountable moral conduct, the one just indicated may be treated first; the forthcomingness of a law, of which sin is transgression; or of a mark, of which sin is the missing. Moral law is a social acquisition; and knowledge of it is socially mediated, not innate to the individual. It is only when we begin to find certain kinds of behaviour expected of us, as what we owe, and become spectators of our conduct from the point of view from which others see us, that conscience emerges in us. It is not inborn, like instinct; nor does the soul possess it, before embodiment. We are born non-moral, not sinners. Further, St. Paul's teaching, that where no law is, sin cannot be imputed, needs to be supplemented. This brings us to the second condition of the possibility of sin. In order that an individual be accountable, it is not enough that there is moral law forthcoming, whether primitive customs or unconditional standards of Christian ethic; he must be aware of them as binding on himself, and must be in a position to perceive his act to be a shortcoming at the time of its occurrence. This reference to time is also essential. For instance, a heathen who may be blameless as to such law as he knows, is no sinner against Christian law that, as yet, he cannot know; and if he become a Christian and learn a higher ethic, he cannot then rightly accuse himself of guilt, in that, in his heathen past, he left undone what, had he been a Christian he should have done. The conduct of the infant that knows no law, or that of the adult heathen who obeys some law but knows not the highest, cannot even from the Christian standpoint, be deemed sinners. Else we should have to attribute sin to snakes and volcanoes. For the only relevant difference between the moral and the non-moral agent, is that the former can, and the latter cannot, be aware of law having dominion over it. We cannot assert sin to be non-compliance with moral law, as distinct from known moral law, without destroying the ethical significance of sin. All sin is imperfection; not all imperfection is sin. Thus it follows that there cannot be one absolute standard of perfection, to fall short of which, in any conditions and at any stage of moral enlightenment, convicts of sin. The only relevant standard is comparable to a sliding scale: it is what, to the all-seeing eye of God, is the highest that a given agent can recognize, at the time of his activity that is in question. Hence the wisdom of the counsel; "then at the balance let's be mute." Development is incompatible with perfection; the Christian, of all men, cannot say it is incompatible with sinlessness.

Turning now from the moral law and knowledge thereof to the acts and conduct to which ethical standards are applicable, we may consider the remaining conditions of what, in the strict sense, is to be called sin. Conscience and moral status, it has been said, are not innate; they are socially acquired, as human experience evolves from its earliest stages. But certain instincts and impulsive or appetitive tendencies are undoubtedly inherited. That is to say that in the body, with which an individual subject or soul becomes associated, are already ingrained aptitudes, etc., transmitted and fixed by heredity, which evoke specific reactions and responses from the soul, with its actual and potential faculties and capacities. Such appetites, instincts, strivings, etc. are involuntary, because, as yet, will or volition is not in existence. They are necessary and inevitable; the embodied soul is not responsible for them, and had no part in moulding them. They are also, from the biologist's point of view, natural or normal; not the outcome of derangement. Some of them, at least, are essential to the health and life of both individual and race. Theology must affirm that they belong to man, as it has pleased God to make him, *i.e.*, through evolutionary process. Lastly they are not only non-moral, in that they are involuntary and prior to conscience, but also neutral, in respect of what shall eventually be made out of them by the moralized person. They are the basis of virtues as well as of vices. In themselves, therefore, these propensities, or tendencies of the stock, are not sinful; no natural passion is base-born or condemnable. They are, however, the primary stuff out of which sinful conduct is shaped. But it is the will that shapes, not the stuff that is shaped, which alone calls for moral evaluation. They can no more be wicked than can alcohol or prussic acid. For the fact that they are strongly entrenched in us at birth, we are not responsible. Nor are we responsible, for the fact that they continue to assert themselves clamorously, after will and conscience have been acquired, and without respect for moral considerations; though it is thus that arise most of the "manifold temptations that death alone can cure." Temptation, however, is not sin; nor is temptability a sign of sinfulness—it is a condition of morality. But before these ethical and psychological reflections suggested themselves with the urgency they now possess, it was usual, and indeed natural, to call such inborn propensities sinful. Hence the expressions "inherited sin" and "original sin." Theologians who have framed and taught the doctrine of original sin have generally, though not universally, been willing to allow that original sin is not sin proper, and that, unlike actual sin, it is not a matter of moral responsibility and guilt. It is now generally admitted to be "sin" in but a figurative sense. Some would urge that retention of the old name "original sin" is no longer expedient, because ministering to confusion and inconsistency. What is "original" in the sense of innate or thrust upon us willy-nilly, cannot strictly be called sin. The root of sin is not a sinful root. For the fourth condition of the possibility of sinful activity is volition, and indeed intention. There must be capacity to choose between higher and lower ends, as has been recognized throughout the history of the doctrine of sin. Consequently, if there be in us, as some authorities have maintained, a moral taint that cleaves to us at our birth; some tendency, the origin of which must be beyond the conscious exercise of our freedom of will; an abiding root of sin,

which a man finds present in himself when his moral consciousness awakes; it must be brought by the soul itself, and have been contracted voluntarily in a life previous to the soul's embodiment. This speculative view has found supporters here and there down the ages; but we have no knowledge as to such life, and certainly, if the soul possessed such moral volition before embodiment, it must somehow have become dispossessed of it on entering into this life, because psychology can trace the development of volition and conscience which, at birth, are absent. This suggestion, like all other forms of doctrine of a fall, whether of the race collectively or of each soul singly, has doubtless been cherished because it has seemed difficult to many minds to account otherwise for the prevalence—often assumed to be strictly universal—of sinfulness throughout mankind; also, perhaps, because it seems to explain the emergence of moral evil in God's good world. But, as for the former of these motivations, it is enough to know that the race has solidarity in respect, not of ready-made sin, but of the non-moral appetites, etc. which prompt the will to evil choice. As for the latter of them, any kind of fall such as is invoked to account for racial sinfulness, would seem only to put the difficulty further back, not to eliminate it. Evil must have entered into the human world somehow and at some time, whether in Adam, or in Satan, or in each soul in a previous life; and that presents just the same difficulty as does the origination of sin in each man in this life. Indeed, in the case of the theory that sin originated in a previous life, the difficulty would seem to be increased. For had we all been in the same case as Milton's Satan, to account for all sinning without exception, each being the Adam of his own soul, and that before embodiment, is hardly possible; whereas our bodily nature supplies the motives which make our sinfulness explicable enough, however condemnable it be. On the other hand, the traditional doctrine that we all owe our sinfulness to the sin of the first parent of the race, either offends our moral consciousness and sense of responsibility or else confounds sinfulness with the non-moral "material" out of which our will makes sin.

Sin has, so far, been dealt with only in its elemental aspects and its earliest stages. It is, in fact, there that we encounter the controversial issues, and the features of the problem that present most difficulty and most interest for theology. The more advanced and complex stages present no further disputable issues. But it should be observed that from the dawn of volition, of thought or ideation, and of morality, our blind springs of action cease to be blind. When imbued with volitional response, they become desires, and eventually personal attitudes. Actions engender habits; emotions establish sentiments; and so on. We soon discover that appetites, the satisfaction of which yields pleasure, can be stimulated, in order to be enjoyed. Hunger may be voluntarily transformed into gluttony, sensibility into voluptuousness; and as knowledge and experience widen the lengths to which "making provision for the flesh" can be carried, become indefinitely extended. But it is not necessary to follow further the development of the intricacy of the moral life of man; the essentials for a sound psychology of sin are manifested, and can be most clearly studied, in the primary moral situations to which attention has here been almost exclusively directed.

LITERATURE.—For a critical account of the main theories and treatment from the standpoint of sin-consciousness, *see* W. E. Orchard, *Modern Theories of Sin* (1909). For a discussion of sin on the lines indicated above, *see* F. R. Tennant, *The Concept of Sin* (1912). (F. R. T.)

SIN, the name of the moon-god in Sumerian, derived from *zu-en,* usually written *en-zu,* "lord of wisdom." He became one of the principal deities of the (Semitic) Babylonian pantheon, and only in the period of the later West Semitic occupation (22nd–18th centuries) is found any trace of the pure Semitic cult of the moon god, when the title *'ammu, ḥammu* "uncle" appears. As god of the new moon he has the title *šeš-ki,* "brother of the earth," pronounced by the Semites *Nannar*>*Nanna.* The chief seats of his worship were Ur in the South and Harran in northern Assyria, but the cult at an early period spread to other centres, and temples to the moon-god are found in all the large cities of Babylonia and Assyria. During the period (*c.* 2399–2282 B.C.) that Ur exercised a large measure of supremacy over the Euphrates valley, Sin was naturally regarded as the head of the pantheon. It is to this period that we must trace such designations of the god as "father of the gods," "chief of the gods," "creator of all things," and the like. The development of astrological science culminating in a calendar and in a system of interpretation of the movements and occurrences in the starry heavens would be an important factor in maintaining the position of Sin in the pantheon. The name of Sin's chief sanctuary at Ur was E-gish-shirgal, "house of the great light"; that at Harran was known as E-khul-khul, "house of joys." On seal-cylinders he is represented as an old man with flowing beard, with the crescent as his symbol. In the astral-theological system he is represented by the number 30, and the planet Venus as his daughter by the number 15. The number 30 stands obviously in connection with the thirty days as the average extent of his course until he stands again in conjunction with the sun. The "wisdom" personified by the moon-god is likewise an expression of the science of astrology in which the observation of the moon's phases is so important a factor. The tendency to centralize the powers of the universe leads to the establishment of the doctrine of a triad consisting of Sin, Shamash and Ishtar (*q.v.*), personifying the moon, sun and Venus.

Nabunidus, the last king of Babylonia, inaugurated a movement to elevate the cult of Sin to the supreme place in religion, a movement clearly based upon astrological and astronomical theory that the triad, moon, sun and Venus are the controlling forces of divine providence. There is no doubt but that the emphasis placed upon moon worship by Sargon of Agade is due to his Semitic connection; in Arabia and throughout the Semitic races of Western Asia the moon god was from the beginning the most important deity. The consort of Sin was Ningal, to whom a special temple was built at Ur, and her cult was widely known in Syria where her name appears as Nikal. The cult of the Babylonian Sin seems to have been particularly favoured by the Assyrian colony in Cappadocia in the 21st–19th centuries, and among the Hittites of Anatolia and Syria.

BIBLIOGRAPHY.—E. G. Pery, *Hymnen und Gebete an Sin* (Leipzig, 1907); S. Langdon, *Oxford Editions of Cuneiform Texts,* Vol. VI. (Paris, 1927); A. Jeremias, *Handbuch der altorientalischen Geisteskultur* (Leipzig, 1913), pp. 240–248. (S. L.)

SINAI, the mountain which has given its name to the "Sinaitic peninsula," the triangle lying between Egypt, South Palestine, Arabia and the Red sea. The mountain is famous in the Old Testament for the law-giving to Moses and the Israelites when they entered into covenant relations with the God who had delivered them from Egypt (Ex. xix. *seq.*). The events, which are the preludes to the journeys into Palestine, stand at the head of the national history of Israel; and Sinai and other places to the south of Palestine (Kadesh, Edom, Mt. Seir, Paran, Midian) are firmly established in tradition as, in some sense, the true home of the national god Yahweh (Deut. xxxiii. 2., Judges, v. 5, Hab. iii. 3, Ps. lxviii. 8).

Mt. Sinai, whose name connects it with the old Babylonian moon-god Sin, is also known as Horeb (1 Ki. viii. 9, Mal. iv. 4, etc.): and not only is the site disputed, but it is possible that they were originally two mountains, which later harmonizing tradition has combined. It has long been felt difficult to suppose that the Sinaitic peninsula could have been the scene of the wanderings of the immense body of Israelites, as described, and a careful study of the biblical narratives has raised questions which have not yet been adequately answered. Analysis has made it probable that Kadesh-Barnea (50 m. S. of Beersheba) was the scene of some of the most important incidents now placed at Sinai, and the mount of the law-giving, or, perhaps, more especially Mt. Horeb, should possibly be looked for in Midian, east of the Gulf of Akaba. (*See* JETHRO.)

The northern part of the Sinaitic peninsula has the ancient oft-trod road between Egypt and Palestine, one of the most famous in all history. Farther south is the bare and gradually rising region known as the wilderness of et-Tih ("wandering"). Two very important roads meet at the station of el-Nakhl, one running from Suez eastward to Akaba (the pilgrim road), another from Gaza southwards, opening out into various parts of the

mountainous district of Sinai itself. Here, the Jebel Serbal (6,750 ft.) and the Jebel Musa (7,359 ft.) compete for the honour of being the mount of the law-giving.

There is no genuine pre-Christian tradition on the subject. The chief authority for the ancient sanctity of Mt. Sinai is Antoninus Martyr (end of the 6th century A.D.), who tells that the heathen Arabs in his time still celebrated a moon feast there. As Sin was a moon-god, the feast has been connected with the name of Sinai. Of Arab origin, too, are the innumerable "Sinaïtic inscriptions," found especially in the Wādy Mokatteb (in the north-west), and sometimes accompanied by rude drawings. The language and character are Aramaic (Natabaean), but the proper names are mainly those of Arabs, who passing by graved their names on the rocks. That they were pilgrims to Sinai cannot be made out with certainty. The inscriptions date from the early centuries of the Christian era. In early Christian times, when the peninsula was once better wooded, many anchorites inhabited Sinai, living for the most part in the caves, which are numerous even in the primitive rocks. Monasteries were built, the most famous being the great one of St. Catherine in Wādy el-Dēr (the valley of the monastery). On Serbāl, too, there were many granite dwellings, and in the neighbouring Pharan (Phoenicion), which was a bishop's see, there were, as the ruins show, churches and convents. Josephus says that Sinai was the highest mountain of the district—a description which might apply to Serbāl as seen from the plain below. Eusebius uses expressions which may also seem to point to Serbāl as the place of the law-giving; whereas the tradition which seeks the holy site in the group of Jebel Mūsā (*i.e.,* the mass of which Mt. Catherine is the highest peak) is not older than the time of Justinian, and, on the whole, in spite of some good authorities, is of less value.

The southern half of the peninsula was famed for its stone, and its mines of copper and turquoise (malachite). At the Wady Maghara and Serabit el-Khadem the Egyptians have left abundant traces of settlements which testify to the constant exploitation of the turquoise mines from the Ist Dynasty onwards. Sinai, too, may have been the land of Magan, whence the Babylonians obtained stone as early as the days of Naram-Sin. In any case the peninsula as a whole must have had considerable strategical and economic importance from very ancient times. It is of special interest, therefore, that remains were found at Serabit of a highly developed cult in connection with the mines. The place has been described by Sir W. M. Flinders Petrie (1905). Although King Snefru, the last of the IIIrd Dynasty, came to be regarded as a sort of tutelary deity, the real guardian was the goddess Hathor, the "lady (or mistress) of turquoise." Her shrine was in a cave, in front of which buildings ran out for a distance of 250 feet. Adjoining the cave was the shrine of Sopdu, the lord of the deserts, and among the more noteworthy indications of an ancient and long-enduring cult was an enormous mass of ashes (estimated at 50 tons) in front of the cave, though the purpose of the ceremonial burnings is unknown.

As Petrie recognized, Hathor represents some Semitic deity. Her cult was Semitic and not Egyptian, and was earlier than any known in Palestine or Arabia. Her Semitic title "baalath" (on which *see* BAAL) was subsequently read upon some remarkable inscribed monuments written in characters which come between the Egyptian hieroglyphs and ancestral Semitic and European alphabets. They are of the XVIIIth Dynasty, and possibly the XIIth; and although the inscriptions still defy complete decipherment, the supposition that they were by, or refer to, the Israelites is—as yet at least—as baseless as an early view that the Aramaean "Semitic inscriptions," mentioned above, had a like origin. The script is of exceptional interest for the problem of the alphabet. It is disputed whether it is to be regarded as the actual ancestor of the two great branches: (1) the South Arabian, (2) the North Semitic (Phoenician, etc.) and the Greek, or whether it is only one of other forms once current before the types became fixed. In any event, since the Sinaitic peninsula touches the Delta and the South Palestinian towns of Rhinocolura (el-'Arish) and Gaza, both of which were in contact with North Arabia and the Levant, its situation makes it a natural centre for the rise and distribution of the alphabet (*q.v.*).

The resources of the peninsula would obviously attract the attention of peoples other than those of Egypt and Babylonia. Amenemhet III. (XIIth Dynasty) and Queen Hatshepshut (XVIIIth Dynasty) industriously exploited Serabit, and with the Ramessids traces of Egypt come to an end. But the invasion of Egypt by the Hyksos (whose seat was at the Delta city of Avaris) comes between the first and second of these periods, while the third marks the decline of Egypt and the increase of Semitic power. It is very unlikely, therefore, that the wealth of the peninsula was appreciated only by Egypt. The peninsula was the meeting-place of diverse influences. It was exposed, on the north, to Aegean, Philistine and other peoples of the eastern Mediterranean. The "land of the Philistines" extended southwards from Gath, Gaza and Gerar (Gen. xxvi., Deut. ii. 23, 1 Sam. xxvii. 8–11); and it is noteworthy that hereabouts are found the markedly un-Semitic names (Kadesh-) Barnea, Ziklag and 'Amālek (perhaps an Arab plural of some such form as 'Amlak). It is not known whether they point to Philistine or related influence. (*See* PHILISTINES.) They do not seem to be Egyptian, although Egyptian influence can be traced as far east as Tema (Teima) in North Arabia. Egypt (*see* MIZRAIM) would lay claim to the whole peninsula, and the "Wady of Egypt" (el-Arīsh) formed the northern end of the boundary. (*Cf.* 1 Ki. viii. 65.) None the less, the peninsula was Semitic rather than Egyptian, and was occupied by tribes with South Palestinian connections. Biblical tradition groups all these under Hagar and Ishmael, Esau, Edom, Mt. Seir and the Horites, and Abraham's concubine Keturah. Moreover, the Horite name Lotan, with which Lot, the ancestor of Ammon and Moab, may no doubt be connected, seems to be an echo of Retenu, an Egyptian name for Palestine; and whether this be so or not, the fact that men of Retenu are explicitly mentioned in Egyptian inscriptions of the XIIth Dynasty at Serabit, unites the peninsula naturally with the Semites of Palestine.

How the name Sinai arose can hardly be determined. There is a wilderness of Sin (Exod. xvi. 1)—Zin (Deut. xxxii. 51, etc.) is quite different—and Sin (Ezek. xxx. 15; old Egyptian *sinw*), situated at or near Pelusium, may have the same meaning. The appearance of the old Babylonian moon-god Sin in this part of the Semitic world is as striking as that of Baal-Zephon, the "Mountain of the north," by the Red Sea (*see* Exod. xiv. 2), and of Mt. Nebo in Moab (Deut. xxxii. 49, *seq.*). These names, with the Semitic cult at Serabit, and the remains of a more or less contemporary sanctuary at ed-Dra, in Moab, point to some definite religious culture long before Israelite times. Sin, the moon-god, had his most famous seats at Ur in Babylonia and at Harran in North Syria; and when, in the 6th century B.C., Nabonidus interested himself in the moon-cult at these places, he also visited Teima in North Arabia—presumably for the same reason. Hebrew tradition claimed, through Abraham (*q.v.*), an early relationship with both Ur and Harran, and some evidence has been adduced by scholars to suggest that Yahweh, the god of Israel, was probably once regarded as a moon-god. (*See* Burney, *Judges*, pp. 249, *seq.*) Yet while the moon-cult seems to have been particularly prominent in early Semitic religion, and in the Sinaitic area, it is not the moon-god but the sun-god who, as god of justice, would be most naturally associated with a law-giving, even as it is from the sun-god Shamash that the Babylonian law-giver Hammurabi received his great code. The religious history of the Sinaitic area goes back to a remote date, and is pre-Israelite; but the biblical narratives have their own national traditions of its significance for them, and these must be subjected to a critical analysis. (*See* AARON, MOSES, EXODUS, NUMBERS and HEBREW RELIGION.)

BIBLIOGRAPHY.—*See* Petrie (and Currelly), *Researches in Sinai* (1906); L. Eckenstein, *History of Sinai* (1921). For the inscriptions at Serabit, *see* in the first instance, the articles by A. N. Gardiner and by Cowley in the *Journal of Egyptian Archaeology*, iii., 1, *seq.*

(S. A. C.)

SINAIA, a town of Rumania, on the railway from Ploeşçi to Braşov in Transylvania. Pop. (1928), 6,400. Sinaia resembles a large model village, widely scattered among the pine forests of the lower Carpathians, and along the banks of the Prahova, a swift

alpine stream. The monastery of Sinaia, founded by Prince Michael Cantacuzino in 1695, was the residence of the royal family until the present chateau was built. Its library contains valuable jewels belonging to the Cantacuzene family. Castle Peleş, the modern palace, named after the hill on which it stands, is of a mixed style of architecture on the whole Germanic. Until 1850 Sinaia consisted of little more than the monastery and a group of huts.

SINALOA, a State of Mexico, on the Gulf of California, with a coast line of nearly 400 miles. Area, 27,557 sq.m. Pop. (1910), 323,642; (1921), 341,265. The surface consists of a narrow coastal zone where tropical conditions prevail, a broad belt of mountainous country covered by the ranges of the Sierra Madre Occidental and their intervening valleys where oak and pine forests are to be found, and an intervening zone among the foothills of the Sierra Madre up to an elevation of 2,000ft., where the conditions are subtropical. The State is traversed by numerous streams, the largest of which have broad valleys among the foothills. The largest of these are the Culiacán, Fuerte and Sinaloa, the last two having short navigable courses across the lowlands.

Rain is plentiful everywhere, except in the extreme north, where the conditions are arid. The climate of the low-lying coast lands is hot; however, in the mountains it is cool and healthy. Cereals and *mezcal* are produced on the uplands, and sugar, rum, coffee, tobacco, grape spirits and fruit in the lower zones. There are excellent cotton lands in the State and the production of this staple was largely developed during the American Civil War, but has since declined. In recent years large quantities of tomatoes have been raised, chiefly for the American market. Grazing receives considerable attention in the uplands, where the temperature is favourable and the pasturage good, and hides are largely exported. Mining, however, is the chief industry, Sinaloa being one of the richest mineral-producing States in the republic. Gold, silver, copper, iron and lead are found. There are also salt deposits and mineral springs. The best-known silver mines are the Rosario, from which about $90,000,000 had been extracted up to the last decade of the 19th century, and the Nuestra Señora de Guadalupe de los Reyes, discovered early in the 19th century and yielding over $85,000,000 before its close. The forest products of the State include rubber, resins, cabinet and dye-woods, orchilla and ixtle fibre. Up to the beginning of the 20th century Sinaloa had only one short railway, which connected Culiacán with its port Altata. Since then the Mexican branch of the (American) Southern Pacific railway from Nogales to Guaymas has been extended south-east along the coast to connect the railways of central Mexico. Sinaloa has excellent natural harbours, only two of which —Mazatlán and Altata—are much used. The Bays of Agiobampo and Topolobampo are prospective railway terminals with fine harbours. The capital of the State is Culiacán Rosales (commonly called Culiacán), on the Culiacán river 39 m. from its port, Altata, at the mouth of the same river, with which it is connected by rail. It is a well-built town, with some thriving manufactures, including cotton goods, cigarettes, liqueurs, etc. It is the see of a bishop and has a fine cathedral. Culiacán (pop. in 1910, 13,527; 1921, 16,034) is the distributing centre for a large district between Guaymas and Mazatlán. The next most important town is Mazatlán (pop. 25,254) one of the leading ports of Mexico on the Pacific coast, and the commercial centre for S. Sinaloa and N. Durango. Other towns are Mocorito (pop. 3,757 in 1921), Sinaloa (pop. 1,666 in 1921), and Fuerte (pop. 2,836 in 1921), all in the N. of the State, Rosario (pop. 7,050 in 1921), and San Ignacio (pop. 1,635 in 1921) in the South.

SINCLAIR, the name of an old Scottish family, members of which have held the titles of earl of Orkney and earl of Caithness. The word is a variant of Saint Clair.

Sir William Sinclair, or Saint Clair (*c.* 1260–*c.* 1303), was the descendant of a line of Anglo-Norman barons, one of whom obtained the barony of Rosslyn from King David I. in the 12th century. Sir William took part in the dispute over the succession to the crown of Scotland in 1292, and was one of the leaders of the Scots in their revolt against Edward I. His grandson Sir William Sinclair, was slain by the Saracens in August 1330, while journeying through Spain to Palestine with Sir James Douglas, the bearer of the heart of Bruce. This Sir William Sinclair married Isabel, daughter of Malise, earl of Strathearn, Caithness and Orkney (d. *c.* 1350), and their son Sir Henry Sinclair (d. *c.* 1400) obtained the earldom of Orkney by a judgment of the Norwegian king Haakon VI. in 1379. He then helped to conquer the Faeroe Islands, and took into his service the Venetian travellers, Niccolo and Antonio Zeno, sailing with Antonio to Greenland.

William, the 3rd earl of his line, whose earldom of Orkney was a Norwegian dignity, was made chancellor of Scotland in 1454 and Lord Sinclair and earl of Caithness in 1455. When in 1470 the Orkney Islands were ceded by Norway to King James III. he resigned all his rights therein to his sovereign and was known merely as earl of Caithness. His eldest son, William, having offended his father by his wasteful habits, the earl settled his earldom on his eldest son by another marriage, also called William, who was killed at Flodden in 1513. The elder William, however, inherited the title of Lord Sinclair, and the family was thus split into two main branches.

George, 4th earl of Caithness (*c.* 1525–1582), a son of the 3rd earl, was a Roman Catholic and a supporter of Mary Queen of Scots, but he was mainly occupied with acts of violence in the north of Scotland. His grandson George, the 5th earl (*c.* 1566–1643), was outlawed and compelled to fly to the Shetlands. He left many debts, and his great-grandson and successor, George, the 6th earl (d. 1676), who was childless, arranged that his estates should pass to a creditor, Sir John Campbell, afterwards earl of Breadalbane. Campbell was created earl of Caithness in 1677, but the title was also claimed by George Sinclair (d. 1698), a grandson of the 5th earl, and in 1681 the privy council decided in his favour. When Alexander, the 9th earl, died in 1765 the title was successfully claimed by William Sinclair (d. 1779), a descendant of the 4th earl, who became the 10th earl.

The title of Lord Sinclair passed from William, the 2nd lord, who died about 1488, to John (1610–1676), who became the 9th lord in 1615. At first a covenanter, afterwards he became a royalist, and was taken prisoner at the battle of Worcester. He died without male issue and the title became dormant. His estates, however, passed to his grandson, Henry St. Clair (1660–1723), the son of his daughter Catherine (d. 1666) and her husband, John St. Clair of Herdmanston, and in 1677 Henry was created Lord Sinclair with the precedence of the older title. He had two sons, John Sinclair (1683–1750) the Jacobite, and James Sinclair, who became a general in the British army, and was also ambassador at Vienna and Turin and a member of parliament for many years. After the attainder of John, in consequence of his share in the rising of 1715, the family estates were settled on James, but he resigned them to his elder brother when the latter was pardoned in 1726. The pardon, however, did not include the restoration of the title. Earlier in life John Sinclair had killed a man named Shaw in a duel and had afterwards shot this man's brother. He was tried by court-martial and sentenced to death, but was pardoned. An account of the proceedings in the court-martial was edited by Sir Walter Scott for the Roxburghe Club (Edinburgh, 1828). Sinclair himself wrote *Memoirs of the Rebellion*, published by the Roxburghe Club in 1858.

Neither of the brothers left male issue, and the title devolved upon a cousin, Charles St. Clair (d. 1775), who was not included in the attainder. Charles did not claim it, but in 1782 his grandson Charles (1768–1863) was declared to be Lord Sinclair. He was a Scottish representative peer from 1807 to 1859 and is the ancestor of the present holder of the title.

See Sir R. Douglas, *The Peerage of Scotland,* new ed. by Sir J. B. Paul; G. E. (Cokayne), *Complete Peerage;* Sinclair, *The Sinclairs of England* (1887); Sir R. Gordon and G. Gordon, *The Earldom of Sutherland* (Edinburgh, 1813), and Hay, *Genealogy of the Sinclairs of Roslin* (1835).

SINCLAIR, SIR JOHN, Bart. (1754–1835), Scottish writer on finance and agriculture, was the eldest son of George Sinclair of Ulbster, a member of the family of the earls of Caithness, and was born at Thurso Castle on May 10, 1754. After studying at Edinburgh, Glasgow, and Trinity College, Oxford, he

whom must be a barrister specially qualified to deal with mercantile cases.

See H. M. Birdwood, *The Province of Sind* (Society of Arts, 1903); and Sir Richard Burton, *Scinde* (1851); Gazetteer of Province of Sind, vol. A. (1907) and vol. B. (districts) 1919; Statistical Atlas of Bombay Presidency (1925); J. Abbott, *Sind: A Re-interpretation* (1924); Royal Comm. on Agriculture in India 1928, Evidence taken in Sind, Bull. 150, Dept. of Agric., Bombay (1928). *See* also INDIAN DESERT bibliography. (A. V. W.)

SINDBAD THE SAILOR, VOYAGES OF, a collection of Arabic travel-romances, partly based upon experiences of oriental navigators (especially in the 8th–10th centuries); partly upon ancient poetry, Homeric and other; partly upon Indian and Persian collections of *mirabilia.* In Sindbad's First Voyage, from Baghdad and Basra, the incident of the Whale-Back island may be compared with the Indian ocean whales of Pliny and Solinus, covering four *jugera,* and the *pristis* sea-monster of the same authorities, 200 cubits long. With the Island of the Mares of King Mihraj, or Mihrjan, we may find (rather imperfect) parallels in Homer's *Iliad* (the mares impregnated by the wind), in Ibn Khurdadbih and Al Kazwini, and in Wolf's account of the three *Ilhas de Cavallos* near Ceylon, so called from the wild horses with which they abounded, to which the Dutch East India merchants of the 17th century sometimes sent their mares for breeding purposes. Sindbad's account of the kingdom of Mihraj (Mihrjan) is perhaps derived from the *Two Musulman Travellers* of the 9th century; it would seem to refer to one of the greater East Indian islands, perhaps Borneo. Sindbad's Valley of Diamonds has fairly complete parallels in Al Kazwini, in Benjamin of Tudela, in Marco Polo and in the far earlier Epiphanius, bishop of Salamis in Cyprus, who died A.D. 403. As to the Mountain, or Island, of Apes in the Third Voyage, Ibn Al Wardi and Idrisi each recognizes an island of this kind, the former in the China sea, the latter near Sokotra. Sindbad's negro cannibal adventure reproduces almost every detail of the Cyclops story in the *Odyssey;* among the Spice islands, and perhaps at Timor, may be located the island rich in sandal-wood, where the wanderer rejoins his friends. The cannibal land of the Fourth Voyage, producing pepper and coco-nuts, where Sindbad's companions were offered food which destroyed their reason, has suggested the Andamans to some enquirers and certain districts of Sumatra to others; with this tale we may compare the lotus-eating of the *Odyssey,* Plutarch's story of Mark Antony's soldiers maddened and killed by an "insane" and fatal root in their Parthian wars, a passage in Davis's *Account of Sumatra* in 1599, and more complete parallels in Ibn Al Wardi and Al Kazwini. The burial of Sindbad in, and his escape from, the cavern of the dead is faintly foreshadowed in the story of Aristomenes, the Messenian hero, and in a reference of St. Jerome to a supposed Scythian custom of burying alive with the dead those who had been dear to them; the fully-developed Sindbad tale finds an echo in "Sir John Mandeville." For the "Old Man of the Sea," in the Fifth Voyage, we may also refer to Al Kazwini, Ibn Al Wardi and the romance of Seyf Zu-l Yezen; Sindbad's tyrannical rider has usually been explained as one of the huge apes of Borneo or Sumatra, improved to make a better story.

See Richard Hole, *Remarks on the Arabian Nights' Entertainments, in which the Origin of Sindbad's Voyages . . . is particularly considered* (1797); Eusebius Renaudot's edition of the *Two Musulman Travellers* (1718, translated into English, 1733, as *Ancient Accounts of India and China by two Mahommedan Travellers . . . in the 9th Century*); J. T. Reinaud, *Relations des voyages faits par les Arabes et les Persans dans l'Inde et à la Chine dans le IXe siècle* (1845); E. W. Lane's translation of the *Arabian Nights* (1859), especially the notes in vol. iii. pp. 77–108; M. J. de Goeje, *La Légende de Saint Brandan* (1890); C. R. Beazley, *Dawn of Modern Geography* (1897), i. 235–238, 438–450.

SINDHI (properly *Sindhī,* the language of Sindh, *i.e.,* Sind) and **LAHNDA** (properly *Lahndā* or *Lahindā,* or *Lahndē-dī-bōlī,* the language of the west), two closely connected forms of speech belonging, together with Kashmiri (*q.v.*), to the north-western group of the outer band of Indo-Aryan languages.

The parent Prakrit, from which Lahnda is sprung, must once have extended over the greater part of the Punjab, but Lahnda and Sindhi, the western outposts of Indo-Aryan speech, have for centuries occupied a peculiarly isolated position, and have in many respects struck out common lines of independent growth. This process was aided by the presence of Dardic languages (*see* INDO-ARYAN LANGUAGES). In early times there were Dardic colonies along the Indus, right down to its delta, and both Sindhi and Lahnda have borrowed many peculiarities from their dialects.

Sindhi is directly derived from the Vrācaḍa Apabhraṁśa Prakrit (*see* PRAKRIT). The name of the Apabhraṁśa from which Lahnda is derived is not known, but it must have been closely allied to Vrācada. Sindhi has one important dialect, Kachchhī, spoken in Cutch. Here the language has come into contact with Gujarati and is somewhat mixed with that form of speech. (*See* also LAHNDA.)

Owing to their geographical position both Sind and the western Punjab were early subject to Mohammedan inroads. The bulk of the population is Muslim, and their languages make free use of words borrowed from Persian and (through Persian) from Arabic. The written character employed for Lahnda is usually that modification of the Persian alphabet which has been adopted for Hindustani. For Sindhi, further modifications have been introduced to represent special sounds. In both languages, Hindus also employ a script akin to the well-known Nagari alphabet (*see* SANSKRIT). It is the same as the "Laṇḍā" (a word distinct from "Lahndā") or "clipped" character current all over the Punjab and is very imperfect, being seldom legible to any one except its original writer, and not always so to him.

Phonetics.—The phonetic system of both languages in most respects resembles that of other Indo-Aryan vernaculars. In other Indo-Aryan languages a final short vowel is generally elided. This rule is also followed in Lahnda, but the genius of Sindhi requires every word to end in a vowel, and hence these short vowels are still retained. In Sindhi these final short vowels are very lightly pronounced, so that they are hardly audible. Lahnda, especially when dropping the final short vowel, has epenthetic changes, which have not been noted in Sindhi. In that language and in Lahnda the short vowel *i,* when preceded or followed by *h,* or at the end of a word, is pronounced as a short *e.*

In Lahnda the double consonant is generally retained, but in Sindhi, while the double consonant is simplified, the vowel remains short. An original long vowel coming before a conjunct consonant is shortened when the conjunct is simplified.

In Sindhi, a sibilant is liable to be changed into *h.* In Lahnda the *s* is generally, but not always, preserved. A medial *d* becomes the hard *r;* there is great confusion between cerebrals and dentals, more common in Sindhi than in Lahnda. In Sindhi, *t* and *d* become regularly cerebralized before *r.* The cerebral *l* does not appear in Sindhi, but it has survived from Prakrit in Lahnda. When *l* represents a Prakrit single *l,* it becomes *ḷ,* but if it represents a Prakrit *ll,* it remains a simple dental *l.*

Sindhi has a series of "recursive" consonants *g̅, j̅, ḍ̅,* and *b̅.* In sounding them the breath is drawn in instead of being expelled, *i.e.,* the larynx being lowered and the glottis closed. They often, but not always, represent an original double letter.

Declension.—Both languages have lost the neuter gender, all nouns being either masculine or feminine. The rules for distinguishing gender are much as in Hindustani. As in other Indo-Aryan languages, nouns may be either strong or weak, the strong forms being derived from nouns with the pleonastic Sanskrit suffix *ka.* In Sindhi, a masculine weak form in *u* corresponds to the strong one in *ō,* and feminine weak forms in *a* and *o* to a strong one in *i.* In Lahnda, weak forms have dropped the final short vowel, and the strong forms end in *ā* (masc.) and *ī* (fem.).

Almost the only old case that has survived throughout the declension of both languages is the general oblique. This is used for any oblique case, the particular case required being as a rule further defined by the help of a postposition. The general oblique case, without any defining postposition, is specially employed for the case of the agent. There are also examples of the survival of the old locative and of the old ablative.

In Lahnda the final short vowel of the weak forms has been dropped, but in some cases the final *u* of the masculine and the final *i* of the feminine have been preserved by epenthesis. The

Lahnda forms of the nominative plural and of the various oblique forms are identical with those found in Panjabi. In both languages the accusative case is the same as the nominative, unless special definiteness is required, when the dative is employed in its place. The agent case is the oblique form without any postposition. All the postpositions are added to the oblique form. The genitive is really a possessive adjective and agrees with the person or thing possessed in gender, number and case.

An adjective agrees with its qualified noun in gender, number and case. In Lahnda the only adjectives which change in these respects are strong adjectives in *ā*. In Sindhi weak forms in *u* also change the *u* to *e* or *a* in the feminine. The plural and oblique forms are made as in the case of nouns. If a postposition is used with the noun it is not also used with the adjective. Comparison is effected by putting the noun with which comparison is made in the ablative case. Sometimes special postpositions are employed for this form of the ablative.

The north-western group of Indo-Aryan vernaculars, Sindhi, Lahnda and Kashmiri, made free use of pronominal suffixes. In Kashmiri these are added only to verbs, but in the other two languages they are also added to nouns. These suffixes take the place of personal pronouns in various cases.

All these suffixes are remnants of the full pronominal forms. In all cases they can be at once explained by a reference to the originals in Dardic rather than to those of other Indo-Aryan languages.

Conjugation.—There are, in both languages, two conjugations, of which one (intransitive) has *-a-* and the other (transitive) *-e-* or *-i-* for its characteristic letter. The differences appear in the present participle and, in Sindhi, also in the conjunctive participle, the present subjunctive, and imperative. The two latter are the only original synthetic tenses which have survived in Sindhi, but in Lahnda the old synthetic future is also in common use. Both languages have a passive voice formed by adding *ij* or *īj* to the root. This form is not employed for the past participle or for tenses derived from it.

The past participle of the transitive verb is passive in signification. There is therefore no need of a past participle for the passive voice. The Sindhi present participle of the passive voice follows a different rule of formation, and, in Lahnda, it omits the letter *j*. In other respects the passive is conjugated like a regular verb of the first conjugation. The passive is directly derived from the outer Prakrit passive in *-ijja-*.

The present subjunctive is the direct descendant of the old Prakrit present indicative.

The imperative is formed in the same way. The Sindhi future is formed by adding the nominative pronominal suffixes to the present participle. As there are no nominative suffixes of the third person, for that person the simple participle is employed. There are slight euphonic changes of the termination of the participle in the other persons.

The past tense is formed from the past participle with pronominal suffixes added in both languages. As in the transitive verb the past participle is passive in signification, the subject must be put in the agent case, and the participle agrees in gender and number with the direct object, or, if the object is put in the dative case instead of the accusative, is treated impersonally in the masculine.

There are numerous compound tenses formed by conjugating the verb substantive with one or other of the participles. The past has slightly different forms with a feminine subject. Additional suffixes may be added to indicate the object, direct or remote.

Numerous verbs have irregular past participles, derived directly from the Prakrit past participles. The many compound verbs are formed much as in Hindustani, and must be learnt from the grammars.

Literature.—Sindhi and Lahnda possess no literature worthy of the name. There is, in both languages, a large stock of folk-songs—rude poems dealing with the popular traditions of the country. *See* Colonel Sir Richard Temple's *Legends of the Panjab* (Bombay, 1884–1900). Also E. Trumpp, *Sindhī Literature, the Dīvān of Abd-ul-Latīf, known by the name of Shāha jō Risālō* (Leipzig, 1866).

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SIN-EATER, a man who for trifling payment was believed to take upon himself, by means of food and drink, the sins of a deceased person. The custom was once common in many parts of England and in the highlands of Scotland. Usually each village had its official sin-eater to whom notice was given as soon as a death occurred. He at once went to the house, and there, a stool being brought, he sat down in front of the door. A groat, a crust of bread and a bowl of ale were handed him, and after he had eaten and drunk he rose and pronounced the ease and rest of the dead person, for whom he thus pawned his own soul.

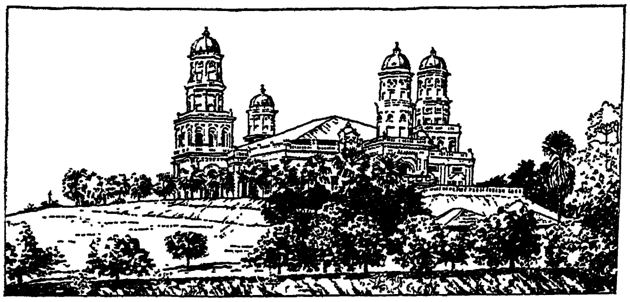
In the earlier form the sin-eater was taken into the death-chamber, and a piece of bread and possibly cheese, having been placed on the breast of the corpse by a relative, usually a woman, was afterwards handed to the sin-eater, who ate it in the presence of the dead. He was then handed his fee and at once hustled and thrust out of the house amid execrations and a shower of sticks, cinders, or other missiles. The custom of sin-eating is generally supposed to be derived from the scapegoat in Leviticus xvi. 21, 22. A symbolic survival of it was witnessed in 1893 at Market Drayton, Shropshire. After a preliminary service had been held over the coffin in the house, a woman poured out a glass of wine for each bearer and handed it to him across the coffin with a "funeral biscuit." In Upper Bavaria sin-eating long survived; a corpse cake was placed on the breast of the dead and then eaten by the nearest relative.

SINEW, a tendon, a cord-like layer of fibrous tissue at the end of a muscle forming the attachment to the bone or other hard part. The broad, flat tendons are usually called *fasciae* (*see* Muscular System and Connective Tissue).

SINGAPORE, a town and island situated at the southern extremity of the Malay peninsula in 1° 20′ N., 103° 50′ E. Singapore is the most important part of the crown colony of the Straits Settlements, which consists with it of Penang, Province Wellesley and the Dindings, and Malacca (*qq.v.*). The port is one of the most valuable of the minor possessions of Great Britain, as it lies midway between India and China, and forms the most important halting-place on the trade-route to the Far East. It is being strongly fortified as a naval base at the cost of the imperial government, aided by an annual military contribution payable by the colony and fixed at 20% of its gross revenue. Its geographical position gives it strategic value; and as a commercial centre it is without a rival in this part of Asia. Its prosperity has been greatly enhanced by the rapid development of the Malay States on the mainland. It possesses a good harbour with docks and extensive coaling-wharves, which were acquired by government from the Tanjong Pagar Dock Company. It is also resorted to by native craft from all parts of the Malay archipelago. On the island of Pulau Brani stand the largest tin-smelting works in existence, which for many years have annually passed through their furnaces more than half the total tin output of the world. Singapore has also establishments for tinning pineapples, a rubber factory, a tannery, a shoe factory and a biscuit factory. Notable are a few large commercial buildings, government house, the law-courts, a magnificent hospital, a new lunatic asylum, Raffles college, Raffles museum and the cathedral of St. Andrew. There are

several Roman Catholic churches, a Free Kirk, an American mission, and chapels belonging to Nonconformist sects. The mosques and Chinese and Hindu temples are numerous. There are military barracks at Tanglin. There is a good race-course and polo-ground, a fine cricket-ground on the esplanade, four golf courses, and yachting, swimming and social clubs.

The island is 27 m. long by 14 m. broad, and is joined to the state of Johore, situated on the mainland of the Malay Peninsula, by a cause-way. A railway runs from the town of Singapore



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIP CO.

THE MOSQUE OF THE SULTAN OF JOHORE, ONE OF THE MANY RELIGIOUS EDIFICES IN SINGAPORE

through Johore Bharu up to Penang and on to Bangkok. The strait which divides the island from the Dutch islands of Bintang, Rhio, etc., bears the name of the Singapore strait. The surface of the island is undulating and diversified by low hills, the highest point being Bukit Timah, on the north-west of the town, which is a little over 500 ft. Geologically, the core of the island consists of crystalline rocks; but in the west there are shale and sandstone. All round the island the valleys are filled with alluvial deposits on a more extensive scale than could have been formed by the existing rivers: they suggest that the island was once united to Johore. The south-west shores are fringed with coral reefs, and living coral fields are found in many parts of the straits. Composed largely of red clays and laterite, the soil is not rich, and calls for the patient cultivation of the Chinese gardener to make it productive. The forest is of a mean type. The humid climate causes the foliage here, as in other parts of Malaya, to be luxuriant, and the contrast presented by the bright green and the rich red laterite of the cliffs is striking. When first occupied by Sir Stamford Raffles, on behalf of the East India Company, the island was covered by jungle, but now all the land not reserved by government has been taken up, principally by Chinese, who plant rubber, vegetables and other products. There are fine botanical gardens at Tanglin.

The climate of Singapore is humid and hot. There is hardly any seasonal change, and the dampness causes the heat to be more oppressive than are higher temperatures in drier climates. The mean temperature in Singapore during 1926 was 80·1° F. The highest shade temperature for the year was 93·5° F registered in April; the lowest 70·7° F, registered in February. North and north-east winds prevail from the middle of October to the end of April, and south and south-west winds from the middle of May to the end of September. The rainfall has been recorded regularly since 1862. The wettest year was 1913 with 3,442·37 mm. and the driest 1877 with 1,482·7 mm. The average number of rainy days during the past decade has been 173 and the average rainfall 2,526·7 mm.

Statistics of population are given in the article STRAITS SETTLEMENTS: *Population.* Singapore with its hordes of immigrants naturally has the lowest proportion of females but it is rapidly making up leeway. There are representatives of almost every Asiatic nation and of many other races, Singapore being one of the most cosmopolitan cities in the world.

As Singapore is the chief administrative centre of the colony, the governor has his principal residence here. Here also are chief offices of the various heads of the government departments, and here the legislative council of the colony holds its sessions.

The trade of Singapore is chiefly dependent upon the position which the port occupies as the principal emporium of the Federated Malay States and of the Malay archipelago, and as the great port of call for ships passing to and from the Far East. The ships using the port during 1926 numbered 15,977 with an aggregate tonnage of 25,628,329 tons of which 7,516 were British ships with an aggregate tonnage of 10,977,421 tons. The retail trade of the place is largely in the hands of Chinese, Indian and Arab traders, but there are good European shops. The port is a free port, import duties being payable only on opium, tobacco, wines and spirits.

It is possible that Singapore was a trading centre in the 12th and 13th centuries, but neither Marco Polo nor Ibn Batuta, both of whom wintered in Sumatra on their way back to Europe from China, have left anything on record confirmatory of this. About the middle of the 14th century it was destroyed by Majapahit. In 1552 St. Xavier despatched letters from the port to Goa. When it passed by treaty to the East India Company in 1819, Sir Stamford Raffles persuading the sultan and temenggong of Johore to cede it to him, it was uninhabited save by fisherfolk. It was at first subordinate to Benkulen, the company's principal station in Sumatra, but in 1823 it was placed under the administration of Bengal. It was incorporated in the colony of the Straits Settlements when that colony was established in 1826. *See* also MALAY PENINSULA and STRAITS SETTLEMENTS. For the naval base *see* DOCKS AND NAVAL BASES and DOCKS.

See Coupland's *Raffles* (Oxford, 1926); Boulger's *Life of Sir Stamford Raffles;* Logan's *Journal of the Malay Archipelago;* the *Journal* of the Straits Branch of the Royal Asiatic Society (Singapore); Sir Frank Swettenham, *British Malaya* (1906); *Malaya,* ed. R. O. Winstedt (London, 1923); *Blue-Book of the Straits Settlements* (1927); *The Straits Directory, 1927* (Singapore, 1927); J. E. Nathan, *Census of British Malaya* (1922); *One Hundred Years of Singapore* (1921); A. Wright and T. H. Reid, *The Malay Peninsula* (1912); C. B. Buckley, *Anecdotal History of Singapore,* 2 vols. (Singapore, 1902). (H. CL.)

SINGER, SIMEON (1846–1906), Jewish preacher, lecturer and public worker, was born in London. In 1867 he became minister of the Borough Synagogue, London. He moved to the new West End Synagogue in 1878, and remained the minister of that congregation until his death. Singer was a power in the Jewish community in the direction of moderate progress; he was a lover of tradition, yet at the same time he recognized the necessity of well-considered changes. In 1892 at his instigation the first English conference of Jewish preachers was held, and some reforms were then and at other times introduced, such as the introduction of Bible readings in English, the admission of women as choristers and the inclusion of the express consent of the bride as well as the bridegroom at the marriage ceremony. Singer did much to reunite Conservatives and Liberals in the community, and he himself preached at the Reform Synagogue in Manchester. His most famous work was his new edition and English translation of the *Authorized Daily Prayer Book* (first published in 1870), a work which has gone through many editions.

See *The Literary Remains of the Rev. Simeon Singer* (3 vols., 1908), with Memoir.

SINGER MANUFACTURING COMPANY, THE, dates its founding from the invention and marketing of the first practical sewing machine by Isaac Merritt Singer in 1851. The first few machines were produced in a small shop in Boston, Mass. A partnership with Mr. Edward Clark was formed soon afterward under the name of I. M. Singer and Company, from which date the rapid expansion of the business began. In 1853 a factory and main office were established in New York. In 1863 the co-partnership was merged into a corporation, The Singer Manufacturing Company (of New York), which in 1873 became a New Jersey corporation under the same name.

The first large modern factory was established at Elizabethport, N.J., in 1872. In 1929 there were nine factories for the manufacture of Singer machines situated in four countries and employing 27,000 persons. In addition to sewing machines for household use the Singer Company early began the development of specialized sewing machines for industrial purposes and in 1928 made more than 3,000 different machines for stitching a wide variety of products. In 1889 the company originated the electric sewing machine and this modern type is now in general use. Export business received close attention from the beginning.

The capital structure of the present company is 900,000 shares of capital stock, all of one class, of the par value of $100 each.

(C. C. F.)

SINGHBHUM, a district of British India, in the Chota Nagpur division of Behar and Orissa. The administrative headquarters are at Chaibasa. Area 3,879 sq. miles. Pop. (1921), 759,438. Singhbhum is a hilly district on the fringe of the Chota Nagpur plateau with mountains in the north-west rising to a height of 2,500 ft., and in the south-west, where they are called the Saranda hills, to nearly 3,000 feet. The central portion consists mainly of well-cleared open country, which is the most fertile tract in the district. The south is another undulating plateau. The eastern portion of the district, which bears the name of Dhalbhum, contains the valley of the Subarnarekha, the principal river. The north-west is included in the estate of Porahat (800 sq.m.), while the central and south-western portions comprise the Government estate of the Kolhan with an area of nearly 2,000 sq. miles. Over one-third of Singhbhum is covered with primaeval forest, containing valuable timber trees; in the forests tigers, leopards, bears, bison and deer are found.

Nearly two-thirds of the inhabitants belong to aboriginal tribes, among whom the Hos, meaning simply "men," are predominant. Their warlike character won for them the name of Larka, or fighting, Kols among outsiders. They were not finally subjugated till 1836, when the Kolhan was brought under British rule. In Porahat they broke out in rebellion during the Mutiny, and after a long campaign submitted in 1859.

During recent years Singhbhum has become one of the most important industrial tracts in Behar and Orissa, largely owing to the establishment of the works of the Tata Iron and Steel company and of subsidiary concerns at Jamshedpur (*q.v.*), and in its neighbourhood. The exploitation of its mineral resources has begun and has great potentialities. The deposits of iron ore in the Saranda hills, which are reputed to be among the finest in the world, supply material to large works near Asansol, in Bengal. The output of iron ore in 1925 was nearly half a million tons. There is a belt of copper extending for about 80 m., where mining has been in operation for many years. Other mineral resources include chromite, manganese ore, apatite and gold: 6,000 ounces of the last were produced between 1915 and 1919. Several companies have also been formed for the production of silica bricks, fire-bricks and pottery, for which materials are obtained north-east of the mineral area. Timber is obtained from the forests, a minor product of which is *sabai* grass for the manufacture of paper, ropes and string.

SINGING. Like other arts, singing has had its periods of development, culmination and decay. It reached its highest point towards the end of the 18th century, since which time the development of music—largely in relation to the orchestra—has led composers to a relative neglect of the voice as an instrument to be studied on its own account.

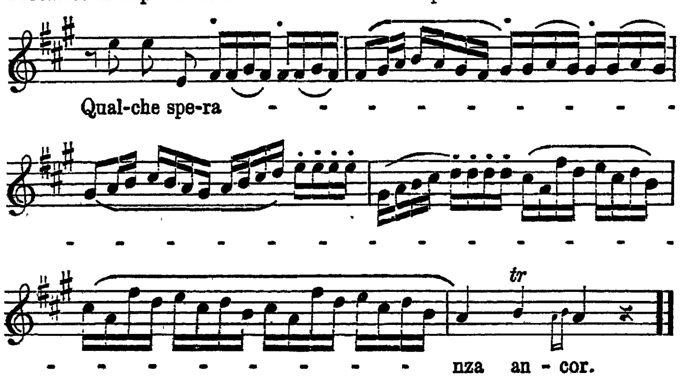
In its highest sense we must regard singing as the art of emitting the voice in fulness, unerringly on the pitch, so that each word is prolonged as naturally as during the most expressive talking. Such a standard demands a special mode of controlling the breath in order that the voice, issuing in freedom and with openness of throat, can be sustained and intensified.

Any language, whose practice is to dwell on the vowels and to avoid throaty combinations of consonants, must tend towards sonority of speech and freedom of throat. We are indebted to the "Land of Song" for the art of *bel canto,* or beautiful singing. To copy the haunting purity of the vowels as sung by Italian artists has ever been the longing and despair of other nations. It may well be that such purity was originally developed through the singers having to sustain, in large cathedrals, the long phrases characteristic of the music of Palestrina (b. 1514).

Unfortunately it was not the habit of the old masters to publish books on their art. He who would form a *bel canto* of the vowels of his own country must rely mostly on the sayings or maxims of the old singers which have been handed down, and show their attitude towards singing and their ideas relative to its cultivation. Of especial interest is Angelo Bontempi's description of the plan of studies at the Papal School at Rome (about 1624). Assembled in class, the pupils practised, for one hour daily, exercises on richness of tone; a second hour was devoted to the "trill"; a third hour to rapid passages; finally, one hour to the cultivation of taste and expression. All this was done in the presence of a professor who saw that the pupils sang before a looking glass so as to learn to avoid grimaces: wrinkling of the brow, winking of the eye-lids, or distortion of the mouth. The richness of these voices was undoubtedly assisted by extreme caution in the selection of studies, always kept within the natural compass of the voice.

It is to the credit of the early English composers, Byrd, Morley, Dowland and Lawes (1550 to 1650) that they wrote songs demanding sustained power. Purcell (b. 1658) composed his touching "Dido's lament" also songs demanding execution, such as "Let the mighty engines." In Italy, celebrated composers for the voice were Carissimi (b. 1604), Alessandro Scarlatti (b. 1659), Lotti (b. 1667) and Bernacchi (b. 1690); the latter was engaged by Handel to sing in his opera "Rinaldo."

Porpora (b. 1686), a pupil of Scarlatti, established a school of singing, whence issued those wonderful singers Farinelli and Caffarelli. The latter, who was kept to one sheet of exercises for five years, excelled in slow and pathetic airs. He was unapproachable in beauty of voice and in the execution of the trill. Farinelli became possibly the most remarkable singer who ever lived. Porpora's airs and exercises are mostly directed to flexibility of the voice; they are of such difficulty as to be almost impossible of execution by singers of the present day. Here for instance is a portion of an aria from his opera "Siroc":



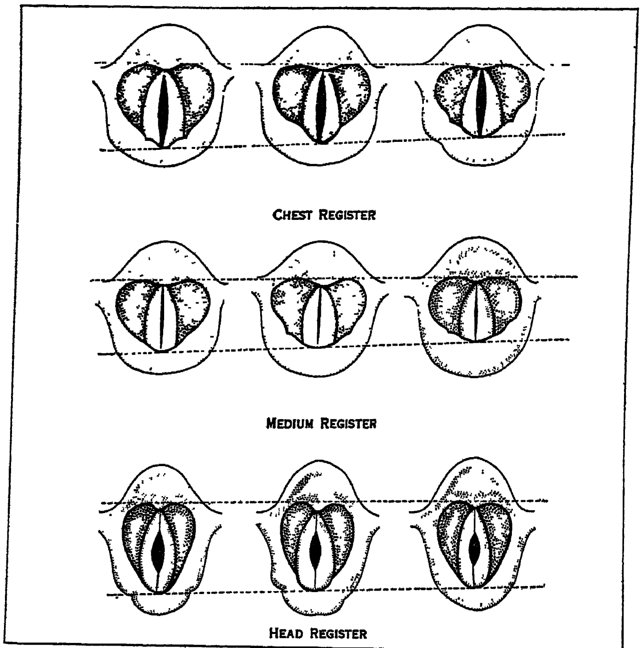
The noble music of Handel, Bach and Gluck was performed with masterly ease and expression by singers of this period. As time passed, the purity of style of the operas of Mozart (b. 1756) and Cherubini (b. 1760) became overshadowed by lovely melody, admirably adapted for the display of the voice. Rossini (b. 1792), Donizetti (b. 1797), and Bellini (b. 1801), composed the delightful music which was sung by such famous artists as Malibran, Grisi, Rubini, Tamburini, Lablache and Jenny Lind. The singing of Mozart's aria "L'amerò" by Jenny Lind was a notable achievement. Later two of the most famous of English singers, the tenor Sims Reeves and the baritone Santley rose to fame in England after completing their studies in Italy. And about the same time Francesco Lamperti of Milan, as the master of Italo Campanini and Albani, became noted as a teacher of *bel canto.*

Some time afterwards the whole question of singing and singing teachers became one of general interest and discussion. Books by Mandl of Paris, Morell Mackenzie, Lennox Browne and others described the anatomy and action of the vocal organs. Professors of singing also wrote about their different methods. Possibly, owing to the surgeons not being singers, or the singing masters not being clear in their physiology, little came of this. About this time too, through the genius of Wagner, the increase in the power of the orchestra reached its climax; and a corresponding increase of sonority on the part of the singers became necessary.

To members of the "old guard" such became possible. When, however, these experienced ones were replaced by younger and sometimes half-trained singers, serious decadence in the art was observed. There seemed occasionally a struggle between the voice

and the orchestra which was not conducive to a feast of *bel canto.* Lamperti attributed this decadence to the quality of the music being no longer suitable to the voice. The composer Verdi, deploring the absence of purity and expressive phrasing, declared that singers must return to the methods of the old masters.

The tendency of modern singing is to arrest the breath by a rigid contraction of the parts which should be free to form the



FROM "PLAIN WORDS ON SINGING" (WM SHAKESPEARE; PUTNAM SONS, LTD.)
DIAGRAM SHOWING THE UNCONSCIOUS SHORTENING OF THE VOCAL CORDS DURING SINGING

tone and pronunciation. The achievement of the old singers was to breathe silently and to control the breath while emitting the voice through the open throat. Lablache, when asked how Rubini breathed, answered "although I sang a duet with him I could not discern *when* or *how* he breathed." Pacchierotti wrote "He who can control the breath and sustain the vowels with the throat open, knows well how to sing." Crescentini added "Singing consists of freedom about the neck and the voice resting on the breath."

Here we will make enquiry into the *tone* of the voice, and the importance of the freedom of spaces in the mouth. An admirable practice for realising the shape of the tone spaces is that of slowly whispering the vowels. As the vocal cords are not in action, nothing distracts the attention from the pronunciation or the breath. After having whispered, the throat feels much more open when we start singing the same vowels. Donders of Utrecht noticed that the vowels, when quietly whispered, caused the air in the mouth to resound at different pitches. Dr. William Aikin has determined the exact pitch of the English vowels, so that these, when correctly whispered, cause a musical scale to be distinctly heard.

Any man by sustaining "Ah" in a whisper and tuning this whisper to the note C (an octave above the third space, treble clef) will realise the greatest resonance possible to that vowel, and a remarkable sense of openness at the back of the tongue. This being undeniable, the following conclusions are worthy of careful consideration: 1. By correctly tuning a whispered vowel, we realise the openness of the throat which we must attain during singing. 2. The vocal cords being so near the base of the tongue, their natural action is dependent on the freedom of the tongue. 3. Freedom of throat and tongue sets up in turn freedom of the soft palate, lips, face and eyes. 4. Throaty, gloomy, nasal or "white" sounds are impossible in that open state of throat by which we correctly tune the vowels.

In the following whispered scale, the pattern words contain the vowel sounds, which only are to be whispered, the consonants being ignored. By reason of their smaller tone cavities, the whispers of women tune a minor third higher than those of men. The pattern sentence suggested is:—*Who would know aught of art must learn and then take his ease.*

A	man	whispering	"who"	should	sound	F,	but	a woman	A♭
"	"	"	"would"	"	"	F♯,	"	"	A
"	"	"	"know"	"	"	G,	"	"	B♭
"	"	"	"aught"	"	"	A,	"	"	C
"	"	"	"of"	"	"	B,	"	"	D
"	"	"	"art"	"	"	C,	"	"	E♭
"	"	"	"must"	"	"	D,	"	"	F
"	"	"	"learn"	"	"	E,	"	"	G
"	"	"	"and"	"	"	F,	"	"	A♭
"	"	"	"then"	"	"	G,	"	"	B♭
"	"	"	"take"	"	"	A,	"	"	C
"	"	"	"his"	"	"	B,	"	"	D
"	"	"	"ease"	"	"	C,	"	"	E♭

We must now realise that we cannot tune the voice by anything we see or feel. We have no direct control over the action of the vocal cords. Many people, when given a note on the pianoforte, are at first all at sea as they try to sing that note. It is only by employing the right mechanism that the voice can tune unconsciously in the very "eye" of the note intended. So it is only by alertness in listening to the tune that the right mechanism can be attained. The accompanying illustration from "Plain words on Singing," by William Shakespeare, shows the unconscious shortening of the vocal cords, which occurs in the different registers.

Giuglio Caccini (b. 1558) maintained that "the first and most important foundation is how to start the voice in every register; not only that the intonation be faultless, but that the quality of the tone be preserved." Agricola (b. 1720) says "Many singers, before reaching a higher note, cause several others to be heard, with the result described as 'seeking the note' or scooping up to it." It is impossible to sing with the tongue rigid, and at the same time, with the throat open. The art of singing lies in the avoidance of rigidity and the adoption of the open throat.

The advantage of the practice of whispering long vowels will now be realised. The pressure which sends *out* the breath is felt below the waist, while just above is realised a simultaneous *hold-back* of the breath. The hold-back must not let the send-out gain the mastery or the result will be wasted. While singing, the breath-feeling should be the same as during whispering. Jean de Reszke declared that "right singing depends on the hold-back of the breath." We realise with every good note a sensation as of "warming" some object; while the freedom of throat should be as of "yawning." The notes of the scale then join as "pearls on a string," the string being the breath.

Johannes Hiller (b. 1728) describes the "legato" as "consisting of no gap in passing from one note to another." Johann Micksch (b. 1765) says: "The first study in training the voice is how to use the breath sparingly, never becoming breathless, by retaining some breath in reserve. Loud singing first becomes beautiful by rightly singing piano. The notes must be drawn out, never pushed out; and taken so quietly that one may produce with the least breath a note that will gradually swell to the loudest degree and again die away. Tone is the material of all music. It has as much variety as the human countenance."

Manstein (b. 1790) says: "It does not matter how *much,* but *how* we sing. By practice, art becomes second nature. The experienced artist, after long continued study, thinks not of the manner and means of execution but devotes himself to expression, with the aim of touching the innermost soul." Lamperti (b. 1813) averred that "The eye is the mirror of the soul." It is impossible to express at the same time joy in the eye and sorrow in the voice. J. A. Hiller previously named said: " 'Well spoken, is half sung' is a motto which should be inscribed on the four walls of every school."

The old style caused every vowel and consonant to be clearly enunciated. At the present day, owing possibly to the heavy orchestration, and the music of Wagner and the modern Italian composers, there is frequently difficulty in understanding the words, and sometimes in deciding even in what language the opera is given. Sonority of voice is not incompatible with richness of tone. Audiences are becoming critical over the quality of expression of the singers. They long for the *bel canto* which once carried sounds of living emotion to the far corners of the theatre.

The composer Ferdinand Hiller, writing about Rubini the tenor, said: "the sonority and overpowering beauty of his high notes combined with unerring precision in attack, thrilled all hearts. In dexterity of execution he excelled the most famous instrumentalists. Further, he had the most distinct pronunciation. Above all, however, a truly electrifying capability of expressing every shade of feeling, the sigh of pure devotion, the distress of the forsaken, the blissful agitation of the happy. Indeed, I believe he could have made all these immutable themes of the loving heart tell on his audience, while singing the simple scale." This is indeed, a summary of the Art of Singing. (W. Sha.)

SINGLE SIDE BAND TRANSMISSION is the method of radio transmission by which one side band (or group of frequencies) is transmitted and the other is suppressed. The carrier wave may be either transmitted or suppressed.

SINGLE-STICK, a slender, round stick of ash about thirty-four inches long and thicker at one end than the other, used as a weapon of attack and defence, the thicker end being thrust through a cup-shaped hilt of basket-work to protect the hand. The original form of the single-stick was the "waster," which appeared in the 16th century and was merely a wooden sword used in practice for the back-sword (*see* Sabre-Fencing), and of the same general shape. By the first quarter of the 17th century wasters had become simple cudgels provided with sword-guards, and when, about twenty-five years later, the basket-hilt came into general use, it was employed with the cudgel also, the heavy metal hilt of the back-sword being discarded in favour of one of wicker-work. The guards, cuts and parries in single-stick play were at first identical with those of back-sword play, no thrusts being allowed (*see* Fencing). The old idea, prevalent in England in the 16th century, that hits below the girdle were unfair, disappeared in the 18th century, and all parts of the person were attacked. Under the first and second Georges back-sword play with sticks was immensely popular under the names "cudgel-play" and "single-sticking," not only in the cities but in the country districts as well, wrestling being its only rival. Towards the end of the 18th century the play became very restricted. The players were placed near together, the feet remaining immovable and all strokes being delivered with a whip-like action of the wrist from a high hanging guard, the hand being held above the head. Blows on any part of the body above the waist were allowed, but all except those aimed at the head were employed only to gain openings, as each bout was decided only by a "broken head," *i.e.* a cut on the head that drew blood. At first the left hand and arm were used to ward off blows not parried with the stick, but near the close of the 18th century the left hand grasped a scarf tied loosely round the left thigh, the elbow being raised to protect the face. Thomas Hughes's story, *Tom Brown's School Days,* contains a spirited description of cudgel-play during the first half of the 19th century. This kind of single-sticking practically died out during the third quarter of that century, but was revived as a school for the sabre, the play being very much the same as for that weapon. The point was introduced and leg hits were allowed. By the beginning of the 20th century single-stick play had become much neglected, the introduction of the light Italian fencing sabre having rendered it less necessary. Stick-play with wooden swords as a school for the cutlass is common in some navies. (X.; A. R. H.)

SINGLE TAX. The name given by Henry George, the American economist, to the doctrine of levying a tax upon rent alone as the sole necessary instrument of taxation. Land, he held, is the true source of wealth, and therefore the only proper revenue of a state is that derived from the appropriation of rent. The doctrine is one with that of the Physiocrats, the school of French economists founded by Quesnay (1694-1774). The "impôt unique" of Quesnay was proposed in days when the produce of the soil constituted by far the greater part of any nation's wealth. Henry George wrote his *Progress and Poverty* in 1879, when already the arts of industry were playing a dominating part in wealth production, and when capital was accumulating in great aggregations. Nevertheless, he believed that profits and industry should remain untaxed. He went further, and appeared to believe that, under a single tax system, all economic problems would be solved.

The essence of the single tax theory may be given in Henry George's own words, taken from his book, *The Condition of Labour,* written in 1891: "We have no fear of capital, regarding it as the natural handmaiden of labour; we look on interest itself as natural and just; we would set no limit to accumulation, nor impose on the rich any burden that is not equally placed on the poor; we see no evil in competition, but deem unrestricted competition to be as necessary to the health of the industrial and social organism as the free circulation of the blood is to the health of the bodily organism—to be the agency whereby the fullest co-operation is to be secured. We would simply take for the community the value that attaches to land by the growth of the community; leave sacredly to the individual all that belongs to the individual; and, treating necessary monopolies as functions of the State, abolish all restrictions and prohibitions save those required for public health, safety, morals, and convenience."

This declaration is the more striking because it was written in answer to a Papal Encyclical on the labour question, which advocated the protection of labour and especially the labour of women and children. The single tax, Henry George thought, would make all, or nearly all, industrial legislation unnecessary.

The fundamental doctrine underlying the proposal was that all men are equally entitled to the use of the land. As, however, the management of the land by the State was impossible in practice, and as it was also impossible to divide it up into equal parcels, or into parcels of equal productivity, the road to justice was to leave the land in private ownership, and to appropriate the "economic rent," thus leaving to the owners the value of their own improvements. Collecting the economic rent as a social surplus by the single tax, the community as a whole would receive justice while individual enterprise would not be fettered. Universal free trade and free competition were thus postulated as parts of the doctrine. Private property was to be sacred as never before, for it was to go scot free of all taxation. The millionaire manufacturer was to pay no more in taxes than his poorest clerk.

It was thus implied that the yield of the single tax would be sufficient to meet the expenses of government. This might easily be so in an agricultural community, but in Great Britain in 1928 the entire economic rent of the land in town and country would not defray more than a small fraction—perhaps one-eighth—of the expenses of the central and local governments.

(*See* George, Henry; Physiocratic School; Economics; Rent; National Expenditure.)

SINGLETON, the oldest town of the Hunter River valley, in central eastern New South Wales, Australia, socially and industrially one of the most interesting and important areas in the southern hemisphere. In its many-sided significance—in respect of its site in the river valley liable to floods, the presence of coal and possibly of petroleum in its neighbourhood, grazing and timber-cutting, mixed agriculture, fruit and vine-growing, co-operative dairying and buttermaking, cattle-marketing—it typifies the historical and economic growth of the area in which it occupies a central and linking position. From the coast round about Newcastle the Hunter valley stretches north-west as a low narrow trough between the northern and southern plateaux for about 120 miles to a saddle near Cassilis (alt. 1,500 ft.) which barely divides its drainage from that of the western rivers (Talbragar-Macquarie). It falls into two main sections (i.) the upper Hunter-Goulburn drainage basin, an irregular hill-and-valley country (7,000 sq. miles; av. elevation 1,000 ft.) with streams descending chiefly from the northern heights, and divided by a constriction (Branxton Gap, 10 miles wide, just below Singleton) from (ii.) the lower, partly deltaic and estuarine valley. Tributaries (Paterson and Williams Rivers) open up important valleys in the north-east and help to extend the lowland northwards from Newcastle. The basalt capping of the north-west and north-east plateaux have supplied rich alluvials to the river floors but the southern sandstone scarps are poor in water and generally infertile. Relief, and the position upon the transition zone between summer and winter rains, help to give the upper basin a drier climate (22–30

in.) with a greater range of temperature (Cassilis: av. ann. temp. 72°–47·5° F; mean daily range, 24·4° F; av. ann. rainfall 21·3 in.), and to the lower basin more humid and equable conditions (Newcastle: 72°–55° F; 15°; 42 in.). In general, also, much more rain falls on the northern slopes than on the southern. In the upper basin the rougher margins supply timber and grazing grounds, and, though good soil abounds, erratic rainfall encourages cattle, sheep and horse rearing (*e.g.,* Scone district) and saw-mills are widely distributed. Nearer the centre, the valleys—which would admit of irrigation—are being invaded by mixed farming, and large holdings are decreasing in number. At Aberdeen is a large meat (mutton, beef, rabbit) freezing works and at Denman a large butter factory serves the growing dairying industry. Here also the physical conditions are favourable for growing cotton. The middle Hunter valley, formerly and still to some extent in pastoral occupation, was devoted to wheat-growing, arable mixed-farming and fruit-growing (citrus and stone fruits, vines), but latterly increasingly to dairying. Thus around Singleton large estates, and also timber-cutting, persist, but farming, fruit-growing, and, most recently, dairying have increased and Singleton is a notable butter-making centre. Fruit is extensively grown in the Paterson and Williams valleys but the wine-making industry, once important, has declined. The disappearance of wheat as a grain crop has been largely due to the humidity of the climate. From and through the Hunter valley come the horses, cattle, meat (*cf.* the famous Maitland cattle-market), and also the agricultural and dairy produce of the valley itself and of the western slopes (Liverpool Ranges). But whereas the markets were formerly chiefly in Sydney or overseas, ever larger proportions have been absorbed by the growing coal-mining and industrial population at hand. All three measures of the State's main coal deposit crop out in the Hunter valley. The most important seams are those of the Newcastle field (Newcastle or Upper Measures), of the Maitland field—mainly Lower (Greta) seams—and those of Muswellbrook (Upper and Lower). The known reserves within the area are estimated at 12,000,000,000 tons, the total possible reserves at 72,000,000,000 tons (Newcastle field: 270,000,000 tons available; S. Maitland field: 1,350,000,000 tons; Muswellbrook: 96,000,000 tons of Lower, besides large reserves of Upper Series coals). Comparative ease of working and access to the sea have made this the chief coal-exporting area of Australia, but from various causes, social as well as economic, the coal industry is severely depressed, the annual output—normally 10,000,000 tons—has greatly declined, and the export trade has at present almost ceased. Output, 1926: northern field: 7,258,000 tons (£6,835,000); *cf.* southern field (*see* BULLI, PORT KEMBLA): 2,025,000 tons (£1,661,000); western field (*see* LITHGOW): 1,604,000 tons (£941,000). The rise of manufacturing industry—notably that of the steel industry with its associated chemical and metallurgical industries—tends to place mining in the second rank and to substitute an industrial for a mining population, though a recent (1929) project for the large-scale (£3,000,000 capital) distillation of the Ellalong (Cessnock; *see* MAITLAND) coal reserves holds out promise for the future of the coal, as well as of other industrial developments.

Newcastle, with its satellites, is the chief industrial area and also the chief port of the valley, but the S. Maitland field (W. Maitland-Cessnock) is now the chief coal-producing area, while Muswellbrook (pop. 2,400), a farming centre in the upper Hunter valley, has a rising coal production. A branching system of railway lines and of roads serves the valley; the river, though navigable to Morpeth (35 miles from the sea), is little used because of its erratic flow. Newcastle provides a not altogether satisfactory harbour and Port Stephens has been suggested as a more desirable outlet. Interesting also is the suggestion for linking the valley by rail with the western system over the Cassilis gap. Population has grown rapidly and now amounts, in the whole valley, to *c.* 225,000. It is mainly an urban population, the Newcastle-Cessnock-Maitland agglomerations alone including some 150,000. Some of the most difficult problems of Australian economic and political life have been introduced during the evolution of this valley which typifies the present stage of growth of the Commonwealth. (*See* F. R. E. Mauldon: *A Study in Social Economics, The Hunter River Valley,* 1927.) (*See* also NEWCASTLE, MAITLAND.)

SINGORA or **SONGKLA** (the *Sangore* of early navigators), a port on the East coast of the Malay peninsula and the headquarters of the high commissioner of the Siamese division of Nakhon Sri Tammarat. It is situated in 7° 12′ N. and 100° 35′ E. It was settled at the beginning of the 19th century by Chinese from Amoy, the leader of whom was appointed by Siam to be governor of the town and district. Having been more than once sacked by Malay pirates, the town was encircled, about 1850, by a strong wall, which, as both Chinese governors and Malay pirates are now things of the past, supplies the public works department with good road metal. The population, about 5,000, Chinese, Siamese and a few Malays, is stationary, and the same may be said of the trade, which is all carried in Chinese junks. The town has become an important administrative centre; good roads and the railway connect it with Kedah and other places in the peninsula, and the mining is developed in the interior. In 1906 railway surveys were undertaken by the government with a view to making Singora the port for S. Siam; but this harbour, formed by the entrance to the inland sea of Patalung, would require dredging to be available for vessels of any size.

SINGPHO. The term used in Assam for the tribe called "Chingpaw" or Kachin (*q.v.*) in Burma.

SINHA, SATYENDRA PRASSANO, 1ST BARON OF RAIPUR (1864–1928), Indian statesman, was born of an ancient family of the Kayashta or writer caste in the village of Raipur, Birbhum district, Bengal, in June 1864. From the Presidency college, Calcutta, he went to London in 1881 to join Lincoln's Inn, where he won many prizes and scholarships, and was called to the bar in 1886. On his return to India he at once began to plead before the high court in Calcutta. In 1903 he became standing counsel to the Government. He was the first Indian to be appointed advocate-general of Bengal (1908), and the first to become a member of the Government of India. He held the law portfolio from April 1909 to Nov. 1910. He then resumed his lucrative practice at the bar. He presided at the Indian National Congress session at Bombay in 1915; in his presidential speech he begged the British Government to declare their policy with regard to the development of constitutional government. He and the Maharaja of Bikaner were the first Indians to participate in Empire deliberations in London, for in 1917 they jointly assisted the secretary of State at the meetings of the Imperial War Cabinet, and were members of the Imperial War Conference. Sinha joined the Bengal executive council in the same year, but returned to England in 1918 as a member of the Imperial War Cabinet and Imperial War Conference, subsequently becoming a representative of India at the Peace Conference.

Knighted in 1914, in 1918 he was made K.C., a distinction not previously conferred upon a barrister of Indian birth or practice. At the beginning of 1919 he joined the Lloyd George ministry as under-secretary for India, being raised to the peerage as Baron Sinha of Raipur and made a member of the privy council. He skilfully conducted the Government of India act, 1919, through the House of Lords. At the close of 1920 he was appointed governor of Behar and Orissa, being the first Indian to preside over a British province. Ill-health prevented him from serving his full term in that office, and in 1921 he resigned. In 1926 Sinha was appointed a member of the judicial committee of the privy council. He was opposed to the setting up of the statutory commission on the Government of India at an earlier date than that indicated in the Government of India act, 1919, in view of the divided state of India; but, the decision once taken, he supported the Simon Commission, and entertained its members at Calcutta. He died on Mar. 5, 1928.

Sinha is remembered by Indians as the first to break down all the barriers against Indians, and by lawyers as a learned, patient and courteous judge. Circumstances drove him into politics but his real interests, which he served whenever opportunity offered, lay in the progress of education.

SIN KIANG, or the "New Territory," is a great region west-north-west of China. Area (approx.), 550,340 sq. miles. Pop. (approx.), 1,200,000. It is bounded on the north-east by the

foothills of the Altai mountains, on the east by Outer Mongolia, Kansu and Kuku Nor, on the south by Tibet, on the south-west by the Karakoram mountains and the Pamirs, on the north-west by a portion of the Tien-shan, from which the boundary diverges northward along various heights till it reaches the hills south of the Irtish, and then turns eastward. The Tien Shan range extends through the middle from west to east, and divides the province into two distinct regions. North of it are the districts of Ili (*see* KULDJA) and Dzungaria, the latter of which is also partly in Outer Mongolia. South of the Tien Shan lies the basin of the Tarim river (*q.v.*), bounded on the south by the Kunlun mountains (*q.v.*), beyond which the province stretches to the Karakoram mountains (*q.v.*). The southern extension of the province between these two ranges is the plateau of inland drainage called Chang-T'ang. Dzungaria is a basin depression, the only part of the Chinese region north of the Tien Shan which is, in places less than 1,000ft. above sea-level. The Borotala here drains eastward into Ebi Nor. It has a remarkably heavy summer rainfall, so that the pastures on the hillsides are rich, while the slopes of the Dzungarian Alatau, on the north, are heavily forested. This depression has been drained as a zone through which peoples have moved throughout history. Beyond the hills of its south-west border lies the well forested Ili valley, containing the town of Kuldja and flanked on the south by the Tien Shan. The Tarim basin is an area of internal drainage more than 2,500ft. above sea-level, and to the north-east lies the Turfan depression, the bottom of which is said to be more than 400ft. below sea-level. The slopes from the Kunlun down to the Tarim basin are remarkably sharp in many places, and the southern part of the basin is known as the Takla Makan desert (*q.v.*). The western end of the Tarim basin leads to a pass between the Tien-shan and the Pamirs from Kashgar (*q.v.*) to Bukhara. East of the Takla Makan desert is the lake-marsh region of Lop Nor.

The climate is intensely continental, with average July temperatures in the Tarim basin varying from 69° F at Yangi-Kul, on the Tarim, to nearly 90° in the Turfan depression. The January average temperatures in the Tarim basin vary from 21° at Yarkand to 9·5° at Yangi-Kul. On the higher lands the variation of temperature within a day may be nearly 55°; in the Turfan depression it rarely exceeds 30°. The winds in the Kuen-lun region blow down the mountain slopes in the morning at great velocity, and they die down towards evening. The rainfall in many places in the Tarim basin is less than 2in. for the year, but may rise to 10in. in localities on heights facing west. Much of the Tarim basin has a temperature below freezing point for at least three months. In Dzungaria the temperatures are lower both in summer and winter, and in the Borotala the rainfall is much higher. On the high mountains the precipitation may be considerable.

A great deal of the region is desert, with salt accumulations in many of its depressions. Tamarisk and reed grow here and there are many groups of poplar trees at the foot of the mountains, while higher up the mountains is a certain amount of summer pasture. In Dzungaria saxaul and tamarisk trees are characteristic. There are fine forests in the Borotala and Ili valleys, and often on the mountain slopes, mostly pine and birch. The northern slopes of the Tien Shan are famed as summer grazing lands. Where irrigation is possible, in certain places near the Tarim, there is some good cultivation of cereals, rice, cotton and fruits. The wild animals include the camel, wild ass, wolf, tiger, yak, gazelle, stag, etc. The nomads keep horses, camels, cattle, sheep, goats and asses.

Sulphur, saltpetre and alum are found at certain places, as in the Turfan depression and near Yarkand. Iron and lead were once mined in the Ili region. Coal occurs in the Turfan depression near Kurla and west of Kashgar, and the latter region also yields lead and copper. The famous Chinese jade occurs south of Khotan and Yarkand, where some of the rivers have golden sands.

The region north of Tien Shan is famed as the home of nomads, who find good summer pasture on the heights. They are mainly Turkoman, including Kirghiz and Kazaks, mainly Sunni Mohammedans; the Mongol element is Buddhist in religion. Turki is the prevalent language. South of Tien Shan is the region of oases, with little opportunity for nomads, save as rulers or marauders, except among the mountains. Here again Turki is spoken and Sunni Mohammedanism is the general religion, but there are Shiah Mohammedans in the south-western mountains. The Chinese element is mainly administrative, and is said to have come largely from the Tientsin area; they are found especially at Urumtsi, the political capital of the dominion on the north side of the Tien Shan. The governor of Sin Kiang is nominally under the viceroy of Kansu; there are four Intendances of Urumtsi, Kuldja, Kashgar and Aksu, and these are divided into 16 prefectures.

The cultivators of the irrigated lands live on cereals, beans and fruit, and grow a good deal of linseed for oil, etc., as well as silk and cotton. Some tea is grown. The towns of the oases of the Tarim basin include Aksu, Kashgar, Yarkand, Khotan. The Ili basin has Kuldja, Dzungaria has Urumchi. The Turfan depression has Turfan. These towns are trading centres with business in skins, silk, cotton, carpets, etc.

The chief roads are (*a*) from Kansu along the north via Hami and Urumchi to Kuldja, (*b*) via Hami to Turfan, Karashar, Aksu, Kashgar and so to Bukhārā, with a branch from Kashgar to Yarkand, and (*c*) a way from Kansu via Lop Nor and Keruja to Khotan and Yarkand; this last is much less important than the others. (*See* also TAKLA-MAKAN; TARIM; ASIA, *Archaeology*.)

SINKING FUNDS, funds specifically ear-marked for the extinction of a debt, especially a national debt. *See* NATIONAL DEBT.

SINOPE (*sinūb*), the capital of a vilayet on the North coast of Asia Minor, on a low isthmus joining the promontory of Boz Tepé to the mainland. Though it possesses the only safe roadstead between the Bosporus and Batum, the difficulties of communication with the interior, and the rivalry of Ineboli on the West and Samsun on the East have prevented Sinope from becoming a great commercial centre. It is shut off from the plateau by forest-clad mountains. Pop. (1927) 32,426. On the isthmus, towards the mainland, stands a huge but for the most part ruined castle, originally Byzantine and afterwards strengthened by the Seljuk sultans; and the Mohammedan quarter is surrounded by massive walls. Of early Roman or Greek antiquities there are only the columns, architraves and inscribed stones built into the old walls; but the ancient local coinage furnishes a very beautiful and interesting series of types.

See M. Six's paper in the *Numismatic Chronicle* (1885), and MM. Babelon & Reinach, *Recueil des monnaies grecques d'Asie Mineure* (1904).

Sinope (Σινώπη), whose origin was assigned by its ancient inhabitants to Autolycus, a companion of Hercules, was founded 630 B.C. by the Ionians of Miletus, and ultimately became the most flourishing Greek settlement on the Euxine, as it was the terminus of a great caravan route from the Euphrates, through Pteria, to the Black Sea, over which were brought the products of Central Asia and Cappadocia (whence came the famous "Sinopic" red earth). In the 5th century B.C. it received a colony of Athenians; and by the 4th it had extended its authority over a considerable tract of country. Its fleet was dominant in the Euxine, except towards the West, where it shared the field with Byzantium. When in 220 B.C. Sinope was attacked by the king of Pontus, the Rhodians enabled it to maintain its independence. But where Mithradates IV. failed Pharnaces succeeded; and the city, taken by surprise in 183 B.C., became the capital of the Pontic monarchy. Under Mithradates VI. the Great, who was born in Sinope, it had just been raised to the highest degree of prosperity, with fine buildings, naval arsenals and well-built harbours, when it was captured by Lucullus and nearly destroyed by fire (70 B.C.). In 64 B.C. the body of the murdered Mithradates was brought home to the royal mausoleum. Under Julius Caesar the city received a Roman colony, but was already declining with the diversion of traffic to Ephesus, the port for Rome, and in part to Amisus (Samsun). In the middle ages it became subject to the Greek Empire of Trebizond, and passed into the hands of the Seljuk Turks, and in 1461 was incorporated in the Ottoman Empire. In November 1853 the

Russian vice-admiral Nakhimov destroyed here a division of the Turkish fleet and reduced a good part of the town to ashes.

SINTER, a word taken from the German (allied to Eng. "cinder") and applied to certain mineral deposits, more or less porous or vesicular in texture. At least two kinds of sinter are recognized—one siliceous, the other calcareous. Siliceous sinter is a deposit of opaline or amorphous silica from hot springs and geysers, occurring as an incrustation around the springs, and sometimes forming conical mounds or terraces. The pink and white sinter-terraces of New Zealand were destroyed by the eruption of Mt. Tarawera in 1886. Mr. W. H. Weed, on studying the deposition of sinter in the Yellowstone national park, found that the colloidal silica was largely due to the action of algae and other forms of vegetation in the thermal waters (*9th Ann. Rep. U.S. Geol. Surv.*, 1889, p. 613). Siliceous sinter is known to mineralogists under such names as geyserite, fiorite and michaelite. (*See* OPAL.)

Calcareous sinter is a deposit of calcium carbonate, exemplified by the travertine, which forms the principal building stone of Rome (Ital. *travertino,* a corruption of *tiburtino,* the stone of Tibur, now Tivoli). The so-called "petrifying springs," not uncommon in limestone-districts, yield calcareous waters which deposit a sintery incrustation on objects exposed to their action. The cavities in calcareous sinter are partly due to the decay of mosses and other vegetable structures which have assisted in its precipitation. Even in thermal waters, like the hot springs of Carlsbad, Bohemia, which deposit *Sprudelstein,* the origin of the deposits is mainly due to organic agencies, as shown as far back as 1862 by Ferd. Cohn. Whilst calcareous deposits in the open air form sinter-like travertine, those in caves constitute stalagmite.

SINUS. Anatomically the term refers to a space filled with blood or air. The word is also used by surgeons to signify a discharging track which will not heal and has in many cases a foreign body, or dead bone at the bottom. Popularly the expression "Sinus trouble" implies an infection, acute or chronic, of one of the air-containing cavities connected with the nose. The largest of these cavities (the antrum) is contained in the cheek-bone; the next in size in the forehead (frontal sinus); smaller cavities open into the back (sphenoidal sinus) and sides (ethmoidal cells) of the nose. (*See* NOSE, ANATOMY OF.)

An *acute* infection of one or more of these sinuses is liable to follow a severe cold, influenza, or other acute infectious illness. There will be pain, often wrongly described as neuralgia, in the face, forehead or behind the eye, which usually comes on about the same time every day. There is sometimes discharge from the nose. The pain is caused by the discharge which collects in the sinus and cannot get out because of swelling of the mucous membrane covering the communication with the nose. Menthol reduces this swelling and thus relieves the pain. A piece of menthol the size of a pea may be placed in a jug of boiling water and the vapour inhaled through the nose. Radiant heat, *e.g.,* a powerful electric light bulb, held close to the forehead or face, is also helpful.

A *chronic* infection of one or more of the sinuses may follow an acute attack or may be associated with chronic nasal obstruction or catarrh. An infection of the antrum may also result from dental disease. Pain may be entirely absent. Sometimes, but by no means always, there is a thick discharge (pus) which may run back into the throat. A discharge from one side of the nose is suggestive of sinus disease. Sometimes the discharge has an unpleasant smell especially when it is derived from an infected antrum. Although causing few symptoms, or indeed none whatever, sinus trouble is important because an infected sinus may act as a "septic focus" and cause disease of the eye, ear, joints, stomach, or indeed of almost any other part of the body, or it may be the starting point of a troublesome neuralgia. Sometimes, especially in the case of the antrum, repeated washing out may result in cure. Usually however, operative treatment is required. This consists in enlargement of the opening into the nose so as to allow free drainage or more rarely complete obliteration of the sinus.

Sinus trouble is prevented by avoidance of colds and early treatment of nasal obstruction and catarrh and of dental disease. It is probable that living in hot stuffy rooms increases susceptibility to sinus infection. (*See* OLFACTORY SYSTEM.)

(S. HA.)

SION, the capital of the Swiss canton of the Valais (1,680 ft. above sea-level). In 1920 it had 6,951 inhabitants (mainly Roman Catholics), of whom 1,344 were German-speaking and 5,379 French-speaking. Sion (*Sedunum*) dates from Roman times, and the bishop's see was removed thither from Martigny (*Octodurum*) about 580. In 999 the bishop received from Rudolf III., king of Burgundy, the dignity of count of the Valais, and henceforward was the temporal as well as the spiritual lord of the Valais, retaining this position, at least in part, till 1798. Sion is one of the most picturesque little cities in Switzerland, being built around two prominent hillocks. The north hillock is crowned by the castle of Tourbillon (built 1294, burnt 1788), which was long the residence of the bishops. The south hillock bears the castle of Valeria (which now contains an historical museum) with the interesting 13th century church of St. Catherine.

See also J. Gremaud, Introduction to vol. v. (Lausanne, 1884) of his *Documents relatifs à l'histoire du Vallais,* and R. R. Hoppeler, *Beiträge zur Geschichte des Wallis im Mittelalter* (Zürich, 1897).

SION COLLEGE, in London, an institution founded as a college, gild of parochial clergy and almshouse, under the will (1623) of Dr. Thomas White, vicar of St. Dunstan's in the West. The clergy who benefit by the foundation are the incumbents of the City parishes, of parishes which adjoined the city bounds when the college was founded, and of parishes subsequently formed out of these. In 1886 Sion College was moved from its original buildings in London Wall to the Victoria Embankment, and is now principally known for its theological library which serves as a lending library to members of the college, and is accessible to the public. A governing body appointed by the members to administer the foundation consists of a president, two deans and four assistants.

SIOUAN INDIANS. This great family of American natives takes its name from that of the largest tribe, the Sioux or Dakota (*q.v.*). Next to the Algonkin, they were perhaps the most populous stock north of Mexico. They held three territories, the largest mainly west of the Mississippi river, another, east of the Appalachian mountains in Virginia and the Carolinas; the smallest, in two fragments, in Mississippi. The last two divisions are nearly extinct. The culture was not uniform, but accorded with the region in which each tribe lived. Physical types probably varied similarly. In the Plains area, the Siouans were the preponderant linguistic stock. The principal tribes were (those asterisked being separately treated): 1, in the west, *Dakota and *Assiniboin, the former really seven tribes; *Mandan, *Hidatsa and *Crow; *Winnebago; tribes speaking the Chiwere dialect, namely the Iowa, Oto Missouri; tribes speaking Dhegiha, viz., *Omaha, Ponca, Kansa, *Osage, Quapaw or Arkansas; 2, in the south, Ofo and Biloxi; 3, in the east, Monacan, Manahoac, Tutelo, Saponi, Occaneechi, Woccon, *Catawba, Santee, Cheraw or Sara, and probably Wateree, Congaree, Pedee and others. About 40,000 remain; the original numbers were probably at least twice as great.

(A. L. K.)

SIOUX CITY, a city of western Iowa, U.S.A., on the Missouri river at the mouth of the Big Sioux, 500 m. W. of Chicago; a port of entry, the county seat of Woodbury county, and the second city of the State in size. It is on Federal highways 20, 75 and 77; has municipal and commercial airports; and is served by the Burlington Route, the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific, the Chicago, St. Paul, Minneapolis and Omaha, the Great Northern and the Illinois Central railways. Pop. (1920) 71,227 (15·7% foreign-born white, the majority from Russia, Sweden, Norway and Germany); 79,183 in 1930 by the Federal census. The city has a beautiful site of 45 sq.m., at an altitude of 1,158 ft. The narrow lowlands along the rivers and creeks are occupied by industry and commerce, while the several distinct residential districts are built on high bluffs, commanding views into three States. On opposite sides of the city stand reminders of the coming of the white man and

the departure of the Indian: a shaft of white stone erected to the memory of Sergeant Charles Floyd of the Lewis and Clark expedition, who died here in 1804; and the grave of War Eagle (d. 1851), a powerful chief of the Yankton Sioux and a friend of the early settlers. In Riverside park is the Council Oak, under which took place many councils of war and peace. The park system includes 1,119 acres. There are 82 churches and 31 public schools. The hotels have 2,000 guest rooms and the hospitals 800 beds. Since 1912 the city was operated under a commission form of government. It is the see of a Roman Catholic bishop, and is the seat of several institutions of that church and of Morningside college (Methodist Episcopal, 1894). Sioux City is an important jobbing, marketing and manufacturing centre. The output of its factories in 1927 was valued at $124,585,809.

The site of Sioux City was a favourite camping ground and meeting place of the Indians. The first white visitors of record were Lewis and Clark and their companions in 1804. In 1848 William Thompson built a cabin on the bluff where Sergeant Floyd had been buried; and in 1849 Théophile Brughier, a French Canadian in the employ of the American Fur Company, settled at the mouth of the Big Sioux river, was received into the tribe of the Yankton Sioux, and married War Eagle's daughter. In 1854 the city was platted by Dr. John K. Cook, who was surveying a part of the region for the U.S. Government. The first mail arrived in July, 1855; the first steamboat from Saint Louis in June, 1856. The city was incorporated in 1857, with a population of 400. In 1868 the first railroad reached the city, and a few years later a packing plant was established. The decade 1880–90 was a period of phenomenal development. The population increased from 7,366 to 37,806; factories, commercial houses and railroads multiplied; public improvements and utilities were begun on a large scale. The panic of 1893 brought temporary depression and an actual loss of population between 1890 and 1900; but since 1900 growth and progress have again been rapid, the population increasing 115% in the first 20 years of the century.

SIOUX FALLS, the largest city of South Dakota, U.S.A., on the Big Sioux river, at an altitude of 1,422 ft., 190 m. N. by W. of Omaha; the county seat of Minnehaha county. It is on the Atlantic–Yellowstone–Pacific and the Custer Battlefield highways; has a municipal airport 3 m. S.E. of the post-office; and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Chicago, St. Paul, Minneapolis and Omaha, the Great Northern, the Illinois Central, and the Rock Island railways, and by 20 interurban motor-coach lines. Pop. (1925 State census) 30,127; 1930 Federal census 33,362. Sioux Falls is the metropolis of a large territory. The falls from which it takes its name are a series of cascades, dropping about 100 ft. in half a mile, which provide picturesque scenery as well as water-power. There are 324 ac. in public parks. The residential sections have wide tree-lined streets, bordered with lawns and gardens. Many of the public buildings and institutions are built of "Sioux Falls granite" (quartzite sandstone) quarried in the vicinity. The city is the see of a Roman Catholic and of a Protestant Episcopal bishop, and is the seat of the State penitentiary, the State school for the deaf, the South Dakota Children's Home (a privately supported institution), Sioux Falls college (Baptist; 1883), Augustana College and Normal School (Lutheran; 1889), Columbus college (Roman Catholic; 1921) and three training schools for nurses. It is an important distributing centre. The output in 1927 of 77 factories in the city was valued at $38,363,882. A settlement was established at the falls in 1856, but it was abandoned six years later. Permanent settlement dates from 1867. The village was incorporated in 1877, and in 1883 it was chartered as a city. By 1900 the population had reached 10,266. This increased to 14,094 in 1910, and then more than doubled in the next 15 years.

SIPHANTO: *see* SIPHNOS.

SIPHNOS (It. and mod. Gr. *Siphanto, Siphěno*), an island of the Greek Archipelago, 30 m. S.W. of Syra (area 28 sq.m.). Along the west slope of a limestone ridge, whose principal summits, Hagios Elias and Hagios Simeon, are crowned by old Byzantine churches, lies a series of villages, each white-washed house with its own garden and orchard. Apollonia, the modern capital has the name of an ancient town: Kastro has mediaeval fortifications, and the town hall bears the date 1365. Inscriptions show that Kastro represents the ancient city of Siphnos. Another ancient town, Minoa, is marked by two Hellenic white marble towers known as the Pharos (lighthouse) and St. John. Byzantine churches and convents are scattered about the island. The "School of the Holy Tomb" was founded by Greek refugees from the iconoclastic persecutions at Byzantium and became a centre of culture. Its endowments are now held by the gymnasium of Syra.

In ancient times Siphnos was colonized by Ionians from Athens. It refused tribute to Xerxes, and sent one ship to fight on the Greek side at Salamis. It was famous for its gold and silver mines, easily recognized by excavations and refuse-heaps. In antiquity, as now, it exported pottery. During the Venetian period it was ruled first by the Da Corogna family and after 1456 by the Gazzadini, who were expelled by the Turks in 1617.

SIPHON or SYPHON, an instrument, usually in the form of a bent tube, for conveying liquid over the edge of a vessel and delivering it at a lower level (Lat. *sipho;* Gr. *σίφων,* a tube). The action depends upon the difference of the pressure on the liquid at the extremities of the tube, the flow being towards the lower level and ceasing when the levels coincide. The instrument affords a ready method of transferring liquids, and is made of glass, indiarubber, copper or lead, according to the liquid which is to be transferred. The simple siphon is used by filling it with the liquid to be decanted, closing the longer limb with the finger and plunging the shorter into the liquid; and it must be filled for each time of using. Innumerable forms have been devised adapted for all purposes, and provided with arrangements for filling the tube, or for keeping it full and starting it into action automatically when required. Pipes conveying the water of an aqueduct across a valley and following the contour of the sides are sometimes called siphons, though they do not depend on the principle of the above instrument. In the siphon used as a container for aerated waters a tube passes through the neck of the vessel, one end terminating in a curved spout while the other reaches to the bottom of the interior. On this tube is a spring valve which is opened by pressing a lever. The vessel is filled through the spout, and the water is driven out by the pressure of the gas it contains, when the valve is opened. The "Regency portable fountain," patented in 1825 by Charles Plinth, was the prototype of the modern siphon, from which it differed in having a stopcock in place of a spring valve. The "siphon champenois" of Deleuze and Dutillet (1829) was a hollow corkscrew, with valve, which was passed through the cork into a bottle of effervescent liquid, and the "vase siphoïde" of Antoine Perpigna (Savaresse *père*), patented in 1837, was essentially the modern siphon, its head being fitted with a valve which was closed by a spring.

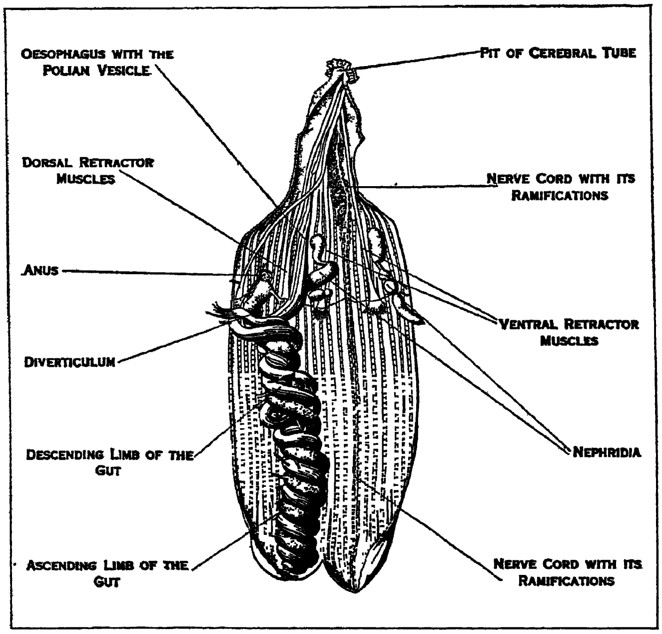
SIPHONAPTERA, an order of insects (*q.v.*) comprising the fleas (*q.v.*).

SIPPAR, a city of ancient Mesopotamia, situated in 33° N., 44° E. The site to-day lies five miles east of the Euphrates, just south of the Royal canal (Nahr al Malik), but in ancient times the Euphrates flowed by the city. The temple of E-Babbar, "the House of the Sun" and its stage tower (*ziggurat*) occupied a terrace beside the river with a superficial area of about 1,300 square feet. East of the temple area and separated from it by a wide avenue lay the residential quarter, the whole city being surrounded by a wall. This wall forms a rectangle, 860 yards wide and 1,400 yards long, the long sides facing north and south. The excavations in the northern part of the eastern mound and on the ziggurat produced over 60,000 tablets, chiefly contracts, and religious and grammatical texts of Neo-Babylonian date. The antiquity of the city however is shown by the fact that there are ancient records of the Euphrates being called the river of Sippar. Its Sumerian name appears to have been Zib-Bar Nun. The Sumerian Sun god was identified with the Semitic Shamash, and it was in this city that the Sun god had his principal cult. In ancient times the two rivers approached closely here and the site therefore commanded the entrance to the southern plain from the north.

See *Cambridge Ancient History,* vol. i., 1923 (bibliography).

SIPUNCULOIDEA, marine animals of uncertain affinities formerly regarded as a subdivision of the class Gephyrea (*q.v.*). Some authorities have linked them with the Phoronidea (*q.v.*) as the Podaxonia, but they are here treated as autonomous. A number of fossil forms occur in the Middle Cambrian of British Columbia.

General Description.—The body is fusiform with a glistening cuticle, and may attain a length of about 12 inches. The body-wall comprises a thick cuticle, an epidermis containing glandular bodies, a thin sheet of connective tissue, several layers of muscle, and finally a coelomic epithelium. The anterior part, the proboscis or introvert, is capable of being retracted into the remainder as the tip of a glove-finger may be pushed into the rest: at the top of the introvert is the mouth, surrounded in *Sipunculus* by a laciniated funnel, but more usually by tentacles each with its ciliated groove creating a current in the direction of the mouth. The mouth leads into the oesophagus surrounded by the retractor muscles of the introvert, which arise in the body-wall about one-third of the body-length from the anterior end. The alimentary canal is a thin-walled tube, not marked off into definite regions, which runs to the posterior end of the body and then turns forward to end in the dorsal anus near the insertion of the retractor muscles. The descending and ascending limbs of the gut are twisted into a spiral coil, the axis of which is often traversed by a muscle arising from the posterior end of the body. Along most of the gut runs a ciliated groove, into which food does not enter. A diverticulum of variable size opens into the rectum. On the dorsal surface of the oesophagus lies a contractile body, the Polian vesicle, filled with corpusculated fluid and closed posteriorly; it opens in front into a circumoesophageal ring, giving off branches to the tentacles, which by its contraction are caused to expand. The excretory organs consist usually of two saccular brown tubes attached by one side to the ventral wall of



FROM THEEL, "NORTHERN AND ARCTIC INVERTEBRATES" (VETENSKAPSAKADEMIEN)

GENERAL DISSECTION OF SIPUNCULUS PRIAPULVIDES FROM THE DORSAL SURFACE SHOWING THE INTERNAL ORGANS IN POSITION

the body and opening to the exterior by a pore. The ventral lip of the internal ciliated funnel is a portion of the coelomic epithelium; the funnel leads by a canal into the nephridial sac. These organs serve both for excretion and for the passage of the genital products: the former function is also served by certain cellular bodies, the urns, which may be free in the coelom or attached to the outer wall of the gut. The essential part of these organs is a ciliary mechanism by which the waste products in the coelomic fluid are agglutinated and brought into contact with the phagocytes, and so eliminated. J. Cantacuzène has shown that the urns are important in the production of immunity. The Sipunculoids are dioecious, and the germ cells arise from the coelomic epithelium near the insertion of the retractor muscles; they drop into the coelom at an early stage and there develop. The coelom is rich in corpuscles and contains haematids carrying a respiratory pigment, haemerythrin, rich in iron. There is a well-developed dorsal brain, usually with two pigmented eye-spots at the bottom of an epidermal invagination passing deeply into it; in some genera this cerebral tube is divided into two: the brain is also connected with the heart-shaped nuchal organ, to the lateral ciliated lobes of which it gives off two large nerves. A nerve-ring joins the brain to the ventral nerve-cord, in which there are no distinct ganglia but a series of ganglion cells. The nerve-cord gives off numerous nerves to the periphery.

Classification.—The Sipunculoids are divided into a number of genera separated on the arrangement and number of the longitudinal muscles and tentacles, the presence of calcareous bodies on the posterior end, etc.

Development.—Segmentation is spiral. The larva is a trochophore but with no protonephridia and flame-cells. The development is characterized by the enormous elongation of the post-anal region which brings about the dorsal and anterior situation of the anus.

Ecology.—Some Sipunculoids live in mud and sand and feed on the organic matter contained in them (*Sipunculus*); others (*Phascolosoma, Physcosoma*) occupy crevices and rock-crannies; others again (*Phascolion, Aspidosiphon*) inhabit the shells and tubes formed by other small marine animals. The two latter groups feed on detritus, etc., which are conveyed to their mouths by means of the cilia on their tentacles. Only the mud and sand dwellers are capable of free movement.

BIBLIOGRAPHY.—The best account of the group as a whole is that by J. W. Spengel, 1913, in the *Handwörterbuch der Naturwissenschaften,* Jena, vol. ix., pp. 97–106, 14 figs. with a bibliography.
See also L. Cuénot, 1922, "Sipunculiens," *Faune de France,* iv., pp. 1–17, figs. and bibl. (C. C. A. M.)

SIQUIJOR, a municipality (with administration centre and 42 *barrios* or districts) of the sub-province of Siquijor, attached to the province of Oriental Negros, island of Negros, Philippine Islands. It is situated on the small coral island of Siquijor, about 14 m. S.E. of Dumaguete, the capital of the province. Pop. (1918), 15,237. The principal industry is the cultivation of coco-nuts and the manufacture of copra. Tobacco, rice, corn, abacá are other agricultural products. In 1918 it had 139 household industry establishments with output valued at 23,700 pesos. Of the 11 schools, 10 were public. The language is a dialect of Bisayan.

SIRDAR or **SARDAR,** a title applied to native nobles in India, *e.g.,* the sirdars of the Deccan (Persian *sardar,* meaning a leader or officer). Sirdar Bahadur is an Indian military distinction; and Sirdar is now the official title of the commander-in-chief of the Egyptian army.

SIRENIA, an order of aquatic placental mammals, comprising the manatees or sea-cows, the dugongs, the recently extinct Steller's sea-cow (*Rhytina*), as well as their fossil relatives of the Tertiary period. The torpedo-shaped body ends behind in a horizontal tail fluke, as in the dolphins; but in contrast with the latter the broad muzzle is truncate and the transversely expanded lips are very mobile. The name Sirenia was given in allusion to the supposed resemblance of these animals to mermaids. A dugong as seen at a distance from the deck of a ship and especially if floating half upright, with its baby under its flipper, might well be mistaken for a mermaid; and many legends gathered round them in the early days of exploration of the Indian ocean. For the evolutionary history and relationships of the Sirenia, *see* UNGULATA.

SIRENS, in Greek mythology, the daughters of Phorcys the sea-god (Gr. Σειρῆνες), or, in later legend, of the river-god Acheloüs and one of the nymphs. In Homer they are two in number (in later writers generally three); their home is an island in the western sea between Aeaea, the island of Circe, and the rock of Scylla. They are nymphs of the sea, who lured mariners to destruction by their sweet song. Odysseus, warned by Circe,

escaped the danger by stopping the ears of his crew with wax and binding himself to the mast until he was out of hearing (*Odyssey* xii.). When the Argonauts were passing by them, Orpheus sang so beautifully that no one had ears for the Sirens. After one or other of these failures they drowned themselves. When the adventures of Odysseus were localized on the Italian and Sicilian coasts, the Sirens were transferred to the neighbourhood of Neapolis (Naples) and Surrentum, the promontory of Pelorum at the entrance to the Straits of Messina, or elsewhere. The tomb of one of them, Parthenope, was shown in Strabo's (v. p. 246) time at Neapolis, where a gymnastic contest with a torch-race was held in her honour.

Perhaps the most reasonable explanation of the Sirens is that they are soul-birds; *i.e.*, winged ghostly figures who fetch the living to join them. They are in this respect not unlike the Harpies (*q.v.*); so Weicker. In early art, they were represented as birds with the heads of women; later, as female figures with the legs of birds, with or without wings.

See H. Schrader, *Die Sirenen* (1868); Preller-Robert, *Griechische Mythologie* (1894), pp. 614–616; G. Weicker, *Der Seelenvogel in der alten Literatur und Kunst* (1902) (Bibl.), and in Roscher's *Lexikon*, art. *Seirenen*.

SIRGUJA or **SURGUJA,** one of the Chota Nagpur feudatory states transferred in 1905 from Bengal to the Central Provinces. It is bounded on the north by the State of Rewa and on the north and north-east by the districts of Mirzapur and Ranchi; on the south is Bilespur; it thus borders three provinces. In the central portion, there is fairly well cultivated country, surrounded on three sides by massive hill barriers and tablelands, of which the *Jamirapat,* a winding ridge 2 miles in width, separates it from Chota Nagpur. The southern barrier of the State is the *Mainpat,* a fine tableland 18 m. by 6 m. with an elevation rising to 3,700 feet. The Ramgarh hill is a rectangular mass of sandstone rising abruptly from the plain, containing a remarkable natural tunnel, many rock caves and remains of temples made of enormous blocks of stone. There are other ruins in the jungles, indicating a higher state of civilization at an earlier epoch than that now prevailing. The area of the State is 6,055 sq.m., and the population (1921) was 377,679. This comprises some 200,000 Hindus and 4,000 Mohammedans and the rest of the population is made up of a remarkable variety of different aboriginal tribes, some of which must have been very ancient. The chief, on whom the title of maharaja has been conferred, comes of ancient Rajput lineage.

SIRHIND, a tract of land in the Punjab, India. It consists of the north-eastern portion of the plain between the Jumna and Sutlej rivers, and is watered by the Sirhind canal, which draws its water-supply from the Sutlej near Rupar. The canal, which was opened in 1882, irrigates over 2,000 sq.m.

SIRICIUS, pope from Dec. 384 to Nov. 399, successor of Damascus. The disfavour which he showed to the monks led to the departure of Jerome from Rome to Bethlehem. Several of the decretal letters of Siricius are extant, setting forth the rules of ecclesiastical discipline. Under his pontificate a general council was convened at Capua in 391, which discussed various Eastern affairs. The council of Capua, inspired by the pope, deferred to the council of Macedonia the affair of Bonosus, bishop of Sardinia, who had been accused of heresy. To safeguard the authority of the Holy See over the bishops of Illyricum, Siricius entrusted his powers to the bishop of Thessalonica, who was henceforth the vicar of the pope in those provinces. Siricius maintained his protest, made in 386, against the attitude of Bishop Ithacius, the accuser of Priscillian, although he disapproved of the latter's doctrines. During his pontificate the last attempt to revive paganism in Rome was made (392–394) by Nicomachus Flavianus. Siricius died on Nov. 26, 399.

SIRIUS, the "dog star," is the brightest star in the heavens. It is situated in the constellation Canis Major (*q.v.*). The mythology and early references to it are discussed in the article CANIS MAJOR. In 1844 Bessel found that Sirius was not moving uniformly through the heavens, being sometimes ahead and sometimes behind the mean position. He deduced that (in addition to uniform proper motion) it had a motion in an elliptic orbit in a period of about 50 years. This indicated that an unseen star must be present, forming with Sirius a double star. In 1862 Alvan Clark, who was testing a large new object-glass, unexpectedly detected the companion as a faint point of light amid the glare of Sirius itself.

Sirius is one of the nearest stars and its parallax has been measured with considerable accuracy. Its distance is 2·7 parsecs =8·8 light years=51 million million miles. Its apparent brilliance is due more to its nearness than to actual luminosity; absolutely it is about 28 times as bright as the sun—a luminosity which is not at all exceptional. Its mass has been determined by Kepler's laws from the double star orbit and is 2·4 times that of the sun. Its spectrum shows that the surface temperature is much higher than the sun's (about 10,000° against 6,000°) and its light is correspondingly whiter. It is a typical star of the spectral class A0, in which the Balmer series of hydrogen is most strongly developed.

The companion is a remarkably interesting body. It revolves at a distance from Sirius nearly equal to the distance of Uranus from the sun in a period 49 years. Although it has one-third the mass of Sirius it gives less than $\frac{1}{10,000}$ of the light. A more convenient comparison is with the sun; it has 0·85 of the sun's mass, but only $\frac{1}{360}$ of the sun's light. It seemed natural to assume that it must be radiating feebly like a star on the verge of extinction, but in 1914 W. S. Adams made the surprising discovery that its spectrum was not much different from that of Sirius itself. This indicates a white light coming from a surface at high temperature and radiating more intensely than the sun's surface. If the small total light is not due to low emitting power, it must be due to small dimensions. Reasoning in this way the radius is found to be 18,800 km.; *i.e.*, intermediate between the earth and the next larger planet Uranus. The mass, which is 0·85 of the sun's or 250,000 times that of the earth, has to be squeezed into this small sphere; and the resulting density is 61,000 times that of water or about a ton to the cubic inch.

The result at first seemed incredible, but the cause of the supposed breakdown of this natural inference remained a mystery. In 1924, however, it was discovered that, owing to the breaking up of the outer systems of electrons in the atoms under the high temperature prevailing in the interior of a star, stellar matter would not offer the resistance to high compression that terrestrial matter does. It was therefore quite conceivable that densities might be attained in the stars far transcending the greatest known terrestrial densities. It was suspected that this might be the explanation of the result for the companion of Sirius. Accordingly, in 1924–25 W. S. Adams carried out a special test, depending on the Einstein effect in the star's spectrum, in order to check the high density. This effect is a lengthening of the wave-length of light which has come from a place of high gravitational potential, manifesting itself as a displacement of the spectral lines towards the red. It is thus theoretically possible to calculate the potential at the surface of a star (*i.e.*, the mass divided by the radius) if the magnitude of the Einstein effect can be measured. In all ordinary stars the shift is too small to measure; it is believed to have been found in the sun, but this can scarcely yet be regarded as certain. But if the foregoing dimensions of the companion of Sirius are right, the Einstein shift will be 30 times as great as on the sun. This quantity should be very easily measurable, were it not for special difficulties which arise from the faintness of the star and the interference of the scattered light from Sirius. Adams applied the test and his results are believed to be trustworthy; they definitely confirm the large spectral shift predicted. It appears therefore that the companion of Sirius is a genuine example of matter compressed to enormously high density—more than 2,000 times the density of platinum.

BIBLIOGRAPHY.—For the high density of the companion of Sirius: A. S. Eddington, *Monthly Notices of Roy. Ast. Soc.*, 84, p. 322 (1924); W. S. Adams, *Proc. Nat. Acad. Sci. Washington*, II., p. 382 (1925). The remarkable physical conditions arising from the high density are discussed by R. H. Fowler, *Monthly Notices*, 87, p. 114 (1926).

(A. S. E.)

SIRMUR or **SARMOR,** an Indian State, within the Punjab. It is also called Nahan, after the chief town. It occupies the

lower ranges of the Himalaya, between Simla and Mussoorie. Area 1,198sq.m. On the northern frontier Chor Peak and station are about 12,000ft. above the sea. Pop. (1921), 140,448. Estimated gross revenue, £45,000.

SIROCCO, a term used specifically for the hot, dry wind in Sicily and south Italy, but the name is in general use on the north Mediterranean seaboard for any warm southerly wind; such winds may be either moist or very dry, and represent the air current in front of the depressions advancing eastward over the Mediterranean sea. (*See* LEVECHE; LESTE; KHAMSIN; SIMOOM; and *Meteorological Office Publication No. 224,* 1919.)

SIROHI, an Indian state in the Rajputana agency. Area 1,958 sq.m. The country is much broken up by hills and rocky ranges; the Aravalli range traverses it from north-east to south-west. The south and south-east part of the territory is mountainous and rugged, containing the lofty Mount Abu. The only river of any importance is the Western Banas. A large portion of the state is covered with dense jungle, in which wild animals, including the tiger, bear and leopard, abound. Many splendid ruins bear witness to the former prosperity and civilization of the country. On Abu the average annual rainfall is about 64 in., whereas in Erinpura, less than 50 m. to the north, the average fall is only between 12 and 13 in. Pop. (1921) 186,639.

In 1823 a treaty was concluded with the British government. For services rendered in 1857 the chief received a remission of half his tribute. The chief, whose title is maharao, is a Deora Rajput of the Chauhan clan, and enjoys a salute of 15 guns.

The town of SIROHI is 28 m. N. of Abu-road station. Pop. (1921) 6,197. It has manufactures of sword-blades and other weapons.

SIS or Kozan (anc. *Sision* or *Siskia,* later *Flaviopolis* or *Flavias*), a kaza in the Adana vilayet of Asiatic Turkey, situated on the left bank of the Kirkgen Su, a tributary of the Jihun (Pyramus) and at the south end of a group of passes leading from the Anti-Taurus valleys to the Cilician plain and Adana. It was besieged by the Arabs in 704 but relieved by the Byzantines. The Caliph, Motawakkil took it and refortified it; but it soon returned to Byzantine hands. It was rebuilt in 1186 by Leo II., king of Lesser Armenia, who made it his capital. In 1374 it was taken and demolished by the sultan of Egypt, and it has never recovered its prosperity. It is now only a big village of some 3,000 inhabitants. It has had, however, a great place in Armenian ecclesiastical history from the times of St. Gregory the Illuminator to our own. Gregory himself was there consecrated the first Catholicus in A.D. 267, but transferred his see to Vagarshabad (Echmiadzin, Etchmiadzin), whence, after the fall of the Arsacids, it passed to Tovin. After the constitution of the kingdom of Lesser Armenia, the catholicate returned to Sis (1294), the capital, and remained there 150 years. In 1441, Sis having fallen from its high estate, the Armenian clergy proposed to remove the see, and on the refusal of the actual Catholicus, Gregory IX., installed a rival at Echmiadzin, who, as soon as Selim I. had conquered Greater Armenia, became the more widely accepted of the two by the Armenian church in the Ottoman empire. The Catholicus of Sis maintained himself nevertheless, and was supported in his pretensions by the Porte up to the middle of the 19th century, when the patriarch Nerses, declaring finally for Echmiadzin, carried the government with him. In 1885 Sis tried to declare Echmiadzin schismatic, and in 1895 its clergy took it on themselves to elect a Catholicus without reference to the patriarch; but the Porte annulled the election, and only allowed it six years later, on Sis renouncing its pretensions to independence. The lofty castle and the monastery and church built by Leo II., and containing the coronation chair of the kings of Lesser Armenia, are interesting. (D. G. H.)

SISAK, a town of Croatia-Slavonia, Yugoslavia. Pop. (1921), 8,802. Sisak was a flourishing city under Roman rule. Augustus made it a military station; Tiberius chose it as his headquarters against the Pannonian rebels, and Septimius Severus made it the centre of a military government. In the third century the city contained the chief imperial mint and treasury; and an engraved coffer, found in Croatia, dating from the 4th century, represents *Siscia* among the five foremost cities of the Empire. Its bishopric was removed to Salona in 441, when Attila appeared, and thenceforward the city declined. For a brief period in the 7th and 8th centuries, it was held by the Serbian princes, but in the 10th century it was sacked by the Magyars, and in 1092 its territories were bestowed upon the cathedral chapter of Zagreb (*Agram*) by Ladislaus I., king of Hungary. Under the walls of its castle, built by this chapter in 1544, the Turks were thrice defeated in 1593. At a fourth venture the city fell, only to be evacuated in 1594. It witnessed a final Turkish defeat in 1641, and from that date until 1918 it was included in the Austro-Hungarian empire.

See C. de St. Aymour, *Les Pays sud-slaves de-l' Autriche-Hongroie* (1883).

SISAL HEMP or HENEQUEN, of Florida and the Bahamas, the product of *Agave rigida,* variety *sisalana,* a native of Yucatan, but found in other parts of Central America and distributed to the West Indies, where it is being increasingly cultivated.

Agave (*q.v.*) is a member of the family Amaryllidaceae; and a well-known species of the genus, *Agave americana,* the century plant, will suggest the habit of the sisal hemp, which, however, differs in the absence of prickles along the margin of the fleshy leaf. After six or seven years the flowering stalk or "pole" develops from the centre of the leaf-cluster, and grows to the height of 15 or 20 ft. The flowers are borne in dense clusters at the ends of short lateral branches, and closely resemble those of *Agave americana.* After they have begun to wither, buds are developed from the point of union with the flower-stalk; these form tiny plants, which, when several inches long, become detached and fall to the ground. Those that fall in a suitable place take root and are soon large enough to transplant. After flowering the main plant perishes, but is renewed by suckers springing from the base of the stem; these suckers are then planted, and the leaves should be ready for cutting in about four years. The other method of planting is by means of "pole" plants just described.

In collecting the fibre the leaves are cut off at the base, the spine at the top end removed, and the leaves carried in bundles to the machines. Here two scraping wheels remove the softer parts from the fibre of the leaves. The fibre is yellowish-white, straight, smooth and clean, and a valuable cordage fibre second only to manila fibre in strength.

The plants thrive on arid rocky land, growing, for instance, on the Florida Keys upon the almost naked coral rock. Their northern limit of cultivation is determined by frost; in Florida this is represented by the line of 27° N. An inferior fibre is obtained

ONE END OF A FIBRE CLEANING MACHINE ON A YUCATAN PLANTATION
The tough henequen leaves enter the machine at this end and emerge as clean, white fibre at the other end

from the leaves of another species, *Agave decipiens,* which is found wild along the coasts and keys of Florida. It is known as the false sisal hemp.

SISKIN or **ABERDEVINE** (*Carduelis spinus*), which has long been known in England as a cage-bird, is one of the finches (*q.v.*). It often feeds upon the catkins of alder or birch, frequently hanging upside down like a titmouse. Above, the male is olive-green marked with black and yellow, and beneath, yellowish-white marked with black. His song is not unmelodious. The hen is more soberly attired. The siskin breeds locally throughout

Scotland and parts of England, but more rarely in Ireland. The greater portion, however, of the bands, which visit the British Isles in winter come from the Continent. Its range stretches across Asia to Japan. The nest of the siskin is like that of the goldfinch, but not so neatly built; the eggs, except in their smaller size, resemble those of the greenfinch.

A larger and more brightly coloured species, *C. spinoides*, inhabits the Himalayas. In the United States of America the name siskin or pine siskin is sometimes used for the pine-finch (*Spinus pinus*).

SISLEY, ALFRED (1840–1899), French landscape painter, was born in Paris in 1839, of English parents. He studied painting under Gleyre, and was afterwards influenced, first by Corot, and then by the impressionists Monet and Renoir. He worked both in France and in England, and made the Seine, the Loing and the Thames the subjects of many pictures that are remarkable for the subtle appreciation of the most delicate colour effects. His life was one of constant poverty and hard struggle. He was essentially a colourist who, like Monet, delighted in recording the changing effects of light in the successive hours of the day, and paid little attention to form.

SISMONDI, JEAN CHARLES LÉONARD DE (1773–1842), whose real name was Simonde, was born at Geneva, on May 9, 1773. During the revolutionary disturbances of 1793–94 the Simonde family took refuge in England. On their return the greater part of the family property was sold, and with the proceeds they emigrated to Italy, bought a small farm at Pescia near Lucca, and set to work to cultivate it themselves. Sismondi's experiences gave him the material of his first book, *Tableau de l'agriculture toscane,* which, after returning to Geneva, he published in 1801. In 1803 he published his *Traité de la richesse commerciale.* As an economist, Sismondi represented a humanitarian protest against the dominant orthodoxy of his time. In his first book he followed Adam Smith, but in his principal subsequent economic work, *Nouveaux Principes d'économie politique* (1819), he insisted on the fact that economic science studied the means of increasing wealth too much, and the use of wealth for producing happiness too little.

Meanwhile he began to compile his great *Histoire des Républiques Italiennes du moyen âge,* and became intimate with Madame de Staël. He was invited or commanded (for Madame de Stael's invitations had something of command) to accompany her on the journey into Italy, described in *Corinne.* During this journey he made the acquaintance of the countess of Albany (*q.v.*) Louisa of Stolberg, widow of Charles Edward. Sismondi's relations with her were close and lasted long, and they produced much valuable and interesting correspondence. In 1807 appeared the first volumes of his history. The completion of this book, which extended to sixteen volumes, occupied him for the next eleven years. He lived at first at Geneva, where he held a minor official post. In 1813 he visited Paris for the first time. During the Hundred Days he defended Napoleon's constitutional schemes or promises, and had an interview with the emperor. After the Restoration he left Paris. On completing (1817) his great book on the Italian republics, he undertook (1818) a still greater, the *Histoire des Français,* of which during the remaining twenty-three years of his life he published twenty-nine volumes. Sismondi died at Geneva on June 25, 1842.

Among his other works are: *Littérature du midi de l'Europe* (1813), an historical novel entitled *Julia Severa ou l'an 492* (1822), *Histoire de la Renaissance de la liberté en Italie* (1832), *Histoire de la chute de l'empire romain* (1835), *Précis de l'histoire des Français,* an abridgment of his own book (1839), with several others, chiefly political pamphlets.

Sismondi's journals and his correspondence with Channing, with the countess of Albany and others have been published chiefly by Mlle. Mongolfier (Paris, 1843) and M. de Saint-René Taillandier (Paris, 1863). The latter work serves as the chief text of two admirable *Lundis* of Sainte-Beuve (September 1863), republished in the *Nouveaux Lundis,* vol. vi.

SISSALA. A people resembling the Nunuma who inhabit the borders of Upper Volta (Gourounsi) and the Northern Territories, Gold Coast in Africa, and speak a language related to Nunuma and Kassena. A sub-tribe known as the Puguli live about 70m. west of Leo and Tumu in the Diébougou district of Upper Volta.

See Tauxier, *Le Noir du Soudan* (1912).

SISTERHOODS (Modern Anglican). The dissolution of religious houses in England (1536–1540) under Henry VIII. swept away more than 140 nunneries, and the Anglican Church was left without sisterhoods for three centuries. But as these had for 900 years formed part of her system, there were protests from time to time and attempts at restoration. Amongst such protests, which generally dwelt a good deal on the want of provision for unmarried women, may be mentioned three in successive centuries. The historian Fuller would have been glad "if such feminine foundations had still continued," only without vows (Bk. vi.). Richardson the novelist, in *Sir Charles Grandison,* wishes there could be a Protestant nunnery in every county, "with a truly worthy divine, at the appointment of the bishop of the diocese, to direct and animate the devotion of such a society"; in 1829 the poet Southey, in his *Colloquies* (cxiii.), trusts that "thirty years hence this reproach also may be effaced, and England may have its Béguines and its sisters of mercy. It is grievously in need of them." Also small practical efforts were made in the religious households of Nicholas Ferrar at Little Gidding, 1625, and of William Law at King's Cliffe, 1743; and under Charles II., says Fr. Bede "about 12 Protestant ladies of gentle birth and considerable means" founded a shortlived convent, with Sancroft, then Dean of St. Paul's, for director.

Southey's appeal had weight, and before the thirty years had passed compassion for the needs of the destitute in great cities, and the impulse of a strong Church revival, aroused a body of laymen, among whom were included Mr. Gladstone, Sir T. D. Acland, Mr. A. J. Beresford-Hope, Lord Lyttelton and Lord John Manners (chairman), to exertions which restored sisterhoods to the Church of England. On March 26th, 1845, the Park Village Community was set on foot in Regent's Park, London, to minister to the poor population of St. Pancras. The "Rule" was compiled by Dr. Pusey, who also gave spiritual supervision. In the Crimean War the superior and other sisters went out as nurses with Florence Nightingale. The community afterwards united with the Devonport Sisters, founded by Miss Sellon in 1849, and together they form what is known as Ascot Priory. The St. Thomas's sisterhood at Oxford commenced in 1847; and the mother-superior of the Holy Trinity Convent at Oxford, Marian Hughes, dedicated herself before witnesses to such a life as early as 1841 (Liddon's *Life of Dr. Pusey,* iii.).

Practically all Anglican sisterhoods originated in works of mercy, and this fact largely accounts for the rapidity with which they have won their way to the good will and confidence of the Church. This change in sympathy, again, has gained a hearing from modern historians, who tend more and more to discredit the wholesale defamation of the dissolution period. Another modern feature is the fuller recognition of family ties: Rule 29 of the Clewer sisters directs that "the sisters shall have free intercourse with relations, who may visit them at any time." But in most essential respects modern sisterhoods follow the ancient traditions. They devote themselves to the celibate life, have property in common, and observe a common rule of prayer, fellowship and work. Government is by a sister superior, assisted by various officers. The warden and chaplain are clergy, and the visitor is commonly a bishop.

In one important regard there has been hesitation, and authorities like Dr. Littledale and Bishop Grafton contend strongly for the primitive ideal of the convent as family, with a constitutional government, as against the later and widespread Jesuit ideal of the convent as regiment, with a theory of absolute rule and obedience. On the other hand, the doctrine of obedience itself, as applied to Anglican Sisterhoods, is subject to the atmosphere of free institutions and a respect for individuals which are themselves correctives of any possible dangers, inherent in the principle.

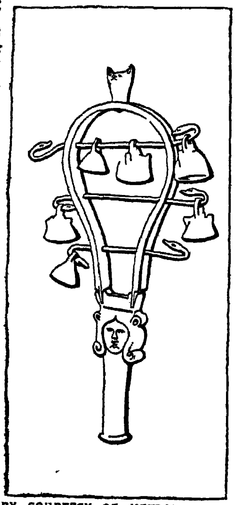
Bibliography.—T. T. Carter, *Memoir of Harriet Monsell;* Dr. R. F. Littledale, Papers on "Sisterhoods" in the *Monthly Packet* (July 1874–November 1879); Parl. Report on *Convent. and Monast. Inst.* (1870); Lina Eckenstein, *Woman under Monasticism* (1896); Mowbray, *Churchman's Year Book* (1929), ref. *s.v.* "Communities."

SISTOVA (Bulg. *Svishtov*), a town of Bulgaria, capital of the

department of the same name, on the Danube, 40 m. W. of Rustchuk. Pop. (1926), 12,068. A branch line connects it with the main Sofia-Rustchuk railway. It is an important commercial centre, exporting wine and grain and importing petroleum. The Roman colony *Novae,* mentioned by Ptolemy, lay a little westward of the present town, which has been destroyed and rebuilt many times (1797, 1810, 1829, 1878). The Treaty of Sistova, determining the Austro-Turkish boundary, was signed here (1790). Near by are the ruins of the palace of Theodoric the Goth. The Walachian town of Alexandria was founded by fugitives from Sistova in 1878.

SISTRUM, an ancient Egyptian instrument of percussion of indefinite musical pitch, a kind of metal rattle. It consisted of an oval metal frame fastened to a handle and crossed by four metal horizontal rods passing through holes large enough to allow them to rattle when the instrument was shaken. Queen Cleopatra made use of a large number of sistra at the battle of Actium (31 B.C.), and accordingly the instrument was satirically called Queen Cleopatra's war trumpet.

SISYPHUS (etymology uncertain), son of Aeolus and Enarete, and king of Ephyra (Corinth). He was the father of the sea-god Glaucus and (in post-Homeric legend) of Odysseus. He was said to have founded the Isthmian games in honour of Melicertes, whose body he found lying on the shore of the Isthmus of Corinth. From Homer onwards Sisyphus was famed as the craftiest of men. When Death came to fetch him, Sisyphus put him into fetters, so that no one died till Ares came and freed Death, and delivered Sisyphus into his custody. But Sisyphus was not yet at the end of his resources. For before he died he told his wife that when he was gone she was not to offer the usual sacrifice to the dead. So in the underworld he complained that his wife was neglecting her duty, and he persuaded Hades to allow him to go back to the upper world and punish her. But when he got back to Corinth he did no such thing and so lived until he died of old age (Pherecydes, frag. 119, Jacoby). In the underworld Sisyphus was compelled to roll a big stone up a steep hill; but before it reached the top of the hill the stone always rolled down, and Sisyphus had to begin all over again (*Odyssey,* xi. 593).



BY COURTESY OF METROPOLITAN MUSEUM OF ART

EGYPTIAN SISTRUM, USED BY PRIESTS IN THE TEMPLE OF ISIS

The way in which Sisyphus cheated Death is not unique in folktales. For several examples, *see* T. F. Crane, *Italian Popular Tales* (1885). The German parallel is Gambling Johnny, who kept Death up a tree for seven years, during which no one died (Grimm 82, *see* the commentary of Bolte-Polivka). The Norse parallel is the tale of the Master Smith (E. W. Dasent, *Popular Tales from the Norse*). For a Lithuanian parallel, *see* A. Schleicher, *Litauische Märchen, Sprichworte, Rätsel und Lieder* (1857); for Slavonic parallels, F. S. Krauss, *Sagen und Märchen der Südslaven,* ii., Nos. 125, 126; *see* also Frazer's *Pausanias,* iii., p. 33; O. Gruppe, *Griechische Mythologie* (1906), ii. p. 1021, note 2.

SITAPUR, a town and district of British India in the Lucknow division of the United Provinces. The town is on the river Sarayan, half-way between Lucknow and Shahjahanpur. Pop. (1921) 21,584. It is a cantonment, garrisoned by a portion of a British regiment. It has a considerable trade, principally in grain.

The DISTRICT OF SITAPUR has an area of 2,250 sq.m. It presents the appearance of a vast plain, well-wooded with numerous groves, and well cultivated, except in those parts where the soil is barren and cut up by ravines. Except in the eastern portion, which lies in the doabs between the Kewani and Chauka and the Gogra and Chauka rivers, the soil is as a rule dry, but even this moist tract is interspersed with patches of land covered with saline efflorescence called *reh.* The principal rivers are the Gogra, which is navigable by boats of large tonnage throughout the year, and the Chauka.

SITKA (formerly New Archangel), historically the most notable settlement of Alaska, on the west coast of Baranof island, in Sitka sound, lat. 57° 03′ N., 135° 19′ W., about 100m. S.S.W. of Juneau. Pop. (1890) 1,193 (300 white and 893 natives); (1930) 1,056. The city is prettily situated on an island-studded and mountain-locked harbour, with a background of forest and snow-capped mountain cones; an extinct volcano, Mt. Edgecumbe (3,467ft.), on Kruzof island, is a conspicuous landmark in the bay. Sitka's mean annual temperature is 2° higher than that of Ottawa, and its climate is more equable. The mean annual temperature is about 43° F; the monthly means range from 33° (January) to 56° (August), and the extreme recorded temperature from —4° to 87° F. Two-thirds of the days of the year are cloudy; on about 208 days in the year it rains or snows; the normal rainfall is 88·1in., the extreme recorded rainfall (in 1886) is 140·26 inches. The city includes an American settlement and an adjoining Indian village. In addition to United States Government buildings (naval coaling station, agricultural experiment station, wireless telegraph station and magnetic observatory), there are two public schools (one for whites and one for Thlinkets), the Sheldon Jackson (ethnological) museum, which is connected with the Presbyterian Industrial Training school, a parochial school of the Orthodox Greek (Russian) Church, a Russian-Greek church, built in 1816, and St. Peter's-by-the-Sea, a Protestant Episcopal mission built in 1899. Sitka is the see of a Greek Catholic and of a Protestant Episcopal bishop. In its early history it was the leading trading post of Alaska. After the discoveries of gold on the mainland, at the end of the 19th century, it lost its commercial primacy, but business improved after the discovery of gold in 1905 on Chicagoff island, about 50m. distant. There is a growing lumber industry; salmon fisheries are of greater importance. In the surrounding region there are gold and silver mines.

Old Sitka or Ft. Archangel Gabriel, about 6m. from the present town, was founded in May 1799. The fort was overwhelmed by the Thlinkets in 1802, but was recaptured by the Russians in Sept. 1804. The settlement was removed at this time by Alexander Baranof to the present site. Thereafter until 1867 it was the chief port and (succeeding Kodiak) the seat of government of Russian America. During the latter days of Russian occupation, Sitka presented a scene of splendour and activity. Here was located the Russian orthodox church of St. Michael with its spired dome and chime of bells, the courtly Baranof Castle, which was the residence of the Russian governor and the centre of social life, and the solidly built log warehouse of the Russian-American Fur company. It also had a shipyard and a foundry, which, it is said, made bells for half the mission churches in California. The formal transfer of Alaska from Russian to American possession took place at Sitka on Oct. 18, 1867. It continued to be the seat of government of Alaska until 1906, when Juneau became the capital.

SITMAR LINE. The "Sitmar" Steamship Company was originally incorporated with the Navigazione Generale Italiana. As an outcome of the deliberations of the Maritime Conventions, the lines of the N.G.I. which served the Mediterranean and Far East were formed into separate companies, which were subsidised by the State, and one of which was the "Sitmar" Company, whose vessels served Egypt, Syria and the Near East in competition with the Austrian and German companies.

In 1912 the "Sitmar" decided to construct new and faster vessels and to provide a more luxurious and comfortable mode of travelling to Egypt than their existing accommodation provided. The construction of two large steamers of 12,500 tons displacement was thereupon undertaken, and the whole of the Company's services were completely reorganized a short time before the World War broke out. Upon the outbreak of hostilities the Company's vessels were commandeered by the State for the transportation of troops in the Adriatic and Aegean Seas. Of the 13 vessels so taken, no fewer than 12, having a total tonnage of 62,000, were sunk by enemy vessels. At the cessation of hostilities it was found necessary to reorganize completely the entire service of the Company, and the reconstruction of vessels was begun on a large scale.

The launching of the well known S.S. "Esperia" took place in

1920. After placing the "Esperia" in the fleet the efforts of the Company were aimed especially at the establishment of a fast, regular service-de-luxe between Italy and Egypt, having weekly sailing from Genoa, at that time taken in turn by the S.S. "Esperia" and the S.S. "Italia."

In May 1926 the construction of a new vessel-de-luxe was commenced, the "Ausonia," to take the place of the S.S. "Italia": this vessel was launched in October 1927, and commenced running in 1928.

In addition to this regular weekly express service to Egypt by the fastest vessels in the Mediterranean, the "Sitmar" links up Italy with the principal ports of the eastern Mediterranean by the two fast "circular" lines, which provide a weekly sailing from Genoa to and from Egypt, Palestine, Athens, Constantinople and other ports.

In addition to these are the mail and commercial services of lesser importance: Fortnightly mail service, Tyrrhenian Sea–Danube; monthly commercial services, Tyrrhenian Sea–Aegean Sea and Tyrrhenian Sea–Black Sea.

The fleet of the "Sitmar" consists of 15 vessels, totalling 116,218 tons. (W. Sto.)

SITTIDAE: *see* Nuthatch.

SITTINGBOURNE, a market town in the Faversham parliamentary division of Kent, England, on a navigable creek of the Swale, 44¾ m. E.S.E. of London by the Southern Ry. Population (1931) 20,175 with Milton. It consists principally of one long street (the Roman Watling street) and the northern suburb of Milton Regis, a separate urban district (pop. 7,481), celebrated for its oysters, the fishery of which used to employ a large number of the inhabitants. Brick and cement making is an important industry employing about 6,000 hands, and there are corn and paper mills and a jam factory. The export trade in corn and import trade in coal is considerable. An earthwork known as Castle Rough, in the marshes below Milton, was probably the work of Hasten the Dane in 892, and Bayford castle, a mile distant, occupies the site of one said to have been built in opposition by King Alfred. Tong castle is about 2 m. E. of Sittingbourne. It consists of a high mound surrounded by a moat, and is said to have been erected by Hengest. Fragments of masonry exist about the mound. The story of the founding of the castle resembles that connected with the city of Carthage. Vortigern is said to have granted Hengest as much land as an ox-hide could encompass, and the hide being cut into strips the site of Tong castle was accordingly marked out. The same tradition attaches to Tong castle in Shropshire. Tradition also asserts, according to the 12th century chronicler, Geoffrey of Monmouth, that it was in Tong castle that Vortigern met Rowena, Hengest's daughter, and became so enamoured of her as to resign his kingdom to her father. In the time of Richard II. Tong castle belonged to Edmund Mortimer, earl of March.

Sittingbourne is mentioned in Saxon documents in 989 and frequently in contemporary records of the 13th and 14th centuries. The first charter was obtained in 1573; a second in 1599.

SITTING BULL (*c.* 1837–1890), a chief and medicine man of the Dakota Sioux, was born on Willow Creek, in what is now North Dakota, about 1837, son of a chief, Jumping Bull. He gained great influence among the reckless and unruly young Indians, and during the Civil War led attacks on white settlements in Iowa and Minnesota. Though he had pretended to make peace in 1866, from 1869 to 1876 he frequently attacked whites or Indians friendly to whites. His refusal to return to the reservation in 1876 led to the campaign in which Gen. George A. Custer (*q.v.*) and his command were massacred. Fearing punishment for his participation in the massacre, Sitting Bull with a large band moved over into Canada.

He returned to the United States in 1881, and after 1883 made his home at the Standing Rock Agency. Rumours of a coming Indian Messiah who should sweep away the whites, and Indian dissatisfaction at the sale of their lands, created such great unrest in Dakota in 1889–90 that it was determined to arrest Sitting Bull as a precaution. He was surprised and captured by Indian police and soldiers on Grand river Dec. 15, 1890, and was killed while his companions were attempting to rescue him.

SIVA (*Shiva*), in post-Vedic mythology the destroyer-god who with Brahma the creator and Vishnu the preserver forms the Indian trinity. In the Vedas *shiva* ("auspicious") was the epithet applied to any god, even euphemistically to the baleful Rudra (*q.v.*). In the Epic literature Siva has many attributes and various functions. He is lord of spirits (*bhūts*), protector of cattle (as Pāsupati) and god of letters, music and dancing. As Natarāja ("dance-king"), however, his worship is confined to southern India; and there, too, is to be found one of his peculiar sects, the Lingāyats (*q.v.*). His spouse is essentially Devi ("the goddess") under the various names, Umā, Pārvati, Durga (*q.v.*), Kālī (*q.v.*), or Karālī.

See W. E. Hopkins, *Epic Mythology* (Strasbourg, 1915); O. C. Gangoly, *South Indian Bronzes* (Calcutta, 1915).

SIVAJI (1627–1680), founder of the Mahratta power in India, was born in May 1627. He was the son of Shahji Bhonsla, a Mahratta soldier of fortune who held a *jagir* under the Bijapur government, and regarded himself as appointed to free the Hindus from the Mohammedan yoke. Forming a national party among the Hindus of the Deccan, he opposed in turn the vassal power of Bijapur and the imperial armies of the Mogul of Delhi. By intrigue and hard fighting, Sivaji won for the Mahrattas practical supremacy in western India. In 1659 he lured Afzul Khan, the Bijapur general, into a personal conference, and killed him with his own hand, while his men attacked and routed the Bijapur army. In 1666 he visited the Mogul emperor, Aurangzeb, at Delhi, but on his expressing dissatisfaction at not being treated with sufficient dignity, he was placed under arrest. Having effected his escape in a sweetmeat basket, he raised the standard of revolt, assumed the title of raja, and the prerogative of coining money in his own name. He died on April 5, 1680. Savaji had a genius both for war and for peaceful administration; but he always preferred to attain his ends by fraud rather than by force. He is the national hero of the Mahrattas.

See Grant Duff, *History of the Mahrattas* (1826); Krishnaji Ananta, *Life and Exploits of Sivaji* (1884); and M. G. Ranade, *Rise of the Maratha Power* (Bombay, 1900).

SIVAS, a vilayet in Asia Minor. Sivas (anc. *Megalopolis-Sebasteia*), altitude 4,420 ft., is the chief town of the vilayet of the same name. It is situated in the broad valley of the Kizil Irmak, on one of its right bank tributaries, the Murdan Su. Pop. (1927) 56,180. The climate is healthy but severe in winter. Coarse cotton cloth and woollen socks are manufactured. The *medresses* (colleges), built in the 13th century by the Seljuk sultans of Rum, are amongst the finest remains of Moslem art in Asia Minor. In one of them is the tomb of its founder, Izz ud-din Kai Kāus I. (1210–1219). Near the town is the Armenian monastery of the Holy Cross, in which are kept the throne of Senekherim and other relics. Under Diocletian Sebasteia became the capital of Armenia Minor, and in the 7th century that of the Sebasteia Theme. Justinian rebuilt the walls and, under the Byzantine emperors, it was second only to Caesarea in size and wealth. In 1021 Senekherim, king of the Armenian province of Vaspuragan (Van), ceded his dominions to Basil II., and became the Byzantine viceroy of Sebasteia and the surrounding country. This position was held by his successors until the town fell into the hands of the Turkomans after the defeat of Romanus II. by the Seljuks (1071). After having been ruled for nearly a century by the Danishmand amirs, it was taken (1172) by the Seljuk sultan of Rum, and in 1224 was rebuilt by Sultan Ala-ed-din Kaikobad I. In 1400, when captured by Timur, the city is said to have had 100,000 inhabitants, and to have been famous for its woollen stuffs. On this occasion the bravest defenders were massacred, and 4,000 Armenians were buried alive. Mohammed the "Conqueror" restored the citadel, and the place has ever since been an important Ottoman provincial capital. Early in the 19th century, like all other Ottoman towns, it was terrorized by janissaries, with whom Mahmud II. commissioned the great Dere Bey of Yuzgat, Chapan Oglu, to deal in 1818. The news of his drastic success provoked a dangerous riot in Stambul, which postponed by some years the final tragedy of the janissaries.

Mechithar, the founder of the Mechitharists (*q.v.*) and of the famous monastery at Venice, was born (1676) at Sivas. Sivas is connected with Angora by a railway which (in 1928) was being extended to Erzeroum.

SIVATHERIUM, an extinct mammal allied to the giraffe but larger, with two pairs of horns, the hinder large and deer-like, the anterior short and pointed. Its remains are found in the Pliocene foundation of the Siwalik hills in India. It reached a height of 7ft. An allied genus of the same geological age, *Samotherium,* with a single pair of horns, present only in the male, is known from Samos.

SIVRI-HISSAR, "Pointed-Castle," a kazah in the Eski Shehir vilayet in Asia Minor, situated 8 m. N. of the site of Pessinus, at the foot of a lofty double-peaked ridge of rock, which bears the ruins of a Byzantine castle. It is a road and commercial centre, with a trade in opium and mohair. Pop. (1927) 31,496. The town occupies the site of ancient *Palia,* re-founded and re-named Justinianopolis by the emperor Justinian. It was one of the chain of fortresses on the Byzantine military road across Asia Minor, and became the chief city of Galatia Salutaris about A.D. 700.

SIWA, an oasis in the Libyan Desert, politically part of Egypt. It is also known as the oasis of Ammon or Jupiter Ammon; its ancient Egyptian name was *Sekhet-am,* "Palm-land." The oasis lies about 350 m. W.S.W. of Cairo; its chief town, also called Siwa, being situated in 29° 12′ N., 25° 30′ E. The oasis is some 6 m. long by 4 to 5 wide. Ten miles north-east is the small oasis of Zetun, and westward of Siwa extends for some 50 m. a chain of little oases. The population of Siwa proper is nearly 4,000. The inhabitants are of Libyan (Berber) stock and have a language of their own, but also speak Arabic. The oasis is extremely fertile and contains many thousands of date palms. The town of Siwa is built on two rocks and resembles a fortress. The houses are frequently built on arches spanning the streets, which are narrow and irregular.

The oasis owes its distinction to the oracle temple of Ammon, which was already famous in the time of Herodotus, and was consulted by Alexander the Great. The remains of the temple are in the walled village of Aghormi, 2 m. E. of the town of Siwa. It is a small building, with inscriptions dating from the 4th century B.C. The oracle fell into disrepute during the Roman occupation of Egypt, and was reported dumb by Pausanias, *c.* A.D. 160. Near the temple are the scanty remains of another temple of the same century, Umm Beda, with reliefs depicting the prince of the oasis making offerings to Ammon, "lord of oracles." At Jebel Muta, 1 m. N.E. of Siwa, are tombs of Ptolemaic and Roman date; 10 m. E. of Aghormi is a well-preserved chapel, with Roman graves; at Kasr Rumi is a temple of the Roman period.

The oasis lies close to the Tripolitan frontier and is largely dominated by the sect of the Senussi (*q.v.*), whose headquarters were formerly at Jarabub, to the north-west. The Senussi successfully prevented various explorers penetrating westward beyond Siwa. The first European to reach Siwa since Roman time was W. G. Browne, who visited the oasis in 1792. There were serious disturbances in 1909, and as a result in 1910 a telegraph line was built across the desert from Alexandria to the oasis.

SIWALIK HILLS, a name given to the foot-hills of the Himalayas in Dehra Dun district of the United Provinces of India and in Nahan state and Hoshiarpur district of the Punjab. The range runs parallel with the Himalayan system from Hardwar on the Ganges to the Beas, with a length of 200 m. and an average width of 10 m. The elevation varies from 2,000 to 3,500 ft. Geologically speaking the Siwaliks belong to the tertiary deposits of the outer Himalayas, and are chiefly composed of low sandstone and conglomerate hills, the solidified and upheaved detritus of the great range in their rear. The intermediate valley lying between the outer hills and the Mussoorie mountains is known as the Dehra Dun (or Dehra valley) and is a popular residential area of Europeans and Anglo-Indians. The principal pass is that of Mohan by which the main road from Saharanpur to Dehra and Mussoorie traverses the range. The Siwalik formation (distinguished for its extraordinary wealth of palaeontological remains) is found on the North-west Frontier occupying much the same position relatively to the Suliman range as it does to the Himalayas, *i.e.,* it faces the plains and becomes the outermost wall of the hills.

SIWARD (d. 1055), earl of Northumbria, was a Dane by birth and probably came to England with Canute. He became earl of Deira after the death of Eadwulf Cutel, earl of Northumbria, about 1038, and earl of all Northumbria after murdering Eadwulf, earl of Bernicia, in 1041. He supported Edward the Confessor in his quarrel with Earl Godwine in 1051, and was appointed earl of Huntingdon soon after this date. In 1054 Siward invaded Scotland in the interests of his kinsman Malcolm Canmore, and he completely routed King Macbeth in a battle in which his son Osbeorn was killed. Early in 1055 the earl died at York. A man of unusual strength and size, he is said to have risen from his bed at the approach of death, and to have died dressed in all his armour. One of his sons was Earl Waltheof.

See E. A. Freeman, *The Norman Conquest,* vols. ii. and iii. (1870–76); and W. F. Skene, *Celtic Scotland* (1876–80).

SIXTUS, the name of five popes.

SIXTUS I. (Xystus) was the sixth bishop of Rome (*c.* 116–125) and took the name on that account. SIXTUS II., successor of Stephanus I. as bishop of Rome in 257, suffered martyrdom under Valerian on Aug. 6, 258. He restored the relations with the African and Eastern Churches which had been broken off by his predecessor on the question of heretical baptism. Dionysius succeeded him.

SIXTUS III. was bishop of Rome from July 31, 432, to Aug. 19, 440. Before his elevation to the pontificate he had been suspected of favouring the Pelagians, but when he became pope he disappointed their expectations, and repelled their attempts to enter again into communion with the Church. During his pontificate the dispute was settled between Cyril of Alexandria and John of Antioch, who had been at variance since the council of Ephesus, but he himself had some difficulties with Proclus of Constantinople with regard to the vicariate of Thessalonica. Sixtus IV. and Sixtus V. have separate notices. (L. D.)

SIXTUS IV. (FRANCESCO DELLA ROVERE), pope from Aug. 9, 1471, to Aug. 12, 1484, was born of a poor family near Savona in 1414. He entered the Franciscan order at an early age and studied philosophy and theology at the universities of Padua and Bologna. He was chosen general of his order in 1464. Three years later he was, to his own surprise, made cardinal-priest of St. Pietro in Vincoli by Paul II., whom he succeeded as pope. Sixtus sent Cardinal Caraffa with a fleet against the Turks, but the expedition was unsuccessful. He continued to condemn the Pragmatic Sanction in France, and denounced especially the ordinance of Louis XI. which required (Jan. 8, 1475) the royal *placet* for the publication of all papal decrees. He likewise continued his predecessor's negotiations with the Tsar Ivan III. for the reunion of the Russian Church with the Roman see and for support against the Turks, but without result. He was visited in 1474 by King Christian of Denmark and Norway, and in the following year (June 12) he established the University of Copenhagen. Sixtus soon abandoned his universal policy in order to concentrate attention on Italian politics, and showed himself a confirmed nepotist. He was cognizant of the conspiracy of the Pazzi, plotted (1478) by his nephew, Cardinal Riario, against Lorenzo de' Medici. He entered into a fruitless and inglorious war with Florence, which kept Italy for two years (1478–80) in confusion. He next incited the Venetians to attack Ferrara, and then, after having been delivered by their general, Roberto Malatesta, from a Neapolitan invasion, he turned upon them and eventually assailed them for refusing to desist from the hostilities which he had himself instigated. He relied on the co-operation of Lodovico Sforza, who speedily forsook him; and vexation at having peace forced upon him by the princes and cities of Italy is said to have hastened his death (Aug. 12, 1484). Sixtus granted many privileges to the mendicant orders, especially to the Franciscans; he endeavoured to suppress abuses in the Spanish Inquisition; he took measures against the Waldenses; he approved (1475) the office of the Immaculate Conception for Dec. 8; in 1478 he formally annulled the decrees of the council of Constance; and he canonized St. Bonaventura

(April 14, 1482). The most praiseworthy side of his pontificate was his munificence as a founder or restorer of useful institutions, and a patron of letters and art. He established and richly endowed the first foundling hospital, built and repaired numerous churches, constructed the Sistine chapel and the Sistine bridge, improved church music and instituted the famous Sistine choir, commissioned paintings on the largest scale, pensioned men of learning, and, above all, immortalized himself as the second founder of the Vatican library. These great works, however, were not accomplished without grievous taxation. Annates were increased and simony flourished.

See L. Pastor, *History of the Popes,* vol. iv., trans. by F. I. Antrobus (1898); M. Creighton, *History of the Papacy,* vol. iv. (1901); F. Gregorovius, *Rome in the Middle Ages,* vol. vii., trans. by Mrs. G. W. Hamilton (1900–02); Jacob Burckhardt, *Geschichte der Renaissance in Italien* (4th ed., 1904); J. A. Symonds, *Renaissance in Italy;* E. Frantz, *Sixtus V. u. die Republik Florenz* (Regensburg, 1880); I. Schlecht, "Sixtus IV. u. die deutschen Drucker in Rom," in S. Ehses, *Festschrift zu elfhundertjährigen Jubiläum des Campo Santo* (Freiburg, 1897); *Aus den Annaten-Registern der Päpste Eugen IV., Pius II., Paul II. u. Sixtus IV.,* ed. by K. Hayn (Cologne, 1896).
(C. H. H.; X.)

SIXTUS V. (Felice Peretti), pope from 1585 to 1590, was born at Grottamara, in Ancona, on Dec. 13, 1521. He was reared in extreme poverty; and at an early age he entered a Franciscan monastery. He soon gave evidence of rare ability as a preacher and a dialectician. About 1552 he came under the notice of Cardinal Carpi, protector of his order, Ghislieri (later Pius V.) and Caraffa (later Paul IV.), and from that time his advancement was assured. He was sent to Venice as inquisitor general, but carried matters with a high hand, became embroiled in quarrels, and was forced to leave (1560). After a brief term as procurator of his order, he was attached to the Spanish legation headed by Buoncampagno (later Gregory XIII.) 1565. The violent dislike he conceived for Buoncampagno exerted a marked influence upon his subsequent actions. He hurried back to Rome upon the accession of Pius V., who made him apostolic vicar of his order, and, later (1570), cardinal. During the pontificate of Gregory XIII. he lived in retirement, occupied with the care of his villa and with his studies, one of the fruits of which was an edition of the works of Ambrose; not neglecting, however, to follow the course of affairs, but carefully avoiding every occasion of offence. This discreetness contributed not a little to his election to the papacy on April 24, 1585.

The terrible condition in which Gregory XIII. had left the ecclesiastical States called for prompt and stern measures. Against the prevailing lawlessness Sixtus proceeded with an almost ferocious severity, which only extreme necessity could justify. Thousands of brigands were brought to justice: within a short time the country was again quiet and safe. Sixtus next set to work to repair the finances. By the sale of offices, the establishment of new "Monti" and by levying new taxes, he accumulated a vast surplus, which he stored up against certain specified emergencies, such as a crusade or the defence of the Holy See. Immense sums were spent upon public works; these include: the completion of the dome of St. Peter's; the loggia of Sixtus in the Lateran; the chapel of the Praesepe in Sta. Maria Maggiore; additions or repairs to the Quirinal, Lateran and Vatican palaces; the erection of four obelisks, including that in the piazza of St. Peter's; the opening of six streets; the restoration of the aqueduct of Severus ("Acqua Felice"); besides numerous roads and bridges, an attempt to drain the Pontine marshes, and the encouragement of agriculture and manufacture. But Sixtus had no appreciation of antiquity: the columns of Trajan and Antoninus were made to serve as pedestals for the statues of SS. Peter and Paul; the Minerva of the Capitol was converted into "Christian Rome"; the Septizonium of Severus was demolished for its building materials.

Sixtus limited the College of Cardinals to 70; and doubled the number of the congregations, and enlarged their functions, assigning to them the principal rôle in the transaction of business (1588). The Jesuits Sixtus regarded with disfavour and suspicion. He meditated radical changes in their constitution, but death prevented the execution of his purpose. In 1589 was begun a revision of the Vulgate, the so-called *Editio Sixtina.*

In his larger political relations Sixtus, strangely enough, showed himself visionary and vacillating. He distrusted Philip II. and viewed with apprehension any extension of his power. So, while he excommunicated Henry of Navarre, and contributed to the League and the Armada, he chafed under his forced alliance with Philip, and looked about for escape. The victories of Henry and the prospect of his conversion to Catholicism raised Sixtus's hopes, and in corresponding degree determined Philip to tighten his grip upon his wavering ally. The pope's negotiations with Henry's representative evoked a bitter and menacing protest and a categorical demand for the performance of promises. Sixtus took refuge in evasion, and temporized until death relieved him of the necessity of coming to a decision (Aug. 27, 1590).

Posterity ranks Sixtus one of the greatest popes. He was hasty, obstinate, severe, autocratic; but his mind was open to large ideas, and he threw himself into his undertakings with an energy and determination that often compelled success. Few popes can boast of greater enterprise or larger achievements.

Lives of Sixtus are numerous: Cicarella's, in Platina, *De vitis pontiff. Rom.,* is by a contemporary of the pope, but nevertheless of slight importance; Leti's *Vita di Sisto V.* (Amsterdam, 1693, translated into English by Farneworth, 1779) is a caricature, full of absurd tales, utterly untrustworthy, wanting even the saving merit of style; Tempesti's *Storia della vita e geste di Sisto Quinto* (1754–55) is valuable for the large use it makes of the original sources, but lacks perspective and is warped by the author's blind admiration for his subject; Cesare's *Vita di Sisto V.* (Naples, 1755) is but an abridgment of Tempesti. Of recent works the best are Hübner, *Sixte-Quint,* etc. (1870), translated into English by H. E. H. Jerningham (1872); and Capranica, *Papa Sisto, storia del s. XVI.* (Milan, 1884). *See* also Lorentz, *Sixtus V. u. seine Zeit* (Mainz, 1852); Dumesnil, *Hist. de Sixte-Quint* (1869, 2nd ed.); Segretain, *Sixte-Quint et Henri IV.* (1861, strongly Ultramontane); Ranke's masterly portrayal, *Popes* (Eng. trans., Austin), i. 446 *sq.,* ii. 205 *sq.;* and v. Reumont, *Gesch. der Stadt Rom,* iii. 2, 575 *sq.,* 733 *sq.* Extended bibliographies may be found in Herzog-Hauck, *Realencyklopädie, s.v.* "Sixtus V."; and *Cambridge Mod. Hist.* iii. 835 *sq. See* also *The Catholic Encyclopedia.*
(T. F. C.)

SIXT VON ARMIN, FRIEDRICH (1851–), German general, was born at Wetzlar, Nov. 27, 1851. He took part in the war of 1870–71 and was severely wounded at St. Privat. After having occupied different positions on the General Staff, he was appointed in 1903 Director of the General Department of War in the Prussian War Ministry, and in 1911 general-in-command of the IV. Army Corps at Magdeburg. During the World War he led his corps as a part of the First and of the Sixth Army; he was appointed in 1917 commander-in-chief of the Fourth Army in Flanders, where he succeeded, in the spring offensive in 1918, in taking Armentières and the Kemmel Hill. At the close of the war he retired from the army.

SKAGERAK, the arm of the North Sea which gives access to the Cattegat and so to the Baltic. It is about 140 m. long and 75 broad. On the Danish shore, which is low and beset with sandbanks, the strait is shallow. Towards the steep Norwegian coast its deepest part is found, 443 fathoms.

For the currents, temperature and salinity of the water, etc., *see* North Sea. For battle, *see* Jutland, Battle of.

SKAGWAY, a town of Alaska, situated at the north end of Lynn canal, a deep and narrow arm of the sea thrust far up between picturesque mountain ranges, in 59° 28′ N. and 135° 20′ W., is at the head of navigation in the waters of south-eastern Alaska. Skagway owes its present importance to being the seaward terminus of the White Pass and Yukon railway. This road, built in the years 1898–1900, extends up the valley of the Skagway river to the summit of White Pass, 20 m., crossing there the international boundary and continuing thence down on the Canadian side 90 m. to White Horse, head of navigation on the Yukon. Historically, it is of interest as the landing place of large quantities of supplies and many thousands of people during the struggle of 1897–98 (known as the "Klondyke Rush") to reach the newly discovered rich deposits of gold in the upper (Canadian) Yukon. Its population in 1930 was 492.

SKANDERBEG or **GEORGE CASTRIOTA** (1403–1468), the national hero of the Albanians, "ranked by Sir William Temple among the seven chiefs who have deserved, with-

out wearing a royal crown," was of Serbian origin. The founder of the family of Castriota was a certain Branilo, who was governor of Kanina in 1368, and whose grandson, Giovanni, lord of Mat and Vumenestia, married Voisava Tripalda, daughter of a Serbian magnate. The offspring of this union was George Castriota. Thus, as the Albanians gave to Greece several leaders of her War of Independence, Serbia furnished the chief figure of their struggle for freedom. George's uncle had, however, married an heiress of the leading Albanian clan of Thopia and thus acquired, together with the fortress of Kroja, some of that family's influence. Born in 1403, George was 11 years old when the Turks began to occupy Albania, and, while the castle of Kroja became the seat of a Turkish governor, he was sent as a hostage to Constantinople. Educated there as a Muslim he received the Turkish name of Iskander ("Alexander"), applied to him by Byron in *Childe Harold,* with the title of *bey*—subsequently abbreviated by his countrymen into Skanderbeg. Like Albanians in later times, he rose to eminence in the Turkish service; he was promoted to the government of a *sanjak,* and for many years fought for his Turkish masters against Venetians and Serbs, till, in 1443, while serving in the Turkish army which had been defeated by Janos Hunyadi's troops near Nish, he heard that his native land had risen against the Turkish garrison.

Then, at the age of 40, he realized that his mission was to free Albania, and the rest of his life was devoted to that object. Seizing Kroja by stratagem, he made it his capital, proclaimed himself a Christian, and gathered the wild Albanian clansmen about him. His personal influence was increased by his marriage with Andronica, daughter of Arianites Comnenus, a prominent Albanian chief, who had vainly endeavoured to drive out the Turks. The other chiefs rallied round his standard; the Montenegrins, whose ruler, Stephen Crnojevich, was his brother-in-law, came to his assistance, and at a gathering of the clans at the Venetian colony of Alessio he was proclaimed Captain-General of Albania. Venice, then mistress of the Albanian coast as far south as Durazzo, at first regarded him as a rival, but subsequently took him into her pay as an ally against the common foe. The pope and the king of Naples helped the Albanian cause, as fellow-Christians and neighbours, and the latter, mindful of the claims of the Neapolitan Angevins beyond the Adriatic, received the homage of the Albanian champion. But Mohammed II., partly by working upon the proverbial jealousy of the other Albanian chiefs, partly by force of arms, temporarily eliminated him, and in 1461 concluded with him a ten years' armistice.

But long before it elapsed, Skanderbeg, at the instigation of Pius II., broke it, with fatal results. That pope's projected crusade was prevented by its author's death; Skanderbeg, abandoned by his western allies, was left to fight single-handed against the great sultan, who himself in 1466 besieged Kroja. The fortress held out, but Skanderbeg went to seek help from Pope Paul II. in Rome, where a lane near the Quirinal still commemorates his name and visit. Returning, he died in the Venetian colony of Alessio on Jan. 17, 1468, whereupon the Turks easily conquered Albania, except Kroja, ceded by his son to Venice, and the other Venetian possessions. His son Giovanni and other Albanian chiefs emigrated to southern Italy, and his posterity formed part of the considerable Albanian colonies there; in our own time a self-styled Castriota claimed the Albanian throne on the ground of his alleged descent from the national hero.

Skanderbeg's grave in the church of St. Nicholas at Alessio was opened by the Turks, who touched his bones with superstitious reverence and wore them as amulets; but the ruins of the castle which he built on Cape Rodoni remain, the Mirdites still wear mourning for him, and the independent Albania of to-day has placed his image on some of her postage stamps. He has been made the subject of a Latin poem by de Bussières, an Italian poem by Signora Sarrocchi, and an English tragedy, *Scanderbeg: or Love and Liberty,* by Whincop (1747). Gen. Wolfe wrote that "he exceeds all the officers, ancient and modern, in the conduct of a small defensive army." His resistance to the Turkish advance helped Christendom, but did not save Albania—a country too small and too much divided by the clan system to stand against a powerful Turkey.

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(W. M.)

SKARA BRAE, the name of sand-dunes, Parish of Sandwick, Orkney. About 1851 a great storm laid bare here an immense kitchen-midden and remains of ancient walls. Subsequent researches during the sixties by William Watt of Skail House, revealed a conglomeration of stone chambers or huts, opening onto a winding passage or street. Further excavations were conducted by Balfour Stewart in 1913, and in 1926 the Office of Works, which had assumed guardianship of the site, was obliged to initiate restoration works to preserve the monument against further encroachments by the sea. In the course of these operations J. Firth, the contractor, opened up a new hut in 1927 and in 1928 yet another hut and a large section of street were freed from superincumbent débris under the direction of Gordon Childe, Professor of Prehistoric Archaeology in Edinburgh University.

The prehistoric village is conveniently situated on the southern shore of the Bay of Skail, that offers a sheltered haven to fishermen and convenient landing-place for ancient mariners. It consists, as noted, of an agglomeration of huts built of dry-masonry. Up to date seven such huts have been identified, but one has been washed away by the waves and a second had been already ruined and abandoned before the desertion of the site in prehistoric times. The huts are roughly square but the corners are in every case rounded. The largest measures about 21 feet square on the floor while others are scarcely twelve feet across. The walls are built of slabs of local stone without mortar and converge towards the top, each course projecting inwards a little beyond the one below; in some cases, particularly in No. 7, they are still intact to a height of 10 feet. It does not seem possible, however, that they were completed to meet eventually in a corbelled dome, and it is still uncertain how the huts were roofed. In the walls at various heights niches have been left.

Moreover, most huts are provided with one or two small beehive cells, built in the thickness of the wall and entered by a low doorway. The floors of the huts were of stamped earth, but part at least was generally paved with slates. Huts 4 and 5, and probably also the others, were provided with drains, laid underneath the slate slabs and serving to carry off moisture and sewage. On the floors various domestic fixtures, being built of stone, still survive. In the centre in each case stands the hearth, framed with stone slabs set on edge. Built along the side walls are enclosures resembling pens formed by three large stone slabs set on edge and held in place by pins and uprights also of stone. Against the rear walls of huts 1 and 7 two-storeyed structures of stone resembling dressers have been reared. In all huts stand cubical slate-lined receptacles, sunk in the floor. The joints between the lining-slabs have always been carefully caulked with clay.

The hut-doors are low and narrow. The jambs are about two feet apart while the height from threshold to lintel seldom exceeds three feet. Immediately within the threshold comes a short passage or porch of only slightly ampler dimensions in the walls of which are holes for the bar that blocked the door to slide in. The entrance passage is always slate flagged.

The door opened on to a narrow street or passage, generally paved with slate and covered over about four feet above the floor with a roof of stone slabs. This street and its branches, of which only one is as yet known, provided the sole means of communication between the huts. The street-roofs are to-day covered over with a deposit of kitchen refuse. In this are found, together with ashes and broken animal bones, stone-knives, pot-sherds, bone implements and ornaments of precisely the same type as those collected on the floors of intact huts. Hence it is clear that

the people who lived in the huts used to dump their rubbish on the roofs of the streets connecting their dwellings and even to camp upon those roofs themselves.

The villagers of Skara Brae certainly possessed domestic animals including short-horned cattle, sheep and swine. There is no evidence that they practised agriculture, but fish played a prominent part in their diet and limpet shells have been found in enormous quantities. For weaving or metallurgy there is no evidence. Picks, shovels, awls (used probably for piercing leather garments), pins and polishing tools were made of bone. Flint, very finely worked, provided scrapers, and knives were manufactured in great numbers from the rolled stones of the beach. When dashed hard upon the ground these yield a sharp-edged flake quite suitable for use as a knife. Such flakes are extremely common in the midden and the huts. Axe-heads were made of polished stone and were not usually perforated. The only possible weapons, found on the site, are stone balls carved all over with nobby projections. These may have been mace-heads or bolas, but may equally well have served as poises for a weighing beam or bismar. The pottery is exceedingly coarse and very badly fired; indeed earthenware was used almost exclusively for cooking vessels, some of which are very large. The pots are nevertheless often decorated with relief patterns, formed by applied strips, below the rim. Other vessels include small cups made from vertebrae, large dishes of whale-bone and stone basins.

As ornaments, beads (disc, cylindrical, barrel-shaped and segmented) and amulets (generally in the form of a tusk or claw) carved out of bone, walrus-ivory, boars'-tusk and the incisor teeth of ruminants were popular.

The cemetery of Skara is yet to be found. One skeleton was unearthed lying above the hearth of hut No. 1 many years ago. In 1928 a double-interment was discovered under the wall of hut No. 7. This grave was an integral part of the hut and must have been covered over before the wall was built. It contained the skeletons of two very aged women which were buried in the contracted posture with a very poor type of furniture. They were probably the victims of a foundation sacrifice. The skeleton from hut No. 1 belonged to a tall woman, 5 ft. 6 in. high with a long head (index 70·6). The skull of the victim from hut No. 7 was likewise dolichocephalic. Hence the lowness of the doorways and passages was not due to the dwarfish stature of the huts' owners. Probably the low door and long covered streets were really designed to exclude drafts of cold air like the entrance-passage of an Esquimaux snow-hut or *igloo*.

The builders of Skara were most probably Picts. In any case the architecture of their houses, their industry and especially their ceramic art carry on a tradition that had been rooted in northern Scotland since neolithic times. The actual age of the settlement is open to dispute. The finely worked flints and polished stone axe-heads would point to a high antiquity. Yet in previous excavations the mould for an early Christian cross and a stone carved with Runic letters were unearthed somewhere on the site. In 1928 an inscription was noticed on a slab in front of the grave. The script is still undecipherable. These facts would all support a date between A.D. 600 and 800, a date by no means incompatible with the stone balls. None the less it must be noted that a broch on the opposite side of Skail Bay has yielded normal Iron Age relics all far in advance of the industry of Skara Brae, while the pottery distinctly resembles that of the late bronze age ("encrusted" type).

See Petrie in *Proc. Soc. Antiquaries Scotland,* 1867, p. 205; Balfour Stewart, *ibid.,* 1913–14, p. 344; Childe, *ibid.,* 1928–29; Garson, *J. Anthrop. Institute,* xiii., p. 56. (V. G. C.)

SKAT, a game of cards, much played in central and northern Germany. It is generally supposed to have been invented about 1817 by an advocate of the name of Hempel in Saxe-Altenburg. There is, however, some reason for believing that the game is of much earlier origin and was played by the Slav inhabitants of Saxe-Altenburg long before that date. In the home of the game of skat (Saxony and Thuringia) the old German single-ended cards are usually employed, while in north and south Germany French cards are ordinarily used. The German cards are 32 in number and of four suits: *Schellen* (bells), the equivalent of diamonds; *Roth* (red), hearts; *Grün* (green), spades; and *Eichel* (acorn), clubs. The eight cards of each suit are the seven, eight, nine, ten, *Wenzel* or knave, queen, king and ace. This arrangement denotes at once the value of the single cards, each following card being higher in value than the preceding; *i.e.,* hearts are higher than diamonds, spades than hearts, and clubs (the highest colour) takes spades, hearts and diamonds. Again, 8 takes 7, 9 takes 8 and 7; but the knave (called *Wenzel* or *Unter*) is an exception (*see* below).

The game is played by three persons; where four play, the dealer takes no part in the play though he shares in the winnings and losings of the opponents of the player. The cards are dealt from left to right—or (as skat players say) in the direction the coffee-mill is turned. After the cards have been shuffled and cut, the dealer first deals three cards to each player, then four and again three, laying aside two cards (the skat). Each player has now ten cards in his hand, which he arranges in suits. The Wenzel or knaves occupy a peculiar position. They are not regarded as colour cards, but are essentially trumps and take all other trumps. The player sitting to the left of the dealer is "first hand," and if he himself intends to make a game, invites the others to declare theirs, or if he wishes to reserve all rights to himself, simply says *"Ich bin vorn"*—"I have the lead," and then his next neighbour on the left has to offer a game. If this neighbour holds such cards as to give him no prospect of winning, he passes, and his neighbour to the left has the right to offer a game. If he in his turn passes, then the first hand is at liberty to determine the game or declare *"Ramsch"* (*see* below). But if the first neighbour thinks he can risk a game, he offers one. If the first hand reserves this game (*see* above, "I have the lead"), either because he intends to play it himself or to play a higher game, the second hand must go higher or pass, *i.e.,* renounce a game, and then his neighbour to the left has the right to offer, and if he again passes and does not offer a higher game than that which the first hand intends to play, the latter determines the game to be played.

The usual games in skat are the following. First the simple colour game, which is, however, seldom played by skat enthusiasts. The player has here the right to take up the skat, and to determine the suit of the game; but here the rule is that the colour must not be lower in value than that of the game offered, though it may be higher. For instance, if spades are offered, the player cannot take hearts as trumps, though he may take clubs, because they are higher in value than spades.

Next to the colour game comes "tourné," the player turning up one of the skat cards, the suit of which becomes trumps. If a knave be turned up the player may announce "grando." Then comes the game of "solo," where the player declares which suit shall be trumps, and the skat remains intact. The highest "solo," still higher than clubs, is "grando." In this game only the four knaves are trumps. If the hand playing grando thinks he can make all the tricks, he declares open grando; *i.e.,* shows his hand. If in open grando a single trick be lost, the player loses the game. If one of the players holds such cards as to enable him to force his opponents to take all the tricks, he can declare "nullo." But here the game is lost if even a single trick falls to the player. In nullo, the knaves are regarded as colour; *i.e.,* are not trumps. Nullo can be played open, if there is no probability of the player taking a single trick. Simple nullo counts higher than diamond solo; open nullo comes after clubs solo. In Ramsch, which takes place when none of the players will risk a game, each player takes (as in whist) all the tricks he makes—but only knaves are trumps—and the loser is he who makes most points. The value of the individual cards given in figures is as follows: the seven, eight and nine count nothing, the knave counts 2, the queen 3, king 4, ten 10 and ace 11 points. This gives the value of the whole game as 120 points. The game is won if the player gets one above the half of this sum, *i.e.,* 61. The hand that does not make 30 is "Schneider," that is "cut," and "Schwarz" (black) if he does not make a single point.

Skat is almost invariably played for money, and the calculation

is made thus. Every game and every suit have a set value:—

Colour game..... .3, 4, 5 and 6, according to the suits.
Tourné ... 5, 6, 7, 8 and 12 (the last the grando).
Solo.............. 9, 10, 11, 12 and 16 (grando).

These figures are increased by the number of "matadores." Suppose a player of club solo holds all four knaves and the ace and ten of clubs, he has a game with 6 matadores. By matadores is accordingly meant an uninterrupted sequence, *e.g.*, from the knave of clubs down to the seven of trumps. If the player has then all four knaves and all the cards of the trump suit in his hand (or in the skat), he has a game with 11 matadores. But if a single card is missing in the series, only the matadores of higher value than the missing card count. If, for instance, the knave of hearts is missing, the game in question has only three matadores. To the number of matadores is added one if the game is simply won, two if won with Schneider (cut), and four if the opponents are Schwarz (black). Thus, if a spade solo with five matadores is won with Schneider, the winner makes $5+2 \times 11=77$ points. (W. Da.)

AMERICAN SKAT

As prescribed by "The Laws of the North American Skat League," American skat differs from the European game. The cards are dealt in the following order: Beginning with the player at the dealer's left, three cards are dealt to each player, then two are dealt the skat; next four cards are dealt to each player, with a last round of three cards to each. Bids must be made in terms of the numerical value of some variety of game. "Passt-Mir-Nicht-Tournée" permits a player who dislikes the first card turned in the skat to reject that card without showing it, and to display the other skat card as the trump. If the exposed card be a jack, the player may choose its suit as the trump or he may elect to play a *grande tournée.* If the player utilizes the skat, neither "Schneider" nor "Schwarz" may be announced. Unannounced *Schneider* counts 2 points; unannounced *Schwarz,* 3 points. Announced *Schneider* counts 3 points, or in case *Schwarz* is made it counts 4 points. Announced *Schwarz* counts 5 points. A "grand" counts 20 points; a "grand ouvert" counts 24 points.

Although readily recognizable, the American nomenclature frequently differs from terms used in the European game: thus *grand* is often employed, instead of *grando; ouvert grand* replaces *open grando,* while *null* frequently supplants *nullo.* Almost invariably the word *jack* is used in place of *knave, wenzel* or *unter.* Except among those of foreign birth or close affiliation with those of foreign birth, the word *suit* is employed universally instead of the word *colour.* (E. V. S.)

SKATING, a mode of progression on ice with the aid of appliances called skates, attached to the sole of the shoe by straps, clamps or screws. The earliest form of skate that we know is that of the bone "runners" worn by the primitive Norsemen. These were bound to the foot with thongs. The Norse sagas speak with pride of the national achievements in skating, and the early development of the art was due principally to the Norsemen, Swedes, Danes, Finns and the Dutch. Whatever its origin in Great Britain, skating was certainly a common sport in England in the 12th century, as is proved by an old translation of Fitz-Stephen's *Description of London,* published in 1180, in which the following words occur:

"When the great fenne or moore (which watereth the walls of the citie on the North side) is frozen, many young men play on the yce . . . asome tye bones to their feete and under their heeles, and shoving themselves with a little picked staffe do slide as swiftlie as a birde flyeth in the aire or an arrow out of a cross-bow."

At what period the use of metal runners was introduced is unknown, but it was possibly not long after the introduction into northern Europe, in the 3rd century, of the art of working in iron. By the time of Charles II. skating had become popular, with the aristocracy as well as with the people, as is proved by entries in the diaries of Pepys and Evelyn.

The modern skate is in the form of a steel blade mounted upon a wood or metal base. In the old-fashioned skate the wooden base was strapped to the boot and kept firm by low spikes or screws that entered the sole. The next step in development was the "club-skate," originally Canadian, a patent appliance adjusted by clamps to fit the sole. There are several varieties of club-skates still popular. They have a broad blade with slightly curved edge, and are more suitable for figure-skating than for speed. The best skaters now use skates fixed permanently to special skating-boots.

As in ancient times, skating is most practised by the Scandinavians, Finns, Dutch and British, to whom in modern days have been added the Germans, Swiss, Austrians, Hungarians, French, Belgians, Italians, Japanese, Russians, Canadians and Americans. All these nations have "control" organizations, the British, founded in 1879, being the National Skating Association. The American, founded in 1884, is similarly styled, and co-operates with the Canadian Amateur Skating Association, founded in 1888. All are subject to the International Skating Union, the central body to which some 23 nations belong. In 1928 the U.S.A. Figure Skating Association transferred its membership of the I.S.U. to the Amateur Skating Union of the U.S.A.

Speed Skating.—Of the earliest skating races no records have been kept. That racing was a popular pastime in Holland two centuries and longer ago is proved by the numerous paintings of the time depicting racing scenes. In England the first skating match recorded was that in which Youngs of Mepal beat Thomson of Wimblingdon, both men of the Fens, in the year 1814. The Fen country has remained the chief English home of skating, owing to the abundance of ice in that district, and most British champions have been Fenmen, notably the Smarts of Welney. In Jan. 1823, according to the *N.S.A. Handbook,* the first amateur match took place between teams of six gentlemen from March and Chatteris, Drake of Chatteris finishing first. In the same year the *Sporting Magazine* records a match for a silver bowl on the Maze lake, Hertfordshire, over a course 5m. long, the winner being Blenkinsop. Racing, more or less intermittent, continued annually, the Fen skaters generally triumphing. In 1854 appeared the celebrated William ("Turkey") Smart, who, after defeating Larmen Register in that year, remained champion for more than a decade. His nephew, George ("Fish") Smart, won the championship in 1878 and held it until 1889, only to relinquish it to his younger brother James. The first amateur championship of England was held in 1880 at Hendon, and was won by F. Norman, a Fen skater.

Owing to the great area and cold winters of Canada and the northern United States, the sport of skating is indulged in to a great extent. Charles June was considered the best American skater from 1838 for many years, and his place of residence, Newburgh, N.Y., on the Hudson river, became the headquarters of American speed skating. This city also is the birthplace of the Donoghue family, who may be called the Smarts of America. The most noted members of this family were Mr. T. Donoghue and his two sons, Tim and J. F. Donoghue, each in his day the fastest skater in the world, Joseph Donoghue winning every event at the international championship meeting at Amsterdam in 1891. There is very little professional skating in America, and the only American who has appeared in important international races in recent years until the Olympiad of 1928 is C. Jewtraw, who won the 500 metres race in the Olympic skating at Chamonix in 1924.

Skating received a great impetus during the last decade of the 19th century, profiting both by the growing devotion to athletics and by increased facilities of communication, which led to international competitions and the institution of skating clubs in Switzerland and elsewhere, especially those of Davos, St. Moritz and Grindelwald, where ice is available every winter. Although skating instruments are so simple, the evolution of the skate has advanced considerably, contributing to marked improvement in the skater's skill. In speed-skating an epoch was marked, first, by the almost universal adoption of the Norwegian type of racing skate; and, secondly, by the institution in 1892, at an international congress held in Holland, of annual races for the championships of Europe and of the world.

The Norwegian skate, introduced and perfected (1887–1902) by

Axel Paulsen and Harald Hagen, is constructed with a view to lightness, strength and diminution of friction. The blade, of specially hardened steel, is set in a hollow horizontal tube of aluminium, and connected by similar vertical tubes with footplates riveted to a closely-fitting boot with thin leather sole. It is $16\frac{1}{2}$–19in. (42–48cm.) long, according to the height of the skater, and $\frac{1}{2}$–4mm. thick (*i.e.*, ·019–·157in.) the average employed for hard ice being $\frac{3}{4}$mm., often thinner towards the heel. This thickness is suitable for hard ice, but for softer ice $\frac{1}{16}$ or $\frac{1}{8}$in. is preferable. The blade is nearly flat on the ice throughout, except for a few inches in front; this flatness distributes the weight, and with the extreme thinness of blade, reduces friction to a minimum. At the same time the very slight curve to which the blades are built permits flexibility of stroke. This curve is such that when the blades are placed against each other, touching in the middle, the distance between them at the front stay should be about 1mm. and at the back about $\frac{1}{2}$mm. only. The edges are right-angled and should be kept sharp. A special machine has been invented for this purpose.

The skater's style has been modified. The blade, when planted on the ice with weight upon it, describes a nearly straight line, the last few feet only curving slightly outwards as the skate leaves the ice. Hence the stroke of the best skaters of the famous Peder Oestlund's period (*c.* 1900), was almost, if not entirely, on the inside edge, a gain in directness and speed, the outside edge being used for curves only. Since the World War there has been a tendency to revert to rather thicker blades than the very thin $\frac{1}{2}$mm.; making it possible to travel for several feet on the flat of the skate, or even on the outside edge as long as there is no appreciable weight yet transferred to that foot. This, however, at once increases the slight curve in the stroke, and the loss of directness must be compensated by more frequent striking. The

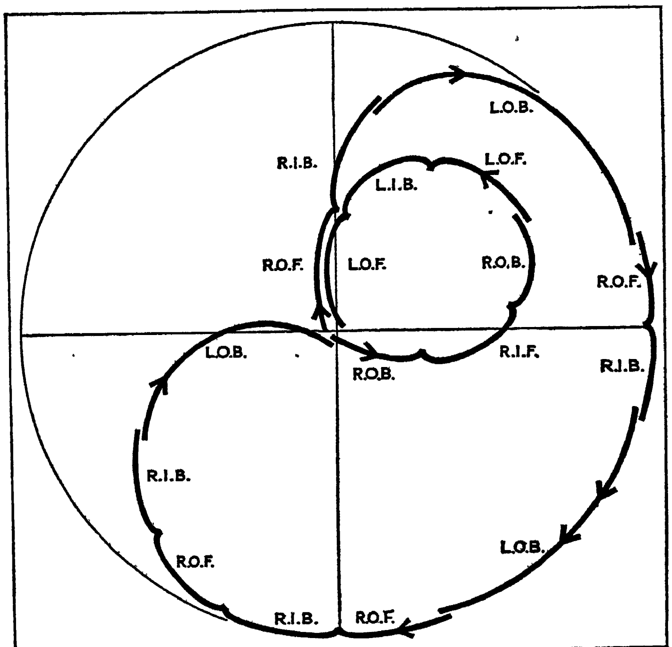


FIG. 1.—ENGLISH STYLE FIGURES SHOWING TWO REPRESENTATIVE COMBINED FIGURES SELECTED FOR THE NATIONAL SKATING ASSOCIATION'S FIRST-CLASS TEST
R=right foot: L=left foot: F=forward: B=back: I=inside edge: O=outside edge

length of stroke has tended on the whole to diminish. Contrasted with the 12–18 yards' stroke attributed to the old English champion, W. "Turkey" Smart, on the wooden fen "runner" which began decidedly on the outside edge, the modern racing stroke rarely exceeds 10yd., and is usually nearer 6 or 7. Particular instances vary with conditions of ice, etc., but at St. Petersburg, in 1896, Eden's stroke in the 10,000 metre race averaged about $7\frac{1}{2}$ yd., that of P. Oestlund at Davos, in 1900, the same (for one lap, 8yd.). J. F. Donoghue's stroke in 1891 was computed at about 9 yards. The general effect has been vastly increased speed, and a conjoint cause is the stricter training undergone before important races, together with the gradual improvement in skates and especially in race-courses.

The races held annually since 1892–93 for the championships of Europe and of the world, under the auspices of the I.S.U., have assembled representatives from the skating countries of Europe. The races are four in number, over distances of 500, 1,500, 5,000

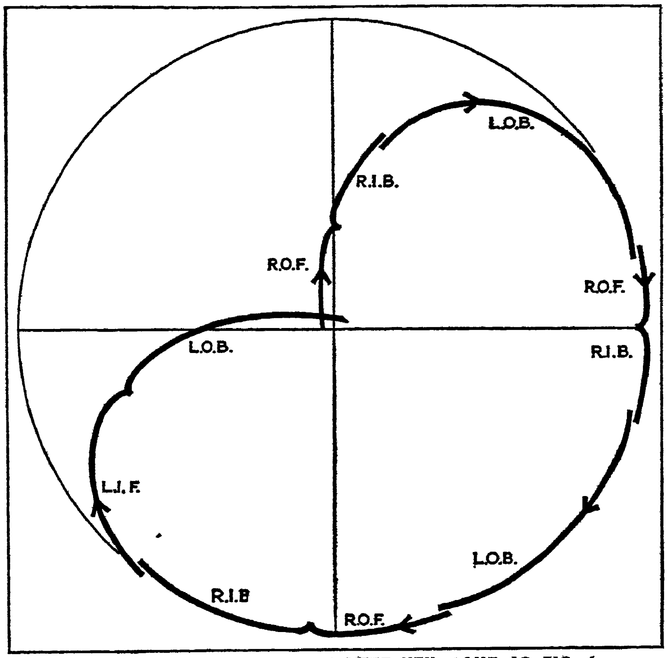


FIG. 2.—STYLE FIGURES; LETTER KEY, SAME AS FIG. 1

and 10,000 metres, and the winner at three or four distances becomes champion; failing this, the decision is by points on an elaborate system of marking. In addition, each country, when possible, holds its own championship races.

In England races are still skated, with rare exceptions, on straight courses, with a sharp turn round a post or barrel, the distance prescribed for N.S.A. championships being $1\frac{1}{2}$m., with three turns. The international system involves a course with straight sides and curved ends of such a radius that no slackening of speed is necessary. In both instances the competitors race two at a time on a double track, and the time test is used. Each skater must keep his own course, to prevent either from using the other as pacemaker or wind-shield. The international regulations (*Eiswettlauf-Ordnung*) prescribe that, if a single track be used, the hindmost skater must keep at a minimum distance of 5 metres from the other, on pain of disqualification. The advantage of inner curve on a Continental course is given alternately, and a space left open between the tracks at one point for the skaters to cross.

The curves are skated with a step-over-step action, and the direction is always from right to left. Hence, on entering the curve the right foot is brought across in front and set down on the inside edge, the left passing behind on the outside edge, and being in its turn set down on an outside edge in front. The strokes thus form a series of tangents to the curve, and are little shorter than in the straight. With a radius of 25 and 30 metres, as on the superb 400 metres racing track at Davos, the curves can be skated with safety at full speed.

The following are the amateur speed records at the principal distances:

Distance	m.	s.	Name	Nationality
500 metres (546·8yd.) .		$43\frac{3}{5}$	R. Larsen	Norway
1,000 metres (1,093·6yd.) .	1	$31\frac{4}{5}$	O. Mathiesen	Norway
1,500 metres (1,640·4yd.) .	2	$17\frac{2}{5}$	O. Mathiesen	Norway
5,000 metres (3 m. 188·2yd.)	8	$26\frac{5}{10}$	H. Strom	Norway
10,000 metres (6 m. 376·3yd.)	17	$17\frac{2}{5}$	A. Carlsen	Norway

The superiority of Norwegian skaters in world's championship races has been remarkable, Norway having provided 13 out of 24 winners between 1893 and 1928. On five occasions before the present system of points was adopted the result was indecisive, no skater winning three out of four races. Of these 13 victories no less than five stand to the credit of the Norwegian champion, Oscar Mathiesen, of Christiania (Oslo), who from 1914–27 was also holder of four out of five world's records for the usual distances. Holland has four victories to its credit (J. J. Eden three and De Koning one), Finland four (F. Wathén one and C. Thunberg three), and Russia two (N. Strunnikoff), while the only New World winner was T. McCulloch (Canada) when the championship was held at Montreal in 1897.

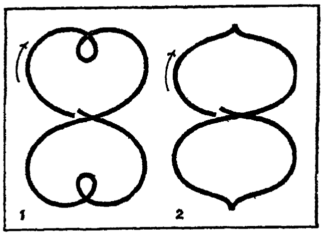


FIG. 3.—(1) LOOP-CHANGE-LOOP AND (2) BRACKET-CHANGE-BRACKET, SCHOOL FIGURES OF THE INTERNATIONAL SKATING UNION

Owing to the fickleness of the British climate, England, through lack of ice, has fallen behind in skill since the days of the Smarts, and practically the only Englishmen to compete in international races during the past 30 years have been C. Edgington, president of the Oxford University Speed Skating club, formed in 1895, which won the first representative race on skates between the universities on the duke of Marlborough's lake at Blenheim, defeating Cambridge in each of six races of 1 m. each, with three turns; F. W. Dix, British amateur champion in 1908–09 and 1912—the last year in which the championship was held up to 1928, winner of the Duddleston Cup (1m., 1908) and Baker Cup (220yd., 1912); and L. T. Redburn, winner of the 1m. amateur championship of London (1927). C. Edgington was second in each of the five international races at Davos (1901), fourth in two races (1,500 and 10,000 metres) in the world's championship at Berlin and in the European championship at Davos (1899), and in 1898 and 1899 twice beat the world's record for an hour's skating, accomplishing 18m. 1709yd. and 19m. 348yd., the latter standing for seven years till C. C. J. de Koning, Dutch world's champion (1905) made the present record, 20m. 207yd. The previous world's record was 18m. 215yd. by A. D. Smith (America) at St. Paul, Minn. (1894). In 1901, Edgington, at Davos, skated 10m. in 33min. 38$\frac{3}{5}$sec., beating the best English professional time of James Smart at Hamar (Norway) in 1891, viz., 35min. 10seconds. The best world's time for 10m. was made by J. S. Johnson (American amateur) at Montreal (1894), viz., 31 min. 11$\frac{1}{5}$ sec.

There are the American records (*see* Morgan-Browne, *Sporting and Athletic Records*), for short distances straight away, and with a wind behind, which show the speed attainable on ice with the help of a strong wind. Such are T. Donoghue, Jr.'s (American amateur) time of 2min. 12$\frac{3}{5}$sec. for 1 mile at Newburgh, N.Y. (1887), H. Davidson's 100yd. in 9sec. at Red Bank, N.J. (1895), H. Davidson and H. P. Moshier's 33$\frac{1}{5}$sec. for $\frac{1}{4}$m. (Orange lake, N.Y., and Red Bank, N.J., 1895), and J. F. Donoghue's 1min. 5$\frac{2}{5}$sec. for $\frac{1}{2}$m. with flying start (Newburgh, N.Y., 1892). Competition records (amateur) in America (outdoors) are: Jewtraw, 100yd., 9$\frac{2}{5}$sec.; Gorman, 440yd., 36$\frac{3}{5}$sec.; Thunberg, Finland, 880 yd., ($\frac{1}{2}$ mile) 1min. 15$\frac{1}{5}$sec.; Thunberg, 1 mile, 2min. 38$\frac{1}{5}$sec.

The best British time for 1m. is that of F. W. Dix, made on Cowbit Wash in 1912, without favour of wind, but with flying start, viz., 2min. 27$\frac{1}{5}$ seconds. In 1912 Dix, at Davos, won the 5,000 metres in 9min. 16$\frac{3}{5}$sec., and 10,000 metres in 18min. 49$\frac{2}{5}$sec., defeating the Austrian champion, T. Bohrer, and was second to the latter in the 1,500m. in 2 min. 33$\frac{1}{5}$ seconds. These are the best times made by an Englishman. On Dec. 31, 1927, on Lingay fen, near Cambridge, the British amateur championship was contested over a course of 1$\frac{1}{2}$m., with three turns, and was won by C. W. Horn (of Upwell, near Wisbech), in 4min. 55sec., with F. W. Dix (of Raunds, Northants), second. Dix had won this championship in Jan. 1908 in 4min. 37$\frac{2}{5}$sec., a time which remains the record. A thaw came before the professional championship could be decided. There had been no competitions for 15 years, and 25 men started, the oldest of whom was J. C. Aveling, champion in 1895 and on the next three occasions.

The world's speed championship for 1928 was decided on Feb. 4 and 5, at Davos, resulting in a narrow victory for C. Thunberg (Finland), who won but one race out of the four distances, each of which fell to a different man. Norwegians monopolized the next six places out of an entry of 31. The result was 1st, C. Thunberg, 193·87 points; 2nd, I. Ballangrud, 194·38; 3rd, B. Evensen, 194·86; 4th, R. Larsen, 195·68; 5th, M. Staksrud, 196·25; 6th, M. Mjelde, 196·41; 7th, A. Carlsen, 199·20. No Americans entered. Two young Englishmen were entered by the N.S.A. after a trial race of 1$\frac{1}{2}$m., in which they finished first and second respectively, C. W. Horn, amateur champion, and Spenser Edgington, but they naturally had no chance against the Norwegians and Finns. Horn skated very creditably in the 5,000 metres, accomplishing 9min. 32 sec., and beating two Dutchmen and a Lithuanian. New world's records for 500 and 10,000 metres were made respectively by R. Larsen (Norway), 43·1sec., and A. Carlsen (Norway), 17min. 17·4 seconds. Thunberg also won the European championship for 1928.

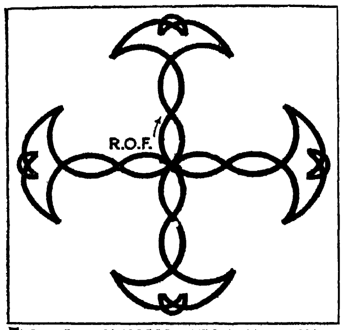


FIG. 4.—SPECIAL FIGURE SKATED BY MR. CUMMING AT PRINCE'S SKATING CLUB, LONDON, OCTOBER 1908
R.O.F. (direction for starting)

The Olympic speed skating was held at St. Moritz on Feb. 13 and 14, with 15 nations represented. The 500 metres was won by C. Thunberg (Finland) and B. Evensen (Norway), who skated a dead heat in 43·4sec., R. Larsen (Norway), J. Friman (Finland), and O. Farrell (U.S.A.), were bracketed for third place in 43·6sec. The 1,500 metres also fell to Thunberg in 2min., 21·1sec., Evensen being a fraction of a second slower, with I. Ballangrud third, R. Larsen fourth, followed by four Americans, E. Murphy, V. Bialas, I. Jaffee, and O. Farrell. The 5,000 metres was won by I. Ballangrud (Norway) in 8min. 50$\frac{1}{2}$sec., J. Skutnobb (Finland) being second, B. Evensen (Norway) third, I. Jaffee (U.S.A.) fourth, A. Carlsen (Norway) fifth, and V. Bialas (U.S.A.) sixth. The 10,000 metres race was spoilt by thaw, and had to be abandoned after four heats were attempted, although it was awarded to I. Jaffee (U.S.A.).

FIGURE SKATING

This artistic and fascinating class of skating, as subjected to definite rules, is quite modern, having originated in the 19th century, though the cutting of figures on the ice was regarded as an accomplishment by skaters long before.

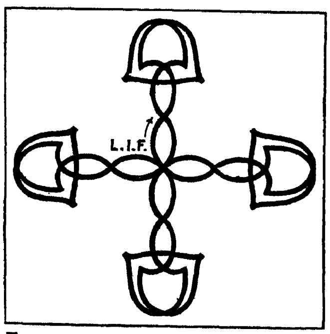
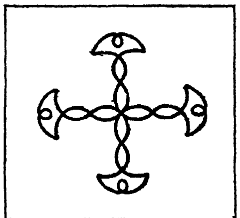


FIG. 5.—THE PANIN STAR SKATED BY MR. PANIN, A RUSSIAN, AT THE PRINCE'S SKATING CLUB IN THE OLYMPIC GAMES, OCTOBER 1908
L.I.F. (direction for starting)

Although the Edinburgh Skating Club, founded probably in 1742, is the oldest skating organization in Great Britain, the Skating club, of London, formed in 1830, is the most important, and for many years practically controlled figure skating. Figure skating championships are held in many countries under the auspices of the national associations, the world's and European championship meetings having been held since 1896 and 1891, respectively, by the International Skating Union. In England great impetus has been given to figure skating by the multiplication of clubs, *e.g.*, Wimbledon, founded 1870, Thames Valley, Crystal Palace, and more recently the Figure Skating club, formed for the encouragement of the International style, the combined Figure Skating club, the Manchester S.C. and Combined F.S.C.,

the Kettering and District, Birmingham, Cambridge university and others, most of which are affiliated to the N.S.A., as well as those of Davos, St. Moritz, Château d'Oex, Engelberg, Wengen, Suvretta and the Bear S.C. at Morgins in Switzerland, the latter an enthusiastic nursery of the English style. Further valuable help has been derived from the construction of numerous artificial rinks, such as at Niagara, the National Skating Palace (known as Hengler's), Prince's club, Manchester Ice palace, and the new Ice club opened in London (Westminster) in 1926. To these must be added the Richmond (1928) and Grosvenor House (1929) rinks. The Richmond Ice Rink Club, on the Middlesex bank of the Thames, built at a cost of £80,000, was opened on Dec. 18, 1928, and has an artificial ice rink 286 ft. by 85 ft. (an area of 24,300 sq.ft.—the largest covered ice skating rink in the world). The periodical planing, scraping and sweeping of the ice surface is performed by electrical apparatus. The surface will accommodate 1,000 skaters, and speed skating is possible on a track of about eight laps to the mile. The N.S.A., which nearly to 1898 had supported exclusively the English style, has in recent years offered 1st, 2nd and 3rd class badges for figure tests in both English and International styles, as well as for speed; in 1893 the association founded a London Skating Council, while in 1898 and 1902 it held the figure skating championship of the world in London. In America comparatively little interest is shown in this branch of the sport.



THE ENGELMANN STAR
This figure was invented by E. Engelmann (Austria), champion of Europe in 1894

In the British style of figure skating, which is not recognized by the International Skating Union, the body is held as nearly as possible upright, the employed leg is kept straight, the unemployed leg carried behind, the arms hang loosely at the sides, and the head is turned as a rule in the direction of progress. In the so-called Anglo-Swiss style, affected by British skaters trained at Davos, St. Moritz, and other Swiss centres such as Morgins, the upright, almost rigid position is insisted on, even the unemployed leg being held straight. Much more latitude is allowed by the Continental school, though here too definite rules of form have been laid down. The knee of the employed leg is slightly bent, and the unemployed leg is in constant action, being used to balance the body during the execution of the figures. The Continental is less difficult in execution than the British style, but its movements are more graceful. There are, of course, local modifications. Canadians, whose Toronto Skating club is affiliated to the N.S.A., cultivate also grape-vines and other two-footed figures. The essential features are, however, identical. Thus Englishmen consider of secondary importance loops, cross-cuts, continuous and hand-in-hand skating (though such figures as grape-vines, single, double, Pennsylvania and Philadelphia are included in the 1st class test of the N.S.A.), and devote themselves mainly to "combined figures." Since 1901, however, the N.S.A., has devoted the English challenge cup to the encouragement of single skating in the English style, and since 1906 this competition has constituted the championship of Great Britain in that style. There was no contest for the years 1915–20; since then it was won for five out of seven years by R. S. Hewett, Bear S.C., and in 1928 by H. A. C. Goodwin.

Combined figures have been defined as "symmetrical execution of a figure by one or more pairs of skaters." Originally known as the "skating club figures," they have been gradually developed, and in 1882 a regular terminology was established, successively revised and extended by delegates from the principal clubs in 1891, 1903 and 1922. The ideal number of skaters for a combined figure is four, though sixes and eights are seen, one being chosen "caller" of the movement to be skated. Various sets of "calls" are arranged at the discretion of different clubs, and consist ordinarily of "turns" and "changes." The N.S.A. offer a challenge shield for an annual competition in combined figure skating, and a challenge cup was instituted in 1924 by the Bear S.C. won in 1928 by the Wimbledon S.C. In 1905 there was instituted a hand-in-hand competition for gentlemen and ladies, the winners of which hold a pair of salvers presented by Viscount Doneraile, president of the N.S.A. The winners the first two years this was held were A. J. Davidson and Miss D. R. Jameson, and in 1927, H. Whitehurst and Miss K. Lovett.

Though English style skating has flourished amazingly in recent years, the development of the international style in England and abroad since the beginning of the 20th century has been no less striking. In 1901 the Figure Skating club was established, as already stated, for this purpose, and its members attained such success that an English lady, Mrs. Syers, gained the second place in the world's championship competition in 1902, and with her husband won an international pair skating contest in that year, and again in 1904; and in 1906 and 1907, the first two years of its institution, she won the ladies' amateur championship of the world, or as it was styled previously to 1924, of the International Skating Union. The only English pair which has won the pair skating championship of the world (previously to 1924 styled the pair skating championship of the I.S.U.) is Mr. and Mrs. J. H. Johnson, also of the F.S.C., who were successful in 1909 at Stockholm and in 1912 at Manchester. This pair presented a trophy known as the Johnson challenge cup for a British pair skating championship in the international style, instituted by the N.S.A. in 1913, and won by themselves the first year, 1914, in 1921–22 by Major and Mrs. K. M. Beaumont, and from 1923–28 inclusive by J. F. Page and Miss E. Muckelt. The Swedish challenge cup, presented to the N.S.A. in 1902 by Col. Balck, president of the I.S.U., in the name of the Stockholm Allmänna Skridskoklub, was won by Mrs. Syers, in 1903 and 1904. In 1905 this was constituted the championship of Great Britain in the international style and was won by two other ladies, Mrs. Greenhough Smith in 1908 and 1911, and Mrs. Johnson in 1921. From 1922–28, inclusive, the holder was J. F. Page, who was fourth in the world's championship at Manchester in 1924, and third in 1925 to Herren Böckl and Dr. Preissecker, of Vienna, in Berlin, in an entry of nine, the greatest success that an English figure skater has ever attained. In 1927 the first competition for the challenge cup presented by H. M. Martineau for the championship of Great Britain in the international style for ladies was won by Miss K. Shaw (Manchester S.C.). In 1928 this was won by Miss C. Wilson (Toronto Skating Club), lady champion of Canada.

The world's figure skating championship was won in 1896 by G. Fuchs, Austria; 1897, G. Hügel, Austria; 1898, H. Grenander, Sweden; 1899 and 1900, G. Hügel, Austria; 1901–11 (inclusive, with the exception of 1906, when Dr. Fuchs was again the winner), U. Salchow, Sweden; 1912–13 and 1923, F. Kachler, Austria; 1914, G. Sandahl, Sweden; 1922 and 1924, G. Grafström, Sweden; 1925–27, W. Böckl, Austria; Böckl also won the European championship for 1928.

The competition consists of two parts, (*a*) compulsory figures (*Pflichtübungen*), (*b*) free skating (*Kürlaufen*), the latter affording scope for the performance of dance steps and brilliant individual figures, such as the "sitting pirouette," the spread-eagle (Mond), and the "star" consisting of four crosses (forward rocker, back loop, back counter), invented by Engelmann and splendidly rendered by Salchow.

The skates used for the English and international styles are shorter than those used for speed-skating, and differ in radius, though both are of the same type, *i.e.*, a blade fastened to the boot by sole-plates, the "Mount Charles" pattern being the one generally adopted by Englishmen. The English radius is 7ft., or in modern times more usually 6ft.; the foreign, 5½ or even 5ft., and the result is seen in the larger curves skated on the former, and the greater pace obtained owing to decreased friction; at the same time, the difficulty of making a turn is greater. The English skate has generally right-angled edges and blade of the same thickness throughout, except in the "Dowler" variety, which is thicker towards the extremities. The foreign skate is sometimes thicker in the middle than at the ends.

The Olympic figure skating championship was held at St. Moritz in Feb. 1928. The figure skating for men was won by G. Grafström (Sweden) for the third time, W. Böckl (Austria) being

second and Van Zeebroeck (Belgium) third. The ladies' event fell to Fröken Sonja Henie (Norway), Fräulein Fritzi Burger (Austria) being second, and Miss Beatrix Loughran (United States) third. The pair skating was won by the French pair, Mlle. Andrée Joly and Monsieur Pierre Brunet, Fräulein Lilli Scholz and Herr Otto Kaiser (Austria) being second, and Fräulein Melitta Brunner and Herr Ludwig Wrede (Austria) third.

The figure skating championship of the world for ladies and the pair skating championship of the world were held in March 1928, at the Ice club in London. This club, which has a membership of 1,500, was established on the lines of the Bath and Hurlingham clubs, and has a rink 170 by 90ft., with a 100ft. circle in the centre. The ice, 1½–2in. thick, is formed by the ammonia process, and there are no less than 8½m. of pipes. The ladies' championship of the world and the world's pair skating championship for 1928 resulted as follows: Ladies, 1st, Fröken Sonja Henie (Norway); 2nd, Miss Maribel Vinson (United States), afterwards winner of the ladies' championship of the U.S.A., and of the U.S.A. pair skating championship (with T. Coolidge); 3rd, Fräulein Fritzi Burger (Austria); 4th, Miss Constance Wilson (Canada); 5th, Fräulein Melitta Brunner (Austria); 6th, Miss Kathleen Shaw (England, Manchester Skating club). Pairs: 1st, Mlle. Andrée Joly and Pierre Brunet (France); 2nd, Fräulein Lilli Scholz and Otto Kaiser (Austria); 3rd, Fräulein Melitta Brunner and Ludwig Wrede (Austria); 4th, Miss Ethel Muckelt and J. F. Page (England, Figure Skating club); 5th, Miss Beatrix Loughran and Sherwin Badger (United States); 6th, Miss Maude Smith and Jack Eastwood (Canada); 7th, Mrs. J. W. Blanchard and N. W. Niles (United States); 8th, Miss K. M. Lovett and A. P. Burman (England, Manchester Skating club). (*See* also ROLLER SKATING.)

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SKEAT, WALTER WILLIAM (1835–1912), English philologist, was born in London on Nov. 21, 1835, and educated at King's College School, Highgate Grammar School, and Christ's College, Cambridge, of which he became a fellow in July 1860. In 1878 he was elected Ellington and Bosworth Professor of Anglo-Saxon at Cambridge. His great work on Middle English literature includes the three parallel texts of *Piers Plowman* (1886), the Oxford edition of Chaucer (6 vols., 1894), with a supplementary volume of *Chaucerian Pieces* (1897), and important editions for the Early English and Scottish Text Societies. In pure philology Skeat's great work is his *Etymological English Dictionary* (4 parts, 1879–82; rev. and enlarged, 1910). In the publications of the English Dialect Society he had a hand as the founder of the society and afterwards its president. He died at Cambridge on Oct. 7, 1912.

SKEGNESS, a seaside resort in Lincolnshire, England; 131 m. N. by E. from London by L.N.E.R. Pop. (1931) 9,121. Since 1873, the place has undergone a transformation, and now possesses good hotels and a pier. There are broad, firm sands.

SKELETON. In most animals and plants, the shape could not be maintained without a thickening and hardening of certain parts to form a support for the whole. These hardened parts are the skeleton; they dry and remain after the rest of the body has disappeared. In higher animals the skeleton is always rendered more rigid and permanent by the deposit in it of lime salts, thus leading to the formation of bone. In most of the lower or invertebrate animals, the skeleton is on the surface and acts as a protection as well as a framework. This is an *exoskeleton.* In the higher or vertebrate animals there is an internal or *endoskeleton* and the exoskeleton is either greatly modified or disappears.

The following account is divided into (1) axial, or skeleton of the trunk, (2) appendicular or skeleton of the limbs, (3) visceral skeleton, or those parts which originally form the gill supports of water breathing vertebrates. The skull and exoskeleton are considered separately (*see* SKULL; SKIN AND EXOSKELETON).

Spine.—The SPINE, SPINAL or VERTEBRAL COLUMN, chine or backbone in man consists of superimposed bones named vertebrae. It lies in the middle of the back of the neck and trunk; has the cranium at its summit; the ribs at its sides, which in their turn support the upper limbs; whilst the pelvis, with the lower limbs, is jointed to its lower end. The spine consists in an adult of twenty-six bones, in a young child of thirty-three, certain of the bones in the spine of the child becoming ankylosed later. The bones of the spine are arranged in groups, named from their position, cervical, thoracic (formerly called dorsal), lumbar, sacral, and coccygeal or caudal; and the number of vertebrae in each group may be expressed in a formula. In man the formula is as follows:—$C_7Th_{12}L_5S_5Coc_4 = 33$ bones, as seen in the child; but the five sacral vertebrae fuse together into a single bone—the sacrum—and the four coccygeal into the single coccyx.

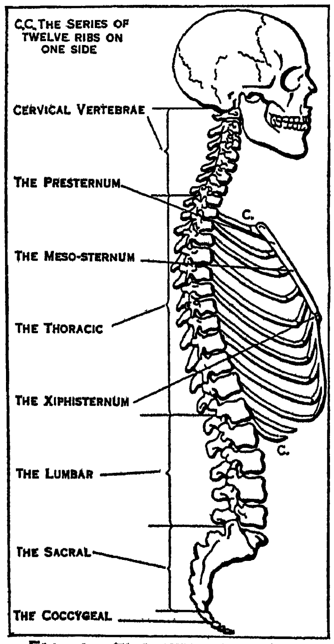


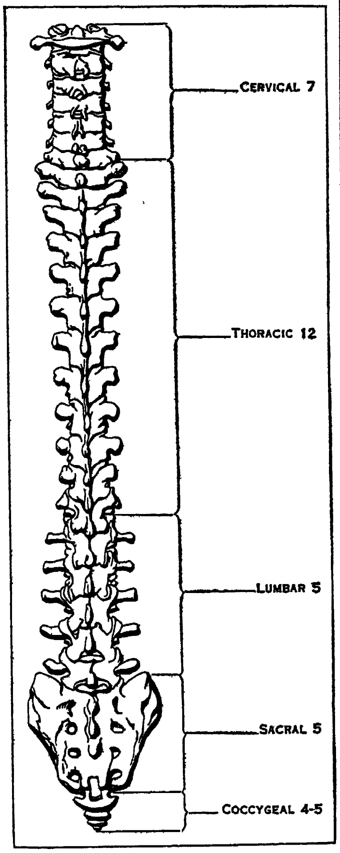
FIG. 1.—THE AXIAL SKELETON

The vertebrae are irregularly-shaped bones, but have certain characters in common. Each possesses a body and an arch, which enclose a ring, with certain processes and notches. The body, or centrum, is a short cylinder, which by its upper and lower surfaces is connected by fibrocartilage with the bodies of the vertebrae immediately above and below. The arch encloses the spinal marrow or nervous axis, springs from the back of the centrum, and consists of two symmetrical halves united behind in the middle line. Each half has an anterior part or pedicle, and a posterior part or lamina. The processes usually spring from the arch. The spinous process projects backward from the junction of the two laminae, and the collective series of these processes gives to the entire column the character from which has arisen the term "spine." The transverse processes project outward, one from each side of the arch. The articular processes project, two upward and two downward, and are for connecting adjacent vertebrae. The notches, situated on the upper and lower borders of the pedicles, form in the articulated spine the intervertebral foramina through which the nerves pass out of the spinal canal. The vertebrae in each group have special characters.

Cervical Vertebrae.—In man and all mammals, with few exceptions, whatever be the length of the neck, the cervical vertebrae are seven in number. The first, or *atlas,* has no body or spine: its ring is very large, and on each side of the ring is a thick mass of bone by which it articulates with the occipital bone above and the second vertebra below. The second vertebra, *axis,* has its body surmounted by a thick, tooth-like *odontoid* process, which is regarded as the body of the atlas displaced from its proper vertebra

and fused with the axis. This process forms a pivot round which the atlas and head move in turning the head from one side to the other; the spine is large, thick and deeply bifid. The seventh is distinguished by its long prominent spine, which is not bifid, and by the small size of the foramen at the root of the transverse process. In the human spine the distinguishing character of all the cervical vertebrae is the foramen at the root of the transverse process.

Thoracic Vertebrae.—There are twelve of these in the human spine and all are distinguished by having one or two smooth surfaces on each side of the body for articulation with the head of one or two ribs. The transverse processes have an articular surface in front for the tubercle of a rib. The first thoracic vertebra is very like the seventh cervical; the twelfth has its lower articular processes shaped like those of a lumbar vertebra.



FROM ARTHUR THOMPSON IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 2.—VERTEBRAL COLUMN, SEEN FROM BEHIND

Lumbar Vertebrae.—These in man are five in number. They are the largest of the true vertebrae, especially in the centrum. The fifth lumbar vertebra has its body much deeper in front than behind and its spine is less massive.

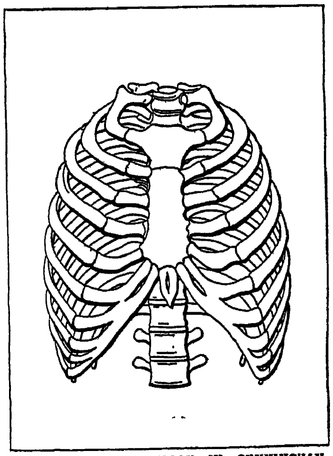
Sacrum.—The sacrum is composed of five originally separate vertebrae fused into a single bone. It forms the upper and back wall of the pelvis, is triangular in form, and possesses two surfaces, two borders, a base and an apex. The anterior or pelvic surface is concave, and is marked by four transverse lines, which indicate its original subdivision into five bones, and by four pairs of foramina, through which are transmitted the anterior sacral nerves. Its posterior surface is convex; in the middle line are four spines. On each side of these are two rows of tubercles, the inner of which are the conjoined articular and mammillary processes, the outer the transverse processes of the originally distinct vertebrae. Between these rows four pairs of foramina transmit the posterior sacral nerves from the sacral canal, which extends through the bone from base to near the apex, and forms the lower end of the spinal canal. By its borders the sacrum is articulated with the haunch-bones—by its base with the last lumbar vertebra, by its apex with the coccyx. The human sacrum is broader in proportion to its length than in other mammals; this great breadth gives solidity to the lower part of the spine, and, conjoined with the size of the lateral articular surfaces, it permits a more perfect junction with the haunch-bones, and is correlated with the erect position. Owing to the need in woman for a wide pelvis, the sacrum is broader than in man. (For details *see* A. M. Paterson, "The Human Sacrum," *Sci. Trans. R. Dublin Soc.* vol. v. ser. 2.)

Coccyx.—The coccyx consists of four or five vertebrae in the human spine though the last one is sometimes suppressed. It is the rudimentary tail, but instead of projecting back, as in mammals generally, is curved forward, an arrangement also found in the anthropoid apes and in Hoffmann's sloth. The vertebrae of which it is composed are small, and represent merely the bodies and transverse processes of the true vertebrae. There are no arches.

The human spine is more uniform in length in persons of the same race than might be supposed, variation in the height of adults being due chiefly to differences in the length of the lower limbs. The average length of the spine is 28 in.; its widest part is at the base of the sacrum, from which it tapers down to the tip of the coccyx. It diminishes also in breadth from the base of the sacrum upwards to widen again in the region of the neck. Behind and laterally it presents an irregular outline, but in front it is more uniformly rounded, owing to the convex form of the antero-lateral surfaces of the bodies of its vertebrae. In its general contour two series of curves may be seen, an antero-posterior and a lateral. The antero-posterior is the more important. In the infant at birth the sacro-coccygeal part of the spine is concave forward, but the rest of the spine is almost straight. When the infant begins to sit up, a convexity forward in the region of the neck appears, and subsequently, as the child learns to walk, a convexity forward in the region of the loins. Hence in the adult spine a series of convexo-concave curves are found, which are alternate and mutually dependent, and are associated with the erect attitude of man. A lateral curve, convex to the right, opposite the third, fourth and fifth thoracic vertebrae, with compensatory curve convex to the left immediately above and below, is due apparently to the greater use of the right arm. In disease of the spine its natural curvatures are much increased, and the deformity known as humpback is produced. As the spine forms the central part of the axial skeleton, it acts as a column to support not only the weight of the body, but of all that can be carried on the head, back and in the upper limbs: by its transverse and spinous processes it serves also to give attachment to numerous muscles, and the transverse processes of its thoracic vertebrae are also for articulation with the ribs.

Thorax.—The thorax, pectus or chest is a cavity, the walls of which are formed of bone and of cartilage. Its skeleton consists of the sternum in front, the twelve thoracic vertebrae behind, and the twelve ribs, with their corresponding cartilages, on each side.

Sternum.—The sternum or breast bone is an elongated bone which inclines downward and forward in the front wall of the chest. It consists of three parts—an upper, called manubrium or presternum; a middle, the gladiolus or mesosternum; and a lower, the ensiform process or xiphisternum. Its anterior and posterior surfaces are marked by transverse lines, which indicate not only the subdivision of the entire bone into three parts, but that of the mesosternum into four originally distinct segments. Each lateral border is marked by seven depressed surfaces for articulation with the seven upper ribs; at each side of the upper border of the presternum is a sinuous depression, where the clavicle articulates. The xiphisternum remains cartilaginous up to a late period of life.



FROM ARTHUR THOMPSON IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

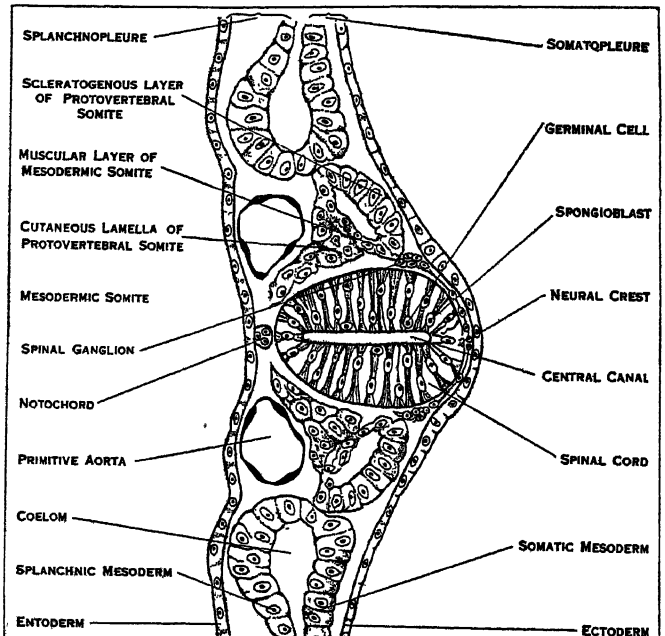
FIG. 3.—THE THORAX, SEEN FROM THE FRONT

Ribs.—The ribs or costae, twelve on each side of the thorax, consist not only of the bony ribs, but of a bar of cartilage continuous with the anterior end of each bone, called a *costal cartilage,* so that they furnish examples of a cartilaginous skeleton in the adult human body; in aged persons these cartilages usually become converted into bone. The upper seven ribs are connected by their costal cartilages to the side of the sternum, and are called *true ribs;* the lower five do not reach the sternum, and are named *false,* and of these the two lowest, from being comparatively unattached in front, are called *floating.* All the ribs are articulated behind to the thoracic vertebrae, and as they are symmetrical on the two sides of the body, the ribs in any given animal are always twice as numerous as the thoracic vertebrae in that animal. They form a series of osseo-cartilaginous arches, which extend more or less perfectly around the sides of the chest. A rib is an elongated bone, and as a rule

possesses a head, a neck, a tubercle and a shaft. The head usually has two articular surfaces, and is connected to the side of the body of two adjacent thoracic vertebrae; the neck is a constricted part of the bone, uniting the head to the shaft; the tubercle, close to the junction of the shaft and neck, is the part which articulates with the transverse process of the vertebra. The shaft is compressed, possesses an inner and outer surface, and an upper and lower border, but from the shaft being somewhat twisted on itself, the direction of the surfaces and borders is not uniform throughout the length of the bone. The ribs slope from their attachments to the spine, at first outward, downward and backward, then downward and forward, and where the curve changes from the backward to the forward direction an *angle* is formed on the rib. The angle and the tubercle are at the same place in the first rib and in each succeeding rib the angle is a little farther from the tubercle than in the last.

The surface of the first rib which is not in contact with the lung is directed upward, forward and outward while that of the second rib is much more outward; the eleventh and twelfth ribs are rudimentary, have neither neck nor tubercle, and are pointed anteriorly. The ribs increase in length from the first to the seventh or eighth, and then diminish to the twelfth; the first and twelfth are therefore the shortest ribs. The first and second costal cartilages are almost horizontal, but the others are directed upward and inward.

In its general form the chest is like a barrel which is wider below than above. It is rounded at the sides and flattened in front and behind, so that a man can lie either on his back or his belly. Its upper opening slopes downward and forward, is small in size, and allows the passage of the windpipe, gullet, large veins and nerves into the chest, and of several large arteries out of the chest into the neck. The base or lower boundary of the cavity is much larger than the upper, slopes downward and backward, and is oc-



FROM A. H. YOUNG AND ARTHUR ROBINSON IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 4.—TRANSVERSE SECTION OF A FERRET EMBRYO, SHOWING FURTHER DIFFERENTIATION OF THE MESODERM

cupied by the diaphragm (*q.v.*), which separates the chest from the abdomen. The transverse diameter is greater than the antero-posterior, and the antero-posterior is greater laterally, where the lungs are lodged, than in the mesial plane, which is occupied by the heart.

Embryology.—The first stiffening of the embryo is the formation of the *notochord*, which in higher vertebrates is temporary and is not converted into cartilage or bone. It is derived from the entoderm or inner of the three layers of the embryo while the bony skeleton is formed from the mesoderm or middle layer and, just as the entoderm is an older layer of the embryo than the mesoderm, so the notochord or entodermal skeleton precedes, both in embryology and in phylogeny or comparative anatomy, the bony mesodermal skeleton.

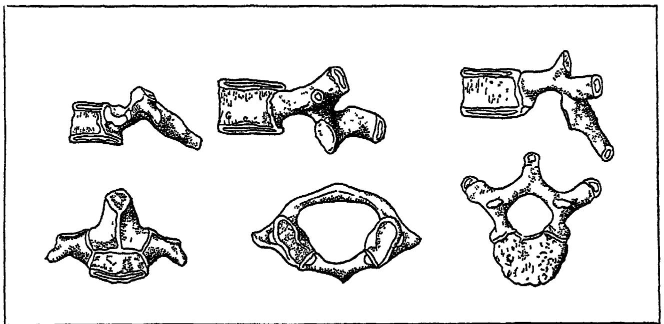
In the accompanying figure (fig. 4) the notochord is seen in section fully formed and lying between the entoderm and the neural canal. Its first formation is at an earlier period than this, before the neural groove has closed into a canal, and it appears at first as an upward groove from the most dorsal part of the entoderm in what will later on be the cervical region of the embryo. The groove, by the union of its edges, becomes a tube, but the cavity of this is soon obliterated by the growth of its cells, so that a solid elastic rod is formed which grows forward as far as the pituitary region of the skull and backward to where the end of the coccyx will be.

While the development of the notochord is going on the mesoderm on each side of it is dividing itself into a series of masses called *mesodermic somites* (see fig. 4, PS) or *protovertebrae*. This process begins in the cervical region and proceeds forward and backward until thirty-eight pairs have been formed for the neck and trunk and probably four extra ones for the occipital region of the skull. Each of these somites consists of three parts: that nearest the surface ectoderm is the cutaneous lamella (fig. 4, CL). Deep to this and separated in the earlier-formed somites by a space is the muscle layer (fig. 4, ML) while deepest of all and nearest the nerve cord and notochord is the *scleratogenous layer* (fig. 4, SL). It is this layer which gradually meets its fellow of the opposite side and encloses the nerve cord and the notochord in continuous tubes of mesodermal tissue, thus forming the *membranous vertebral column,* which is perforated for the exit of the spinal nerves, but the intervals between the successive mesodermic somites are still marked by the tissue being rather denser there. The next stage is conversion into cartilage of each segment of the membranous vertebral column surrounding the notochord. In this way the bodies of the cartilaginous vertebrae are formed and each of these is segmental, that is, it corresponds to a muscle segment and a spinal nerve. The cartilaginous neural arch, however, which surrounds the nerve cord is intersegmental and is formed in the denser fibrous tissue which separates each somite from the next. This also applies to the cartilaginous ribs which appear in the fibrous intervals (myocommata) between the muscle plates (myotomes), and so it is easy to realize that each typical rib must articulate with the bodies of two adjacent vertebrae, but with the neural arch, through its tranverse process, of only one.

The intersegmental tissue between the bodies of the vertebrae becomes the intervertebral discs and in the centre of these a pulpy mass is found which contains some remnants of the notochord. Elsewhere this structure is pressed out of existence and there is no further use for it when the cartilaginous vertebrae are once formed. One other series of structures must be mentioned though they do not play any great part in human development. In the intersegmental tissue ventral to each of the intervertebral discs a transverse rod of cells, known as a *hypochordal bar,* is formed which connects the heads of two opposite ribs. In man the greater number of these disappear, but in the case of the atlas the rod chondrifies to form the anterior (ventral) arch which is therefore intersegmental, while the segmental body of the atlas, through which the notochord is passing, joins the axis to form the odontoid process. These hypochordal bars are the last remnant in man of the haemal arch of the vertebrae of fishes (*see* subsection on comparative anatomy). In the cervical region the ribs form the ventral boundary of the foramen for the vertebral artery. They are so short that they become fused with the centrum and transverse process, leaving the vertebrarterial canal between. Sometimes in the seventh cervical vertebra the rib element is much longer and remains as a separate cervical rib with definite joints.

The sternum is developed according to G. Ruge by a fusion of the ventral ends of the ribs on each side thus forming two parallel longitudinal bars which chondrify and eventually fuse together in the mid line. The anterior seven or sometimes eight ribs reach the sternum, but the ventral ends of the ninth and sometimes the eighth probably remain as the xiphisternum. The morphological

meaning of the sternum and surrounding parts cannot be settled entirely by a study of their development even when combined with what we know of their comparative anatomy or phylogeny. Professor A. M. Paterson (*The Human Sternum,* London, 1904) takes



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 5.—OSSIFICATION OF VERTEBRAE

a different view from the foregoing and regards the sternum as derived from the shoulder girdle. To this point of view we shall return in the section on comparative anatomy. The position of the vertebral and sternal centres of ossification is shown in figs. 5, 6 and 7. The ribs ossify by one primary centre appearing about the sixth week and by secondary ones for the tubercle and head. The sternum is ossified by centres which do not appear opposite the attachment of the ribs but alternately with them, so that although the original cartilaginous structure is probably intersegmental the bony segments are segmental like those of the vertebral centra.

For further details *see* C. S. McMurrich, *The Development of the Human Body* (London, 1923). This includes bibliography, but G. Ruge's paper on the development of the sternum (*Morph. Jahrb.* vi. 1880) is of special importance.

Comparative Anatomy.—Just as in development the notochord forms the earliest structure for stiffening the embryo, so in the animal kingdom it appears before the true vertebral column is evolved. This is so important that the older phylum of Vertebrata has now been expanded into that of Chordata to include all animals which either permanently or temporarily possess a notochord. In the subphylum Adelochorda, which includes the worm-like Balanoglossus, as well as the colonial forms Rhabdopleura and Cephalodiscus, an entodermal structure, apparently corresponding to the notochord of higher forms, is found in the dorsal wall of the pharynx. In the subphylum Urochorda or Tunicata, to which the ascidians or sea-squirts belong, the notochord is present in the tail region only and as a rule disappears after the metamorphosis from the larval to the adult form. In the Acrania, which are represented by Amphioxus (the lancelet) and are sometimes classed as the lowest division of the subphylum Vertebrata, the notochord is permanent and extends the whole length of the animal. Both this and the nerve cord dorsal to it are enclosed in tubes of mesodermal connective tissue which are continuous with the fibrous myocommata between the myotomes. Here then is a notochord and a membranous vertebral column resembling a stage in man's development.

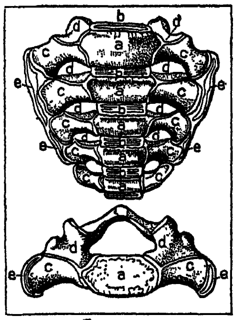


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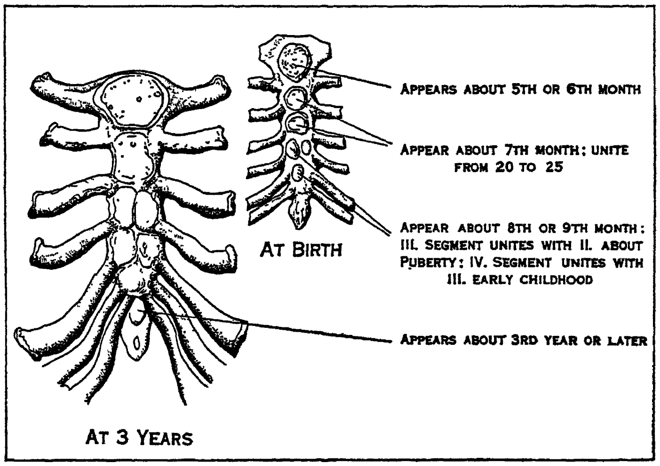
FIG. 6.—OSSIFICATION OF SACRUM

(a, a) Centres for bodies, (b, b) Epiphysial plates on bodies, (c, c) Centres for costal elements, (d, d) Centres for neural arches, (e, e) Lateral epiphyses

In the Cyclostomata (hags and lampreys) the notochord and its sheath persist through life, but in the adult lamprey (Petromyzon) cartilaginous neural arches are developed. In cartilaginous ganoid fishes like the sturgeon, the notochord is persistent and has a strong fibrous sheath into which the cartilage from the neural arches encroaches while in the elasmobranch fishes (sharks and rays) the cartilaginous centra are formed and grow into the notochord, thus causing its partial absorption. Each centrum is deeply concave toward both the head and tail; such a vertebra is spoken of as *amphicoelous* and with one exception is always found in fishes which have centra. In the bony fish (Teleostei) and mudfish (Dipnoi) the vertebrae are ossified.

A vertebra from the tail of a bony fish like the herring has a ventral (haemal) arch surrounding the caudal blood-vessels and corresponding to the dorsal or neural arch which is also present. In the anterior or visceral part of the body the haemal arch is



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 7.—OSSIFICATION OF THE STERNUM, SHOWING THE SECOND AS WELL AS THE THIRD SEGMENT OF THE BODY POSSESSING TWO CENTRES

split and its two sides spread out deep to the muscles and form the ribs. In the elasmobranchs on the other hand the ribs lie among the muscles as they do in higher vertebrates, and the fact that both kinds of ribs are coexistent in the same segments in the interesting and archaic Nilotic fish *Polypterus bichir* shows that they are developed independently of one another. The sternum is never found in fishes with the possible exception of the comb-toothed shark (Notidanus). Among the Amphibia the tailed forms (Urodela) have amphicoelous vertebrae in embryonic life and so have some of the adult salamanders, but usually the intercentral remnants of the notochord are pressed out of existence by the forward growth of the centrum behind it, so that in the adult each vertebra is only concave behind (opisthocoelous). In the Anura (frogs and toads), on the other hand, the centra are usually concave forward (procoelous) and some of the posterior ones become fused into a long delicate bone, the *urostyle.* The ribs of urodeles have forked vertebral ends and are thus attached to the centrum as well as to the neural arch of a vertebra; this forking is supposed to be homologous with the double ribs of Polypterus already referred to. The sternum as a constant structure first appears in amphibians and is more closely connected with the shoulder girdle than with the ribs, the ventral ends of which, except in the salamander Necturus, are rudimentary. It is not certain whether it is the homologue of the sternum of the fish Notidanus; the subject is discussed by T. J. Parker and A. M. Paterson (*The Human Sternum,* London, 1904, p. 50).

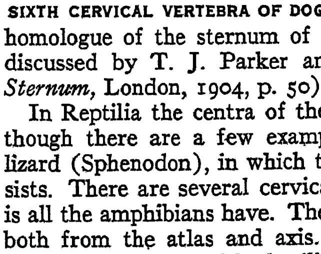


FIG. 8.—ANTERIOR SURFACE OF SIXTH CERVICAL VERTEBRA OF DOG

In Reptilia the centra of the vertebrae are usually procoelous, though there are a few examples, such as the archaic Tuatera lizard (Sphenodon), in which the amphicoelous arrangement persists. There are several cervical vertebrae instead of one, which is all the amphibians have. The odontoid bone is usually separate both from the atlas and axis. Two sacral vertebrae (*i.e.,* vertebrae articulating with the ilium) are generally present instead of the one of the Amphibia, but they are not fused together as in mammals. In the tail region haemal arches are often found enclosing the caudal artery and vein as in urodele amphibians; in

some species these are separate and are then spoken of as *chevron bones*. In the Crocodilia intervertebral disks first appear. Ribs are present in the cervical, thoracic and lumbar regions, and in the Chelonia (tortoises) the cervical ones blend with the vertebrae as they do in higher forms. In crocodiles a definite vertebrarterial canal is established in the cervical region which henceforward becomes permanent. The shafts of the ribs are sometimes all in one piece as in snakes or they may be developed by three separate centres as in Sphenodon with intervening joints.

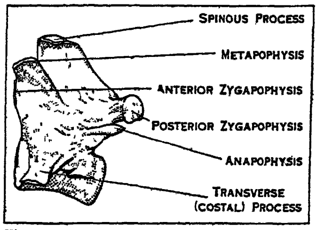
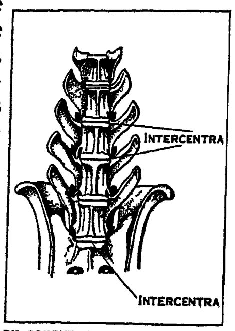


FIG. 9.—SIDE VIEW OF THE FIRST LUMBAR VERTEBRA OF A DOG

In Crocodilia and Sphenodon there are spurs from each thoracic rib which overlap the next rib behind and are known as *uncinate processes;* they are developed in connection with the origin of the external oblique muscle of the abdomen and are very constant in birds. The ventral elements of some of the hinder ribs are found in the Crocodilia lying loose in the myocommata of the rectus and obliquus internus (inscriptiones tendineae) and are known as abdominal ribs, while the sacral vertebrae articulate with the ilium through the intervention of short rods of bone, sometimes called *pleurapophyses,* which are no doubt sacral ribs. The sternum of reptiles is a broad plate of cartilage which may be calcified but is seldom converted into true bone; it always articulates with the coracoids (*see* section *Appendicular*) anteriorly and with a variable number of ribs laterally and posteriorly. It should not be confounded with the dagger-shaped interclavicle which, like the clavicles, is a membrane bone and overlaps the sternum ventrally.



BY COURTESY OF F. G. PARSONS AND THE ZOOLOGICAL SOCIETY OF LONDON

FIG. 10.—INTERCENTRA OF LOWER PART OF THE VERTEBRAL COLUMN

In birds the characteristics are largely reptilian with some specialized adaptations to their bipedal locomotion and power of flight. One effect of this is that the two true sacral vertebrae become secondarily fused with the adjacent lumbar, caudal and even thoracic, and these again fuse with the ilium so that the posterior part of a bird's trunk is very rigid. The neck, on the other hand, is very movable and the centra articulate by means of saddle-shaped joints which give the maximum of movement combined with strength (*see* JOINTS). The caudal vertebrae are fused into a flattened bone, the *pygostyle,* to support the tail feathers. In the fossil bird Archaeopteryx the centra are amphicoelous and the long tail has separate caudal vertebrae. The ribs are few and consist of dorsal and ventral parts; the former almost always have uncinate processes. Free cervical ribs are often present and Archaeopteryx possessed abdominal ribs. The sternum is very large and in flying birds (Carinatae) has a median keel (carina) projecting from it, while the non-flying, ostrich-like birds (Ratitae) have no such structure.

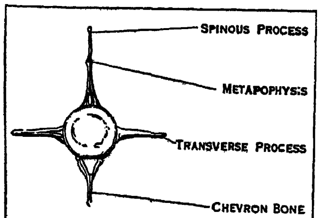


FIG. 11.—ANTERIOR SURFACE OF FOURTH CAUDAL VERTEBRA OF PORPOISE (PHOCAENA COMMUNIS)

In Mammalia the centra articulate by means of the intervertebral disks and it is only in this class that the epiphysial plates appear though these are absent in the Monotremata (duck-mole etc.) and Sirenia (sea-cows). The cervical vertebrae are with a few exceptions (two-toed and three-toed sloths and the manatee or sea-cow) always seven in number, and some, usually all, of them have a vertebrarterial canal in the transverse process. In some of the Cetacea they are fused together. In the Ornithorhynchus the odontoid is a separate bone, as in many reptiles, but this part includes the facets by means of which the axis and atlas articulate. The thoracic vertebrae vary from ten in some of the whales and the peba armadillo to twenty-four in the two-toed sloth, though thirteen or fourteen is the commonest number. In the anterior part of the thoracic region the spines point backward, while in the posterior thoracic and lumbar regions they have a forward direction. There is always one spine in the posterior thoracic region which is vertical, and the vertebra which bears this is known as the *anticlinal vertebra.* The lumbar vertebrae vary from two in the Ornithorhynchus and some of the armadillos to twenty-one in the dolphin, the average number being probably six. Both the mammillary and accessory tubercles are in some forms greatly enlarged. It is usually held that the former are morphologically muscular processes while the latter represent the transverse processes of the thoracic vertebrae. In the American edentates additional articular processes (zygapophyses) are developed, so that these animals are sometimes divided from the old-world edentates and spoken of as Xenarthra.

Lying ventral to the intervertebral disks in many mammals small paired ossicles are occasionally found; these are called *intercentra* and are ossifications in the hypochordal bar (*see* subsection on embryology). They probably represent the places where the chevron bones or haemal arches would be attached and are the serial homologues of the anterior arch of the atlas (*see* fig. 10); these intercentra, either as paired or median ossicles, are often found in lizards. The sacrum consists of true sacral vertebrae, which directly articulate with the sacrum, and false, which are caudal vertebrae fused with the others to form a single bone. There is also reason to believe that vertebrae which are originally lumbar become secondarily included in the sacrum because in the development of man the pelvis is at first attached to the thirtieth vertebra, but gradually shifts forward until it reaches the twenty-fifth, twenty-sixth and twenty-seventh; the twenty-fifth or first sacral vertebra, however, often reverts to the lumbar type and sometimes may do so on one side only.

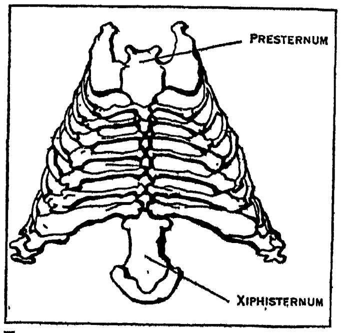


FIG. 12.—STERNUM AND STRONGLY OSSIFIED RIBS OF GREAT ARMADILLO (PRIODON GIGAS)

Taking the vertebrae which fuse together as an arbitrary definition of the sacrum, we find that the number may vary from one in *Cercopithecus patas* to thirteen in some of the armadillos, and, if the Cetacea are included, seventeen in the bottle-nosed dolphin, Tursiops. Four seems to be about the average in the mammalia and of these one or two are true sacral. In some of the Edentata the posterior sacral vertebrae are fused with the ischium, in other words the great sacro-sciatic ligament is ossified. The tail vertebrae vary from none at all in the bat Megaderma to forty-nine in the pangolin (*Manis macrura*). The anterior ones are remarkable for usually having chevron bones (shaped like a V) on the ventral surface of the intercentral articulation. These protect the caudal vessels and give attachment to the ventral tail muscles. The ribs in mammals correspond in number to the thoracic vertebrae. In typical pronograde mammals the shape of the ribs differs from that of the higher Primates and man: they are so curved that the dorso-ventral diameter of the thorax is greater than the transverse while in the higher Primates the thorax is broader from side to side than it is dorso-ventrally. In this respect the bats agree with man and the lemurs with the pronograde mammals.

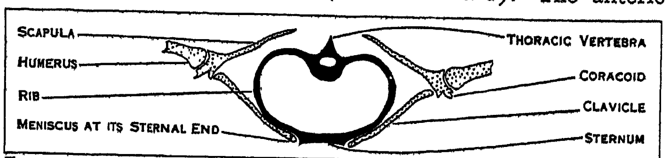


FIG. 13.—DIAGRAMMATIC SECTION REPRESENTING THE RELATIONS OF THE SHOULDER GIRDLE TO THE TRUNK

For further details and literature *see* S. H. Reynolds, *The Vertebrate*

Skeleton (Cambridge, 1897); W. H. Flower and H. Gadow, *Osteology of the Mammalia* (London, 1885); R. Wiedersheim, *Comparative Anatomy of Vertebrates,* adapted and translated by W. N. Parker (London, 1907); R. Wiedersheim and G. Howes, *The Structure of Man* (London, 1897); C. Gegenbaur, *Vergleich. Anat. der Wirbeltiere,* Band i. (Leipzig, 1901).

APPENDICULAR SKELETON

The bony framework of the upper and lower limbs is built up on the same plan in both. Each consists of a limb girdle connecting it with the axial skeleton, a proximal single bone segment, a distal double bone segment, the hand and foot segments and the digits (phalanges). It should be understood that in the following descriptions the terms internal and external are used in relation to the mid-line of the body and not to that of the limb.

Upper Limb.—The upper limb in man consists of a proximal part or shoulder, a distal part or hand, and an intermediate shaft, which consists of an upper arm, and a forearm. In each of these subdivisions certain bones are found: in the shoulder, the clavicle and scapula; in the upper arm, the humerus; in the forearm, the radius and ulna, the bone of the upper arm in man being longer than the bones of the forearm; in the hand, the carpal and metacarpal bones and the phalanges. The scapula and clavicle together form an imperfect bony arch, the Shoulder Girdle; the shaft and hand form a free divergent Appendage. The shoulder girdle is the direct medium of connection between the axial skeleton and the divergent part of the limb; its anterior segment, the clavicle, articulates with the upper end of the sternum, whilst its posterior segment, the scapula, approaches, but does not reach, the dorsal spines.

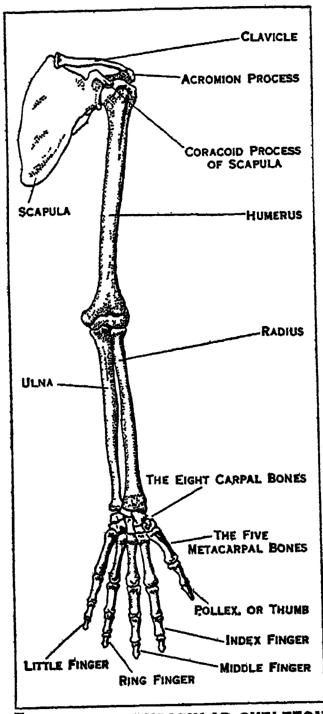


FIG. 14.—APPENDICULAR SKELETON OF LEFT UPPER LIMB

Clavicle.—The clavicle or collar bone (fig. 14) is an elongated bone which extends from the upper end of the sternum horizontally outward, to articulate with the acromion process of the scapula. It presents a strong sigmoidal curve, is slender in the female, but powerful in muscular males; its sternal end is thick and somewhat triangular; its acromial end, flattened from above downward, has an oval articular surface for the acromion. Its shaft has four surfaces for the attachment of muscles; and strong ligaments connecting it with the coracoid and the first rib.

Scapula.—The scapula or shoulder blade (fig. 14) is present in all mammals. It lies at the upper and back part of the wall of the chest, reaching from the second to the seventh rib. Its form is plate-like and triangular, with three surfaces, three borders and three angles. Its ventral surface is in relation to the ribs, from which it is separated by certain muscles: the dorsum is traversed from behind forward by a prominent *spine,* which subdivides this aspect of the bone into a *supra-spinous* and an *infra-spinous fossa.* The spine arches forward to end in a broad flattened process, the *acromion,* which has an oval articular surface for the clavicle; both spine and acromion are largely developed in the human scapula in correlation with the great size of the trapezius and deltoid muscles, which are concerned in the elevation and abduction of the upper limb. The borders of the scapula give attachment to several muscles. The angles are inferior, antero-superior and postero-superior. The antero-superior is truncated and has a large, shallow, oval, smooth surface, the *glenoid fossa,* for articulation with the humerus, to form the shoulder joint. Overhanging the glenoid fossa is a curved beak-like process, the *coracoid,* corresponding with the separate coracoid bone of monotremes, birds and reptiles.

Humerus.—The humerus (fig. 14) is a long bone, and consists of a shaft and two extremities. The upper extremity possesses a convex spheroidal smooth surface, the *head,* for articulation with the glenoid fossa of the scapula; it is surrounded by a narrow constricted *neck,* and where the neck and shaft become continuous with each other, two processes or *tuberosities* are found, to which are attached the rotator muscles arising from the scapular fossae. Between the tuberosities is a groove in which the long tendon of the biceps rests. The shaft is triangular in section above, but flattened and expanded below. A shallow groove winds round the back of the bone, in which the musculo-spiral nerve is lodged. The lower extremity consists of an articular and a non-articular portion. The articular has a small head externally for the radius, and a pulley internally for the movements of the ulna in flexion and extension of the limb. The non-articular part has projections on its inner and outer aspects, the *internal* and *external* condyles; each is surmounted by a *supracondylar ridge,* and the internal condyle and ridge attach the muscles passing to the flexor surface of the forearm, while the external are for those passing to the extensor surface.

Before describing the two bones of the forearm, the range of movement which can take place between them should be noticed. In one position, *supine,* they lie parallel to each other, the radius being the more external bone, and the palm of the hand being directed forward; in the other or *prone* position the radius crosses obliquely in front of the ulna, and the palm of the hand is directed backward. Not only the bones of the forearm, but those of the hand are supposed to be in the supine position when they are described.

Radius.—The radius (fig. 14) is the outer bone of the forearm, and possesses a shaft and two extremities. The upper extremity or *head* has a shallow, smooth cup for articulation with the humerus; the outer margin of the cup is also smooth, for articulation with the ulna and orbicular ligament; below the cup is a constricted *neck,* and immediately below the neck a *tuberosity* for the insertion of the biceps. The shaft of the bone possesses three surfaces for the attachment of muscles and a sharp inner border for the interosseous membrane. The lower end of the bone is much broader than the upper, and is marked posteriorly by grooves for the lodgment of tendons passing to the back of the hand: from its outer border a pointed *styloid* process projects downward; its inner border has a smooth shallow fossa for articulation with the ulna, and its broad lower surface is smooth and concave, for articulation with the scaphoid and semilunar bones of the wrist.

Ulna.—The ulna (fig. 14) is also a long bone. Its upper end is subdivided into two strong processes by a deep fossa which possesses a smooth surface for articulation with the humerus. The anterior process is rough in front for the insertion of the brachialis anticus, whilst the posterior or *olecranon* process gives insertion to the large triceps muscle of the upper arm. Immediately below the outer border of the great fossa is the *small sigmoid cavity* for articulation with the side of the head of the radius. The shaft of the bone has three surfaces for the attachment of muscles, and a sharp outer border for the interosseous membrane. The lower end, much smaller than the upper, has a pointed *styloid* process and a smooth articular surface, the outer portion of which is for the lower end of the radius, the lower part for moving on a cartilage of the wrist joint called the triangular fibro-cartilage.

Hand.—The hand consists of the carpus or wrist, the metacarpus or palm and the free digits, the thumb and four fingers. Anatomists describe it with the palm turned to the front, and with its axis in line with the axis of the forearm.

The *carpal* or *wrist* bones (fig. 14) are eight in number arranged in two rows, a *proximal,* consisting of the scaphoid, semilunar, cuneiform and pisiform, and a *distal,* consisting of a trapezium, trapezoid, os magnum and unciform; the bones in each row being named in the order they are met with, from the radial or outer to the ulnar or inner side of the wrist.

The *metacarpal* bones are five in number (fig. 14). They are miniature long bones, and each possesses a shaft and two extremities. The metacarpal of the thumb is the shortest, and diverges outward from the rest; its carpal extremity is saddle-shaped, for articulation with the trapezium; its shaft is somewhat compressed, and its phalangeal end is smooth and rounded, for the first phalanx of the thumb. The four other metacarpal bones belong to the four fingers. Their carpal ends articulate with the trapezoid, os magnum and unciform: their phalangeal ends articulate with the proximal phalanges of the fingers.

The number of *digits* in the hand is five. They are distinguished by the names of pollex or thumb, index, medius, annularis and minimus. Their skeleton consists of fourteen bones named phalanges, of which the thumb has two, and each of the four fingers three. Each is a miniature long bone, with two articular extremities and an intermediate shaft, except the terminal phalanges in which the distal end is rounded for the nail.

Lower Limb.—The lower limb consists of a proximal part or haunch, a distal part or foot, and an intermediate shaft subdivided into thigh and leg. Each part has its appropriate skeleton (the thigh-bone in man being longer than the leg-bones). The bone of the haunch (os innominatum) forms an arch or pelvic girdle, which articulates behind with the side of the sacrum, and arches forward to articulate with the opposite haunch-bone at the pubic symphysis. It is the direct medium of connection between the axial skeleton and the shaft and foot, which form a free divergent appendage.

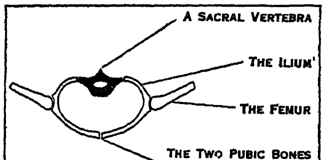


FIG. 15.—DIAGRAMMATIC SECTION SHOWING RELATIONS OF PELVIC GIRDLE TO THE TRUNK

The os innominatum, or haunch-bone, is a large irregular plate-like bone, which forms the lateral and inferior boundary of the cavity of the pelvis. In early life it consists of three bones—ilium, ischium and pubis—which unite about the twenty-fifth year into a single bone. These bones converge, and join to form a cup, the *acetabulum,* on the outer surface of the bone, which lodges the head of the thigh-bone at the hip-joint. At the bottom of the acetabulum is a depression, to the sides of which the ligamentum teres of the hip-joint is attached. From the acetabulum the ilium extends upward and backward, the ischium downward and backward, the pubis forward, inward and downward. Below the acetabulum is a large hole, the *obturator foramen,* which is bounded by the ischium and pubes; behind and above the acetabulum is the *deep sciatic notch,* which is bounded by the ischium and ilium, and below this is the *small sciatic notch.*

Ilium.—The ilium (fig. 16) in man is a broad plate-like bone, the lower end of which aids in forming the acetabulum, while the upper end forms the iliac crest, which, in man, is elongated into the sinuous crest of the ilium. This crest affords attachment to the broad muscles which form the wall of the abdominal cavity. One surface of the ilium is *external,* and marked by curved lines which subdivide it into areas for the origin of the muscles of the buttock; another is *anterior,* and hollowed out to give origin to the iliacus muscle; the third, or *internal,* surface articulates posteriorly with the sacrum, whilst anteriorly it forms a part of the wall of the true pelvis. The external is separated from the anterior surface by a border which joins the anterior end of the crest, where it forms a process, the *anterior superior spine.* Between the anterior and internal surfaces is the ilio-pectineal line, which forms part of the line of separation between the true and false pelvis.

Pubis.—The pubis (fig. 16) is also a three-sided, prismatic, rod-like bone, the fundamental form of which is obscured by the modification in shape of its inner end. In human anatomy it is customary to regard it as consisting of a *body* and of two branches, an upper and a lower *ramus.* Projecting forward from the junction of the body and upper ramus is the *pubic spine,* a landmark in surgery, and to this the ilio-pectineal line may be traced.

Ischium.—The ischium (fig. 16) also has the fundamental form of a three-sided prismatic rod. One extremity (the upper) completes the acetabulum, whilst the lower forms the large prominence, or *tuber ischii.* The tuberosity, a thick, rough and strong process, gives origin to several powerful muscles: on it the body rests in the sitting posture; a flattened ramus ascends from it to join the lower ramus of the pubis, and completes both the pubic arch and the margin of the obturator foramen.

Pelvis.—By the articulation of the two innominate bones with each other in front at the pubic symphysis, and with the sides of the sacrum behind, the osseous walls of the cavity of the pelvis are formed. This cavity is subdivided into a false and a true pelvis. The false pelvis lies between the expanded wing-like portions of the two ilia. The true pelvis lies below the two ilio-pectineal lines and the base of the sacrum, which surround the upper orifice or brim of the true pelvis, or pelvic inlet, whilst its lower orifice or outlet is bounded behind by the coccyx, laterally by the ischial tuberosities, and in front by the pubic arch. In the erect attitude the pelvis is so inclined that the plane of the brim forms with the horizontal plane an angle of from 60° to 65°. The axis of the cavity is curved, and is represented by a line dropped perpendicularly from the planes of the brim, the cavity and the outlet; at the brim it is directed downward and backward, at the outlet downward and a little forward. Owing to the inclination of the pelvis, the base of the sacrum is nearly 4 in. higher than the upper border of the pubic symphysis. The female pelvis is distinguished from the male by certain sexual characters. The bones are more slender, the ridges and processes for muscular attachment more feeble, the breadth and capacity greater, the depth less, giving the greater breadth to the hips of a woman; the inlet more nearly circular, the pubic arch wider, the distance between the tuberosities greater, and the acetabulum smaller in the female than in the male. The greater capacity of the woman's over the man's pelvis is to afford greater room for the expansion of the uterus during pregnancy, and for the expulsion of the child at the time of birth.

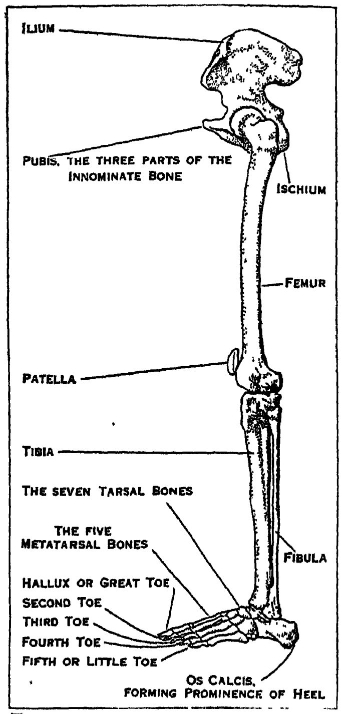


FIG. 16.—APPENDICULAR SKELETON OF THE LEFT LOWER LIMB

Femur.—The femur or thigh-bone (fig. 16) is the longest bone in the body, and consists of a shaft and two extremities. The upper extremity or *head* has a smooth hemispherical surface, in which an oval roughened fossa, for the attachment of the ligamentum teres of the hip, is found; from the head a strong elongated *neck* passes downward and outward to join the upper end of the shaft; the place of junction is marked by two processes or trochanters; to the *external* or *great trochanter* are attached many muscles; the *internal* or *lesser trochanter* gives attachment to the psoas and iliacus. A line drawn through the axis of the head and neck forms with a vertical line drawn through the shaft an angle of 30°; in a woman this angle is a little less obtuse, and the obliquity of the shaft of the femur is slightly greater. The shaft is almost cylindrical about its centre, but expanded above and below; its front and sides give origin to the extensor muscles of the leg; behind there is a rough ridge, which gives attachment to several muscles. The lower end of the bone presents a large smooth articular surface for the knee-joint, the anterior portion of which forms a *trochlea* or pulley for the movements of the patella, whilst the lower and posterior part is subdivided into two convex *condyles* by a deep fossa which gives attachment to the crucial ligaments of the knee.

The *femur* constitutes usually about 0·275 of the individual stature; but this proportion is not constant, as this bone forms a

larger element in the stature of a tall than of a short man. The human femur presents also a concave popliteal surface, thus differing from that of Pithecanthropus, whose popliteal surface is convex. In the bones of some races the dorsal ridge of the thighbone (linea aspera) projects as a prominent crest causing the bones to appear "pilastered." Pilastering, though characteristic of lower and primitive races of man, is never found in the anthropoids.

Patella.—The patella or knee-cap (fig. 16) is a triangular flattened bone developed in the tendon of the great extensor muscles of the leg. Its anterior surface and sides are rough, for the attachment of the fibres of that tendon; its posterior surface is smooth, and enters into the formation of the knee-joint.

Between the two bones of the leg there are no movements of pronation and supination as between the two bones of the forearm. The tibia and fibula are fixed in position; the fibula is always external, the tibia internal.

Tibia.—The tibia or shin-bone (fig. 16) is the larger of the two bones of the leg; the femur moves and rests upon its upper end, and down it the weight of the body in the erect position is transmitted to the foot. Except the femur, it is the longest bone of the skeleton, and consists of a shaft and two extremities. The upper extremity is broad, and is expanded into two *tuberosities,* the external of which has a small articular facet inferiorly, for the head of the fibula; superiorly, the tuberosities have two smooth surfaces, for articulation with the condyles of the femur; they are separated by an intermediate rough surface, from which a short *spine* (really a series of elevations) projects, which gives attachments to the interarticular crucial ligaments and semilunar cartilages of the knee, and lies opposite the intercondylar fossa of the femur. The shaft of the bone is three-sided; its inner surface is subcutaneous, and forms the shin; its outer and posterior surfaces are for the origin of muscles; the anterior border forms the sharp ridge of the shin, and terminates superiorly in a tubercle for the insertion of the extensor tendon of the leg; the outer border of the bone gives attachment to the interosseous membrane of the leg. The lower end of the bone, smaller than the upper, is prolonged into a broad process, *internal malleolus,* which forms the inner prominence of the ankle: its under surface is smooth for articulation with the astragalus; externally it articulates with the lower end of the fibula.

The tibia in most civilized races is triangular in the section of its shaft, but in many savage and prehistoric races it is two-edged. The foetal tibia has its head slightly bent backward with regard to the shaft, a condition which usually disappears in the adult, but is shown in the prehistoric tibiae found in the cave of Spy. In races that squat on their heels the front margin of the lower end of the tibia is marked by a small articular facet for the neck of the astragalus.

Fibula.—The fibula, or splint-bone of the leg (fig. 16), is a slender long bone with a shaft and two extremities. The upper end or *head* articulates with the outer tuberosity of the tibia. The shaft is four-sided and roughened for the origins of the muscles. Separating the anterior from the internal surface is a slender ridge for the attachment of the interosseous membrane. The lower end has a strong process (*external malleolus*) projecting downward to form the outer prominence of the ankle, and a smooth inner surface for articulation with the astragalus, above which is a rough surface for the attachment of ligaments which bind together the tibia and fibula.

Foot.—The foot consists of the tarsus, the metatarsus and the five free digits or toes. The human foot is placed in the prone position, with the dorsum or back of the foot directed upward; the axis of the foot at about a right angle to the axis of the leg; and the great toe or hallux, which is the corresponding digit to the thumb, at the inner border of the foot. The human foot, therefore, is a pentadactylous, plantigrade foot.

The bones of the tarsus or ankle (fig. 16) are seven in number, and are arranged in three transverse rows—a proximal, consisting of the astragalus and os calcis, a middle, of the scaphoid and a distal, consisting of the cuboid, ecto-, meso- and ento-cuneiform. The tarsal, like the carpal bones, are short and, with the exception of the cuneiforms which are wedge-shaped, irregularly cuboidal; the dorsal and plantar surfaces are as a rule rough for ligaments, but as the astragalus is locked in between the bones of the leg and the os calcis, its dorsal and plantar surfaces, as well as the dorsum of the os calcis, are smooth for articulation; similarly, its lateral surfaces are smooth for articulation with the two malleoli. The posterior surface of the os calcis projects backward to form the prominence of the heel. With this exception, the bones have their anterior and posterior surfaces smooth for articulation. Their lateral surfaces are also articular, except the outer surface of the os calcis and cuboid, which form the outer border; and the inner surface of the os calcis, scaphoid and the ento-cuneiform, which form the inner border of the tarsus. Supernumerary bones are occasionally found as in the hand.

The metatarsal bones and the phalanges of the toes agree in number and general form with the metacarpal bones and the phalanges in the hand. The bones of the great toe or hallux are more massive than those of the other digits, and this digit, unlike the thumb or pollex, does not diverge from the other digits, but lies almost parallel to them.

Embryology.—The development of the appendicular skeleton takes place in the core of mesenchyme in the centre of each limb. By mesenchyme is meant that part of the mesoderm, or middle layer of the embryo, in which the cells are irregularly scattered in a matrix, and are not arranged in definite rows or sheets as in the coelomic membrane. This substance first becomes changed into cartilage, except perhaps in the case of the clavicle.

The factors which determine the general shape and proportionate size of each limb bone are at work while the cartilage is being formed, because each future bone has a good cartilaginous model laid down before ossification begins. Calcification usually begins at one point in each bone, unless that bone be a compound one formed by the fusion of two or more elements which were distinct in lower vertebrate types, as is the case with the os innominatum.

Calcification, once established, acts as an attraction for blood-vessels, which probably bring with them osteoblasts, and the subsequent ossification is a process which needs and receives a plenteous supply of nourishment. After a long bone has reached a certain size it very often has extra centres of ossification (epiphyses) developed at its ends as well as at places where important muscles have raised lever-like knobs of cartilage on the model.

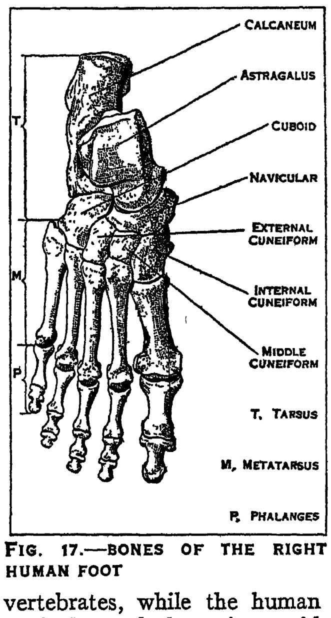


FIG. 17.—BONES OF THE RIGHT HUMAN FOOT

Turning now to the development of the individual bones of the axial skeleton, the clavicle is partly fibrous, and partly cartilaginous; its primary centre is the earliest of all in the body to appear, while its sternal epiphysis does not come till the bone is fully grown, and so can have no effect on the growth of the bone. It is probably atavistic, and is often regarded as the vestige of the precoracoid, though it may represent the inter-clavicle. It sometimes fails to appear at all.

The centres for the scapula are shown in the accompanying figures (fig. 19). G. B. Howes regarded the subcoracoid centre as the atavistic epiphysis representing the coracoid bone of lower vertebrates, while the human coracoid he looked upon as the equivalent of the epicoracoid. The epiphyses in the vertebral border are atavistic and represent the supra-scapular element (*see* section on *Comparative Anatomy*).

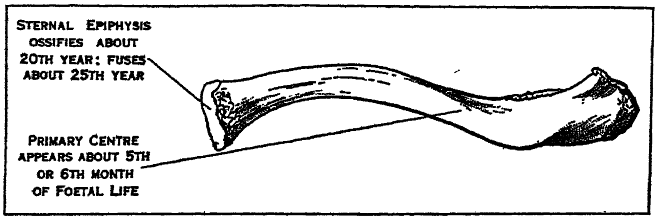
In the humerus the centre for the shaft appears about the eighth week of foetal life, which is the usual time for primary centres.

The ulna is a very interesting bone. The upper epiphysis shown

in fig. 21 does not encroach upon the articular surface, but is developed in the triceps tendon and is serially homologous with the patella in the lower limb.

In the radius there are two terminal epiphyses and one for the insertion of the biceps.

The carpus ossifies after birth, one centre for each bone occurring in the following order: os magnum, 11 to 12 months; unciform, 12 to 14 months; cuneiform, 3 years; semilunar, 5 to 6 years; trapezium, 6 years; scaphoid, 6 years; trapezoid, 6 to 7 years; pisiform, 10 to 12 years.



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

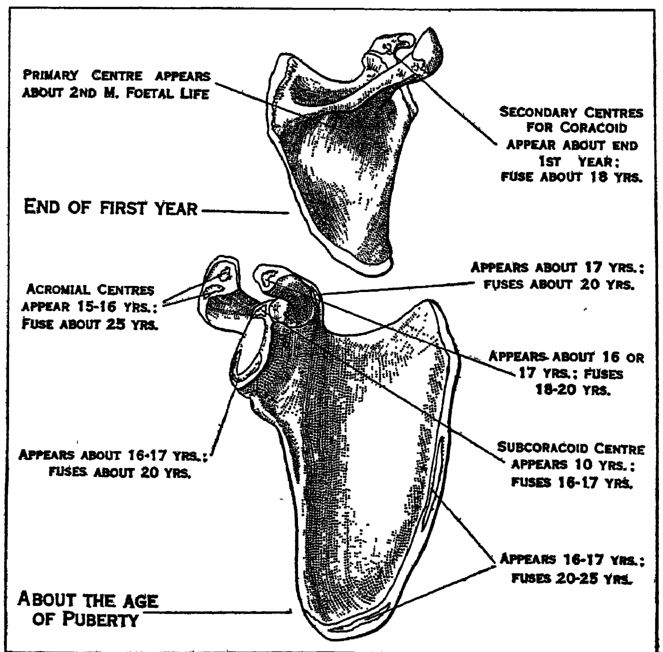
FIG. 18.—OSSIFICATION OF THE CLAVICLE

The metacarpal bones have one centre each for the shaft and one epiphysis for the head, except that for the thumb which has one centre for the shaft and one epiphysis for the proximal end.

The phalanges develop in the same way that the metacarpal bone of the thumb does.

The os innominatum has three primary centres for the ilium, ischium and pubis.

The special centres for the crest of the ilium are probably a serial repetition of those for the vertebral border of the scapula (*see* fig. 19). The centre for the pubic symphysis probably represents the epipubis of amphibians, while that for the tuberosity of the ischium is the hypoischium of reptiles (*see* subsection on comparative anatomy). The most anterior of the epiphyses in the acetabulum is the os acetabuli of lower mammals, while the occasional one for the spine of the pubis is often looked on as the vestige of the marsupial bone of monotremes and marsupials. It will thus be seen that many of the secondary centres of the os innominatum are atavistic.



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

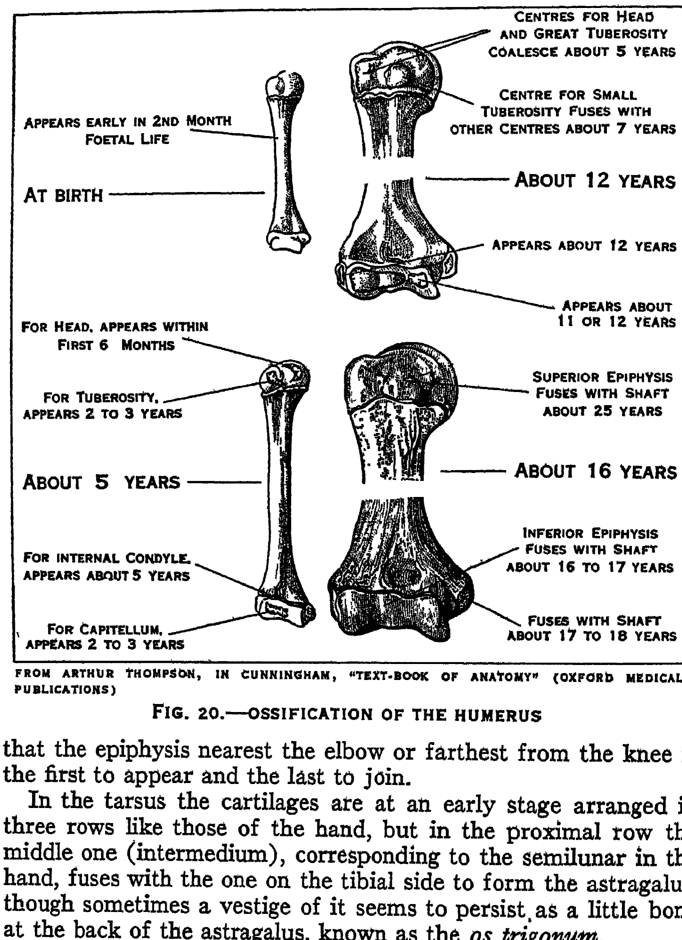
FIG. 19.—OSSIFICATION OF THE SCAPULA

The femur has epiphyses for the head, the lower end, the great and the small trochanters.

The cartilaginous patella does not appear until the third month of foetal life, that is well after the quadriceps extensor cruris, in the tendon of which it is formed, is defined. Its ossification begins in the third year. The patella is usually looked upon as the largest and most typical example of a sesamoid bone in the body.

The tibia has an epiphysis at either end, but that for the upper comes down in front so as to include a good deal of the tubercle. In almost any other mammal, and often in man himself, it may be seen that this down-growth is an epiphysis developed in the quadriceps tendon below the patella and joining the main upper epiphysis before uniting with the diaphysis or shaft.

The fibula has two epiphyses, the lower of which appears first. The general rule with the long bones of the extremities is that the epiphysis nearest the elbow or farthest from the knee is the first to appear and the last to join.



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 20.—OSSIFICATION OF THE HUMERUS

In the tarsus the cartilages are at an early stage arranged in three rows like those of the hand, but in the proximal row the middle one (intermedium), corresponding to the semilunar in the hand, fuses with the one on the tibial side to form the astragalus, though sometimes a vestige of it seems to persist as a little bone at the back of the astragalus, known as the *os trigonum*.

The centre for the calcaneum appears in the sixth month of foetal life, that for the astragalus in the seventh, the cuboid about birth, the external, middle and internal cuneiforms in the first and second years, while the navicular is the last to appear in the third year.

The calcaneum has an epiphysis developed in the insertion of the tendo Achillis behind.

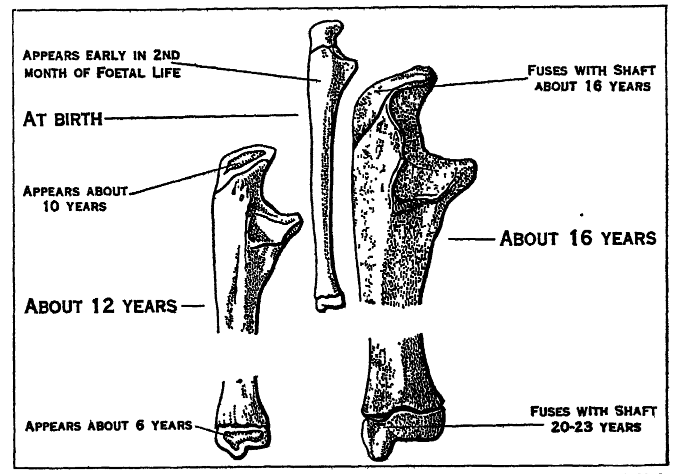
The development of the metatarsal bones and phalanges of the foot is the same as that of the hand.

For further details and literature *see* J. P. M'Murrich's *Development of the Human Body* (London, 1923) and D. J. Cunningham's *Text-Book of Anatomy*.

Comparative Anatomy.—It is only when the class of pisces is reached that paired appendages are found, and there are two main theories to account for their first occurrence. The one which is at present most favoured is that in some ancestral fishes two folds ran along the ventro-lateral part of the body, like the bilge keels of a boat, and that these joined one another in the mid-ventral line behind the cloacal orifice to form the median caudal fin. Into these folds the segments of the body, including myotomes and myocommata, extended. Later on parts of these ridges were suppressed, but in the pectoral and pelvic regions they were retained to form the paired fins. This theory is supported by the fact that in some elasmobranch embryos the whole length of

the folds can be traced. The second theory is that the limbs are elaborated gills. It is probable that the limb girdles are of later evolution than the skeleton of the fins themselves.

In the elasmobranch fishes (sharks and rays) there is a crescentic bar of cartilage (*pectoral girdle*), concave upward, which girdles the ventral and lateral parts of the body; it is divided into a dorsal part (scapula) and a ventral part (precoracoid and coracoid) by a facet for the articulation of the fin. This of course is the glenoid cavity. In some forms, *e.g.*, the shark Heptanchus, there is a perforation in the ventral part of the bar on each side, which possibly indicates the division between the precoracoid and coracoid elements.



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 21.—OSSIFICATION OF THE ULNA

In many of the bony fish (Teleostei) the outline is obscured by a series of bones which connect the girdle with the skull and may be the precursors of the clavicle.

In the Amphibia the dorsally-placed scapula (fig. 27, S) has more dorsally still a cartilaginous plate, the supra-scapula (fig. 27, S.S), which may be calcified. The precoracoid (fig. 27, P.C) and coracoid (C) are quite distinct, the former being in front (cephalad) and overlaid by a dermal bone, the clavicle (Cl). Uniting the ventral ends of the precoracoid and coracoid is the epicoracoid on each side (fig. 27, E.C).

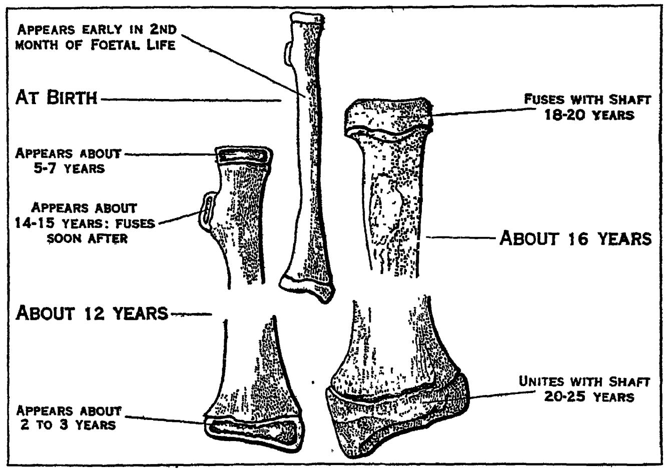
In the Reptilia the same general plan is evident, but in the lizards the ventral ends of the two clavicles are united by a median dagger-like dermal bone, the *interclavicle* (fig. 27, I.C), which lies on a plane superficial to the sternum and epicoracoids.

In birds the scapula has the shape of a sabre blade, and there is a rudimentary acromion process, though this is also indicated in some reptiles. The pre- and epi-coracoids are aborted, but the coracoids are very strong. The clavicles and interclavicle unite into a V-shaped bar which forms the furcula or "merrythought."

In the Mammalia the Monotremata (Ornithorhynchus and Echidna) retain the reptilian arrangement of large coracoids and epicoracoids articulating with the sternum, while the clavicles and interclavicle are also largely developed; the scapula too is more bird-like in shape than mammalian. In the higher mammals the scapula develops a spine and usually an acromial process, and has a triangular outline. As long as the forelimb is used for support, the vertebral border is the shortest of the three, and the long axis of the bone runs from this border to the glenoid cavity; but when the extremity is used for prehension, as in the Primates, or for flight, as in the Chiroptera, the vertebral border elongates and the distance from it to the glenoid cavity decreases so that the long axis is now parallel with that of the body instead of being transverse.

Above the monotremes too the coracoid becomes a mere knob for muscles, and no longer articulates with the sternum. There is thus a sudden transition from the way in which the forepart of the body is propped up on the forelimbs when the coracoid is functional (as in reptiles) to the way in which it is suspended like a suspension bridge between the two scapulae in pronograde mammals, the serratus magnus muscles forming the chains of the bridge (*see* fig. 28).

The clavicle is often entirely suppressed in mammals; this is the case in most of the Ursidae, all the Pinnipedia, Manis among edentates, the Cetacea, Sirenia, all Ungulata and some of the Rodentia. It is complete in all the Primates, Chiroptera, Insectivora (except Potamogale), many of the Rodentia, most Edentata, and all the Marsupialia except Perameles. In the Monotremata it is fused with a well-developed interclavicle, but in other mammals the interclavicle is either suppressed or possibly represented by the sternal epiphysis of the clavicle of the Primates. The pre-coracoid as a distinct structure entirely disappears, though vestiges of it may remain in the cartilaginous parts of the clavicle.

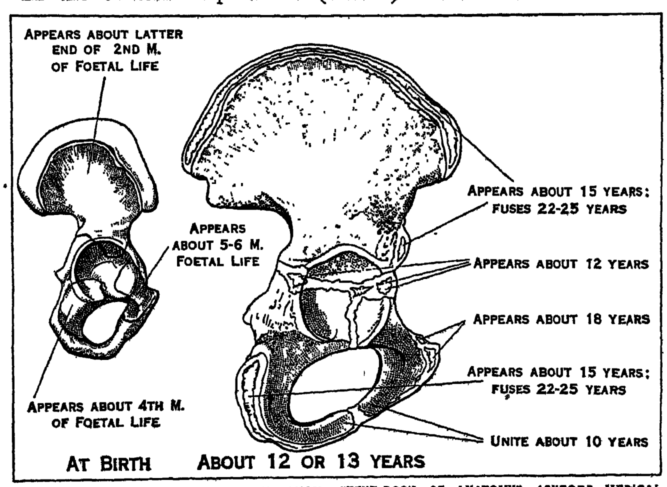


FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 22.—OSSIFICATION OF THE RADIUS

The chief modifications of the *humerus* are the development of the *pectoral ridge*, which is large whenever the pectoral muscles are strong, and is represented in man by the outer lip of the bicipital groove and the *supracondylar foramina*. Epiphyses are found in this, as in other long bones, in amphibians, reptiles and mammals, but not in birds.

In the tailless amphibians (Anura) the *radius* and *ulna* are fused, while in the Urodela and reptiles they are always distinct. In some lizards (Iguana, Sphenodon, etc.) the olecranon epiphysis remains a distinct sesamoid bone just as the patella does, and this is also the case in some bats. In the pronograde mammals the radius is in a position of permanent pronation, and is a much more important bone than the ulna, which is sometimes suppressed, so that little more than the olecranon process remains (*e.g.*, horse, giraffe). In the lower Primates the ulna articulates directly with the cuneiform and (sometimes) pisiform bones, and is not shut off

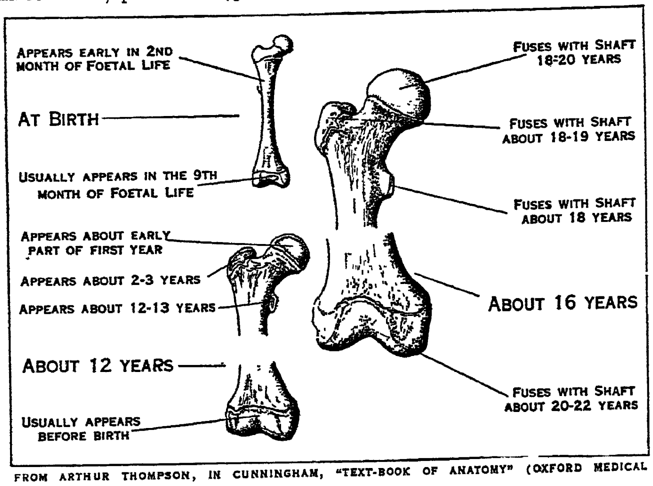


FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 23.—OSSIFICATION OF THE INNOMINATE BONE

from the carpus by a meniscus as in man.

The *carpus* of the higher vertebrates may be reduced from a generalized type by the fusion or suppression of certain of its elements. A perfect generalized type (*see* fig. 29) is not known to exist in any vertebrate. In such a type the bones are arranged in three rows; proximal (5 bones), middle (2 bones), and distal (5



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 24.—OSSIFICATION OF FEMUR

bones). The primitive reptile sphenodon has all these bones except the radiale marginale.

In many of the urodele amphibians, *e.g.*, the salamander and newt (Molge), the carpus is very generalized; in the tailless forms (Anura), however, it is more specialized. When only four distalia are present it is doubtful whether the fifth is suppressed, or has fused with the fourth.

In the Reptilia the carpus is often very generalized, as in Sphenodon and Chelydra (*see* fig. 30).

In the birds the radiale and ulnare are distinct, but the distal bones are fused with the metacarpus to form a *carpo-metacarpus*. In Mammalia various examples of fusion and suppression occur. In man the radiale, radiale marginale, and centrale radiale fuse to form the scaphoid; the semilunar is the intermedium; the cuneiform the ulnare; and the pisiform the ulnare marginale. The trapezium and trapezoid are distalia I. and II.; the os magnum distale III. fused with the centrale ulnare; while distalia IV. and V. have either fused to form the unciform, or, as some believe, distale V. has been suppressed.

In some mammals the radiale marginale is very large, *e.g.*, mole and elephant, and is regarded as a stage in the evolution of a digit on the radial side of the pollex, hence named the *prepollex*. In the Cape jumping hare (*Pedetes*) this digit is two-jointed and bears a rudimentary nail. Feebler indications of another digit on the ulnar side of the carpus, called the *post-minimus*, are sometimes seen in relation with the pisiform, which is therefore no longer regarded as a sesamoid bone, but, with the radiale marginale, as a stage in the progress from a pentadactylous to a heptadactylous manus. The centrale radiale and radiale marginale persist as distinct bones throughout life in many monkeys.

In the suppression of digits in vertebrates a regular sequence occurs; the pollex is the first to go, then the minimus, index and annularis one after another, so that an animal like the horse, which has only one digit, has lost all except the medius.

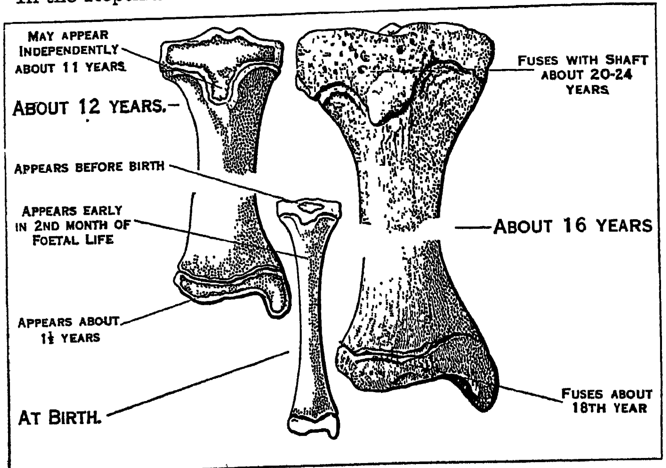
In the mammals the number of the phalanges usually corresponds with that of man, though in the lower vertebrates they are often much more numerous. When the extremity is modified to form a paddle, as in Ichthyosaurus and the Cetacea, the phalanges are often greatly increased in number.

In the elasmobranch fishes the *pelvic girdle* is a repetition of the pectoral though it is not quite so well marked. The acetabulum corresponds to the glenoid cavity, and the part of the girdle dorsal to this is the ilium; the ventral part, uniting with its fellow in the mid-line, is the ischio-pubis, the two elements of which are sometimes separated by a small foramen for the passage of a nerve. When this is the case the anterior (cephalic) part is the pubis, and is in series with the precoracoid, while the ischium (caudad) repeats the coracoid.

In Amphibia the connection between the ilium and sacrum becomes established, and some of the extinct Labyrinthodontia have separate pubic and ischial symphyses, though in existing forms the ischium and pubis are generally fused.

In the Urodela there is usually a bifid cartilage just in front (cephalad) of the pubes, in the mid-line, which is called the *epipubis*.

In the Reptilia the ilium always projects backward towards the

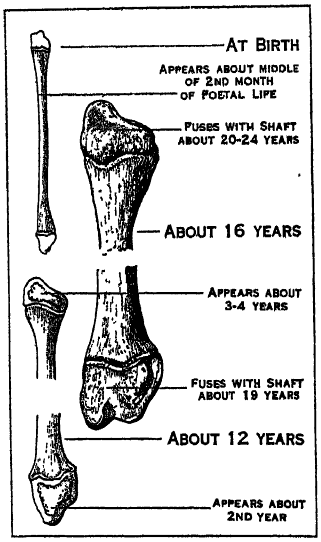


FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 25.—OSSIFICATION OF THE TIBIA

tail; the ischia usually meet in a ventral ischial symphysis, from which a cartilage or bone projects backward to support the anterior lip of the cloacal orifice; this is the *hypoischium*, a structure which is traceable throughout the Vertebrata to man (*see* fig. 31).

The hypoischium and epipubis are parts of a cartilaginous pelvic sternum, the former representing the xiphisternum and the latter the episternum of the shoulder girdle (*see* F. G. Parsons, "Epiphyses of the Pelvis," *J. Anat. and Phys.*, vol. xxxvii., p. 315).



FROM ARTHUR THOMPSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 26.—OSSIFICATION OF FIBULA

In birds the ilium extends forward and backward, and is fused with the vertebral column. The ischia and pubes do not form a symphysis except in the struthious birds (ostrich and rhea). The acetabulum is always perforate.

In mammals the ilium projects forward toward the head, and an ischio-pubic symphysis is common, though sometimes it is only pubic as in man. In Echidna among the monotremes the acetabulum is perforate as in birds. In the monotremes and marsupials part of the external oblique muscle is ossified to form the *marsupial bones;* these are sometimes regarded as part of the epipubis, though it is more probable that they are merely adaptive strengthenings of the external oblique to support the traction of the pouch. A *cotyloid bone* (*os acetabuli*) is usually present, at all events in early life, and it often shuts out the pubis from taking any part in the formation of the acetabulum.

The *femur* is comparatively a very stable bone. Sometimes, especially in the odd-toed ungulates (Perissodactyla), the gluteal ridge forms a large third trochanter, while in most mammals, though not in ungulates, there are two sesamoid bones, called fabellae, developed in the gastrocnemius just above the condyles.

The *patella* first appears in the reptiles, though it is not present in all of them. Most of the Lacertilia show it as a small sesamoid structure in the quadriceps extensor tendon. It is present in all birds and mammals, with the exception of some bats. In most marsupials it remains cartilaginous throughout life.

The *tibia* and *fibula* fuse in the Anura and also in some mammals (*e.g.*, rodents). The fibula is often nearly or quite suppressed in birds and mammals, while in birds the tibia fuses with the proximal row of tarsal bones, so that the ankle joint is obliterated and a tibio-tarsus formed. In the marsupials the upper end of the fibula is large and may articulate with the femur in certain positions of the knee, but, as a whole, it reaches its maximum development in the Carnivora in the aquatic suborder of which (Pinnipedia) it is as large as the tibia. It is curious that the only epiphysis which occurs in the long bones of birds is in the head of the tibia of the Gallinaceae.

In the *tarsus* the bones are arranged on the same generalized plan as in the carpus, but the middle row as far as we know only contains one *centrale.*

It is more difficult to trace the fate of these structures in existing vertebrates than it is with the carpal bones. In man the astragalus probably contains the tibiale, tibiale marginale and intermedium. The fibulare and fibulare marginale probably form the calcaneum, though it is unlikely that the epiphysis at the back of that bone represents any integral part of a generalized tarsus. The centrale persists as the navicular, while the three cuneiform represent tarsalia I., II. and III. and the cuboid tarsalia IV. and V., unless V. is suppressed as some believe. Vestiges of a *prehallux* are found in the Cape jumping hare and other rodents, though they are usually more closely connected with the navicular and internal cuneiform than with the bones of the proximal row. The large size of the hallux in man is an adaptation to the erect position.

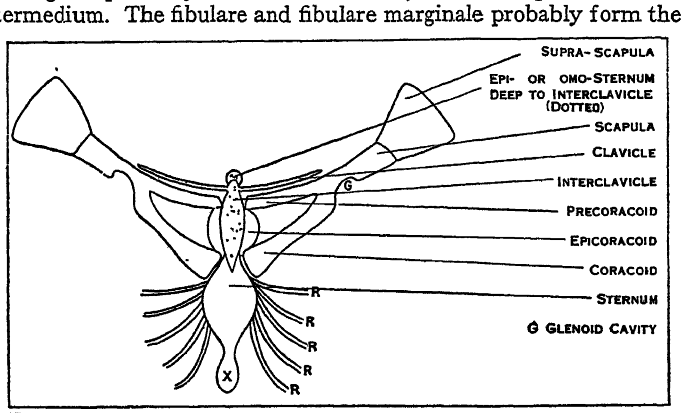


FIG. 27.—DIAGRAM OF A GENERALISED FORM OF SHOULDER GIRDLE

Most of the remarks already made about the metacarpals and phalanges of the hand apply equally to the foot, though there is a greater tendency to reduction of digits in the hind limb than in the fore.

For further details and literature *see* S. H. Reynolds, *The Vertebrate Skeleton* (Cambridge, 1897); W. Flower and H. Gadow, *Osteology of the Mammalia* (London, 1885); R. Wiedersheim, *Comparative Anatomy of Vertebrates,* adapted by W. N. Parker (London, 1907); C. Gegenbaur, *Vergleich Anat. der Wirbeltiere* (Bd. i.) (Leipzig, 1901).

VISCERAL SKELETON

In the lower vertebrates as well as in the embryo of man, a number of cartilaginous or bony arches encircle the mouth and pharynx (anterior part of the food tube), just as hoops encircle a barrel. There is little doubt that, when they first appeared in the history of evolution, all these bars supported gills and bounded gill slits, but in all existing types the first arch has been modified to surround the mouth and to act as both upper and lower jaws, gaining in different animals a more or less complete connection with the cranium or brain-containing part of the skull. The first of these visceral arches, therefore, is known as the oral or jaw arch and, as has been shown, the muscles in connection with it are supplied by the fifth nerve (*see* MUSCULAR SYSTEM; and NERVE: *Cranial*). The second visceral arch is the hyoid and is accompanied by the seventh or facial nerve. The third visceral or first branchial arch of most writers has the ninth or glossopharyngeal for its nerve supply, while the arches behind this are supplied by the vagus or tenth nerve.

In man the maxilla, palate, internal pterygoid plate, malar and tympanic bones as well as the ear ossicles, mandible, hyoid bone and thyroid cartilage are developed in connection with this visceral skeleton. Of these the ear ossicles are described in the article EAR, the thyroid cartilage in that on the RESPIRATORY SYSTEM, while the other bones, with the exception of the hyoid, are treated under SKULL. It therefore only remains to describe here the hyoid bone of man.

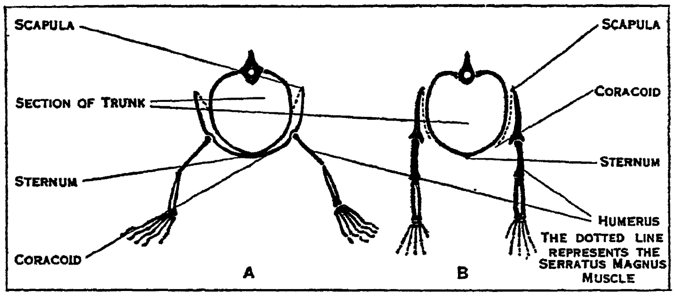


FIG. 28.—TYPES OF SHOULDER GIRDLE, DIAGRAM SHOWING CHANGE OF MECHANISM IN SUPPORTING THE THORAX IN (A) THE REPTILIAN, AND (B) THE MAMMALIAN

Hyoid Bone.—The hyoid bone lies in the upper part of the neck in close connection with the root of the tongue and just above the thyroid cartilage. It consists of a body across the mid-ventral line and a great and small cornu on each side (*see* fig. 32).

The *body* (*basihyal*) is rectangular with its long axis horizontal; behind it is concave from above downward and from side to side. In front it attaches several muscles, but behind it is smooth and is separated from the thyrohyoid membrane by a bursa. From its upper border this membrane runs downward to the thyroid cartilage. The *great cornua* (*thyrohyals*) are attached to each side of the body by cartilage until middle life and afterwards by bony union. They curve upward and backward round the side of the pharynx and are laterally compressed. To their inner surfaces the thyrohyoid membrane is attached, while their knob-like ends are connected with the superior cornua of the thyroid cartilage by the lateral thyrohyoid ligaments.

The *small cornua* (*ceratohyals*) are about a quarter of an inch long. It is only in late life that they become united with the body by bony union, if they ever do so. At their apices they are connected with the tips of the styloid processes by the long stylohyoid ligaments (epihyals).

Embryology.—In the early embryo (*see* MOUTH and SALIVARY GLANDS) the mandibular processes grow forward on each side of the slit-like stomatodaeum or primitive mouth, and at length join one another in the mid-ventral line. From the proximal part of each of these another process, the maxillary, grows forward (ventrad), only more slowly, to blend with the fronto-nasal process. In each of these processes cartilage is formed in the lower vertebrates, which in the case of the mandible (lower jaw) reaches to the mid-ventral line and forms what is known as Meckel's cartilage; but in the maxillary process the stage of chondrification is suppressed in man and other mammals, and the palato-quadrate cartilaginous bar which is so evident in embryo fishes and amphibians is not formed. Thus both the maxillary and the mandibular bars are derivatives of the first visceral arch. In the maxillary process a membrane bone is formed which blends with the sphenoid to form the internal pterygoid plate, while in front (ventrad) of this the upper jaw (maxilla) is developed in membrane by several centres. Of these, one, or perhaps two, form the premaxilla, each of the latter contributing a socket for one of the two incisor teeth. When these premaxillary sutures fail to unite, the deformity known as "cleft

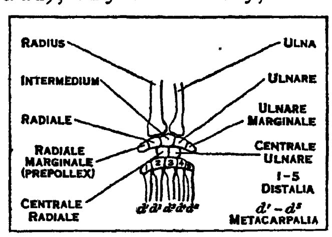
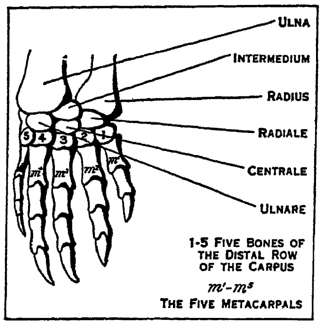


FIG. 29.—DIAGRAM OF A GENERALISED CARPUS

palate" is produced and this may occur either between the lateral incisor and the canine or between the central and lateral incisor teeth.

The *mandibular* or *Meckel's cartilage* is continued up into the tympanum where it joins the proximal end of the cartilage of the second or hyoid arch, and it is from this junction (hyomandibular plate) that, according to H. Gadow, *Anat. Anzeiger,* Bd. 19, p. 396, the malleus and incus bones of the middle ear are developed (*see* EAR). Between the slender process of the malleus and the region of the inferior dental foramen, the cartilage later on disappears and its fibrous sheath forms the *long internal lateral* or *sphenomandibular ligament* (*see* fig. 33, L.I.L.).



FROM GEGENBAUR, "VERGLEICHENDE ANATOMIE DER WIRBELTIERE" (ENGELMANN)

FIG. 30.—DORSAL SURFACE OF RIGHT MANUS OF WATER TORTOISE (CHELYDRA SERPENTINA)

Each half of the lower jaw was long considered to be composed of several distinct skeletal elements, homologous with the elements found in the jaws of lower vertebrates, but it seems evident that in man the process of ossification is slurred over although some of the original elements of the lower vertebrates are repeated as temporary cartilaginous masses, *e.g.,* coronary, condylar and angular. (*See* A. Lowe, "Development of Lower Jaw in Man," *Proc. Anat. Soc.* of the University of Aberdeen, 1905, p. 59.)

At birth the two halves of the mandible are separate as they are throughout life in many mammals (*e.g.,* rodents), but in man they join together about the end of the first year.

It has been stated that within the tympanum the dorsal or proximal ends of the first and second visceral arches unite to form the hyomandibular plate from which the *malleus* and *incus* are derived. The *stapes* is also probably formed from the proximal end of the second or hyoid arch (*see* fig. 33, St.), and just ventral to this the cartilage of the arch fuses with that of the periotic capsule, where it is later on ossified as the *tympanohyal* element of the temporal bone (fig. 33, T.H.). From this point the cartilage becomes free from the skull and runs round the pharynx until it meets its fellow of the opposite side in the mid-ventral line. That part of the cartilage which is nearest the skull remains as the *stylohyal* element (fig. 33, S.H.) and this later on ossifies to form the *styloid process* which fuses with the tympanohyal between twenty and twenty-five. For some distance beyond the stylohyal element the cartilage degenerates into fibrous tissue forming the *stylohyoid ligament;* this represents the *epihyal* element, and occasionally instead of degenerating it ossifies to form an abnormal bone (fig. 33, E.H.). Near the middle line the cartilage persists as the *ceratohyal* element or *lesser cornu of the hyoid bone* (fig. 33, C.H.), while the most ventral part, where it fuses with its fellow of the opposite side as well as with the ventral part of the third arch, is the *basihyal* or *body of the hyoid bone* (fig. 33, B.H.).

The dorsal part of the cartilage of the third arch is wanting, but the lateral part forms the *thyrohyal* or *great cornu of the hyoid bone* (fig. 33, Th.H.), while its ventral part fuses with its fellow of the opposite side as well as with the ventral part of the second arch to form the body of the hyoid bone. The fourth and fifth arches only develop cartilage in their ventro-lateral parts and fuse to form the thyroid cartilage of the larynx (fig. 33, Th.C.) (*see* RESPIRATORY SYSTEM).

Comparative Anatomy.—In the Amphioxus the pharynx is stiffened by chitinous bars which lie between the gill slits, but it is unlikely that these are really homologous with the visceral skeleton of higher forms, though, in serving the same purpose, they are certainly analogous.

Among the Cyclostomata (hags and lampreys) there is an arrangement known as the "branchial basket," which has a more superficial position than the visceral arches of fish and probably corresponds to the extra-branchials of those vertebrates. The oral and hyoid arches are very rudimentary and probably have degenerated in consequence of the suctorial mode of nourishment. In the Elasmobranchii (sharks and rays) the visceral skeleton is entirely cartilaginous. In the more primitive types such as the comb-toothed shark (Notidanus) the oral and hyoid arches are quite distinct. The oral arch consists of the upper jaw, or *palatoquadrate cartilage,* and the lower jaw, or *Meckel's cartilage;* these articulate with one another posteriorly and also with the skull. Behind these and distinct from them is the hyoid arch. Such a type of *suspensorium* or jaw articulation is called *autostylic.* In the rays, on the other hand, the oral arch is connected with the skull by the proximal segment of the hyoid arch, which, since it connects both the hyoid and mandibular (oral) arches with the skull, is called the hyomandibular cartilage. This type of suspensorium is termed *hyostylic.*

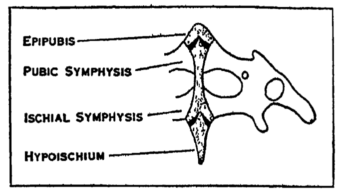
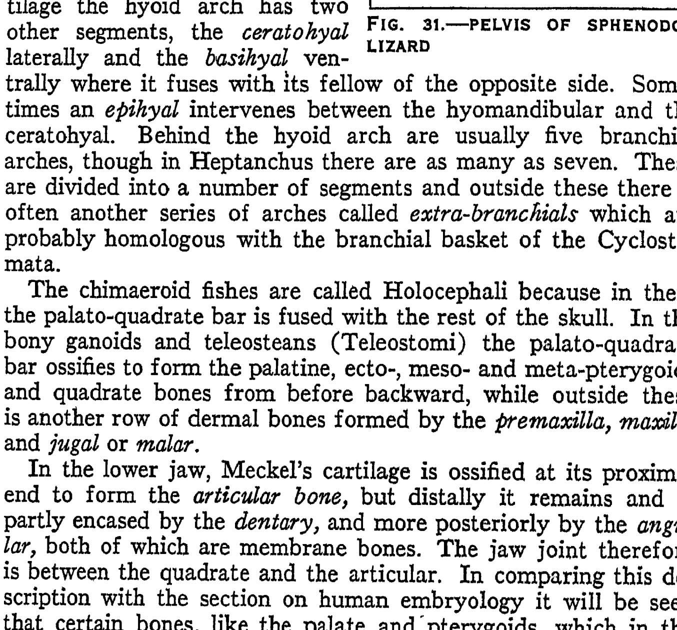


FIG. 31.—PELVIS OF SPHENODON LIZARD

Below the hyomandibular cartilage the hyoid arch has two other segments, the *ceratohyal* laterally and the *basihyal* ventrally where it fuses with its fellow of the opposite side. Sometimes an *epihyal* intervenes between the hyomandibular and the ceratohyal. Behind the hyoid arch are usually five branchial arches, though in Heptanchus there are as many as seven. These are divided into a number of segments and outside these there is often another series of arches called *extra-branchials* which are probably homologous with the branchial basket of the Cyclostomata.

The chimaeroid fishes are called Holocephali because in them the palato-quadrate bar is fused with the rest of the skull. In the bony ganoids and teleosteans (Teleostomi) the palato-quadrate bar ossifies to form the palatine, ecto-, meso- and meta-pterygoids and quadrate bones from before backward, while outside these is another row of dermal bones formed by the *premaxilla, maxilla* and *jugal* or *malar.*

In the lower jaw, Meckel's cartilage is ossified at its proximal end to form the *articular bone,* but distally it remains and is partly encased by the *dentary,* and more posteriorly by the *angular,* both of which are membrane bones. The jaw joint therefore is between the quadrate and the articular. In comparing this description with the section on human embryology it will be seen that certain bones, like the palate and pterygoids, which in the fish are ossifications in cartilage, become in the higher vertebrates



FROM GRAY, "ANATOMY" (LONGMANS GREEN)

FIG. 32.—HYOID BONE, ANTERIOR SURFACE (ENLARGED)

membrane bones, and so it is clear that too great stress must not be laid on the histological history of a bone in determining its morphological significance.

The branchial arches of the Teleostomi closely resemble those of the Elasmobranchii except that they are ossified and that the extra-branchials have disappeared.

In the Dipnoi (mudfish) the suspensorium is autostylic, and either five or six branchial arches are present. In the Amphibia, too, the suspensorium is autostylic, the palato-quadrate bar remains largely cartilaginous, though its posterior part is often ossified to form the quadrate. The membranous *premaxilla, maxilla, palatine, pterygoid, quadratojugal* and *squamosal* bones are

developed in connection with it, though it is interesting to notice that the pterygoid is sometimes partly cartilaginous and the quadrato-jugal is absent in the tailed forms (Urodela). In the lower jaw a *splenial* element has appeared, and in the frog a cartilaginous *mento-meckellian* bone develops close to the symphysis. In the larval stages there are rudiments of four branchial arches behind the hyoid, but in the adult these are reduced in the Anura and their ventral ends are united into a broad basilingual plate.

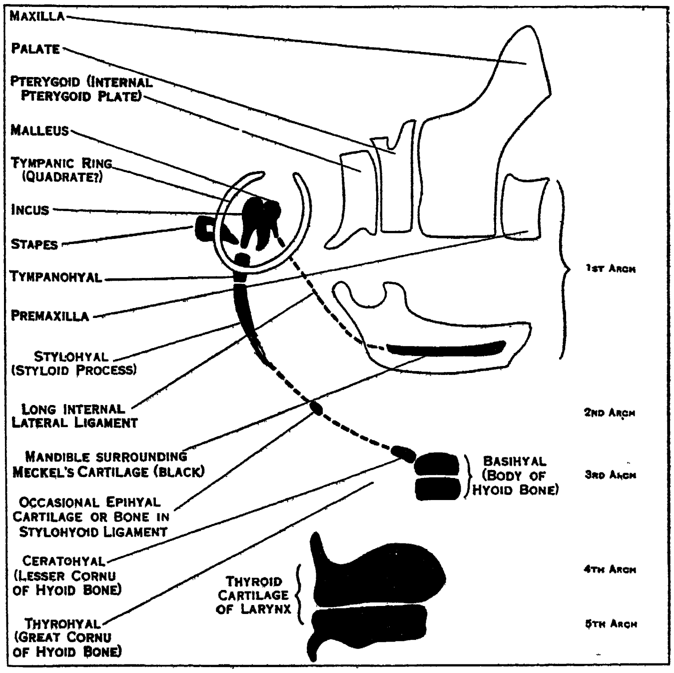


FIG. 33.—DIAGRAM SHOWING FATE OF VISCERAL ARCHES IN MAN AND (WITH MODIFICATIONS) IN OTHER MAMMALS
Membrane bones are white; cartilage and cartilage bones, black; and cartilage which has degenerated into ligaments is dotted

In the Reptilia the site of the palato-quadrate bar is surrounded by the same series of bones that are found in the Amphibia, but in lizards and chelonians a *para-quadrate* bone is found which, according to E. Gaupp, is the precursor of the tympanic ring of mammals. In the crocodiles the maxilla and palate grow inwards to meet one another and so form a hard palate. The mandible has *dentary, splenial, angular, surangular, articular* and *coronoid* ossifications and in some cases a *mento-meckellian* as well. The quadrate bone with which it still articulates is becoming included in the wall of the tympanic cavity, and, according to H. Gadow, it is this bone and not the para-quadrate which will become the tympanic of mammals. The hyoid arch is sometimes suppressed in snakes, but in Sphenodon its continuity with the *columella* or *stapes* can be demonstrated.

The branchial skeleton is reduced with the cessation of branchial respiration and only the ventral parts of two arches can be seen; these unite to form a plate with the hyoid (*basihyobranchial*) and with this the glottis is closely connected. In birds the morphology of the visceral skeleton is on the reptilian plan, and, although the modifications are numerous, they are not of special interest in elucidating the problems of human morphology.

In the Mammalia the *premaxilla, maxilla, palate* and *pterygoid* bones can be seen in connection with the region where the palato-quadrate cartilage lay in the lower Vertebrata (*see* fig. 34). The *premaxilla* bears the incisor teeth, and except in man the suture between it and the maxilla is evident on the face if a young enough animal be looked at. The *maxilla* bears the rest of the teeth and articulates laterally with the *jugal* or *malar,* which in its turn articulates posteriorly with the zygomatic process of the squamosal, so that a zygomatic arch, peculiar to mammals, is formed. Both the maxilla and palate form the hard palate as in crocodiles, but the pterygoid bone fuses with the sphenoid to form the internal pterygoid plate (*see* fig. 34, Pt.). The *mandible* no longer articulates with the *quadrate* but forms a new articulation, by means of the condyle, with the *glenoid cavity of the squamosal,* and many modern morphologists hold that the quadrate has become the *tympanic bone.* In many mammals (*e.g.,* Carnivora) this bone swells out to form the *bulla tympani.* The derivation of the auditory ossicles has been discussed in the section on embryology as well as in the article EAR. The presence of a chain of ossicles is peculiar to the Mammalia.

In many of the lower mammals (*e.g.,* Ungulata and Carnivora) the hyoid arch is much more completely ossified than it is in man, *tympano-, stylo-, epi-, cerato-* and *basihyal* elements all being bony (*see* fig. 34). It is of interest to notice that in the hares and rabbits the body of the hyoid has occasionally been found in two pieces, indicating its derivation from the second and third visceral arches. The fourth and fifth arches, which form the thyroid cartilage in mammals, are considered in the article RESPIRATORY SYSTEM.

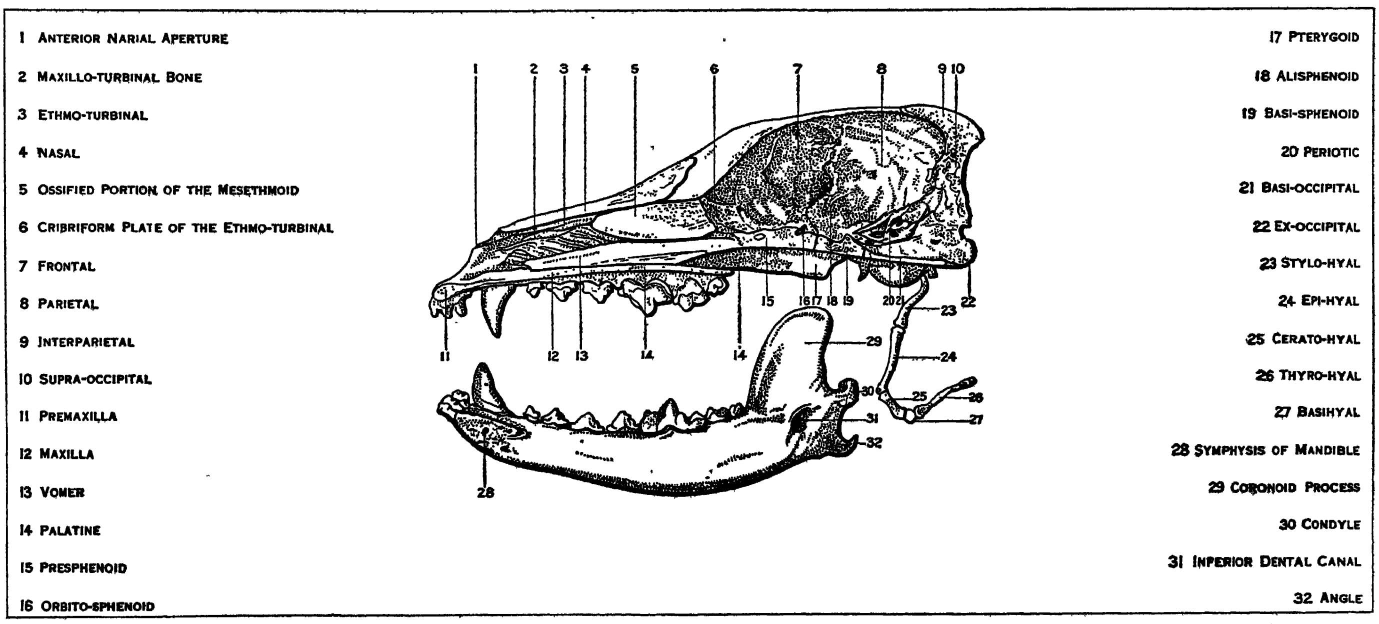


FIG. 34.—LONGITUDINAL AND VERTICAL SECTION OF THE SKULL OF A DOG (CANIS FAMILIARIS), WITH MANDIBLE AND HYOID ARCH

BIBLIOGRAPHY.—W. Flower, *Osteology of the Mammalia* (1885); S. H. Reynolds, *The Vertebrate Skeleton* (1897); R. Wiedersheim, *Comparative Anatomy of Vertebrates* (1907); A. F. Dixon, *Manual of*

Human Osteology (1912); G. Gegenbaur, *Vergleich Anat. der Wirbeltiere* (Leipzig 1901); K. Pearson and J. Bell, *A Study of the Long Bones of the English Skeleton* (1917); A. M. Buchanan, *Manual of Anatomy*, 4th ed. (1919); J. E. Frazer, *Anatomy of the Human Skeleton*, 2nd ed. (1920); J. S. Kingsley, *The Vertebrate Skeleton* (1925); *Cunningham's Manual of Practical Anatomy*, 3 vols., 8th ed. rev. A. Robinson (1927). (F. G. P.)

THE INVERTEBRATE SKELETON

The materials of the skeleton are very variable; it may, as in the case of the Vertebrate notochord, consist of living cells which have acquired rigidity by the accumulation of water under pressure in vacuoles and their cytoplasm, that is, by turgones. More usually it consists of non-living materials laid down by cells either within their cytoplasm or outside their surface membrane.

In the case of an exoskeleton, the process of skeleton formation begins with the formation on the outer surface of the animal of a thin layer, usually of an organic substance which forms a cuticle, a structure exactly similar theoretically to a cell wall, but forming a continuous sheet over an epithelium, and resulting from the activities of many cells. This cuticle may remain as a thin layer, serving to resist the mechanical wear to which the outer surface of all animals is subjected, added to only sufficiently to replace loss by abrasion. But in many cases the cuticle is so much thickened that it becomes inflexible, and gives a permanent form to the part of the animal which it surrounds. It may serve, even when thin, to cement a sedentary animal to its base. The cuticle usually consists of a substance which is a protein, though in Tunicates the test, which is, in effect, a much modified cuticle, is of tunicin, a cellulose. The scleroproteins which compose cuticles vary much in their nature, chitin, which is chemically, perhaps, as closely allied to cellulose as to the proteins, is the most widespread and important. The organic basis of the cuticle may serve as a matrix in which mineral salts may be laid down, so as to harden and still further stiffen the exoskeleton. These salts are usually mixtures of phosphates of calcium and magnesium, or calcium carbonate, in the crystalline form of arragonite or calcite. An exoskeleton of this kind is found in certain Protozoa, in Hydomedusae, Gorgonians, and Zoantharia amongst the Coelenterates, in Polyzoa, Brachiopoda, Mollusca, and reaches its highest development amongst the Arthropoda.

In Coelenterates, the exoskeleton forms a mere support to the animal, and is, except in certain Gorgonians, inflexible and continuous. In Brachiopoda and Mollusca, it forms a shell to which muscles are attached, so that movements of the animal with respect to the shell and of the different parts of the skeleton can be brought about. The shells of Brachiopods and Molluscs are often beautiful mechanical devices provided with interlocking teeth which ensure accurate closure, and presenting, in their shape and special structure, a very great strength for their weight.

The exoskeleton of the Arthropods is far more complex, although actually continuous, not only over the whole external surface, but into those anterior and posterior portions of the gut which are lined by ectoderm. It is functionally divided into a series of segments or somites consisting of a ring of hard chitin, often more or less calcified, which are connected together by areas of thinner and flexible chitin, so that they may move on one another. Each segment may bear a pair of appendages, each of which is covered by a chitinous cuticle divided into segments movable on one another, though, like those of the body, connected by flexible rings.

The individual sclerites, the hard areas of cuticle, may become hinged to one another by special processes, and are, in all cases, moved by muscles which lie inside them. In such cases as the claw of a lobster, special processes arising from the exoskeleton push their way into the body of the animal in order to give favourable points of attachment to muscles.

The existence of this exoskeleton, which cannot, when once made, increase in area, and whose existence is necessary for the functioning of the animal, renders continuous growth impossible, and has led to the strange process of ecdysis. After a certain period the cuticle cracks along definite lines and the animal crawls out of it, leaving behind the complete structure, retaining the whole of the external surface and even part of the lining of the gut. The animal so freed of restraint very rapidly enlarges and then a new cuticle is formed and hardens to form a new skeleton. Details of the structure of these skeletons must be sought in the separate articles.

An endoskeleton exists in Protozoa, sponges, some Alcyonaria, Brachiopoda, Echinodermata, Chordata and Cephalopod molluscs The protozoan endoskeleton may be protein in nature, or it may consist of calcium and magnesium carbonates, silica, or even in one case, of strontium sulphate. It is necessarily intracellular, being completely covered by the cytoplasm of the single cell of which the animal consists.

The sponge skeleton appears always to begin as a series of small rods of some organic material on which spicules of calcium carbonate or of silica are formed. These spicules, in some cases, at any rate, are formed within the bodies of cells, or of fused groups of cells. They arise as isolated structures, and may retain their independence throughout the life of the animal, or they may fuse to form more elaborate structures. Though usually small, they may become gigantic, several feet in length in the case of the anchoring spicules of the glass rope sponge and its allies.

In addition to the spicules, many sponges possess a skeleton of a protein substance, spongin, which extends throughout their substance but is usually regarded as an exoskeleton. The endoskeleton of the Alcyonaria consists of spicules which are of intracellular formation that may remain isolated or may be fused into such a substance as precious coral. The Echinoderm skeleton is of mesodermal origin, and is unique in that each of the elements of which it is composed consists of a single crystal of calcite. It is very highly developed in most forms, the individual elements articulating with one another, often by elaborate joints, and being movable by a highly-developed musculature. (D. M. S. W.)

SKELTON, JOHN (*c.* 1460–1529), English poet, is variously asserted to have belonged to a Cumberland family and to have been a native of Diss in Norfolk. He is said to have been educated at Oxford. He certainly studied at Cambridge, and he is probably the "one Scheklton" mentioned by William Cole (ms. *Athen. Cantabr.*) as taking his M.A. degree in 1484. In 1490 Caxton writes of him, in the preface to *The Boke of Eneydos compyled by Vyrgyle*, in terms which prove that he had already won a reputation as a scholar. "But I pray mayster John Skelton," he says, "late created poete laureate in the unyversite of Oxenforde, to oversee and correct this sayd book . . . for him I know for suffycyent to expowne and englysshe every dyffyculte that is therein. For he hath late translated the epystlys of Tulle, and the boke of dyodorus siculus, and diverse other works . . . in polysshed and ornate termes craftely . . . I suppose he hath drunken of Elycons well." The laureateship referred to was a degree in rhetoric. Skelton received in 1493 the same honour at Cambridge. Skelton found a patron in the pious and learned countess of Richmond, Henry VII.'s mother, for whom he wrote *Of Mannes Lyfe the Peregrynacioun*, a translation, now lost, of Guillaume de Deguilleville's *Pèlerinage de la vie humaine*. An elegy "Of the death of the noble prince Kynge Edwarde the forth," included in some of the editions of the *Mirror for Magistrates*, and another (1489) on the death of Henry Percy, fourth earl of Northumberland, are among his earliest poems. In the last decade of the century he was appointed tutor to Prince Henry (afterwards Henry VIII.). He wrote for his pupil a lost *Speculum principis*, and Erasmus, in dedicating an ode to the prince in 1500, speaks of Skelton as "unum Britannicarum literarum lumen ac decus." In 1498 he was successively ordained sub-deacon, deacon and priest. He seems to have been imprisoned in 1502, but no reason is known for his disgrace. Two years later he retired from regular attendance at court to become rector of Diss, a benefice which he retained nominally till his death. Skelton frequently signed himself "regius orator" and poet-laureate, but there is no record of any emoluments paid in connection with these dignities. His parishioners thought him, says Anthony à Wood, more fit for the stage than for the pulpit. He was secretly married to a woman who lived in his house, and he had earned the hatred of the Dominican monks by his fierce

satire. He was censured by Richard Nix, bishop of the diocese, and appears to have been temporarily suspended. After his death a collection of farcical tales, no doubt chiefly, if not entirely, apocryphal, gathered round his name—*The Merie Tales of Skelton.* During the rest of the century he figured in the popular imagination as an incorrigible practical joker. His sarcastic wit made him some enemies, among them Sir Christopher Garnesche or Garneys, Alexander Barclay, William Lilly and the French scholar, Robert Gaguin (*c.* 1425–1502). Earlier in his career he had found a friend and patron in Cardinal Wolsey, and the dedication to the cardinal of his *Replycacion* is couched in the most flattering terms. But in 1522, when Wolsey in his capacity of legate dissolved convocation at St. Paul's, Skelton put in circulation the couplet:

> Gentle Paul, laie doune thy sweard
> For Peter of Westminster hath shaven thy beard.

In *Colyn Cloute* he incidentally attacked Wolsey in a general satire on the clergy, but *Speke, Parrot* and *Why come ye nat to Courte?* are direct and fierce invectives against the cardinal who is said to have more than once imprisoned the author. To avoid another arrest Skelton took sanctuary in Westminster Abbey. He was kindly received by the abbot, John Islip, who continued to protect him until his death on June 21, 1529.

In his *Garlande of Laurell* Skelton gives a long list of his works, only a few of which are extant. The garland in question was worked for him in silks, gold and pearls by the ladies of the countess of Surrey at Sheriff Hutton Castle, where he was the guest of the duke of Norfolk. The composition includes complimentary verses to the various ladies concerned, and a good deal of information about himself. But it is as a satirist that Skelton merits attention. *The Bowge of Court* is directed against the vices and dangers of court life. He had already in his *Boke of the Thre Foles* drawn on Alexander Barclay's version of the *Narrenschiff* of Sebastian Brant, and this more elaborate and imaginative poem belongs to the same class. Skelton, falling into a dream at Harwich, sees a stately ship in the harbour called the *Bowge of Court,* the owner of which is the Dame Saunce Pere. Her merchandise is Favour; the helmsman Fortune; and the poet, who figures as Drede (modesty), finds on board Favell (the flatterer), Suspect, Harvy Hafter (the clever thief), Dysdayne, Ryotte, Dyssymuler and Subtylte, who all explain themselves in turn, until at last Drede, who finds they are secretly his enemies, is about to save his life by jumping overboard, when he wakes. Both of these poems are written in the seven-lined Chaucerian stanza, but it is in an irregular metre of his own that his most characteristic work was accomplished. *The Boke of Phyllyp Sparowe,* the lament of Jane Scroop, a schoolgirl in the Benedictine convent of Carowe near Norwich, for her dead bird, was no doubt inspired by Catullus. It is a poem of some 1,400 lines with many digressions. We learn what a wide reading Jane had in the romances of Charlemagne, of the Round Table, The Four Sons of Aymon and the Trojan cycle. Skelton finds space to give his opinion of Chaucer, Gower and Lydgate. He seems fully to have realized Chaucer's value as a master of the English language. Gower's matter was, he said, "worth gold," but his English antiquated. The verse in which the poem is written, called from its inventor "Skeltonical," is here turned entirely to whimsical use. The lines are usually six-syllabled, but vary in length, and rhyme in groups of two, three, four and even more. It is not far removed from the old alliterative English verse, and well fitted to be chanted by the minstrels who had sung the old ballads. For its comic admixture of Latin Skelton had abundant example in French and Low Latin macaronic verse. He makes frequent use of Latin and French words to carry out his exacting system of frequently recurring rhymes. This breathless, voluble measure was in Skelton's energetic hands an admirable vehicle for invective, but it easily degenerated into doggerel. By the end of the 16th century he was a "rude rayling rimer" (Puttenham, *Arte of English Poesie*), and at the hands of Pope[1] and Warton he fared even worse. His own criticism is a just one:—

> For though my ryme be ragged,
> Tattered and jagged,
> Rudely rayne beaten,
> Rusty and moughte eaten,
> It hath in it some pyth.

Colyn Cloute represents the average country man who gives his opinions on the state of the church. There is no more scathing indictment of the sins of the clergy before the Reformation. He exposes their greed, their ignorance, the ostentation of the bishops and the common practice of simony, but takes care to explain that he writes in defence of, not against, the church.

The charge of coarseness regularly brought against Skelton is based chiefly on *The Tunnynge of Elynoure Rummynge,* a realistic description in the same metre of the drunken women who gathered at a well-known ale-house kept by Elynour Rummynge at Leatherhead, not far from the royal palace of Nonsuch. "Skelton Laureate against the Scottes" is a fierce song of triumph celebrating the victory of Flodden. "Jemmy is ded And closed in led, That was theyr owne Kynge," says the poem; but there was an earlier version written before the news of James IV.'s death had reached London. This, which is the earliest singly printed ballad in the language, was entitled *A Ballade of the Scottysshe Kynge,* and was rescued in 1878 from the wooden covers of a copy of *Huon de Bordeaux.* "Howe the douty Duke of Albany, lyke a cowarde knight" deals with the campaign of 1523, and contains a panegyric of Henry VIII. To this is attached an *envoi* to Wolsey, but it must surely have been misplaced, for both the satires on the cardinal are of earlier date.

Skelton also wrote three plays, only one of which survives. *Magnificence* is one of the best examples of the morality play. It deals with the same topic as his satires, the evils of ambition; its moral, "how suddenly worldly wealth doth decay," being a favourite one with him. Thomas Warton in his *History of English Poetry* described another piece *Nigramansir,* printed by Wynkyn de Worde in 1504, and dealing with simony and the love of money in the church; but no copy is known to exist, and some suspicion has been cast on Warton's statement.

Illustration of the hold Skelton had on the public imagination is supplied from the stage. A play (1600) called *Scogan and Skelton,* by Richard Hathway and William Rankins, is mentioned by Henslowe. In Anthony Munday's *Downfall of Robert, earl of Huntingdon,* Skelton acts the part of Friar Tuck, and Ben Jonson in his masque, *The Fortunate Isles,* introduced "Skogan and Skelton in like habits as they lived."

Very few of Skelton's productions are dated, and their titles are here necessarily abbreviated. Wynkyn de Worde printed the *Bowge of Court* twice. *Divers Balettys and dyties solacious devysed by Master Skelton Laureat,* and *Skelton Laureate agaynste a comely Coystroune* . . . have no date or printer's name, but are evidently from the press of Richard Pynson, who also printed *Replycacion against certain yong scolers,* dedicated to Wolsey. *The Garlande or Chapelet of Laurell* was printed by Richard Faukes (1523); *Magnificence, A goodly interlude,* . . . probably by John Rastell about 1533, reprinted (1821) for the Roxburghe Club. *Hereafter foloweth the Boke of Phyllyp Sparowe* was printed by Richard Kele (1550?), Robert Toy, Antony Kitson (1560?), Abraham Veale (1570?), John Walley, John Wyght (1560?). *Hereafter foloweth certaine bokes compyled by mayster Skelton* . . . including "Speke, Parrot," "Ware the Hawke," "Elynoure Rummynge" and others, was printed by Richard Lant (1550?), John King and Thomas March (1565?), and John Day (1560). *Hereafter foloweth a litle boke called Colyn Cloute* and *Hereafter . . . why come ye nat to Courte?* were printed by Richard Kele (1550?) and in numerous subsequent editions. *Pithy, plesaunt and profitable workes of maister Skelton, Poete Laureate. Nowe collected and newly published* was printed in 1568, and reprinted in 1736. A scarce reprint of *Elinour Rummin* by Samuel Rand appeared in 1624.

See *The Poetical Works of John Skelton; with Notes and some account of the author and his writings,* by the Rev. Alexander Dyce (2 vols., 1843). A selection of his works was edited by W. H. Williams (London, 1902). *See* also *Zur Charakteristik John Skeltons* by Dr. Arthur Koelbing (Stuttgart, 1904); F. Brie, "Skelton Studien" in *Englische Studien,* vol. 38 (Heilbronn, 1877, etc.); A. Rey, *Skelton's Satirical Poems* . . . (Berne, 1899); A. Thümmel, *Studien über John Skelton* (Leipzig-Reudnitz, 1905); G. Saintsbury, *Hist. of Eng. Prosody* (3 vols. 1906–10); and A. Kölbing in the *Cambridge History of English Literature* (vol. iii., 1909).

SKELTON AND BROTTON, an urban district in the North Riding of Yorkshire, England, 17 m. E. by S. of Middles-

[1]Pope said: "Skelton's poems are all low and bad, there is nothing in them that is worth reading" (Spence, *Anecdotes,* p. 87).

brough by the L.N.E. railway, with stations at Brotton and North Skelton. Pop. (1931) 13,654. Altitude 400 feet. This is one of the largest townships in the Cleveland ironstone district, and its industrial population is wholly employed in the quarries. It is near the Skelton Beck which flows to the sea at Saltburn, 3 m. away. The Cleveland hills rise sharply southward to elevations sometimes exceeding 1,000 feet. The modern Skelton castle incorporates part of a 12th century stronghold. Ruins remain of an ancient church, and a fine Norman font is preserved.

SKENE, WILLIAM FORBES (1809–1892), Scottish historian and antiquary, was the second son of Sir Walter Scott's friend, James Skene (1775–1864), of Rubislaw, near Aberdeen. In 1832 he became a writer to the signet, and shortly afterwards obtained an official appointment in the bill department of the Court of Session, which he held until 1865. His early interest in the history and antiquities of the Scottish Highlands bore its first fruit in 1837, when he published *The Highlanders of Scotland, their Origin, History and Antiquities.* His chief work, however, is his *Celtic Scotland, a History of Ancient Alban* (3 vols., Edinburgh, 1876–1880), perhaps the most important contribution to Scottish history written during the 19th century. In 1881 he became historiographer royal for Scotland. He died in Edinburgh on Aug. 29, 1892.

The most important of Skene's other works are: editions of John of Fordun's *Chronica gentis Scotorum* (Edinburgh, 1871–1872); of the *Four Ancient Books of Wales* (Edinburgh, 1868); of the *Chronicles of the Picts and Scots* (Edinburgh, 1867); and of Adamuan's *Vita S. Columbae* (Edinburgh, 1874); an *Essay on the Coronation Stone of Scone* (Edinburgh, 1869); and *Memorials of the Family of Skene of Skene* (Aberdeen, 1887).

SKI (shē or skē), the wooden snow-shoe used in Scandinavia and neighbouring countries for travel over the snow. (Icel. *scidh,* snow-shoe, properly "piece of wood.") Implements for this purpose were used by many nations of antiquity. Xenophon (*Anab.* iv. 5) describes the shoes or pattens of skins with which the horses of the Armenians were shod, to prevent them from sinking into the snow, and Procopius made mention of the ancient Lapps, known in Scandinavia as "Skrid-Finnen," or sliders. Snow-shoes have always been used by the Mongols of north-western Asia. From the evidence of the old Norse sagas they must have been general in Scandinavia long before the Christian era. Ulf (or Ullar), the god of winter, is always spoken of as walking upon ski, the curved toes of which gave rise to the legend that they were really ships upon which the god was wafted over hill and dale. Northern poets of the 9th century refer to ships as "the ski of the sea." Ski have been used time out of mind by Lapps, Finns and Scandinavians for hunting and journeying across the frozen country. The first ski of which there is any record were elongated, curved frames covered with leather. Those of the Skrid-Finnen of the 16th century were leather shoes, pointed at the toe, about 3ft. long, into which, a few inches from the rear end, the feet were thrust up to the ankles. On a rune-stone standing at a cross-road not very far from Upsala there is a picture of a ski-runner with arm-bow; this is probably the oldest picture of a skier. It dates from the 11th century. Modern ski are not, like the North American snow-shoe, made of broad frames covered with a thong web, but long, narrow, nearly flat pieces of ash, oak, beech, birch, spruce or hickory, pointed, turned up about a foot at the toe. Their length is usually the distance the wearer can reach upwards with his hand, that for the average man being about 7ft. 6in., although some advocate less length. Their width at the broadest part is about 5in., and their greatest thickness (just under the foot) about 1¼in., tapering towards both ends. The under surface is usually perfectly smooth, although some ski have slight grooves to prevent the snow caking. They are kept in condition by oiling and waxing; paraffin wax is used to produce a very highly polished surface, which greatly increases the speed of the runner. Long strips of sealskin are sometimes attached to the under side of the ski, to prevent back-sliding, and assist the climber to make a more direct ascent. Without the use of skins one must climb in a zigzag course or place the ski alternately, in a herring-bone pattern.

The ski are fitted to the feet by an arrangement of straps, called the *binding.* There are a very large number of bindings of various types, the commonest among novice runners is the *huitfeld,* and the most popular with more experienced skiers the B.B. This is a metal binding without any straps, relying entirely on a hook and eye arrangement at the toe of the boot. The boots are stoutly made of deer hide and for use with the heel-strap bindings have specially shaped heels with a groove which holds the strap in place. On level ground the ski glide evenly over the snow without being lifted from it, the heels being raised with each forward movement: long gliding steps can be taken without undue fatigue, the runner having a stick about 4ft. or 5ft. long in each hand, to assist progression; these sticks have a spiked end, about 7in. above which a metal disk is fixed to prevent the stick sinking into the snow. Downhill progression attains great velocity; the skier places one foot slightly in advance of the other and runs in a somewhat crouched position with the feet close together and body leaning forward. A single staff was formerly used as a brake in coasting downhill, but the popularity of two sticks used chiefly for assistance in uphill work, but also for balance on the descent, is now almost universal.

Ski-ing as a sport began about 1860 in the Norwegian district of Telemark and rapidly spread over all the Scandinavian peninsula. The climax of the racing season is the great international ski tournament held annually in February at Holmenkollen, 6m. from Oslo. This famous contest was first held in the year 1892, Swedish skiers being present: a few weeks later the first international ski races were organized in Stockholm. The "Norwegian Derby" is divided into two parts, the first devoted to jumping contests, the other to long-distance racing. The take-off for the jumping contests is built into the side of a hill, and each competitor must jump three times. No staff is allowed and no jump is counted if the jumper falls in alighting. The distances covered are extraordinary, 58·50 metres being the record. The jumper, starting a distance up the hill, descends at top speed, stoops as he nears the take-off, and launches himself into the air with all his force. He maintains an erect position until he reaches the ground, alighting with bended knees, on both feet, one a little in advance of the other and "giving" with his legs to overcome the force of the fall and to preserve his balance. Another feature is double jumping, performed by two persons hand in hand. The highest prize is the King's Cup. The principal distance race is over a difficult course of about 20 miles. The record for 25km. (15½ miles) is 2hr., 7 minutes. A Lapp once covered 220km. (about 138 miles) in 21hr. 22 min., the country being level. Ski-ing is very popular in Norway with both men and women; in fact it may be called the national sport of Norway. The sport has been introduced into other countries where the winter is severe, and has become very popular in Switzerland and the United States, especially in Minnesota and the Rocky Mountain country. The mails between Chile and the Argentine republic are carried in winter by relays of Norwegian ski-runners, about 300 being employed. The ski worn by them are usually shod with horn. Ski cannot be used with advantage during a thaw or where the snow is less than 6in. deep. On this account, and because of their general unwieldiness, they are less convenient in thick forests than the Indian snow-shoe, though faster in the open country.

Great Britain.—In Great Britain the use of the ski has been encouraged by the activities of several ski clubs. The Ski Club of Great Britain, founded in 1903, was for years recognized as the governing body for the sport. In 1908 the Alpine Ski Club was started, and membership confined to those who qualified for election by tours on ski in the High Alps. This club was founded entirely for the mountaineer who climbed on ski. In 1912 the British Ski Association was formed; this body had aims very similar to those of the Ski Club of Great Britain and in 1924 the two clubs amalgamated and jointly became known as the Ski Club of Great Britain, and as such is the governing body for the sport in the British Isles. According to Arnold Lunn in a "History of Ski-ing" in the Year-Book of the Ski Club of Great Britain (1925), ski were used in Cumberland in the 19th century and probably in Devonshire 300 years ago.

Germany.—Ski-ing in Germany was almost unheard of until

Wilhelm Paulke was given a pair of ski for a present, about the year 1883. Paulke afterwards became the pioneer of ski-ing in his country, and together with two Norwegians who ascended The Brocken in 1884 was responsible for the foundation of the sport in Germany. In 1890 the first German ski club was formed; it was called the "Ski Club Munich." The first ski competitions were held in Germany in 1896.

Switzerland.—In 1883 the monks of St. Bernard were presented by a traveller with a pair of ski, and six years later the friars had become skiers indeed, for the monastery owned about a dozen pairs of ski, and races were held. This seems the earliest record of ski-ing in Switzerland, but the sport seems to have really gained ground after the year 1889 when a Norwegian, O. Kjelsberg, made some ascents on ski. The first Swiss ski club was formed in the year 1893 and was called "The Ski Club Glarus" —and in 1902 the first ski races were held at Berne. This was not a championship meeting, however, and it was not until the year 1905 that the first Swiss championship meeting was held at Glarus.

France.—Ski-ing in France dates from the great exhibition of 1878 in Paris. Swedish ski were a feature of one of the exhibits, and were afterwards the property of M. Duhamel, who attempted to use them without any conspicuous success. In the year 1893, some ski-runners appeared in the Bois de Boulogne; their efforts were not very enlightening and the French people were derisive. However, three years later the first French ski club was formed with headquarters at Grenoble, and was called the Ski Club des Alpes,-and French ski-ing really became popular at Chamonix in 1898.

Canada.—Canada's natural resources made it an ideal country for ski-ing, and in the Laurentians it has become one of the most popular winter pastimes. The early pioneers were members of the universities who, fresh from a tour in Europe, had seen ski-running and jumping at Davos; and students at McGill university were soon practising on the narrow Scandinavian type of racing ski. The famous Revelstoke hill is the world's fastest "jumping hill"; it was on this that Nels Nelson jumped 202ft.

Australia and New Zealand.—The largest ski resort in Australia is Mt. Kosciusko in New South Wales; here there is an excellent hotel well equipped for the ski enthusiasts who foregather for the meetings organized by the Mt. Kosciusko Ski Club. In New Zealand the popularity of ski-ing as a sport has yet to become established, although the mobile value of the ski has been demonstrated in no uncertain way on the Tasman Glacier.

Military Ski-ing.—Ski have been used for military purposes by the northern peoples for several centuries, and of late years other nations which have mountainous regions of snow have turned their attention to this most useful mode of winter marching. The army of Sweden (under Gustavus Adolphus and his successors one of the foremost in Europe) employed infantry provided with ski in its military operations. In Norway special units so provided were organized in 1710. Since 1902 the Alpine infantry of France and Italy have taken up the question. In Briançon, attached to the 159th regiment of French infantry, is an *école militaire de ski* (established 1903) which trains the *Chasseurs Alpins* of the first line, and also the regional troops which are intended to take part in the defence of the south-eastern frontier of France. These regiments as a rule furnish one officer, one non-commissioned officer, and a few soldiers each to every course of instruction, which lasts two months. At the end of the first month the *skieur* is expected in full marching order to cover 60km. (37½ miles) of Alpine territory in the day. The ski are put to a variety of ingenious uses; to form a stretcher-sledge for wounded men; and if rapidity of movement is desired, a horse or pony pulls the *skieur* along by means of long reins attached to the horse's girth. Even camps in the mountains are improvised. The *skieur* is thickly clothed and muffled, and his eyes are protected against snow-blindness by blue or black spectacles. Some of the performances of soldiers on ski have been notable. Capt. Bernard, chief of the *école* of Briançon, ascended the *cols* of Arsiné (2,400 metres) and of the Cauterel (2,080 metres) in 16hr. with a party of 25 men. In Russia some troops from Finland in full marching order made a long hunting march in Carelia. In 29 days they covered 860 kilometres. In Switzerland a *skieur* took less than 1½hr. to cover 25km., including altitudes of 1,547 metres. In order to witness this competition, which took place in Glarus, the soldiers from the St. Gotthard garrison made a march of 48km. including the ascent of the Klausenpass (2,000 metres). A Norwegian soldier named Holte covered with one leap a distance of 21·20 metres, and his companion Heyderdahl later achieved 24 metres.

In Italy each company of *Alpini* has an annual credit for the provision of ski. Their duties in war time are almost the same as those of mounted infantry—exploration and communication, and the seizure of advanced positions. In the seven months of snow on these frontiers the garrisons of the lonely posts cannot go out save on ski or snow-shoes, as to the respective merits of which military opinion is divided.

See T. W. Schreiner, *Norway's National Sport; Outing,* vol. xxxvii.; F. Nansen, *Auf Schneeschuhen durch Grönland,* (Hamburg, 1891); E. C. Richardson, *Ski-running* (1904); *Year-Book of the Ski Club of Great Britain;* W. R. Rickmers, *Ski-ing for Beginners and Mountaineers* (1910); E. C. Richardson, *The Ski-Runner* (1910); Vivian Caulfield, *How to Ski* (1911); *Canadian Ski Annual* (Montreal).

(V. M. C.)

The United States.—Ski-ing has become the major winter outdoor recreation along the snow belt of Canada and the United States. Though the best all around development of the sport is in Canada, since about 1920 the United States, especially northern New England, has shown a phenomenal increase in clubs, tournaments and the actual numbers of people who are using ski. One merchant in a New England town of 8,000 population sold 1,200 pair of ski in one season. In practically all the snow sections of the United States the tendency of ski-ing towards becoming an outstanding national sport is evident.

Popular interest in ski-ing takes the form of tours, or "hikes" as they are termed in the United States. These tours consist of club or group ski trips over charted or uncharted trails ranging from trips over hills and meadows to more adventurous expeditions up mountains and over mountain ranges. Ski clubs maintain cabins and huts on trails marked out over the White mountains, Green mountains and the Rockies.

Ski proficiency tests are maintained by which a high standard of ski proficiency on tours and in contests may be secured. A few clubs engage the services of ski instructors. One of the outstanding clubs in the United States for the promotion of general ski training for all around ability in touring is the Lake Placid Club, in New York.

The United States have helped to make ski-ing history in the development of the most sensational type of ski sport—ski jumping. Torjus Hemmestvelt, one of the first of the world's record-breaking jumpers, came to Red Wing, Minn., in 1893 and jumped 103 ft. on this pioneer United States hill. This established a world's record. Since then the record-jumping distances have advanced steadily. In the United States, due to the size of the country, two major competitions are held, the National Tournament fostered by the U.S. Amateur Ski Association, and the Eastern Tournament, conducted under the auspices of the Eastern United States Ski Association. In addition to these competitions a great number of lesser but important tournaments that attract thousands of people are conducted. Each snow season produces a great number of State, interstate, collegiate, interscholastic and inter-club ski-jumping competitions. Listed among the world's greatest jumping hills, where jumps of over 150 ft. can be made, is Brattleboro, Vt., with a record of 190 feet. There are other hills in development where jumps of over 150 ft. will be made.

Cross-country ski racing has been conducted as a separate race. Its distances have lacked standardization. They have ranged from 5 to 25 miles. The ski clubs are tending to follow the plan of the Continental clubs and have the cross-country race combined with the ski jumping, the highest point winner in both events winning the competition. This plan will give the cross-country race a greater interest and importance, which it deserves.

Ski racing down a long or short hill, either in what is called

the down-hill or the shalom, has only recently been taken up in the United States. The lack of accessible mountains near most of the ski clubs or tournament grounds makes the Alpine style of long down-hill race almost impossible. But the shorter shalom race down a hill around artificial obstacles is rapidly becoming a feature of the competitions. The U.S. clubs look to the shalom race to develop a greater number of experts in all around ski-ing.

The United States and Canada affiliate their amateur ski interests through a close association of the national organizations, the Canadian Amateur Ski Association, the National Ski Association of America and the Eastern United States Ski Association. These, in turn, are affiliated with the British Ski Association and exchange courtesies, information and competitive co-operation.

See *The Ski Sport,* year-book of the National Ski Association of America, Inc.; Elon Jessup, *Snow and Ice Sports* (1923).

(F. K. B.)

SKIBBEREEN, a market town of Co. Cork, Ireland, on the river Ilen about 3 m. from its estuary, 53¾ m. S.W. of Cork by the Great Southern railway. Pop. (1926) 2,620. The river is navigable for small vessels to Skibbereen itself, and for larger ones to Old Court on the estuary; and the town is a flourishing fishing-station. Trade is in corn and other agricultural produce. The district suffered much in the famine of 1847, and many were buried in the graveyard adjoining the ruined Cistercian cell of Abbeystrowry, a mile west of the town. The Ilen offers fishing, late in the season, for brown and sea trout.

SKIEN, a seaport of southern Norway, in Bratsberg *amt* (county), on the river Skien, 6 m. above Frier Fjord. Pop. (1927) 15,950. It was mostly rebuilt after a fire in 1886. Here Henrik Ibsen, the dramatist, was born in 1828. In 1892 a canal ascending 189 ft. by means of 17 locks was made between lakes Bandak and Nord, giving access to the Telemark district by way of Dalen. The distance between the lakes is 40 m., and several fine falls, as the Ulefos, Eidsfos, and Vrangfos, are passed. The engineering is noteworthy. There are numerous saw-mills, planing, cotton-spinning and flour-mills, factories for wood-pulp and domestic commodities. The exports are ice, timber (including telegraph poles), wood-pulp and iron ore, and the imports coal and china-clay. The town (the ancient *Skida*) dates from the 14th century.

SKILLUH, the name given by the Arabized Moors to the Berber peoples of southern Morocco. They occupy chiefly the province of Sus. The name is said to be a corruption of *áshlūh* (pl. *ishláh*), a camel-hair tent. They are of fine physique, strong and wiry, and true Berbers in features and fairness.

SKIMMER, the name of aquatic birds of the genus *Rhynchops,* remarkable for the unique formation of the bill, in which the upper mandible is capable of vertical movement, while the lower is much longer and is laterally compressed like a knife-blade. This is adapted to its mode of feeding. By means of its lower mandible the bird may be said literally "to plough the main." The black skimmer, *R. nigra,* is found in North America. Other species occur in South America, India and Africa. The sexes are alike. In breeding-habits the skimmers agree with the terns (*q.v.*) to which they are related.

SKIN, SENSORY FUNCTIONS OF. It is the function of our senses to keep us in relation with our surroundings and to enable us to move with impunity about a world full of hard angular and dangerous objects. In this task the senses of the skin take an important and characteristic part. They occupy a position between what we may call the intimate senses of taste and smell on the one hand and the distant senses of sight and hearing on the other. In the former group the stimulating substance has to be brought into very close contact with the body and the mechanism of stimulation is probably chemical; in the latter group the stimulating agent may act from great distances. Unlike both these the skin gives us news chiefly of nearby events; it has nothing to tell us of the intimate chemical nature of objects and very little directly of distant things.

The external events which by acting on the skin arouse sensation are found to be for the most part the simple and obvious physical processes, mechanical and thermal.

Touch.—The feeling of contact or touch in the non-technical sense comprises two sensations. One of these, which is sharply localized in time and place and is in its essence delicate and exact, is touch in the strict technical sense. Its characteristic stimulus is movement at the surface of the skin. The other sensation is pressure; it is in its essence less precise and although well localized in place, is temporally indefinite so that the subject of it finds it impossible to decide by the sensation alone when a pressure stimulus has ceased. The characteristic stimulus of this sensation is simple static pressure.

True touch is probably the most elaborate product of evolution among the skin senses. It is interesting to notice that the essential neurological fact behind the tactile sense—that mere mechanical movement can be transmuted by the body into sensation—is also the fact on which the not more useful but far more imposing sense of hearing is based.

Thermal Sense.—Thermal sensations do not depend directly on the absolute temperature of the object that causes them but on its temperature relative to that of the skin. In other words the characteristic stimulus of the thermal sense is the interchange of heat between the stimulating object and the body. Sensations of warmth and heat are caused by heat passing into the skin, and sensations of coolness and cold by heat passing out of it. The intensity of the sensation varies with the rapidity of heat transference and therefore not only with the temperature difference but also with the conductivity for heat of the object. A good conductor therefore feels hotter or colder as the case may be than a bad conductor at the same temperature.

Most of our thermal sensations come to us by conduction through things actually touching the skin, including of course the air. The thermal sense is then usually, like the tactile sense, a short range process involving contact. Thermal sensations can however also be set up by radiated heat. Such radiation probably acts by warming the skin from which heat is then conducted in the ordinary way to the thermal nerve endings. It is conceivable however that these nerve endings are capable of direct response to the radiation. If this were so it would show the skin to possess the rudiment of a true long range sense, and perhaps a rudiment that by adaptation to higher frequencies of radiation has given us sight—the greatest of all the senses.

Pain.—The pain sense does not show the same simple and orderly relation between stimulus and sensation that is found with the tactile and thermal senses. Sensations of pain are set up by a heterogeneous group of stimuli which do not permit of any inclusive general physical or physiological description. It is of course obvious that any process that actually damages the skin is likely to cause pain at the moment of infliction though even this, as we shall see, is not an invariable rule. Many stimuli however, though at intensities giving clear sensation of pain, do not cause any perceptible injury—such for example are brisk heat and cold and the faradic current. The anomalous relation of stimulus and sensation to the possibility of injury is well seen in connection with radiant stimuli. Heat rays easily excite pain when too weak to cause injury as is shown in the sensitiveness of the ocular cornea to the radiation of a dull red fire. On the other hand the far more injurious ultra-violet and X-rays excite no sensation whatever even at the moment when they may be seriously damaging the skin. In general however it may be said that most of the stimuli capable of causing pain are such that if they were of but little increased intensity they would actually cause injury. From this it follows that the characteristic pain stimulus is of considerable energy—far greater in fact than that of the tactile or thermal stimulus—and that the pain sense in comparison with all others is a dull sense or has, in physiological terms, a high threshold.

However insensitive the mechanism may be, the sensation itself has a peculiarly vivid and explosive quality and differs from all other sensations in arousing in the subject of it a strong impulse to make some kind of motor response. The barely controllable flinching with which we suffer the mildest of pin-pricks is familiar evidence of this unique character of the pain sensation.

In comparison with other senses, pain then is seen to be highly anomalous. Its anomalies have been the subject of much theo-

retical discussion from which however no generally accepted doctrine has yet emerged.

Distribution of Sensibility.—It has long been known that the whole of a given area of skin is not equally sensitive. If its surface is explored with stimuli sufficiently fine, it is found that in some places no response is obtained to any stimulus and that sensitiveness is limited to certain small areas mostly less than a millimeter across. These spots are distinct for each kind of stimulus and respond to it only, so that there are separate spots for touch, heat, cold and pain.

The sensitiveness of a given region depends on whether the distribution of sensitive spots is thick or thin. As a general rule density of distribution varies together for all four senses so that a part sensitive to one stimulus is sensitive to all. To this however there are important exceptions. The skin of the face and the skin of the finger tip are both highly sensitive to touch but the latter is much the less sensitive to pain. A far more striking anomaly however is that certain regions—the cornea of the eye and a part of the glans penis—possess sensibility to pain only. It is difficult to give a functional explanation of this curious fact but it is interesting to note that these two regions have this in common that their embryological development includes a longitudinal splitting of the skin into two layers.

The Peripheral Sensory Mechanisms.—The sensory nerve fibres of the skin terminate in certain well-marked and minute structures called end-organs which are regarded as having the power to originate under appropriate stimulation the nerve-impulse which yields the characteristic sensation. These end-organs show a great variety of structure, but they are clearly divisible into two groups. First there is a group in which the end-organ consists of a mere breaking up of the nerve fibre into many fine naked branches among the cells of the part; this "terminal aborisation" is the end-organ of the pain nerve. Secondly there is a group the members of which though varying much have this in common—that the end of the nerve fibre is enclosed in a definite and often thick capsular structure. These end-organs are concerned with the sensations other than pain. This marked structural difference between the encapsuled or insulated and the naked or uninsulated end-organs is yet another peculiar character of the pain sense.

Into the intimate nature of the process whereby a stimulus to an end-organ causes an impulse in the nerve fibre we cannot as yet penetrate. The less exacting problem of what is the precise quality of the stimulus is as we have seen still unsolved for the pain sense. For the thermal and tactile senses the stimulus can be reduced to the simple physical processes of heat transference and movement respectively. In the case of touch we can even define in some detail the mechanisms by which very light touches are enabled to produce the movements which are essential to adequate stimulation of the touch-spots.

Each touch-spot is found to be placed close to a hair and the latter can be seen to move when the touch-spot is pressed on and sensation aroused. It is probable that the rigid root of the hair acts as a lever which magnifies the movement set up by the actual touch. The adequacy of the mechanism is shown by the experimentally established fact that the touch-spots of a rather coarse hairy skin are slightly more sensitive than those of a fine smooth skin. When the projecting part of a hair itself is gently touched a vague tickling sensation is felt quite unlike the clear light "pat" elicited by proper stimulation of a touch-spot. The hair is too flexible to transmit the whole movement intact to the end-organ and a sub-minimal stimulus results. This sensation of "tickle" is comparable with the sensation of itching which is probably the result of sub-minimal stimulation of pain nerves. It seems likely that the great reduction in hairiness shown by man's skin in comparison with that of other animals was favoured by the precision it gave to touch through the elimination of tickling sensations.

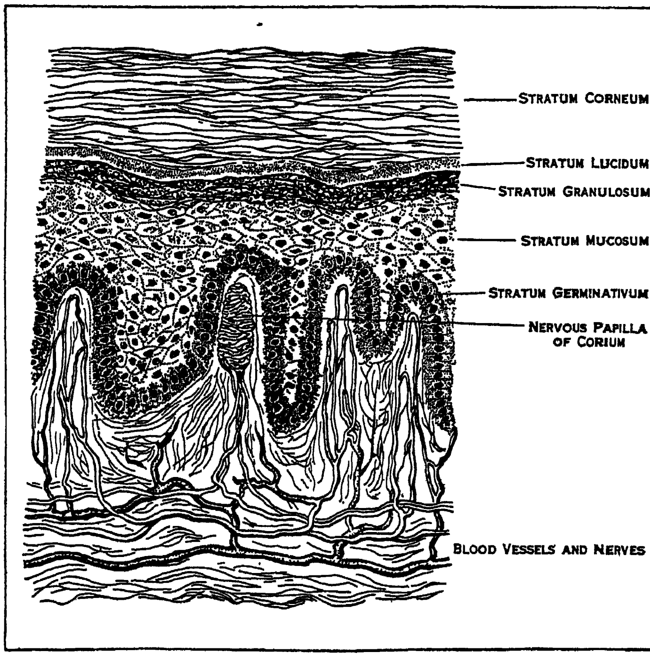
The hair bulb is then the ordinary means by which movement is transmitted to tactile end-organs. Where the skin is hairless however, as it is in some of its most sensitive parts, other mechanisms are necessary. The simplest substitute is to keep the surface layers of the skin flexible by reducing the amount of horny material in them and to keep them moist. This is the condition of the red surface of the lips which is highly sensitive to touch but at the expense of a high degree of vulnerability.

No such solution of the problem is possible in the fingers which must be kept sensitive and yet allowed a thick and horny protective covering. There the thick horny layer is grown on long closely parallel ridges with grooves between; the grooves are lines of diminished rigidity and permit the thick epidermis to remain highly flexible and therefore sensitive to touch. These ridges and grooves that by their individual uniqueness and constancy have proved so gratifying to the criminologist, are thus seen to have another and perhaps a higher function in serving the great sense of touch.

Bibliographical Note.—The sensory functions of the skin are not usually dealt with very fully in text-books of physiology. An elaborate account of the subject (with references to the work of other investigators) will be found in Sir Henry Head's "Studies in Neurology"—1920. A recent important contribution by Sir E. Sharpey-Schäfer appears in the *Quarterly Journal of Experimental Physiology*—August 1928.

SKIN AND EXOSKELETON, in anatomy. The skin is the covering of the whole body, and is continuous at the different orifices with the mucous membrane. It acts as a protective layer, as a regulator of the temperature, as an excretory organ and as a tactile and sensory organ in which nerves end.

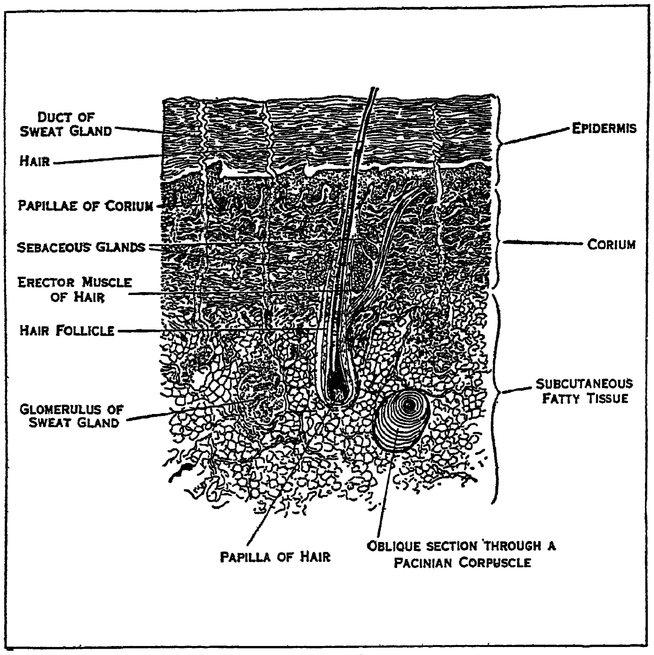
The skin varies in thickness from ·5mm. in the eyelids to 4 or more mm. in the palms and soles; it is also very thick over the back of the body. Two main layers are recognized, superficially the epidermis and more deeply the dermis or true skin. The *epidermis* under the microscope is seen to consist of five layers. On the surface is the horny layer or *stratum corneum* (*see* fig. 1) composed of layers of scale-like cells, the walls of which are turned into the horny substance keratin. Deep to this is a thin layer of scale-like cells without keratin known as the *stratum lucidum.* Deeper still is a layer, the *stratum granulosum,* in which the cells are not so flattened and contain granules of a substance known as eleidin. In the fourth layer, *stratum mucosum* or *stratum Malpighii,* the cells are polygonal and are connected together by delicate prickle-like processes. It is in the deeper layers of these cells that the pigment of the negro's skin is found. The fifth and deepest layer of the epidermis is the *stratum germinativum,* in which there is only one layer of columnar cells. The whole of the epidermis is non-vascular. The *true skin, dermis* or *corium* is composed of a felted network of white fibrous tissue with a small number of yellow elastic fibres interspersed. It is divided into two layers.



FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 1.—VERTICAL SECTION OF EPIDERMIS AND PAPILLAE OF CORIUM

The superficial or *papillary layer* lies next to the epidermis and is raised into a number of papillae or conical projections which fit into corresponding depressions on the deep surface of the epidermis. In sensitive parts like the palms and soles these papillae are specially prominent and form wavy lines, each of which consists of a double row between which the ducts of the sweat glands pass on their way to the surface. So large are the papillae in these situations that the epidermis is also raised into ridges, and these in the fingers form the characteristic whorls so valuable for purposes of identification. The papillae contain leashes of blood-vessels, and in some of them are special tactile corpuscles in which the nerves end (*see* NERVOUS SYSTEM).



FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 2.—VERTICAL SECTION OF THE SKIN

In the deeper or *reticular layer* of the true skin the fibrous feltwork is looser and encloses pellets of fat. It also contains a network of blood-vessels and nerves, and in some places a layer of striped or unstriped muscle. Where hairs are present the hair follicles lie in this deeper layer, which gradually merges with the subcutaneous fatty tissue (*see* fig. 2).

As appendages of the skin are found the hairs, the nails and the sebaceous and sweat glands.

Hair.—The hairs are found in man on the scalp, eyelids, eyebrows, armpits, pubic region, vestibule of the nose, external auditory meatus, face, ventral surface of the trunk and dorsal surfaces of the leg, forearm and hand; indeed the only places which are quite free from them are the palms of the hands, soles of the feet and the glans penis. In some places, such as the armpits, pubic region and the face of the male they grow to a considerable length at and after puberty. In section it is only the straight hairs which are circular; wavy and curly hairs are oval. In the centre of each hair is the medulla or pith, though this is not always present; it is composed of nucleated cells containing pigment, fat and air spaces. Outside this is the fibrous layer or cortex, also containing pigment and air spaces, while most superficially is the cuticle made up of overlapping scales. The hair grows at its root from a *hair follicle* (*see* fig. 2), which is a tubular inpushing of the epidermis into the true skin or, in the case of large hairs, deeper still into the superficial fascia. It is divided into an *inner* and *outer root sheath,* the former representing the more superficial layers of the epidermis, the latter the deeper layers. At the bottom of the follicle the hair enlarges to form the bulb, and into the lower part of this a vascular papilla projects from the true skin. The cells of the hair are derived from, and are continuous at the bulb with those of the outer root sheath, and therefore with the deeper layers of the epidermis.

The hair follicle always projects somewhat obliquely into the skin, and attached to the side toward which it is leaning is a small band of non-striated muscular fibres called *arrector pili.* When this acts it diminishes the obliquity of the hair and so makes it "bristle" or "stand on end," while a general contraction of these small muscles leads to the familiar condition of "gooseflesh."

Nails.—The nails are specially thickened parts of the epidermis, and are divided into a root and a body. The former is concealed by a fold of skin, and the corium on which it lies is known as the *nail matrix.* The body of the nail also lies on the corium, or true skin, which forms the *nail bed* and is very sensitive. This body of the nail is formed by the stratum germinativum and stratum mucosum in its deeper part, and more superficially by the stratum lucidum, which is here very much thickened and converted into keratin or horn. Near the root of each nail is a semilunar area which is more opaque than the rest and forms the white *lunula.*

Glands.—Sebaceous glands are found wherever there are hairs, however rudimentary, and open by their ducts into the superficial part of the hair follicle (*see* fig. 2). Their deeper or secreting part divides into a number of bag-like alveoli composed of cells, which secrete oil droplets. There may be two or three glands to each hair follicle, and their size does not vary directly with that of the hair, since they are very large in the nose, where the hairs are quite rudimentary. They are also found on the labia minora and nipples, where no hairs are. *Sudoriparous* or sweat glands (*see* fig. 2) are found all over the surface of the body, but are specially numerous on the palms and soles. It is estimated that in the palm there are nearly 3,000 to a square inch, while in the skin of the back they do not reach 500 to the same area. In the armpits and groins they are very large. Each consists of a single long tube, lined by columnar epithelium, and coiled up into a ball or glomerulus in the subcutaneous tissue, after which it pierces the corium and epidermis to reach the surface at the *porus sudoriferus.* Where the stratum corneum of the epidermis is thick the duct is twisted like a corkscrew as it goes through.

The *glands of Moll* in the eyelids and the ceruminous or wax glands of the ear are modified sweat glands; the former, when inflamed, cause a "sty."

EMBRYOLOGY

The skin is derived partly from the ectoderm and partly from the mesoderm of the embryo. The whole of the epidermis and its appendages are ectodermal, and in the early embryo consist of a single layer of cells; later on this becomes double, and the superficial layer, after the sixth month, is cast off and mixes with the secretion of the large sebaceous glands to form the soapy *vernix caseosa* with which the foetus is coated at birth. In the meantime the cells of the deeper layer divide and form the various layers of the epidermis already enumerated. The mesodermal cells belong to the mesenchyme, and form the fibrous tissue of the true skin as well as the arrectores pilorum muscles and, in the scrotum, the *dartos* layers of unstriped muscle. In the sixth month fatty tissue appears in the deeper parts, and so the fat of the superficial fascia or sub-cutaneous tissue is formed. The nails are said to appear as thickenings of the epidermis at about the ninth week, quite at the tips of the digits. Later on they shift to the dorsal side, and in doing so carry the nerves in the nail bed with them. This is the only explanation available of the fact that the ventral nerves to the tips of the fingers encroach on the dorsal area. By about the twelfth week the nails are perfectly formed, but they do not reach the level of the finger tips until the eighth month. The hairs are developed in the third month of foetal life by ingrowths of the stratum mucosum of the epidermis into the corium. During the fourth and fifth months the body becomes covered by fine unpigmented hairs which are known as *lanugo;* these begin to disappear about the eighth month, but some remain until after birth. On the scalp, however, the hair at birth is often more deeply pigmented than that which succeeds it. The sebaceous and sweat glands, like the hair follicles, are ingrowths of the stratum mucosum of the epidermis into the corium. The former become very large in the later months of embryonic life,

and secrete a large part of the above-mentioned vernix caseosa. The development of the mammary gland from modified sebaceous glands has already been referred to (*see* MAMMARY GLAND).

For further details *see* J. P. M'Murrich, *Development of the Human Body* (London, 1923); J. C. Heisler, *Text-book of Embryology* (London, 1907); Quain's *Anatomy*, vol. i. (London, 1908).

COMPARATIVE ANATOMY

In the larval (gastrula) stage of the Amphioxus (lancelet) cilia are present on the surface, and in the superficial epidermal cells of some fishes and amphibian larvae there is a striated layer on the free edge which is looked upon as a relic of ancestral cilia.

Skin Glands.—The skin glands of the Cyclostomata (hags and lampreys) and fishes are generally unicellular and secrete slime which protects the surface of the body. Some of the teleostean fish have poison glands at the bases of their dorsal fins and opercula.

In the mud fish (Dipnoi) and amphibians multicellular spherical glands appear as involutions of the ectoderm. Sometimes, as in the so-called parotids of the toad, these form large masses. Reptiles and birds are singularly wanting in skin glands, though the latter have a large *uropygial gland* at the root of the tail which secretes oil to lubricate the feathers; it is the chief constituent of the "parson's nose" of the fowl. In mammals, except the Cetacea, the sebaceous and sudoriparous glands already described in man are found; some of the former sometimes attain a large size, as in the interdigital gland of the sheep, Müller's gland at the back of the pig's knee and the suborbital gland of ruminants. In addition to these, special scent-producing glands are often found in different parts, the most remarkable of which, perhaps, are the scent glands beneath the tail of the skunk, while in male monotremes there is a special poison gland in the leg which is connected with a spur in the foot.

Pigment.—Pigment cells are present both in the dermis and epidermis of fishes and amphibians, and the pigment may be either intra- or extra-cellular. In many cases it is under the control of the nervous system, so that forms like the flat-fish and the common frog can adapt their colouration to that of their background. In animals permanently excluded from the light, pigment is absent. In reptiles movable pigment cells are often found, as in the chameleon, while in birds the pigment is sometimes of great brilliancy in the necks and wattles. In mammals, as in man, the pigment is confined to the cells of the stratum mucosum layer of the epidermis.

Scales.—In the elasmobranch fishes scales are found composed of enamel superficially, and of dentine and bone deeply. They are developed from the epidermis and dermis, and in almost every way resemble the teeth of these animals, which are only modifications of them. The bony basal part of each scale is plate-like, hence this kind of scale is known as *placoid*. In the ganoid fishes, such as the sturgeon, much larger plaques called *ganoid scales* form a complete armature. In the teleostean fishes the scales overlap like tiles and are either *cycloid*, having a smooth border, or *ctenoid*, in which the free posterior border is serrated. Existing amphibians are usually remarkable for absence of any skin armour, though in fossil forms (Stegocephala) it was very complete. The reptilian class is specially noticeable for the production of epidermal scales, which undergo many modifications. In the Ophidia they are cast off periodically in one mass as the snake's slough, while in the Chelonia they form the different varieties of tortoise-shell. Bony structures, developed in the dermis, may underlie these epidermal horny thickenings, and are very strongly developed in the dorsal and ventral bony shields of the Chelonia (carapace and plastron), which secondarily fuse with the true endoskeleton. The armadillo is the only mammal which has a true bony exoskeleton.

Feathers.—Birds are remarkable for the possession of feathers, which are highly modified scales. The embryonic or *down feathers* are simple, and consist of a brush of hair-like *barbs* springing from a basal quill or *calamus*. From the whole length of each barb a series of smaller *barbules* comes off like branches of a shrub. The adult or *contour feathers* are formed at the bottom of the same follicles which lodge the down feathers and, by their growth, push these out. At first they are nothing more than enlarged down feathers, but soon one of the barbs grows enormously, and forms a main shaft or *rachis* to which the other barbs are attached on either side. From the sides of the barbs grow the barbules, just as in the down feathers, and these, in the case of the large wing feathers (*remiges*) and tail feathers (*rectrices*), are connected by minute hooks so that the feather *vane*, as opposed to the shaft, has a more resistant texture than it has in the feathers of the back or breast. The bird's moult is comparable to the casting of the scales in the reptiles.

Hairs.—Hairs are only found in the mammalian class, and are divided into the long tactile bristles or vibrissae and the smaller hairs which maintain the warmth of the body. In some animals the hair of the body is composed of long, stiff hairs, which are probably specialized for protective purposes, and short, soft hairs, which form the fur and keep in the warmth. Sometimes these long hairs are greatly enlarged and hardened to form protective spines as in the porcupine, hedgehog, spiny mouse and spiny ant-eater (Echidna).

Horns.—Horns are of three kinds: (1) antlers, (2) hollow horns and (3) hairy horns of the rhinoceros.

Antlers are growths of true bone and, except for their very vascular covering of skin (velvet), are not exoskeletal structures. They grow with great rapidity, and in the deer family are renewed each year. As soon as their growth is finished the skin covering dries up and strips off. The small horns of giraffes are also bony structures though permanent.

The hollow horns of the ruminants (Bovidae) are cases of hardened epidermis which fit over a bony core and are permanent. They are found in both sexes, and in this differ from the antlers of the deer, which, except in the reindeer, are confined to the male. In the prongbuck (Antilocapra) the hollow horns are shed periodically.

The hairy horns of the rhinoceros are a mass of hairs cemented together by cells. The hairs grow from dermal papillae, but differ from true hairs in not being sunk into hair follicles.

Claws and Hoofs.—These are modifications of nails, but whereas in nails and claws the structures are confined to the dorsal aspect of the digits, in hoofs they spread to the plantar surface as well. It has been shown in the embryological section of this article that the nail appears at the very tip of the digit, and in this position it remains in many amphibians, *e.g.* giant salamander, while in hoofed mammals it develops both ventrally and dorsally. In the Felidae the claws are retractile, but the real movement occurs between the middle and terminal phalanges of the digits.

Spurs.—Spurs are quite distinct from nails and claws; they are very common in birds as horny epidermal sheaths covering bony outgrowths of the radial side of the carpus, metacarpus or metatarsus. The spur-winged goose has a carpal spur; in the screamers (Palamedea and Chauna) the spur or spurs are metacarpal, while in many gallinaceous birds (*e.g.* common fowls and pheasants) metatarsal spurs are found. In the mammals the male monotremes (Echidna and Ornithorhynchus) have spurs attached to an extra (? sesamoid) bone in the hind leg, perforated for the duct of the already mentioned poison gland.

Beaks.—Certain fishes belonging to the family Mormyridae have a fleshy prolongation of the lower lip, and are hence termed beaked fishes. In the Amphibia *Siren* and the tadpoles of most Anura (frogs and toads) have small horny beaks. In the Reptilia horny beaks are found in the Chelonia while in birds beaks are constant and replace the teeth in modern species. In mammals a horny beak is found in Ornithorhynchus, though it coexists with true teeth in the young and with horny pads in adult specimens. In all these cases the beaks are formed from cornified epidermal scales.

Baleen.—The baleen which is found in the mouths of the Balaenidae or whalebone whales is a series of flattened triangular horny plates arranged on either side of the palate. The inner edges and apices of these are frayed out into long fibres which act as strainers. In *Balaena mysticetus*, the Greenland whale, there are nearly four hundred of these plates, the longest of which often

exceed ten feet. In its development baleen resembles rhinoceros horn in that it consists of a number of epidermal hair-like fibres cemented together and growing from dermal papillae, though not from true hair follicles.

For further details and literature *see* R. Windersheim, *Comparative Anatomy of Vertebrates,* translated by W. N. Parker (London, 1907); S. H. Reynolds, *The Vertebrate Skeleton* (Cambridge, 1897). (F. G. P.)

SKIN DISEASES. The diseases of the skin do not essentially differ from those of the other organs of the body. But skin has certain differences from other organs, some dependent on its structure and some on its exposed position. There are no depths to be attacked, and any diseases, if they spread, must do so superficially; spreading as they often do equally in all directions, the diseases of the skin have a tendency to assume a circular form, independently of any parasitic cause, though when such cause is present the patches are of a more perfectly circular shape. Further, from the extent of its superficial area and its exposed position, the skin is liable to be attacked by more forms of irritation, parasitic or other, than any other organ of the body.

Classification.—The classification of skin diseases, at first based on naked-eye appearances, and, later, on the underlying pathological changes, is becoming simplified by the adoption of an etiological basis, and, as our knowledge of their causation becomes more complete, such an ideal becomes possible, and is being attempted in the more recent text-books. At the present time, however, the cause of certain skin diseases remains obscure, but, as the gaps in our knowledge become gradually filled in, the group of the unclassified affections becomes correspondingly diminished.

Of the new forms of skin disease which have been recognized in recent years, the most numerous have been those occurring in tropical countries, and of them a considerable number are due to fungi, and constitute the group of the tropical dermato-mycoses. In Great Britain the cutaneous lesions associated with diseases of the blood have been the subject of careful study, especially those which occur in connection with the leukaemias and lymphadenoma.

Ringworm.—It is now established that the disease, popularly known as ringworm, is due to a number of mould-fungi, which vary in different climates and countries, like other members of the vegetable kingdom, and have a wide distribution in the animal kingdom, occasionally even in birds, from which they are capable of being transmitted readily to man. Certain resistant forms of dermatitis, affecting various parts of the body, but more especially the groins and the extremities, which may closely resemble eczema, are not variants of that protean disease, but the result of the presence in the skin of certain ringworm fungi. This type of ringworm has increased since the World War, as it was common among the troops, especially those who went through the Gallipoli campaign, or served in the East, and was brought home and spread by them.

Eczema.—Eczema, the commonest of skin affections, is no longer regarded as a disease due to a single cause, but as a form of cutaneous reaction, due to a variety of irritants, acting either locally, from without, or circulating in the blood, possibly in an individual predisposed by some lowered resistance. In the group of the eczemas it is customary now to include the various forms of occupational dermatitis. These are attracting attention, as they are responsible for considerable disablement. The list of irritants, chemical and physical, which may cause them, is continually being extended, and the problem of their prevention is receiving the close attention of the Public Health Authorities (*see* INDUSTRIAL WELFARE).

Actinic Action.—The actinic rays of light have been shown to be an important factor in causing inflammation of the skin. For years it has been known that they are responsible for the peculiar eruption of the face and hands which recurs in summer in individuals sensitive to light (*Hydroa aestivale*), and for the more serious freckled affection which goes on to cutaneous cancer (*Xeroderma pigmentosum*). It is only recently, however, that the peculiar, dry, atrophic, freckled condition of the skin, dotted over with dilated capillaries, and horny thickenings which may become malignant, has been shown to be due to the sun's rays. This is met with on the unprotected parts, namely the arms, hands and face, of people long exposed to the sun, in countries where its rays are intense, such as India, South Africa, Australia, etc.; it is now designated as chronic solar dermatitis, and corresponds closely to a chronic burn from the X-rays. In Australia the ears of sheep sometimes develop cancer as the result of exposure to the sun's rays on the plains.

Microbial Action.—The rôle of micro-organisms and parasites in causing skin disease is highly important. Bacteria (*see* BACTERIOLOGY) have been shown to be the cause, not only of the common forms of septic impetigo, but of a variety of scaly affections, previously regarded as forms of eczema, which are now included under the heading of Dermo-épidermites microbiennes. Ultra-microscopic organisms, capable of passing through a Berkefeld filter, which have become prominent lately in connection with cancer (*see* CANCER; FILTER-PASSING VIRUSES), would seem to be responsible for the small epidermal growths, known as *Molluscum contagiosum,* and it is more than probable that similar organisms will be found to be the cause of other types of benign and malignant epithelial growths. In the Tropics, the so-called Calabar swellings have been found to be of filarial origin, and the Oriental sore to be due to a parasite of the trypanosome family.

Focal Infection.—Focal infection, in the sense of protein poisoning from bacteria in some crypt or tissue, or in the alimentary tract, has of late years been advanced as a possible cause of *Lupus erythematosus,* circumscribed patches of eczema, and other erythematous conditions, and the improvement in them which sometimes follows the injection of an autogenous vaccine has been taken as evidence of an etiological connection.

Nervous System.—Although certain affections of the skin, such as *Herpes zoster,* or shingles, have been proved to be of nervous origin, the trend of recent research has gone to show that the influence of the nervous system as a cause of cutaneous disease has been overrated, and that a number of affections, which were vaguely attributed to reflex nervous disturbances, are either of toxic origin, or due to imperfect action of a ductless gland, or to some disordered state of the blood.

Anaphylaxis.—The doctrine of anaphylaxis (*q.v.*) has contributed to our knowledge of certain cutaneous phenomena, and has explained the liability to recur of a dermatitis due to local irritation, or to the presence in the blood of some foreign protein.

Therapeutics.—Recent advances in treatment have been remarkable. Internal treatment has become based more on general medical principles and on the discovery and correction of some underlying disturbance in an organ or system than on so-called specific medication. That sheet-anchor of the earlier physicians—arsenic—has lost its position as a panacea for chronic skin affections, and any value it may have in the treatment of psoriasis, pemphigus, etc. is being regarded more as the result of its value as a nerve tonic than as a specific drug. It has attained, however, a new importance in its organic preparations, in the treatment of syphilis (*see* VENEREAL DISEASE).

Organo-therapy.—The increase in our knowledge of the ductless glands (*see* ENDOCRINOLOGY) has added organo-therapy to our methods of treatment, and thyroid medication has proved to be of benefit in various skin affections in childhood, associated with retarded development, and especially in mild ichthyosis, in which eczematous changes are so liable to be superimposed.

Vaccine Therapy.—The value of vaccines (*see* VACCINE THERAPY) in the treatment of skin diseases has been overrated, and their use in the past was too promiscuous. They are of most value in acute suppurating lesions of staphylococcic origin, such as recent boils. The development in local treatment has been even more striking than that from internal medication.

Refrigeration; Diathermy.—Refrigeration, with carbon dioxide as the freezing agent, is a useful means of destroying vascular naevi, moles, warts, superficial rodent ulcers, and of ameliorating Lupus erythematosus of the fixed type. Diathermy has proved of great value in inoperable cases of rodent ulcer, and for cauterisation of malignant growths in the mouth or naso-

pharynx (*see* ELECTRO-THERAPY).

Radiotherapy.—The greatest advances in late years, however, have taken place in connection with radiotherapeutics (*see* RÖNTGENOLOGY). The newer methods of X-ray dosage, made possible by the use of the Coolidge tube, have increased the usefulness of the X-rays as a means of healing chronic ulcers, relieving local irritations, reducing epidermal thickening and causing the defluvium of the hair for the cure of ringworm of the scalp. Radium has proved to be of special service in the treatment of rodent ulcers and hypertrophic scars (*see* RADIUM THERAPY). The value of the actinic rays of light, when applied locally, in the treatment of tuberculosis of the skin, and in healing chronic ulcers, has been greatly enhanced by its use over the whole cutaneous surface, in the form of actinic ray baths, which have been found to improve the general health by stimulating metabolism and increasing the bactericidal power of the blood. *See* HELIOTHERAPY.

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SKINNER, JAMES (1778–1841), British soldier, born in India, son of Lieut.-Colonel Hercules Skinner and a Rajput lady, entered the Mahratta army under de Boigne and remained in the same service under Perron until 1803, when, on the outbreak of the Mahratta War, he refused to serve against his countrymen. He joined Lord Lake, and raised a regiment of irregular horse called "Skinner's Horse" or the "Yellow Boys," which became the most famous regiment of light cavalry in the India of that day. He died at Hansi on Dec. 4, 1841.

See J. Baillie Fraser, *Military Memoir of Lieut.-Colonel James Skinner* (1851).

SKINNER'S CASE, the name usually given to the celebrated dispute between the House of Lords and the House of Commons over the question of the original jurisdiction of the former house in civil suits. In 1668 a London merchant named Thomas Skinner presented a petition to Charles II. asserting that he could not obtain any redress against the East India company, which, he asserted, had injured his property. The case was referred to the House of Lords, and Skinner obtained a verdict for £5,000. The company complained to the House of Commons which declared that the proceedings in the other House were illegal. The Lords defended their action, and after two conferences between the Houses had produced no result the Commons ordered Skinner to be put in prison on a charge of breach of privilege; to this the Lords replied by fining and imprisoning Sir Samuel Barnardiston, the chairman of the company. Then for about a year the dispute slumbered, but it was renewed in 1669, when Charles II. advised the two Houses to stop all proceedings and to erase all mention of the case from their records. This was done and since this time the House of Lords has tacitly abandoned all claim to original jurisdiction in civil suits.

See Lord Holles, *The Grand Question concerning the Judicature of the House of Peers* (1689); L. O. Pike, *Constitutional History of the House of Lords* (1894); and H. Hallam, *Constitutional History,* vol. iii. (1885).

SKINS: *see* HIDES.

SKIPPON, PHILIP (d. 1660), English soldier, was born at West Lexham, Norfolk. At an early age he adopted the military profession and in 1622 served with Sir Horace Vere in the Palatinate. He took part in most of the battles and sieges of the time in the Low Countries. At the sieges of Breda in 1625 and 1637 he was wounded, and under his old commander, Lord Vere, he was present when Bois-le-Duc ('s Hertogenbosch) and Maestricht were attacked in 1629. A veteran of considerable experience, Skippon returned to England in 1639, and was appointed to a command in the (Honourable) Artillery Company. In January 1642 Skippon was made commander of the City troops. He was not present at Edgehill, but he cheered his raw militiamen at Turnham Green, in the face of the king's victorious army. Essex, the Lord General of the Parliament forces, made Skippon his major-general, a post which carried with it the command of the foot and the duty of arranging the line of battle. At the end of 1644 Essex's desertion at Lostwithiel left Skippon in command; compelled to surrender without firing a shot, he bore himself with calmness and fortitude in this adversity. Soon after the second battle of Newbury he became major-general of the New Model Army. In this capacity he supported Fairfax as loyally as he supported Essex, and at Naseby refused to quit the field. He only reappeared at the siege of Oxford, which he directed.

Under the Commonwealth he held office, military and civil, but ceased to influence passing events. He was a member of Cromwell's House of Lords, and was universally respected and beloved. He died in March 1660. Skippon was a deeply religious man, and wrote several books of devotion for the use of soldiers.

See Vicars, *English Worthies* (1647).

SKIPTON, an urban district in the West Riding of Yorkshire, 26 m. N.W. of Leeds, *via* the L.M.S., and Leeds and Liverpool canal. Pop. (1931) 12,434. It is situated in the hilly district of the upper valley of the Aire where it is joined by the Eller Beck from the north. It is the nodal town of the Craven Gaps, the lowest ways through the Pennines from Trent to Tyne, and so has become an important route centre, and the principal market town of Craven. During the middle ages, the Craven Gaps were the chief routes through the Pennines along which the Angles, and later the Danes, moved westwards, and Skipton was the capital of Craven. At the Norman conquest, it became part of the possessions of Earl Edwin and was granted to Robert de Romille, who built the castle in the 11th century. It was taken by the parliamentary forces in 1645 and was partly demolished in 1648, but was later restored; all that remains of the ancient Norman buildings is the west doorway of the inner castle. In the castle grounds are the remains of the chapel of St. John. The church of the Holy Trinity, mainly Perpendicular, was also partly destroyed during the Civil War, but has been restored. The grammar school was founded in 1548. There are woollen and cotton factories in the town, and a large limestone quarry near by. (M. K. M.)

SKIRRET, known botanically as *Sium Sisarum* (family Umbelliferae), a fleshy-rooted perennial, the roots of which are boiled, and afterwards served up like salsify.

SKOBELEV, MIKHAIL DIMITRIÉVICH (1843–1882), Russian general, was born near Moscow on Sept. 29, 1843. After graduating as a staff officer at St. Petersburg he was sent to Turkestan in 1868 and, with the exception of an interval of two years, during which he was on the staff of the grand duke Michael in the Caucasus, remained in Central Asia until 1877. He commanded the advanced guard of General Lomakine's column from Kinderly Bay, in the Caspian, to join General Verefkin, from Orenburg, in the expedition to Khiva in 1874, and, after great suffering on the desert march, took a prominent part in the capture of the Khivan capital. Dressed as a Turkoman, he intrepidly explored in a hostile country the route from Khiva to Igdy, and also the old bed of the Oxus. In 1875 he was given a command in the expedition against Khokand under General Kaufmann. For his great services he was promoted to be major-general and appointed the first governor of Fergana. In the Turkish War of 1877 he seized the bridge over the Sereth at Barborchi in April, and in June crossed the Danube with the 8th corps. He commanded the Caucasian Cossack Brigade in the attack of the Green Hills at the second battle of Plevna. He captured Lovtcha on Sept. 3, and distinguished himself again in the desperate fighting on the Green Hills in the third battle of Plevna. In command of the 16th Division, he took part in the investment of Plevna and also in the fight of Dec. 9, when Osman Pasha surrendered, with his army. In January 1878 he crossed the Balkans in a severe snowstorm, defeating the Turks at Senova, near Schipka, and capturing 36,000 men and 90 guns. Dressed in white uniform and mounted on a white horse, and always in the thickest of the fray, he was known and adored by his soldiers as the "White General." He returned to Turkestan after the war, and in 1880 and 1881 further distinguished himself in retrieving the disasters inflicted by the Tekke Turkomans, captured Geok-Tepe, and,

after much slaughter, reduced the Akhal-Tekke country to submission. He was advancing on Askabad and Kalat i-Nadiri when he was disavowed and recalled. He was given the command at Minsk. In the last years of his short life he engaged actively in politics, and made speeches in Paris and in Moscow in the beginning of 1882 in favour of a militant Panslavism, predicting a desperate strife between Teuton and Slav. He was at once recalled to St. Petersburg. He was staying at a Moscow hotel, on his way from Minsk to his estate close by, when he died suddenly of heart disease on July 7, 1882.

SKOPLJE, the capital of southern Serbia, Yugoslavia (Turkish *Usküb*). It lies on a fertile plain, with the Vardar running through it, and is completely encircled by a Turkish cemetery. Pop. (1921) 41,066, comprising Serbs, Albanians, Turks, Bulgars and a few gipsies. The agricultural production of the district includes maize, oats and barley, and silkworm culture is extensively carried on. There is an important opium market and Skoplje is the distributing centre for a very large area. At the outbreak of the World War (1914–18) it possessed a steam flour mill, a brewery, distilleries, tanneries, braid, soap, horseshoe and sugar factories, and was the centre of the silver filigree industry. The principal buildings are the citadel, the palace of the former Turkish governor, a Roman aqueduct, many churches and mosques, a School of Agriculture, an electric power station, an Institute of Tropical Diseases, two banks, several schools, including one for girls, and a university. The second urban Serbian school in Macedonia was opened here in 1830, and the first Macedonian newspaper published here in 1908. It is the seat of a Greek Orthodox bishop, a Roman Catholic and a Bulgarian bishop. Skoplje is the headquarters of one of the five Army provinces, and is strategically the most important point in Macedonia, and perhaps in the Balkans, several main arteries of communication, and four railways, converging upon it. Antimony, saltpetre, and veins of pure magnesite are found in the district and there is said to be much gold at Kara Dagh to the north.

The name is derived from *Scupi*, an ancient town whose ruins lie near by, and which was destroyed by an earthquake in 518, and rebuilt by Justinian. In the 13th century Skoplje was taken by King Milutin of Serbia and made his capital, and his successor, Stephen Dushan was crowned here in 1346, and here composed his famous Code.

SKOPTSI, a secret religious sect of Russia. It is an offshoot of the sect known as the "People of God" or *Khlysti* (*see* Russia: *Religion*). It was in 1771 in the government of Orel that the Skoptsi were first discovered by the authorities. A peasant, Andrei Ivanov, was convicted of having persuaded thirteen other peasants to castrate themselves. His assistant was another peasant, known as Selivanov. A legal investigation followed. Ivanov was knouted and sent to Siberia: Selivanov fled, but was arrested in 1775. Skoptsism, however, increased, and Selivanov escaped from Siberia and proclaimed himself the Son of God incarnate in the person of Peter III. Peter had been popular among the *Raskolniki* (schismatics, or dissidents) because he granted them liberty of conscience, and among the peasants because when pillaging the convents he divided their lands among the labourers. Selivanov claimed the title "God of Gods and King of Kings," and announced his accomplishment of the salvation of believers through a self-inflicted mutilation. For eighteen years he lived in St. Petersburg, in the house of one of his disciples, receiving double homage as Christ and tsar. In 1797 he was rearrested by order of Paul I. and imprisoned in a madhouse. Under Alexander I. Selivanov regained his liberty, but in 1820 was again shut up, this time in a monastery at Suzdal, where he died in 1832 in his hundredth year. Skoptsism was, however, not exterminated, and grave scandals constantly arose. The most remarkable feature of this extraordinary sect has always been the type of people who joined it. Nobles, military and naval officers, civil servants, priests and merchants were to be found in its ranks, and so rapidly did the numbers increase that 515 men and 240 women were transported to Siberia between 1847 and 1866 without seriously threatening its existence. In 1872 many trials of Skoptsi took place all over Russia. In 1874 the sect numbered at least 5,444, including 1,465 women. Of these 703 men and 160 women had mutilated themselves. Repressive measures proving useless, an unsuccessful attempt was made to kill the sect by ridicule: Skoptsi were dressed up in women's clothes and paraded with fools' caps on through the villages. In 1876 130 Skoptsi were sentenced in a batch to transportation. To escape prosecution some of the sect have emigrated, generally to Rumania, where they are known as Lipovans. Of late years, there is said to be a tendency among many Skoptsi to consider their creed fulfilled by chaste living merely.

Bibliography.—*See* Anatole Leroy-Beaulieu, *The Empire of the Tsars* (Eng. trans., 1896), vol. iii.; E. Pelikan, *Geschichtlich-medizinische Untersuchungen über das Skopzentum in Russland* (Giessen, 1876); K. K. Grass, *Die geheime heilige Schrift der Skopzen* (Leipzig, 1904) and *Die russischen Sekten* (Leipzig, 1907, etc.).

SKOULOUDIS, STEPHEN (1836–1928), Greek statesman, a Chiot, was born an Ottoman subject, in Constantinople in 1836. He founded the Banque de Constantinople, and after retiring from business lived in Athens and became a Hellenic subject. He was several times elected member of the Greek chamber (1879 and 1892–1906). He was appointed minister in Spain in 1883, and minister of marine in the Trikoupis cabinet of 1892. As minister for foreign affairs in the Ralli cabinet of 1897, his knowledge of the Turks enabled him to exert his influence on the terms of peace after the war of 1897. He then resigned office, and retired into private life until 1912, when Venizelos obtained his appointment on the delegation to meet the Turks in London. In Nov. 1915 he became prime minister, in succession to Zaïmis. Soon after his appointment he announced his policy of benevolent neutrality. The confidence of the Allies was, however, shaken by his reported intention, at the instigation of German ministers, to disarm Serbian troops who were being forced into Greek territory by the German and Bulgarian advance, and the commercial blockade of Greece by the Allies (Nov. 18) was followed by an ultimatum which Skouloudis accepted. After six months' continued effort to satisfy both sides in the world conflict, Skouloudis resigned on June 19, 1916, shortly after the evacuation of Fort Rupel by the Greek garrison. A charge of treasonable correspondence was afterward brought against him, but was not proved. He died on Aug. 20, 1928.

SKOWHEGAN, the shire-town of Somerset county, Maine, U.S.A., on the Kennebec river, 40 m. N. of Augusta. It is on Federal highways 2 and 201, and is served by the Maine Central railroad. Pop. (1930) 6,433. The town has an area of 50 square miles. Water-power is abundant, and there is a large hydroelectric plant. The town manufactures woollens, worsteds, worsted yarns, shoes and various other commodities. Skowhegan was settled about 1770. It became a separate town in 1823, under the name of Milburn, and in 1836 adopted the old Indian name of the locality, said to mean a "spearing" or "watching" place.

SKRAM, PEDER (*c.* 1500–1581), Danish senator and naval hero, born between 1491 and 1503, at his father's estate at Urup near Horsens in Jutland. He first saw service in the Swedish war of Christian II. at the battle of Brannkyrka, 1518, and at the battle of Uppsala two years later he saved the life of the Danish standard-bearer. For his services he was rewarded with an estate in Norway. During "Grevens Fejde," or "the Count's War," Skram was sent by the Danish government to assist Gustavus Vasa, then in alliance with Christian III. against the partisans of Christian II., to organize the untried Swedish fleet; and Skram seems, for the point is still obscure, to have shared the chief command with the Swedish Admiral Måns Some. Skram greatly hampered the movements of the Hanseatic fleets who fought on the side of Christian II., captured a whole Lübeck squadron off Svendborg, and prevented the revictualling of Copenhagen by Lübeck. But the incurable suspicion of Gustavus I. minimized the successes of the allied fleets throughout 1535. Skram's services were richly rewarded by Christian III. As a senator he contributed to the victory of the Danish party over the German in the councils of Christian III. In 1555, feeling too infirm to go to sea, he resigned his post of admiral; but when the Scandinavian Seven Years' War broke out seven years later, the new king, Frederick II., offered Skram the chief command.

He put to sea in August 1562, and compelled the Swedish admiral, after a successful engagement off the coast of Gotland, to take refuge behind the Skerries. He was superseded at the end of the year by Herluf Trolle. Skram was twice (1565–1568) unsuccessfully besieged by the Swedes in his castle of Laholm, which he and his wife defended with great intrepidity. Skram died at Urup on July 11, 1581.

Skram's audacity won for him the nickname of "Denmark's dare-devil," and he contributed perhaps more than any other Dane of his day to destroy the Hanseatic dominion of the Baltic. His humanity was equally remarkable; he often imperilled his life by preventing his crews from plundering.

See Axel Larsen, *Dansk-Norske Heltehistorier* (Copenhagen, 1893).

SKRZYNECKI, JAN ZYGMUNT (1787–1860), Polish general, organised the Polish army at the revolution of 1830. After his defeat by Diebitsch at Ostrolenka he had to resign his command. He took refuge at Cracow, where he died.

SKRZYNSKI, ALEXANDER, Count (1882–), Polish statesman, was born at Zagorzany, Galicia. Educated at Cracow and Munich, he entered the diplomatic service in 1906 and was appointed secretary to the ambassador to the Holy See in 1910. When the World War broke out he was secretary to the Austro-Hungarian Ambassador in Paris. After a short military service at the beginning of the War, he completed his studies for the Bar, receiving the degree of Doctor of the Law at the University of Vienna. When the new Polish State was established, he was appointed Polish Minister Plenipotentiary at Bucharest, and later succeeded in concluding a Polish-Rumanian political treaty in 1921. In Dec. 1922, after the murder of Narutowicz, the first international President of the Republic, Skrzynski became Minister of Foreign Affairs. He threw himself energetically into the task of settling all open questions, inaugurated a pacific policy based on the final stabilisation of frontiers and gained the necessary confidence of the Powers. When a Cabinet of the Right was formed in May 1923, Skrzynski thereby lost office, and he was appointed in the following month Polish delegate to the League of Nations. In Aug. 1924 he again became Minister of Foreign Affairs in the Grabski Cabinet.

By a number of conventions, the regulation of the British and American debts, the concordat with the Vatican, the rapprochement with Czechoslovakia, Skrzynski strengthened Poland's international position, taking an active part in the League of Nations in elaborating the scheme for the Geneva Protocol and in securing settlement of the Danzig disputes in a manner favourable to Poland. He tried to disarm the suspicions of Moscow as to the new configuration of Europe by receiving Chicherin at Warsaw (Sept. 1924). In the negotiations in connection with the German proposals with regard to the Locarno Pact (1925), Skrzynski sought to reconcile Polish interests with the general scheme of the conference, and signed an arbitration agreement with Germany and also a convention with France in accordance therewith. After the fall of Grabski's Government Nov. 13, 1925, Skrzynski was entrusted with the formation of a government by Wojciechowski, the President of the Republic, and with the participation of the Socialists formed a coalition cabinet in which he himself was Prime Minister and Minister of Foreign Affairs. In May 1926, however, the Socialists seceded from the Cabinet on account of the refusal of their financial proposals, which involved inflation. After the Pilsudski *coup d'état* of that month Skrzynski remained in retirement. *See* also Poland.

SKUA, sea-birds forming the genus *Stercorarius* of the *Laridae* (*see* Gull). Except during the breeding season, when they obtain their own food, the skuas live almost exclusively by preying upon gulls, which they compel to disgorge what they have caught. For this purpose they are swift of flight, powerfully armed and endowed with great courage. The largest species, equalling a herring gull (*Larus argentatus*) in size, is *S. skua,* the great skua or bonxie. The plumage is dark brown above, lighter beneath, with a patch of white at the base of the primaries. It breeds in the Faeroes, Shetlands, and Iceland, laying its two dark olive eggs in a nest in the heather. Out of the breeding season it occurs all over the north Atlantic. *S. antarcticus,* the Port Egmont hen, from the Pacific, closely resembles it. Maccormick's skua (*S. maccormicki*) breeds on the Antarctic continent, where it plunders the penguin colonies.

The Arctic or Richardson's skua (*S. crepidatus*) is interesting as showing great variety in the colour of the underside from dark to white, with a thin dark collar. In the Arctic, skuas nest only in years when food is plentiful. The skuas have a remarkable injury-feigning performance to lure intruders from the nest. If this does not succeed, they swoop at the intruder's head. Some species may strike severe blows. American ornithologists assign three of the skuas, which they call jaegers, to the genus *Stercorarius:* the pomarine jaeger (*S. pomarinus*), the parasitic jaeger (*S. parasiticus*), and the long-tailed jaeger (*S. longicaudus*).

SKULL, the skeleton of the head, composed of 22 bones, 8 of which form the skeleton of the cranium, 14 that of the face. Except the lower jaw, which is movable, the bones are united by immovable joints. In the following article the skull is considered as a whole, and for this purpose a normal European skull is studied from in front, from above, from the side, from behind and from below. Afterwards the interior is considered by means of sections.

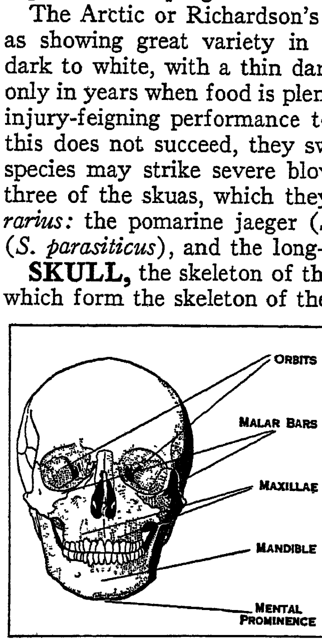


Fig. 1.—Skull, full faced

The Skull from in Front (*see* fig. 1).—The forehead region is formed by the frontal bone, the two halves of which usually unite in the second year. The lower limit of the forehead is formed by the upper margin of the orbit on each side, and by the articulation between the frontal and nasal bones near the mid line. At the junction of the inner and middle third of each supra-orbital margin is the supra-orbital notch for the nerve of that name. Above each supra-orbital margin is an elevation, better marked in adult males, called the supra-ciliary ridge, while between these ridges in the middle line there is a slight prominence, the *glabella.* Below the forehead the two *nasal bones* form the skeleton of the upper part of the nose; they articulate with one another in the mid line, but laterally they are joined by a suture to the nasal processes of the maxillae which run up to articulate with the frontal at the internal orbital process, thus forming the inner margin of the orbit.

Externally the malar bones articulate with the frontal at the external orbital process and form the lower and outer quadrant of the orbital margin.

The *maxillae* or upper jaws form the greater part of the skeleton of the face; they complete the lower and inner quadrant of the orbit, and below the nasal bones leave the anterior nasal aperture between them, and project slightly at the middle of the lower border of this aperture to form the anterior nasal spine. About a quarter of an inch below the infra-orbital margin and just below the articulation with the malar the *infra-orbital foramen,* for the infra-orbital branch of the fifth nerve, is seen on each side. The lower parts of the maxillae form the *alveolar margin* in which all the upper teeth are set. Laterally each maxilla is prolonged out into the *zygomatic process,* which supports the malar bone.

Below the maxillae the *mandible* or lower jaw is seen in perspective. The horizontal part or body is in two halves up to the second year, but after that complete bony union takes place, forming the symphysis. Above the body of the mandible is an alveolar margin containing the sockets of the lower teeth, while below, near the mid line, the bone projects forward to a variable extent and so forms the *mental prominence,* one of the special characteristics of a human skull. Below the second bicuspid tooth on each side is the *mental foramen* for the exit of the mental branch of the fifth nerve.

The Orbit.—Each orbit is a pyramidal cavity, the base of the pyramid being in front and the apex behind, at the optic foramen, where the optic nerve and ophthalmic artery pass through. The four sides of the pyramid form the roof, floor, inner and outer

walls of the orbit. The roof and floor are arched from side to side, the inner wall is antero-posterior and parallel with its fellow of the opposite orbit; the outer wall slopes backward and inward, the two opposite sides therefore converge as they run back. Seven bones enter into the composition of the orbit, viz. the frontal, sphenoid, maxilla, malar, lacrymal, ethnoid and palate. Between the roof and the outer wall, behind, is a slit in the *sphenoidal fis-*

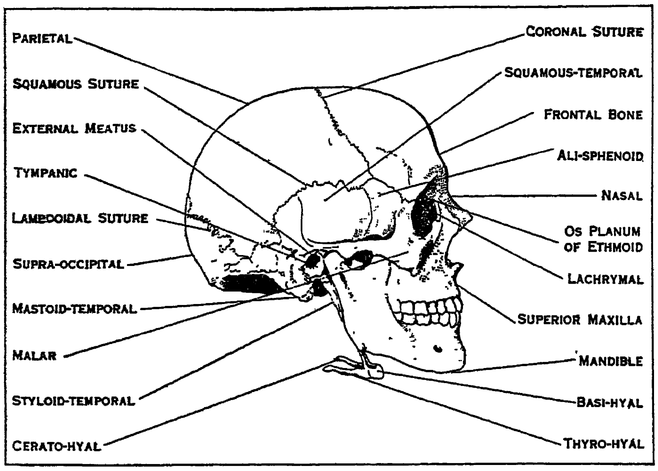


FIG. 2.—PROFILE OF THE SKULL

sure which transmits the third, fourth, first division of the fifth and sixth cranial nerves and the ophthalmic vein. Another slit (*spheno-maxillary fissure*) lies in the line of junction of the outer wall and floor, it leads into the spheno-maxillary and zygomatic fossae and transmits the second division of the fifth nerve and some veins.

The Skull from Above.—When looked at from above the frontal bone is seen forming the anterior part of the vertex and articulating with the two parietals posteriorly by a nearly transverse serrated suture (*coronal suture*). Running back from the middle of this is the median *sagittal suture* extending as far as the lambda behind. The point where the sagittal and coronal sutures join is the *bregma,* the site of the lozenge-shaped *anterior fontanelle* in the infant's skull, but this closes during the second year of life. Small ossicles called *Wormian bones* are often found in the cranial sutures. About two-thirds of the way back the sagittal suture becomes less serrated and on each side the small *parietal foramen* may be seen. This only transmits a small emissary vein (*see* VEINS) in the adult, but, as will be seen later, is of morphological interest. As middle life is reached, the cranial sutures tend to become obliterated and the bones can no longer be separated; this fusion begins at the places where the sutures are least deeply serrated, and as a rule the sagittal suture disappears between the two parietal foramina between thirty and forty years of age.

The Skull from the Side (fig. 2).—The *calvaria* or brain case forms all the upper part, while the face is below the anterior half. Taking the calvaria first the side view of the frontal bone extends back as far as the coronal suture. On each side is an elevation, *the frontal eminence,* better seen in female than in male skulls. The junction between the frontal and malar at the outer margin of the orbit (*external angular process*) is an important landmark for measurements, and from it a curved line (the temporal crest) runs back crossing the coronal suture to reach the parietal bone; as it runs back this line divides into two. The quadrilateral outline of the parietal bone is seen as well as its articulations; above it touches its fellow of the opposite side; in front, the frontal; below, the great wing of the sphenoid or alisphenoid, the squamous part of the temporal and the mastoid part of the temporal, while behind it articulates with the supra-occipital, through the lambdoid suture. All four angles of the parietal are points of special interest; the antero-superior angle or *bregma* lies nearly above the ear opening or *external auditory meatus* in the temporal bone. The antero-inferior angle where the frontal, parietal and alisphenoid meet is the *pterion* and is the site of an occasional Wormian bone. The posterior superior angle is the lambda and is better seen behind while the posterior inferior angle, where the parietal, supra-occipital and mastoid temporal bones meet, is known as the *asterion* and marks the lateral sinus within the cranium. A little above and behind the middle of the parietal bone, and just above the superior temporal crest, is the *parietal eminence* where ossification starts. The *squamous part of the temporal bone* overlaps the parietal at the *squamous suture,* while from its lower part the *zygomatic process* projects forward to articulate with the malar. At the root of this process is the *glenoid cavity* where the condyle of the lower jaw articulates, and just behind this is the *external auditory meatus.* Behind this again the mastoid temporal is prolonged down into a nipple-shaped swelling, the *mastoid process,* containing air cells and only found in the adult human skull, while just in front of the external auditory meatus is the *styloid process,* connected with the hyoid bone by the stylo-hyoid ligament (dotted). In the side view of the face the nasal and maxillary bones are seen, and from this point of view it will be noticed that just below the nasal aperture the maxillae, where they join, are produced forward into a little spur, *the anterior nasal spine,* which is a purely human characteristic. At the side of the maxilla the lozenge-shaped *malar* bone is placed; it forms the anterior part of the zygomatic arch. When the mandible is disarticulated and removed the posterior part of the maxilla is seen, and behind it the *external pterygoid plate* of the sphenoid. Between these two bones there is a vertical slit-like opening into a cave, the *spheno-maxillary fossa,* which communicates with the orbit through the *spheno-maxillary fissure,* with the nasal cavity through the *spheno-palatine foramen,* with the cranial cavity through the *foramen rotundum,* and with the mouth through the *posterior palatine canal,* as well as having other smaller openings.

The side view of the *mandible* or lower jaw shows the body, and the ramus projecting up from the back part of it at an angle of from 110° to 120° in the adult. Before the teeth come and after they are lost the angle is greater. At the upper part of the ramus are two projections; the most anterior is the *coronoid process* for the attachment of the temporal muscle, while posteriorly is the *condyle* which articulates with the glenoid cavity of the temporal bone.

The Skull from Behind.—From this point of view the posterior ends of the parietal bones, with the sagittal suture between them, are seen. Below these comes the *supra-occipital bone* separated from them by the *lambdoid suture* which is deeply serrated and a frequent site of Wormian bones. Where the sagittal and lambdoid sutures meet is the *lambda.* In the mid line about a hand's breadth (2¾–3in.) below the lambda is the *external occipital protuberance* or *inion,* for the attachment of the *ligamentum nuchae,* while running out on each side from this are the *superior curved lines* which attach muscles of the neck.

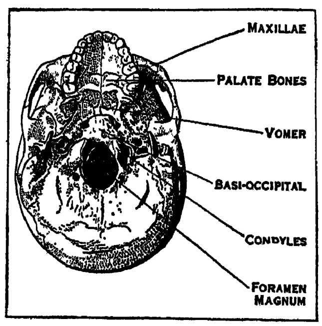


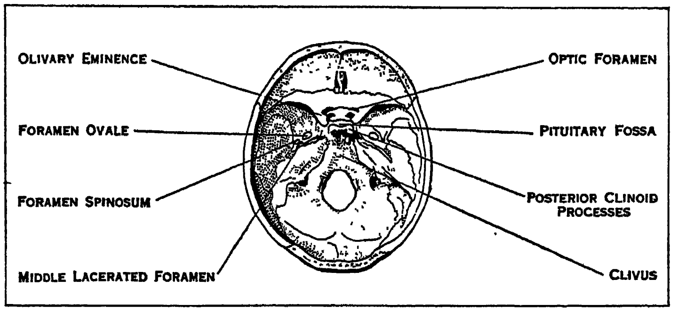
FIG. 3.—SKULL FROM BELOW

The Skull from Below (fig. 3).—Starting from in front, the *superior alveolar arcade* with the teeth sockets is seen. This in a European skull approaches a semicircle, but in lower races the sides become more parallel. Within the arcade is the *hard palate* formed by the maxillae in front, and the palate bones behind. At the front of the median suture between the maxillae is the *anterior palatine canal.* In young skulls a suture runs outward from the anterior palatine canal to between the lateral incisor and canine sockets, and sometimes another runs from the same place to between the central and lateral incisor teeth.

At each postero-lateral angle of the palate are the posterior palatine canals for the descending palatine nerves. The posterior margin of the hard palate is a free edge which forms the lower boundary of the *posterior nasal apertures* and attaches the soft palate (*see* PHARYNX). Behind the alveolar arcade on each side are the *external* and *internal pterygoid plates* of the sphenoid;

the external is a muscular process for the attachment of the pterygoid muscles, while the internal ends below in the hook-like hamular process which is directed backward and outward. Dividing the posterior nasal aperture into two is the vertical hind edge of the *vomer,* which articulates above with the body of the sphenoid (basi-sphenoid), and just behind this the sphenoid is united by bone with the basioccipital, though up to twenty years of age there is a synchrondrosis (*see* JOINTS) called the *basilar suture* between them. Passing back in the mid line the *foramen magnum* is seen, through which pass the spinal cord and its membranes, the vertebral arteries and the spinal accessory nerves. A little in front of this is a small tubercle, the *pharyngeal spine,* to which the constrictors of the pharynx are attached. On each side of the foramen magnum and in front of its mid transverse diameter are the condyles, which articulate with the atlas, while just above these are the *anterior condylar foramina,* one on each side, for the exit of the hypoglossal nerves.

External to the pterygoid plates the base of the skull is formed by the ali-sphenoid, which projects backward into a point, *the spine of the sphenoid,* and just in front of this is the small *foramen spinosum* for the passage of the middle meningeal artery. In front and a little internal to the foramen spinosum is a larger opening, the *foramen ovale,* through which the third division of the fifth nerve leaves the skull. Into the re-entering angle between the ali-sphenoid and basi-occipital is fitted the *petrous part of the temporal,* which, however, does not quite fill the gap but leaves a space on each side of the site of the basilar suture to be closed in by fibro-cartilage, and this is known as the *middle lacerated foramen.* On the lower surface of the petrous bone is the round opening of the *carotid canal* through which the internal carotid artery and its accompanying sympathetic nerves pass into the skull, while more externally the *styloid process* projects downward and forward. Between the styloid process and the occipital condyle lies the *jugular* or *posterior lacerated foramen* through which pass the lateral and inferior petrosal sinuses, and the glosso-pharyngeal, vagus and spinal accessory nerves. The bone which bounds this foramen behind, and bears the posterior two-thirds of the occipital condyle, is the *ex-occipital* part of the occipital. A little behind and external to the styloid process is the tip of the mastoid process, just internal to which is the deep antero-posterior groove for the digastric muscle, and internal to that another slighter groove for the occipital artery. Behind the styloid process and between it and the mastoid is the stylo-mastoid foramen through which the facial nerve passes, while in front of the process the glenoid cavity can be seen in its entirety, bounded in front by the *eminentia articularis* and divided into an anterior part and a posterior *tympanic plate* by the *Glaserian fissure.* Just internal



FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 4.—BASE OF THE SKULL SHOWING INTERNAL ASPECT

to the glenoid cavity is the opening of the bony *Eustachian tube.*

The posterior part of the base behind the foramen magnum is formed by the *supra-occipital* part of the occipital bone, so that all the four parts of the bone, which are separate up to the third year, help in the formation of that large opening. Between the foramen magnum and the external occipital protuberance and superior curved line already noticed, the bone attaches the deep muscles of the neck.

The Interior of the Cranium (fig. 4).—If the roof of the skull be sawn off the interior or cerebral surface of both the vault and the base may be examined. The vault shows the cerebral aspects of parts of the frontal, parietal and occipital bones, and of the sutures between them. In the mid line is a shallow antero-posterior groove for the superior longitudinal blood sinus, and on each side of this irregular depressions are often seen for the Pacchionian bodies (*see* BRAIN). The *base* is divided into three fossae, anterior, middle and posterior, each being behind and on a lower level than the one in front of it.

The *anterior cranial fossa* is formed by the *cribriform plate of the ethmoid,* near the mid line, freely perforated for the passage of the olfactory nerves. In the mid line, near the front, is a triangular plate rising up which attaches the falx cerebri (*see* BRAIN) and is called the *crista galli.* On each side of this is the *nasal slit* for the nasal branch of the first division of the fifth nerve. On each side of the cribriform plate is the *orbital plate* of the frontal, while the back part of the fossa has for its floor the body of the sphenoid (pre-sphenoid) near the mid line and the lesser wing (*orbito-sphenoid*) on each side. Each lesser wing is prolonged back into a tongue-like process, the *anterior clinoid process,* just internal to which is the *optic foramen,* and the two foramina are joined by the *optic groove* for the optic commissure. Behind this groove is a transverse elevation, the *olivary eminence,* which marks the junction of the *pre-* and *basi-sphenoid* parts of the body of the sphenoid bone.

The *middle cranial fossa* is like an hour-glass placed transversely, as there is a central constricted, and two lateral expanded, parts. The central part forms the *pituitary fossa* for the pituitary body (*see* BRAIN) and is bounded behind by the wall-like *dorsum sellae,* at the sides of which are the *posterior clinoid processes.* The olivary eminence, pituitary fossa and dorsum sellae together resemble a Turkish saddle and are often called the *sella turcica.* The lateral expanded part of the middle cranial fossa is bounded in front by the great wing of the sphenoid (alisphenoid), behind by the front of the petrous part of the temporal (*periotic*) and laterally by the squamous part of the temporal (*squamosal*). Between the alisphenoid and orbitosphenoid is the *sphenoidal fissure* already noticed in the orbit, and a little behind this, piercing the alisphenoid, is the posterior opening of the *foramen rotundum,* through which the second division of the fifth nerve passes into the spheno-maxillary fossa. Further back the alisphenoid is pierced by the foramen ovale and foramen spinosum, both of which have been already noticed. From the latter a groove for the middle meningeal artery runs forward and outward, and soon divides into anterior and posterior branches, the former of which deepens into a tunnel near the pterion. At the apex of the petrous bone and at the side of the dorsum sellae is the *middle lacerated foramen,* already noticed, and running inward to this from an aperture in the petrous bone is a groove for the great superficial petrosal nerve which is overlaid by the Gasserian ganglion of the fifth nerve.

The *posterior cranial fossa* is pentagonal in outline, having an anterior border formed by the dorsum sellae, two antero-lateral borders, by the upper borders of the petrous bones, and two postero-lateral curved borders, by the grooves for the lateral sinuses. In the middle of this fossa is the foramen magnum. In front of the foramen magnum the floor of the fossa is formed by the basi-occipital and basi-sphenoid bones, which unite soon after twenty and form a steep slope, downward and backward, known as the *clivus.* This is slightly grooved from side to side, and lodges the pons and medulla (*see* BRAIN) and the basilar artery.

On each side of the basi-occipital the posterior surface of the petrous bone bounds the fossa, and lying over the suture between them is the groove for the inferior petrosal venous sinus which leads backward and outward to the *jugular foramen* already noticed. About the middle of the posterior surface of the petrous bone is the *internal auditory meatus,* through which pass the facial and auditory nerves, the pars intermedia (*see* NERVES, CRANIAL) and the auditory artery. Close to the antero-lateral part of the foramen magnum is the inner opening of the *anterior condylar foramen* which is sometimes double for the two bundles of the hypoglossal nerve, and a little in front of and outside this is a heaping up of bone called the *tuberculum jugulare,* which marks

the union of the basi- and ex-occipital bones. The hindmost limit of the posterior fossa in the mid line is marked by an elevation called the *internal occipital protuberance,* and at this point the grooves for the superior longitudinal, and two lateral sinuses join to form the *torcular Herophili* (*see* VEINS). Running from the internal occipital protuberance toward the foramen magnum in the mid line is the *internal occipital crest,* which attaches the

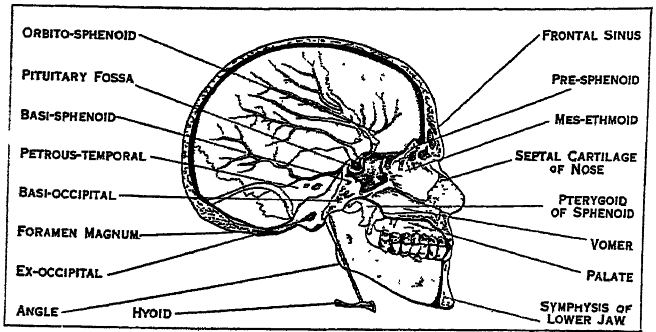
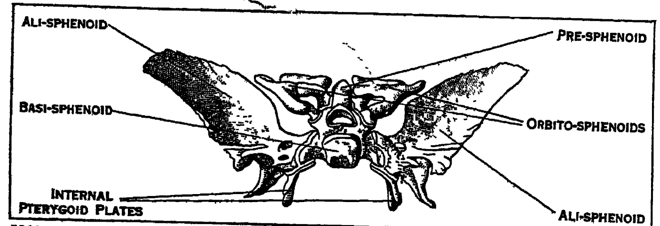


FIG. 5.—SECTION THROUGH THE SKULL IMMEDIATELY TO THE RIGHT OF THE MESIAL PLANE

falx cerebelli (*see* BRAIN) and on each side of this is the cerebellar fossa.

From the internal occipital protuberance the two wide grooves for the lateral venous sinuses run nearly horizontally outward till they reach the posterior inferior angles of the parietal bones; here they turn downward with an **S**-shaped curve, grooving the mastoid portion of the temporal and later on the exoccipital bones, until they reach the jugular foramina. To the edges of the horizontal parts of these grooves, and to the upper edge of the petrous bones the tentorium cerebelli is attached.

The Skull in Sagittal Section.—If the skull be sawn down just to the right of the mid line and the left half be looked at, the appearance will be that reproduced in fig. 5. The section of the cranial bones shows that they are formed of an *outer* and *inner table* of hard bone, while between the two is a layer of cancellous tissue called the *diploë.* In certain places the diploë is invaded by ingrowths from the air passage which separate the two tables and form the air sinuses of the skull, though it is important not to confuse these with the intracranial blood or venous sinuses. In the section under consideration two of these spaces, the *frontal* and the *sphenoidal air sinuses* are seen. Behind the frontal sinus is the *crista galli* already mentioned, while below is the bony septum of the nose formed, by the *mes-ethmoid plate,* the *vomer* and the line of junction of the palatine processes of the two maxillae and two palate bones. The re-entering angle between the mes-



FROM ARTHUR THOMPSON IN CUNNINGHAM, "TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 6.—OSSIFICATION OF SPHENOID

ethmoid and vomer is filled in the recent state by the septal cartilage.

Below the face is the inner surface of the body and ramus of the *mandible,* and half-way down the latter is the *inferior dental foramen* where the inferior dental branch of the fifth nerve accompanied by its artery passes into the *inferior dental canal* in the substance of the bone to supply the lower teeth.

If the cut surface of the right half of the skull be looked at, the outer wall of the nasal cavity will be seen with the three turbinated bones each overhanging its own meatus, but the anatomy of this part has already been dealt with in the article on the olfactory system (*q.v.*).

For further details *see* any standard anatomical textbook—Quain, Gray, Cunningham, etc.

EMBRYOLOGY

The *notochord* (*see* SKELETON: *Axial*) extends forward to the ventral surface of the middle cerebral vesicle (*see* BRAIN) or as far as the place where the dorsum sellae will be. It is partly surrounded by the mesenchyme just as it is completely in the rest of the axial skeleton, and this mesenchyme extends dorsally on each side to wrap round the nerve cord, which is here the brain. In this way the brain becomes enclosed in a primitive membranous cranium, the inner part of which persists in its primitive condition as the dura mater, while the outer part may chondrify, chondrify and ossify, or ossify without a cartilage stage. On each side of the notochord a basicranial plate of cartilage is formed which soon meets its fellow of the opposite side, and forms the floor of the skull as far forward as the dorsum sellae, and as far back as the external occipital protuberance. Laterally it comes in contact with the mesenchyme surrounding the internal ear, which is also chondrifying to form the cartilaginous *periotic capsule,* and the two structures fuse together to form a continuous floor for the back of the skull. In the hinder occipital region of the calf there are evidences of four vertebrae having been incorporated with the basicranial plate, that is to say that the plate and its coalesced vertebrae represent five mesodermic somites. The same is true for man. Moreover, the primitive membranous skull shows signs of metameric segmentation in the way in which the cranial nerves pierce the dura mater one behind the other. These segments, however, had lost their distinctness even before the cartilaginous cranium had become developed, so that there is no real segmental value in the elements of this, still less in those of the bony skull. The only place in which segmental elements can be distinguished is in the occipital region, which is in structure transitional between the head and vertebral column. The notochord, it has been shown, ends just behind the place where the stomodaeum pouches up through the cranial base to form the anterior part of the pituitary body (*see* BRAIN). Where it ends two curved bars of cartilage are formed, which run forward till they meet the olfactory capsules, which are also now chondrifying. These bars are the *prechordal cartilages* or *trabeculae cranii* and enclose between them the *cranio-pharyngeal canal* by which the pituitary body ascends, but later on, as they grow, they join together and cut off the pituitary body from the pharynx. By the growth outward they form the floor of the prechordal part of the chondro-cranium, so that from them is developed that part of the cartilaginous skull which will later on be part of the basisphenoid, the presphenoid, orbitosphenoid and alisphenoid regions. It was assumed that this process held good for man, but later research showed that the anterior part of the base of the skull chondrifies in the same way that ice appears on a pond and that the trabeculae are at no time definite structures. Chondrification of the nasal capsules is later than that of the parts of the skull behind, so that there is a steady progress in the process from the occipital to the ethmoidal region. There is a median centre of chondrification, the *mesethmoid cartilage,* which projects down into the fronto-nasal process (*see* OLFACTORY SYSTEM), and two lateral *ectethmoid cartilages* which eventually join with the mesethmoid to form the cartilaginous ethmoid.

The cartilaginous base of the cranium is now formed, but the vault is membranous. While the base has been developing the two anterior visceral arches have been also forming and have gained an attachment to the cranium, but the formation and fate of these is recorded in the article SKELETON (*Visceral*). About the sixth week of foetal life ossification begins at different points in the membranous vault of the skull. In this way the frontal, parietal, supra-occipital, and a little later the squamous part of the temporal bones are formed. About the eighth week, too, the lachrymal, nasal and vomer appear in the membrane lying superficial to different parts of the olfactory capsule. All these are dermal bones, comparable to the deeper parts of the scales of fishes, and developed in the mesenchyme lying deep to and in contact with the ectoderm. It is therefore necessary to think of the primitive skull as a three-layered structure, the deepest layer persisting as

the dura mater, the middle forming the chondro-cranium, which ossifies to form the base, and a superficial layer close to the skin or mucous membrane (ectoderm), from which the bones of the vault and superficial parts of the olfactory capsules are derived. At the four angles of the parietal, ossification is checked for some time to form *fontanelles,* of which the *bregma* is the most important, and at each of these points, as well as elsewhere in the sutures, accessory centres of ossification may occur to form *Wormian bones.*

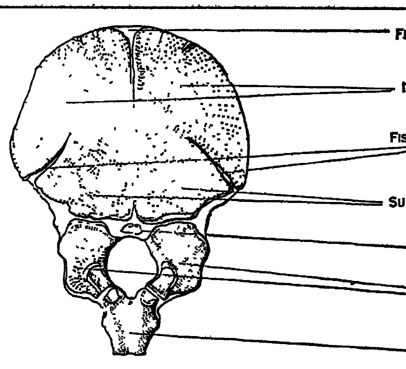
Along the middle line of the base of the skull the same progress of ossification from behind forward is seen that was noticed in the process of chondrification. Bilateral centres for the basioccipital appear about the sixth week, for the basisphenoid in the eighth, and for the presphenoid in the tenth, while the lateral mass of the ethmoid does not ossify till the fifth month and the mesethmoid not until the first year of extrauterine life. In the lateral part of the base the exoccipitals and alisphenoids begin to ossify about the eighth week and the presphenoids about the tenth. In connection with the alisphenoid there is a small extra centre of morphological interest only, which forms a little tongue-shaped process called the *lingula,* projecting back into the middle lacerated foramen and apparently corresponding to the *sphenotic* bone of lower vertebrates.

The auditory or *periotic capsule,* like the olfactory, is late in ossifying; it has four centres (pro-otic, epiotic, opisthotic and pterotic) which do not come until the fifth month.

Some parts of the chondro-cranium do not ossify at all; this is the case in the anterior part of the mesethmoid, which remains as the septal cartilage of the nose, while, as has been already pointed out, a buffer of cartilage persists between the basioccipital and basisphenoid until the twentieth year of life.

From what has been said it is evident, and it will be still more evident if the article Skeleton (*Visceral*) be looked at, that some of the bones of the adult skull are compounded of various contributions from the different elements which make up the adult cranium. These, recapitulated, are (1) the dura mater or endocranium, which in man does not ossify except perhaps in the crista galli. (2) The chondro-cranium or mesocranium. (3) The superficial part of the mesenchyme (ectocranium) from which dermal bones are formed. (4) The olfactory and auditory sense capsules. (5) The visceral arches. (6) Some fused vertebrae posteriorly.

The occipital bone (fig. 7) for example, has the basioccipital, exoccipital and basal part of the supra-occipital derived from the



FROM ARTHUR THOMPSON IN CUNNINGHAM, "TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 7.—OSSIFICATION OF OCCIPITAL BONE

chondro-cranium and fused vertebrae, while the vault part of the supra-occipital has four dermal centres of ossification corresponding to the interparietal and preinterparietal bones of lower mammals. The bone of Kerkring is an abnormality, the meaning of which is not understood.

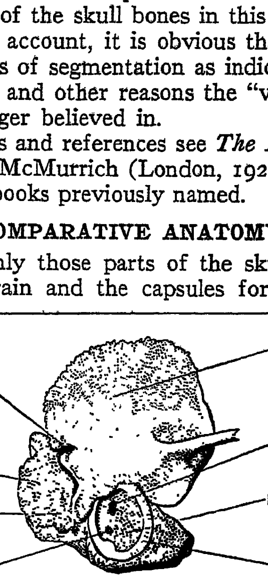
The temporal (fig. 8) is also a very composite bone; in it the petro-mastoid portion represents the auditory sense capsule; the tabular external auditory meatus is formed by the outgrowth of the tympanic ring which is probably part of the first visceral arch (*see* Skeleton, *Visceral*); the squamo-zygomatic part is a dermal bone, while the styloid process is a part of the second visceral arch.

The mastoid process is not present at birth, but appears about the second year and becomes pneumatic about puberty. From what has been seen of the skull bones in this necessarily concentrated and abridged account, it is obvious that they do not correspond to the traces of segmentation as indicated by the cranial nerves, and for this and other reasons the "vertebrate theory of the skull" is no longer believed in.

For further details and references see ***The Development of the Human Body,*** J. P. McMurrich (London, 1923) and other standard anatomical textbooks previously named.

COMPARATIVE ANATOMY

In this section only those parts of the skull which form the covering for the brain and the capsules for the olfactory and



FROM ARTHUR THOMPSON IN CUNNINGHAM, "TEXTBOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 8.—OUTER SURFACE OF THE RIGHT TEMPORAL BONE AT BIRTH

auditory apparatus are considered. Those parts of the face and jaws which are developed in connection with the visceral arches are dealt with in the article Skeleton (*Visceral*). In the Acrania (Amphioxus) the enlarged anterior end of the nerve cord is merely surrounded by fibrous tissue continuous with the sheath of the rest of the nerve cord; there is therefore, in a sense, no true cranium.

In the Cyclostomata (hags and lampreys) a cartilaginous cranium is developed, the anterior part of which forms an unpaired olfactory capsule connected with the rest of the cranium by fibrous tissue only. In the floor, just in front of the anterior end of the notochord, an aperture; the *basi-cranial fontanelle,* remains unchondrified for the passage of the pituitary diverticulum into the skull.

In the Elasmobranchii (sharks and rays) and Holocephali (Chimaera) among the fishes the skull is still a complete cartilaginous box, though calcification of the cartilage often takes place. Taking the skull of the dogfish as a type, two large olfactory capsules are seen in front, and behind these the cranial brain-box is narrowed, being excavated at its sides for the great orbits. More posteriorly the auditory capsules widen the skull, and on the posterior (caudal) aspect the foramen magnum is seen with an occipital condyle on each side of it for the first vertebra to articulate with. On the upper (dorsal) surface of the skull are two apertures in the middle line; the more anterior of these forms a rudimentary median orbit for the pineal eye (*see* Brain). The posterior fontanelle is a depression which leads into two lateral tubes, each of which passes into the auditory capsule and is known as an *aqueductus vestibuli* (*see* Ear).

In the cartilaginous ganoid fishes (sturgeon), which, like the elasmobranchs, are of great antiquity, the chondro-cranium is partly ossified so that ali- and orbito-sphenoids are found; in addition to this a large number of dermal bones have made their appearance, such as *nasals, frontals, parietals, supra* and *post temporals,* while in the roof of the mouth and pharynx a long membrane bone, the *parasphenoid,* is formed, and lies ventral to and strengthens the cartilaginous base of the skull. These fish are important morphological landmarks, because in them the almost unchanged chondro-cranium coexists with a dermal ectocranium.

In the bony ganoids such as the "bow fin" (Amia) the dermal bones are still more numerous and, among others, squamosals, pro-otics and exoccipitals appear. These fish are also remarkable for a fusion of the anterior part of the vertebral column with the

occipital region of the skull, an arrangement recalling that in the skull of the calf embryo mentioned in the section on embryology.

In the bony fishes (Teleostei) the membrane or dermal bones are still more numerous, and many of them are unrepresented in the mammalian skull, while others, which are there quite rudimentary, are very large. The chondro-cranium tends to disappear in the vault, but the base is fully ossified. Among other cartilage bones the five ossifications of the auditory capsule are seen, the pro-, epi-, opisth-, pter- and sphen-otics, all of which are found as centres of ossification in man. In the cod, for example, the sphenotic, which is represented in man by the little lingula sphenoidalis, is larger than the alisphenoid.

In the Dipnoi (mud-fish) the chondro-cranium is very slightly ossified, only exoccipitals being found, but there is the same coalescence with anterior vertebrae which was noticed in the ganoids. Dermal bones are plentiful.

In the Amphibia the chondro-cranium persists and is only ossified in front by the girdle bone or sphenethmoid, and behind by the pro-otics and exoccipitals, the latter of which bear the two condyles. The anterior fontanelle is well marked in the chondro-cranium, but is completely overlaid and concealed by the dermal fronto-parietals. The membrane bones though large are much less numerous than in the bony fishes.

In the Reptilia the skull varies immensely in the different orders, but speaking broadly, the chondro-cranium is less distinct than in the Amphibia, except in the ethmoidal region. In the base of the skull the basioccipital and basisphenoid are tending to replace the membranous parasphenoid, and instead of two exoccipital condyles only one in the mid line is present, though this in many forms (*e.g.*, Chelonia) consists of three parts, a median borne on the basioccipital and two lateral on the exoccipitals. The parietal foramen is usually definitely marked in the dermal part of the skull and forms a median orbit for the pineal eye; this is especially the case in the Lacertilia (lizards). Except in the Ophidia (snakes) and Amphisbaenidae (worm-like lizards) there is a fibro-cartilaginous septum between the orbits so that the cranial cavity does not reach forward to the ethmoidal region. The pro-, epi- and opisthotic bones are all developed, but the epiotic usually fuses with the supra-occipital and the opisthotic with the exoccipital.

In the Crocodilia the first attempt at pneumaticity is seen in the basisphenoid, which is traversed by a complicated system of Eustachian passages leading eventually to the tympanum. In the class Aves the general scheme of the reptilian skull is maintained, though the bones fuse together very early, thus obliterating the sutures between them. Almost all of them have air in their interior, and so are said to be pneumatic.

The single occipital condyle, if looked at in a young specimen, is seen to consist of a basioccipital and two exoccipital elements, though these are indistinguishable in the adult. The parasphenoid is represented by a broad plate which is called the basitemporal. The pro-, epi- and opisth-otic bones fuse together to form the auditory capsule.

In the Mammalia the calvaria varies considerably in the different orders, the characteristic features being best marked in adult males. Usually the different bones are interlocked by sutures, as in man, until adult life, but in some orders (*e.g.*, Monotremata, Edentata and Carnivora) they fuse together quite early.

In the basicranium the cartilage bones presphenoid, basisphenoid and basioccipital, are so well developed that the parasphenoid has disappeared. In the basisphenoid of the rabbit the craniopharyngeal canal (*see* section on embryology) persists as a foramen at the bottom of the pituitary fossa. In the lower orders the face lies well in front of the brain case, as it does in reptiles and amphibians, but as the Primates are reached the increasing size of the calvaria causes it to overlie the face. Many of the bones are pneumatic, the process reaching its maximum in the elephant and the adult male gorilla. The periotic capsule blends with the squamosal and tympanic to form the petrous bone, though it is practically only in man that the second visceral arch ossifies on to this as a styloid process. There are usually two occipital condyles which have basi- and exoccipital elements, though there are many mammals in which there is one large crescentic condyle surrounding the anterior half of the foramen magnum.

Ossification of the processes of the dura mater occurs in the tentorium cerebelli of the carnivora and in the falx cerebri of the ornithorhynchus and porpoise. The orbits are in most mammals continuous with the temporal fossae. Sometimes, as in many of the ungulates and in the lemurs, they are outlined by a bony ring, but it is not until the higher Primates are reached that the two cavities are shut off and even then a vestige of their original continuity remains in the spheno-maxillary fissure.

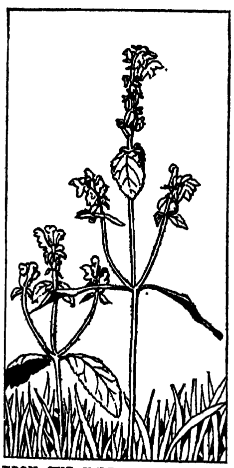
Bibliography.—A. A. R. Green, *An X-Ray Atlas of the Skull* (1918); J. R. Whitaker, *Anatomy of Brain & Spinal Cord*. For other works *see* bibl. of Skeleton. (F. G. P.)

SKULL, SURGERY OF. Fractures of the vault of the skull may occur without the bone being driven in to compress the brain, and in such cases their existence may be revealed only after death. But if there is also a severe scalp wound the line of fracture may be traced in the bare bone as a thin red crack. The patient with a suspected fracture of the skull is put to bed in a dark, quiet room, and is watched. It may be that the crack has extended across a bony groove in which an artery is running, and, the artery being torn, haemorrhage may take place within the skull and symptoms of compression of the brain may supervene.

Compression of the brain may be the direct and immediate result of a head-injury, a piece of the vault of the skull being driven in, and a local or a general paralysis of muscles being at once observed. In addition to the muscular paralysis, there may be insensibility, laborious breathing, dilated pupils that do not react to light. In such cases the treatment is trephining.

Fractures of the base of the skull are always serious, in that they may run across important nerves and large blood-vessels; passing through the roof of the nose, or the ear, they may communicate with air-cavities. Thus, the dangers of sepsis are added to those of concussion or compression of the brain. Fractures of the base of the skull are often associated with bleeding from the nose, mouth or ear, or with extravasation of blood over the eyeball. Facial paralysis is the result of the line of fracture passing across the bony channel in which the seventh or facial nerve is running. When the fracture passes across the temporal bone and the middle ear, and ruptures the membrane of the tympanum, not only blood may escape from the ear, but an apparently unlimited amount of cerebro-spinal fluid. When the fracture extends through the anterior part of the base of the skull this same clear fluid may escape from the nose. In both cases its appearance implies that the dura mater has been lacerated and the sub-dural space opened.

Concussion of the brain (stunning) may result from a blow upon the head or from a fall from a height. The symptoms may be those of mere giddiness and a feeling of stupidity, which may quickly pass off, or they may be those of severe shock (*see* Shock). The person may die from the concussion, or he may slowly or quickly recover. As a rule, the pupils react to light. One of the first signs of returning consciousness is that the person vomits, and after this he gradually comes round. As a result of the injury, however, he may remain irritable, liable to headache or to lapses of memory. *See* also Brain, Surgery of.



FROM THE WILD FLOWER PRES. SOC.

SKULL-CAP (SCUTELLARIA), AN HERB COMMON IN DAMP AND SHADY PLACES

SKULL-CAP (*Scutellaria*), the common name for a numerous genus of herbs and subshrubs of the mint family (Labiatae, *q.v.*), comprising some 200 species of nearly world-wide distribution. They have numerous blue, violet, yellow, scarlet or white flowers, borne in opposite pairs or in axillary or terminal, slender, one-sided spikelike racemes. The corolla has a long tube, dilated at the throat and surmounted with two unequal lips, the upper usually entire and the lower notched. The persist-

ent calyx bears a conspicuous protuberance on the upper lip, giving it a helmet-like appearance, whence the common name. Two species occur in the British Isles, the common or marsh skull-cap (*S. galericulata*), with handsome violet-blue flowers, and the lesser skull-cap (*S. minor*). Besides the common skull-cap, which is found across the continent, some 25 other species occur in North America.

SKUNK, a North American carnivorous mammal, belonging to the family *Mustelidae* and noted for its evil smell arising from a secretion of the anal glands. This is under the control of the animal, which can propel the yellow liquid to a distance of 8 or 12ft. The common skunk (*Mephitis mephitica*) inhabits North America from Hudson bay to Texas and eastward. About the size of a cat, though more heavily built, it has black fur, with a streak of white on the back. The muzzle is long and pointed, the white tail long and bushy. Insects form its staple diet, but it will also eat mice, eggs, frogs, and carrion, and occasionally rob hen-roosts. The skunk evinces little dread of man or other animals, and its normal gait is a walk. No animal attacks it knowingly, and its leisurely gait and conspicuous coloration well advertise its disagreeable properties. During very severe weather the animal hibernates. Six to ten young are brought forth each spring. Several other forms inhabit Central and South America. (*See* C. H. Merriam, *Mammals of the Adirondack Region;* W. H. Hudson, *A Naturalist in La Plata.*)

THE COMMON SKUNK

It lives in dens or burrows, and is chiefly nocturnal in its habits. Since colonial times, it has been trapped, and sometimes reared for its valuable fur. *See* U.S. Dept. Agr. Reports Bulletins. Com. Reports on Fur Production Census.

SKUNK CABBAGE (*Symplocarpus foetidus* or *Spathyema foetida*), a fleshy herbaceous plant of the arum family, Araceae (*q.v.*), so called because of its fetid odour and large leaves, native to eastern North America and north-eastern Asia. It grows in swampy places and in very early spring (March or sometimes February) it sends up from thick rootstocks grotesque, swollen, shell-like, purple-brown spathes, each enclosing many small flowers borne in a short thick cluster. These are soon followed by numerous ovate leaves, 1 to 3 ft. long, and later by large globular masses of fleshy berries. The similar western skunk cabbage (*Lysichiton kamtschatcense*) occurs from California to Alaska and also in Siberia.

SKY, the apparent covering of the atmosphere, the overarching heaven. (M.Eng. *skie,* cloud; O.Eng. *skua,* shade; connected with an Indo-European root *sku,* cover, whence "scum," Lat. *obscurus,* dark, etc.)

The Colour of the Sky.—It is a matter of common observation that the blue of the sky is highly variable, even on days that are free from clouds. The colour usually deepens toward the zenith and also with the elevation of the observer. It is evident that the normal blue is more or less diluted with extraneous white light, having its origin in reflections from the grosser particles of foreign matter with which the air is usually charged. Closely associated with the colour is the *polarization* of the light from the sky. This takes place in a plane passing through the sun, and attains a maximum about 90° therefrom. Under favourable conditions more than half the light is polarized.

As to the origin of the normal blue, very discrepant views have been held. Some writers, even of good reputation, have held that the blue is the true body colour of the air, or of some ingredient in it such as ozone. It is a sufficient answer to remark that on this theory the blue would reach its maximum development in the colour of the setting sun. It should be evident that what we have first to explain is the fact that we receive any light from the sky at all. Were the atmosphere non-existent or absolutely transparent, the sky would necessarily be black. There must be something capable of *reflecting* light in the wider sense of that term.

A theory that received much support in the past attributed the reflections to thin bubbles of water, similar to soap-bubbles, in which form vapour was supposed to condense. According to it, sky blue would be the blue of the first order in Newton's scale of colours. The theory was developed by R. Clausius (*Pogg. Ann.* vols. 72, 76, 88), who regarded it as meeting the requirements of the case. It must be noticed, however, that the angle of maximum polarization would be about 76° instead of 90°.

Apart from the difficulty of seeing how the bubbles could arise, there is a formidable objection, mentioned by E. W. Brücke (*Pogg. Ann.* 88, 363), that the blue of the sky is a much richer colour than the blue of the first order. Brücke also brought forward an experiment of great importance, in which he showed that gum mastic, precipitated from an alcoholic solution poured into a large quantity of water, scatters light of a blue tint. He remarks that it is impossible to suppose that the particles of mastic are in the form of bubbles. Another point of great importance is well brought out in the experiments of John Tyndall (*Phil. Mag.* [4], 137, 388) upon clouds precipitated by the chemical action of light. Whenever the particles are sufficiently fine, the light emitted laterally is blue in colour and, in a direction perpendicular to the incident beam, is *completely plane-polarized.*

The dependence of the amount of scattering upon the wave-length of the light can be settled in the case of very small particles by an application of the method of dimensions. The particle acts as a centre for a radiating beam. The amplitude of the light sent out by it at a distance R varies inversely as R; it is also proportional to the volume of the particle when this is small compared with the wave-length of the light. Thus the ratio of the scattered to the incident *intensity* varies as $\frac{V^2}{R^2}$; that is a quantity whose dimensions are those of the fourth power of a length. The ratio of intensities must, however, be a pure number; and since the wave length λ is the only other linear quantity that can be concerned, the ratio must also depend on the inverse fourth power of λ.

Lord Rayleigh's Theory.—A more detailed investigation was conducted by the third Lord Rayleigh (*Phil. Mag.* XLI., 107, 275) based on an elastic-solid theory of light. This enquiry showed that both the intensity and the polarization could be satisfactorily accounted for on such a theory, if (and only if) the vibrations are perpendicular to the plane of polarization and the difference between the substance of the particles and that of the surrounding medium is one of density only.

Later (*Phil. Mag.* XII. 81–101, 1881) Rayleigh examined the question from the point of view of the electromagnetic theory in which the particles are treated as dielectric spheres. Maxwell's equations can be applied exactly in the case of vanishingly small spheres. The azimuth of the electric displacement travelling in any direction in the scattered wave is at right angles to that direction and is in the plane containing the scattered *ray* and the azimuth of the incident *displacement;* further the intensity is proportional to the square of the sine of the angle between these two lines. It follows that when this angle is zero the scattered light in the given direction is zero. This occurs in the direction at right angles to the incident ray. Thus, in this case, if unpolarized light is incident the light scattered at right angles is completely polarized.

According to either theory, sunlight in penetrating through the earth's atmosphere should fall off according to an exponential law for each colour.

In order to test the theory Rayleigh compared the bl[illegible] of the sky taken from near the zenith with sunligh[illegible] through white paper. For different wave-lengths the [illegible] culated from the formula are given together with obse[illegible] for comparison:—

Fraunhofer line	C	D	b_3	[illegible]
Calculated	25	40	63	[illegible]
Observed	25	41	70	9[illegible]

It appears that the sky light when compared with that diffused through white paper was bluer than that required by theory; but this may possibly arise from yellowness of the paper or from the yellowness of the sunlight when it reaches us compared with its colour at higher levels.

A much more important calculation has reference to the size and number of the particles concerned in the production of the blue of the sky. Since the light scattered by each particle is proportional to the *square* of its volume the total amount scattered per unit volume depends not only upon the quantity of matter therein but upon its fineness of division also. Assuming that the *molecules* of the air are the effective scatterers Rayleigh in 1899 calculated (taking Maxwell's value 19×10^{18} for the number of molecules per unit volume of a gas at standard pressure and temperature) that sunlight should diminish to $\frac{1}{e}$ of its value in passing through a distance of 83 kilometres in normal air. This value might agree roughly with the visibility of Mount Everest from Darjeeling but Rayleigh considered that it implied too high a visibility since there is certainly suspended matter to be reckoned with as well. Small particles of saline or other matter (including organic germs) must play a part and to them may be attributed much of the bluish haze by which the moderately distant landscape is often suffused.

American Investigations.—In recent years considerable attention has been paid to this question in America where advantage could be taken of the remarkable clearness and dryness of the air above Mount Wilson in California. F. E. Fowle in these investigations has obtained values of the transparency coefficients for zenith observations for 30 different wave-lengths between $0{\cdot}34\ \mu$ and $2{\cdot}24\ \mu$ (μ = one millionth of a metre). The logarithms of the observed coefficients were plotted as ordinates against the corresponding quantities of precipitable atmospheric moisture as abscissae. The curves which were very nearly straight were extrapolated to zero moisture so as to obtain the transparencies for perfectly dry air. From these values for dry air the number of molecules per c.c. was calculated by means of Rayleigh's formula. The value obtained was $2{\cdot}7\times10^{19}$, while the best value obtained by Millikan by other methods is $2{\cdot}705\times10^{19}$. The conclusion drawn from this result is that for the clear air above Mt. Wilson the scattering is almost entirely due to the molecules of air themselves. (Fowle, *Astroph. J.* 1914.)

Tyndall's Residual Blue.—The experiments of Tyndall upon precipitated clouds have been mentioned. When the precipitated particles are very fine, the light dispersed in a perpendicular direction is sky-blue and fully polarized. At a further stage of their growth the particles disperse in the perpendicular direction a light which is no longer fully polarized. When quenched as far as possible by rotation of a nicol prism, it exhibits a residue of a more intense blue colour; and further it is found that the direction of the most nearly complete polarization becomes inclined to the direction of the primary rays.

Electromagnetic Theory.—A discussion of these and other questions upon the basis of the electromagnetic theory of light is given in the *Phil. Mag.*, 1881, 12, p. 81. Here we must be content with a statement of some of the results. So long as the particles are supposed to be very small and to differ little from their environment in optical properties, there is little difference between the electric and the elastic solid theories. Whatever may be the shape or size of the particles, there is no scattered light in a direction parallel to the primary electric displacements. In order to render an account of Tyndall's "residual blue" it is necessary to pursue the approximation further, taking for simplicity the case of spherical shape. We learn that the light dispersed in the direction of primary *vibration* is not only of higher order in the difference of optical quality, but is also of order k^2c^2 in comparison with that dispersed in other directions, where c is the radius of the sphere, and $k=2\pi/\lambda$. The incident light being white, the intensity of the component colours scattered in this direction varies as the inverse *eighth* power of the wave-length, so that the resultant light is a rich blue.

As regards the polarization of the dispersed light as dependent on the angle at which it is emitted, we find that although, when terms of the second order are included, the scattered light no longer vanishes in the same direction as before, the peculiarity is not lost but merely transferred to another direction. The angle θ through which the displacement occurs is measured backwards, *i.e.*, towards the incident ray, and its value is given by

$$\theta=\frac{\Delta K}{K}\,\frac{k^2c^2}{25}, \tag{23}$$

ΔK being the difference of dielectric constants.

Experiments upon this subject are not difficult. In a darkened room a beam of sunlight (or electric light) is concentrated by a large lens of 2 or 3 ft. focus; and in the path of the light is placed a glass beaker containing a dilute solution of sodium thiosulphate (hyposulphite of soda). On the addition, well stirred, of a small quantity of dilute sulphuric acid, a precipitate of sulphur slowly forms, and during its growth manifests exceedingly well the phenomena under consideration. The more dilute the solutions, the slower is the progress of the precipitation. A strength such that there is a delay of 4 or 5 minutes before any effect is apparent will be found suitable, but no great nicety of adjustment is necessary.

Polarization.—In the optical examination we may, if we prefer it, polarize the primary light; but it is usually more convenient to analyze the scattered light. In the early stages of the precipitation the polarization is complete in a perpendicular direction, and incomplete in oblique directions. After an interval the polarization begins to be incomplete in the perpendicular direction, the light which reaches the eye when the nicol is set to minimum transmission being of a beautiful blue, much richer than anything that can be seen in the earlier stages. This is the moment to examine whether there is a more complete polarization in a direction somewhat oblique; and it is found that with θ positive there is, in fact, a direction of more complete polarization, while with θ negative the polarization is more imperfect than in the perpendicular direction itself.

The polarization in a distinctly oblique direction, however, is not perfect, a feature for which more than one reason may be put forward. In the first place, with a given size of particles, the direction of complete polarization indicated by (23) is a function of the colour of the light, the value of θ being 3 or 4 times as large for the violet as for the red end of the spectrum. The experiment is, in fact, much improved by passing the primary light through a coloured glass. Not only is the oblique direction of maximum polarization more definite and the polarization itself more complete, but the observation is easier than with white light in consequence of the uniformity in the colour of the light scattered in various directions. If we begin with a blue glass, we may observe the gradually increasing obliquity of the direction of maximum polarization; and then by exchanging the blue glass for a red one, we may revert to the original condition of things, and observe the transition from perpendicularity to obliquity over again. The change in the wave-length of the light has the same effect in this respect as a change in the size of the particles, and the comparison gives curious information as to the rate of growth.

But even with homogeneous light it would be unreasonable to expect an oblique direction of perfect polarization. So long as the particles are all very small in comparison with the wave-length, there is complete polarization in the perpendicular direction; but when the size is such that obliquity sets in, the degree of obliquity will vary with the size of the particles, and the polarization will be complete only on the very unlikely condition that the size is the same for them all. It must not be forgotten, too, that a very moderate increase of dimensions may carry the particles beyond the reach of our approximations.

The fact that at this stage the polarization is a maximum, when the angle through which the light is turned *exceeds* a right angle, is the more worthy of note, as the opposite result would probably have been expected. By Brewster's law this angle in the case of regular reflection from a plate is *less* than a right angle; so that not only is the law of polarization for a very small par-

ticle different from that applicable to a plate, but the first effect of an increase of size is to augment the difference.

Sunset Colours.—The simple theory of the scattering of light by small particles suffices to explain not only the blue of the zenith, but the comparative absence of small wave-lengths from the direct solar rays, and the brilliant orange and red coloration of the setting sun and of the clouds illuminated by his rays. The hyposulphite experiment here again affords an excellent illustration. But we must not expect a simple theory to cover all the facts. It is obvious that the aerial particles are illuminated not only by the direct solar rays, but also by light dispersed from other parts of the atmosphere and from the earth's surface. On this and other accounts the coloration of the sky is highly variable. The transition from blue to orange or red at sunset is usually through green, but exceptional conditions may easily disturb the normal state of things. The brilliant sunset effects observed in Europe after the Krakatoa eruption may naturally be attributed to dust of unusual quality or quantity in the upper regions of the atmosphere.

To illustrate further the complications that arise when the particles are not infinitely small it may be mentioned that if the solution of "hypo" prepared as above be observed for a longer time it becomes more opaque owing to the growth of the sulphur particles and afterwards becomes more transparent again even though kept well stirred; and further that in this last stage it *transmits* blue more than red and consequently scatters red more than blue. This is a complete reversal of the blue-sky effect. (Keen and Porter, *Roy. Soc. Proc. A. 89,* 370, 1914.) A similar phenomenon had previously been observed by Captain Abney and by W. Ritz. Abney says in connection with certain suspensions of silver bromide in collodion: "In some cases I obtained it in such a state which, when viewed by transmitted light, appeared of a sky-blue colour inclining to green." (Abney, *Phil. Trans. Roy. Soc.* Pt. II., p. 653, 1880; W. Ritz, *Comptes Rendus 143,* 167, 1906.) This phenomenon is well known to preparers of emulsions for photographic plates.

Related to abnormalities of colour we may expect to find corresponding abnormalities in polarization. Of this nature are the neutral points, where the polarization changes character, observed by F. J. D. Arago, J. Babinet and Sir D. Brewster for an account of which reference may be made to Mascart, Traité d'Optique. (R.; A. W. Po.)

SKYE, largest island of the Inner Hebrides, Inverness-shire, Scotland. From the mainland it is separated by the Sound of Sleat, Kyle Rhea, Loch Alsh and the Inner Sound, and from the Outer Hebrides by the Minch and Little Minch. At Kyleakin, on the western end of Loch Alsh, the channel is only about ¼ m. wide, and there is a ferry. The length of the island from S.E. to N.W. is 48½ m., but its coast is deeply indented, so that no part of the interior is more than 5 m. from the sea. It has a total area of 428,966 acres. The population was 23,082 in 1841, but in 1921 only 11,031 (or 17 to the sq.m.), 1,062 of whom spoke Gaelic only and 9,201 Gaelic and English.

The chief arms of the sea are Lochs Snizort and Dunvegan in the N., Loch Bracadale in the W., Lochs Scavaig and Eishort in the S. and Loch Sligachan in the E. The jagged mass of the Cuilline (Coolins) dominates the view whether by land or sea. Their highest point is Sgurr Alasdair (3,309 ft.), and at least six other peaks exceed 3,000 ft. To the north of Loch Slapin stands the group of Red Hills of which the highest points are Ben Caillich and Ben Dearg More and near Loch Ainort rises Ben Glamaig. About 8 m. N. of Portree is the curious basaltic group of the Storr, consisting of pinnacles and towers, the most remarkable of which, "The Old Man" forms a landmark for sailors.

Most of the land is moor and hill pasture, with cultivated patches here and there, chiefly on Lochs Snizort and Bracadale, the Sound of Sleat, Kyleakin and Portree. The crofting system is still general. Turnips and potatoes are grown, but the climate is better adapted for sheep and cattle (West Highland) than for crops, and the sheep farms carry famous stocks, principally black-faced with some Cheviots. The condition of the crofters, which was pitiable in the extreme, has been improved by the Crofters' Holdings Act of 1886, and by sums spent in recent years by the Board of Agriculture. The old black huts have been replaced, in those parishes where stone is obtainable, by well-built houses. The many ejections between 1840 and 1880 and the emigration that followed was mainly responsible for the serious decline of the population. The railways to Strome Ferry, Kyle of Loch Alsh and Mallaig, by rendering markets more accessible, effected an improvement in the fisheries, which have always been a mainstay of the inhabitants. The fisheries include herring, cod, ling and salmon, and seals are not uncommon. Whiskey is distilled at Carbost and there are marble quarries.

The inhabited isles off the coast of Skye are mainly situated near the eastern shore. Of these the principal is Raasay (pop. 368). Brochel Castle, now a ruin, stands on the eastern coast. The island is 13 m. long, by about 3½ m. at its widest. Off its north-western shore lies the isle of Fladday. To the north of Raasay, separated by a narrow strait, is Rona, pop. 98 (Seal Island, from the Gaelic *ron,* a seal), 4½ m. long with a maximum breadth of 1¼ m., with a lighthouse. Scalpay, immediately south of Raasay, has a hill of 1,298 ft. The other isles are Pabbay in Broadford Bay, Ornsay in the Sound of Sleat, and Soay near Loch Scavaig.

Portree (pop. 1,628 in parish), the capital, lies at the head of a fine harbour about the middle of the eastern seaboard. Steamers run daily to and from Mallaig and Kyle of Loch Alsh, and there is, besides, other communication by steamer with Oban and other ports. There is a factory for tweeds, plaids, carpets and other woollens. The exports are principally sheep, cattle, wool, salmon and other fish, and the town is the headquarters of the fishing fleet. The name of the town was derived from the fact that James V. landed there on the occasion of his tour in the Western Highlands. The place thus became, in Gaelic, *Port-an Righ,* or the King's Harbour. It was to Portree that Flora Macdonald (1722–1790) conducted Prince Charles Edward when he escaped from Benbecula.

Among other places in Skye associated with the Young Pretender are Prince Charles's Point near Monkstadt, on the west of the peninsula of Trotternish, where he landed with Flora Macdonald, and Kingsburgh, on the eastern shore of Loch Snizort. The castle of the Macleods of Macleod, on a rocky promontory at Dunvegan, was erected in the 9th century and extended by later chieftains. The MacCrimmons, the famous race of hereditary pipers, hailed from this quarter of Skye and were attached to the Macleods of Dunvegan. At Duntulm is the ruined castle of the Macdonalds, another of the great Skye chieftains.

SKYSCRAPER: *see* ARCHITECTURE.

SLADE, FELIX (1790–1868), English art collector and patron, was born at Lambeth, London, in Aug. 1790. He collected books, engravings and glass. He died unmarried on March 29, 1868, leaving personalty to the value of £160,000. He bequeathed the bulk of his art collection to the British Museum, and £35,000 for the endowment of art professorships, to be known as Slade Professorships, at Oxford, Cambridge and University College, London. University College received the additional bequest of six art scholarships.

SLAG. A waste substance of many kinds formed during smelting operations. Thus, in the blast furnace, limestone is charged with the coke and iron-ore to form with the ash of the fuel and the gangue of the ore a lime silicate or "slag," which is run out of the furnace liquid, taking with it the sulphur. Blast furnace slags are of variable composition, the quantity of limestone used varying with the nature of the ore.

In the basic process of steel manufacture, which employs phosphoric ores, the resulting slag, rich in phosphorus (as soluble calcium phosphates) is known as "basic slag" and forms a very valuable manure. *See* IRON AND STEEL; METALLURGY; BASIC SLAG.

SLANDER: *see* LIBEL AND SLANDER.

SLANG, the current name for a particular kind of speech. At one moment a word or locution may be felt definitely as slang, but in another set of circumstances the same word or locution may not produce this impression at all. Subject to these

observations, slang may be regarded as the employment of an usual word in an unusual sense or of an unusual word in an usual sense. Thus *to beat it* would be slang, but *to depart, to go away* would be standard English. Slang is thus denied the kind of approval which is accorded to standard English. But in its origins and in its intent, slang is not merely an attempt to do violence to accepted customs. This is a by-product of its use, not the cause of it.

INVENTION OF SLANG

Among the impulses which lead to the invention of slang, the two most important seem to be the desire to secure increased vivacity and the desire to secure increased sense of intimacy in the use of language. Slang originates and flourishes best in the soil of the colloquial speech. On this level a slang word or phrase may attain a very wide currency, like *nut, bean,* and similar terms for *head,* but if such a word passes into literary use it ceases to be slang. The verb *walk,* for example, comes from Anglo-Saxon *wealcan,* meaning *to roll,* and it is not an unreasonable assumption that it comes by the way of a slang extension of the older term. This notion of locomotion by means of the legs seems to have something peculiarly appealing to the fancy of language innovators; *cf. beat it, vamoose, mosey, saunter, skidoo, slide, slip, slope,* and other metaphorical extensions. The word *pot-boiler* used for work done for a livelihood bears the marks of slang origin. But the word is not now notable or striking. The phrase *go to pot,* "go to ruin," is also of doubtful origin, and the word *pot* in this phrase may not have been the same to begin with as the word *pot,* "vessel." It suggests the modern phrase, *in the soup,* of similar meaning.

An element of humour is almost always present in slang, usually as humorous exaggeration. Thus to call a hat a *lid* is amusing because it puts a hat and a pot-lid in the same class. So when an alluring woman is called a *vamp,* from vampire. Slang is rarely or never bitter in its implied judgments. It places things in their proper places with a smile. When a male charmer is called *sheik* and the sheik's female counterpart *sheba,* this is obviously the language of a world that takes its passions lightly.

Lower Slang Forms.—On a lower rhetorical level are the forms of slang which are humorous merely because the sound of the slang words is humorous. Thus the word *skeezicks* as a disrespectful name for a man seems to mean nothing more than what is suggested by the undignified sound of the word. Some of these slang words may have an onomatopoeic colour, like *biff,* "a blow," *flummox,* "disconcert," *flabbergast,* of similar meaning, but, if so, the associations are frequently slight and remote. On a still lower rhetorical level come abbreviations employed as casual adornments of colloquial conversation, like *sec* for *second,* as *Wait a sec,* or *ever so.* Perhaps, the lowest level is reached in language mutilations like *ciricutous* for *circuitous, pictureaskew* for *picturesque, gust* for *guest.* Oaths on the other hand scarcely fall within the limits of inclusion of slang. In their origins they usually accompany a more powerful emotional experience than that which produces slang. Certain inventive geniuses, however, produce oaths which have a good deal of the playfulness and ingenuity of slang.

Slang develops most freely in groups with a strong realization of group activity and interest, and groups without this sense of unity, *e.g.,* farmers, rarely invent slang terms. The stage, prizefighting, baseball, football, and other sports are productive of an extraordinarily rich crop of slang. The language of many newspaper correspondents who write about sports is often unintelligible except to the initiated. School boys and college students also invent slang freely, and the slang of one school will often be quite different from that of another school. It is possible to have a fashionable as well as a vulgar slang. In Swift's *Complete Collection of genteel and ingenious Conversation* (1738), many of the fashionable slang terms of the day are ridiculed and condemned, and almost any novel of modern "smart" society will provide numerous illustrations. An element of secrecy sometimes enters into this use of the group language. School boys thus invent a secret language of their own.

Many of the terms that pass current in cultivated conversation have a good deal of the colour of slang. Among such terms are the words like *awful, terrible, horrid, lovely.*

Thus the common adjective of approval in Elizabethan days was *fair,* and in the 18th century it was *elegant.* Both of these terms are now archaic. A later synonym was *nice,* which in turn tends to be replaced by *wonderful.* Such counter-words are devised for the purpose of avoiding the precise definition of moments which call for nothing more than a quick and general expression. Quite meaningless expressions are often utilized in this way, for example the archaic *How would you like to be the iceman?* or *So is your old man,* or *What do you know about that?* Here is a kind of shorthand language which enables the group to express and to realize its experiences without elaborate analysis.

The Slang of Trade.—Distinction must be made between technical language and this intimate colloquial language of the group which may be called slang. Some technical words in trades and professions were in the beginning probably slang words. Thus the first tailor who called his smoothing-iron a goose, probably raised a smile and certainly started a fashion in tailoring circles.

Early Thieves' Cant.—The first extensive records of English slang occur in the cant or canting language of thieves and vagabonds in the 16th century. To a certain extent this professional cant of thieves was probably a secret language, but this could hardly have been the main motive in the invention of the cant. Thieves and vagabonds were a group with a strong sense of corporate unity and one also with certain sporting attitudes that would be highly favourable to the development of a class language.

In his treatise *On the Excellency of the English Tongue,* written about 1595, Richard Carew mentions as one of the excellences of English its ability to express the same thing in a variety of ways: "for example, when wee would be rid of one, wee vse to saye *Bee going, trudge, pack, be faring, hence, awaye, shifte,* and by circumlocution, *rather your roome than your companye, Letts see your backe, come againe when I bid you, when you are called, sent for, intreated, willed, desiered, inuited, spare vs your place, another in your steede, a shipp of salte for you, saue your credite, you are next the door, the doore is open for you, there's noe bodye holdes you, no bodie teares your sleeue,* etc." No one can doubt that some of these phrases mentioned by Carew are the equivalents of what would be called slang phrases in our day. When Chaucer wrote *There been no sterres, god wot, than a paire,* this suggests the modern equivalents *There's more than one pebble on the beach, There's more than one tin can in the alley,* etc.

American Slang.—The mixture of races and the general breaking of old associations which accompanied the first great western migrations were peculiarly favourable to the development of a highly flavoured colloquial style. And in general it may be said that the frontier in America, after the colonial period, has always been a border line of romance between reality and unreality in which slang expressions have made a vigorous growth.

Australia has slang probably for a similar reason, that the occupying of the country has been in no little degree an exhilarating and romantic adventure. (*See* Lists: *American Slang* and *Australian Slang.*

The Earliest Example.—The earliest use of the word "slang" hitherto discovered occurs in Toldervy's *History of Two Orphans,* published in 1756. A more unequivocal instance is quoted in J. C. Hotten's *Slang Dictionary* (1864) from a book entitled *Jonathan Wild's Advice to his Successor:* "Let proper Nurses be assigned to take care of these Babes of Grace (*i.e.,* young thieves). . . . The Master who teaches them should be a man well versed in the Cant Language, commonly called the Slang Patter, in which they should by all means excel." Four years later, in 1762, the word is found with a different and now obsolete meaning, in Foote's play *The Orators.* A fast young Oxford man, invited to attend a lecture on oratory, is asked, "Have you not seen the bills?" He replies, "What, about the lectures? ay, but that's all slang, I suppose." Here the word seems to be equivalent to "humbug."

In the first edition of Hugh Kelly's comedy, *The School for Wives,* there is a passage (omitted in some of the later reprints) in which one of a company of sharpers, who pretend to be for-

eigners and speak broken English, says: "There's a language called slang, that we sometimes talk in. . . . It's a little rum tongue, that we understand among von another." Francis Grose's *Dictionary of the Vulgar Tongue* (1785) has the entry, "*Slang*, the cant language."

It may be that the word is genuinely dialectal—an inheritance from the language of the Scandinavian settlers in the north of England—as shown by the coincidence of its uses with those of the modern Norwegian verb *slengja* (etymologically equivalent to the English "to sling") and related words, as given in the dictionary of Ivar Aasen. *Slengja kjeften* (literally, to sling the jaw), means to pour out abuse. The French synonym is *argot*.

The known history of European slang begins (leaving out of account the meagre references in German documents hereafter to be mentioned) about the time of the "Ballades" of François Villon in the 15th century. The French *argot* of these compositions contains much that is still obscure, but the origin of some of its words is evident enough. Facetious expressions relating to the destined end of the malefactor are prominent. *Paroir* and *montjoye* (for which latter the less ironical *monte à regret* was substituted) are nicknames for the scaffold. *Acollez*, hanged, corresponds to the English "scragged"; the synonymous *grup* seems to be an onomatopoeic formation suggestive of choking. There are some derivatives formed with the suffix *art: riflart* is a police-officer, *abrouart*, fog. A few words from foreign languages occur: *audi nos*, prayer, is the Latin *audi nos* of the litanies; *arton*, bread, is obviously Greek, and its appearance in the 15th century is somewhat hard to account for. *Moller*, to eat, may perhaps be the Latin *molere*, to grind. *Anse*, the ear, is no doubt the Latin *ansa*, handle.

In Germany the word *Rotwalsch* (the modern *Rotwelsch*, still the name for the cant of vagrants) occurs as early as the middle of the 13th century. The earliest attempt at a vocabulary of "Rotwelsch" is that of Gerold Edilbach, compiled about 1490. A second vocabulary, containing nearly the same set of words, is contained in the famous *Liber vagatorum*, first printed in 1510 in High German; versions in Low German and the dialect of the Lower Rhine appeared shortly afterwards. An edition of this work printed in 1529 has a preface by Martin Luther. The most remarkable feature of the jargon represented in these early glossaries is the large number of Hebrew words that it contains. There are some words from Italian, as *bregan*, to beg, from *pregare*, and *barlen*, to speak, from *parlare*. The language of the gipsies seems to have contributed nothing, nor are there any words from Latin or Greek. Some of the words are ordinary German words used metaphorically, like *wetterhan* (weathercock) for a hat, *zwicker* (twitcher) for the hangman, *brief* (letter) for a playing-card. Others are descriptive compounds such as *breitfuss* (broad-foot) for a duck or goose, or derivatives formed by means of the suffixes *-hart* (or *-art*) and *-ling*, as *grunhart* (from *grün*, green), a field, *glathart* (from *glatt*, smooth), a table, *fluckart* (from *flug*, flight), a bird, *funckart* (from *funke*, spark), fire, *flossart* (from *floss*, stream), water, *flossling*, a fish, *lüssling* (from *lüssnen*, to listen), the ear. It is noteworthy that modern Dutch thieves' cant, as presented in the dictionary of I. Teirlinck, is closely similar in its principles of formation, and in many of its actual words, to that of the early German vocabularies.

The earliest English "cant" or "Pedlars' French," as exhibited in R. Copland's *The Hye Waye to the Spyttel House* (1517), John Awdeley's *Fraternitye of Vacabondes* (1561), Thomas Harman's *Caueat for Commen Cursetours* (1567) and various later writers, bears a close resemblance in its general character to the German *Rotwelsch* of the *Liber vagatorum*, the most noteworthy point of difference being the absence of Hebrew words.

BIBLIOGRAPHY.—English: Most of the authorities for the early history of English vagrant slang are reprinted in vol. ix. of the Extra Series of the Early English Text Society, edited by E. Viles and F. J. Furnivall (1869), which contains John Awdeley's *The Fraternitye of Vacabondes* (from the edition of 1575), Thomas Harman's *Caueat for Commen Cursetours* (1567–73), and *The Groundwork of Connycatching* (anonymous, 1592), besides extracts from other early works which furnish glossaries. *The Dictionary of the Canting Crew*, by B. E. (no date, but printed at the end of the 17th century; photographic reprint by J. S. Farmer), is valuable as containing the earliest known record of many words still in use; while mainly treating of thieves' and vagrants' language, it includes much that belongs to slang in the wider sense. Among the many later works, only the following need be mentioned here: Francis Grose's *Classical Dictionary of the Vulgar Tongue* (3rd ed. 1796); *The Slang Dictionary*, anonymous but understood to be by the publisher, J. C. Hotten (new ed. 1874), a work of considerable merit, with an excellent bibliography; *A Dictionary of Slang, Jargon and Cant*, by A. Barrere and C. G. Leland (1889); and *Slang and its Analogues* by J. S. Farmer and W. E. Henley (1890–1904), which surpasses all similar works in extent of vocabulary and abundance of illustrative matter, though the dates and even the text of the quotations are often inaccurate. A supplement to Farmer and Henley's *Slang and its Analogues* is J. Redding Ware's *Passing English of the Victorian Era* (1909). For the slang of public schools see *The Winchester Word-book*, by R. G. K. Wrench (1901), and *The Eton Glossary*, by C. R. Stone (1902). For a collection of American college slang words, *see* H. J. Savage's *College Slang Words*, in Dialect Notes V. 139–148 (1922), and for a more extended bibliography in general, *see* Kennedy's *Bibliography of Writings on the English Language*, pp. 419–435 (1927).

French: The earliest systematic treatment of *argot* is found in *La Vie généreuse des Mattois, Gueux Bohémiens et Cagoux*, by Pechon de Ruby (a pseudonym), which went through several editions in the early part of the 17th century and has been reprinted in 1831 and 1868. The slang of the 15th century is discussed in *Le Jargon au quinzième siècle*, by Auguste Vitu (1883), which includes an edition of the *Ballades* of Villon; in *Le Jargon et jobelin de F. Villon*, by Lucien Schöne (1887), and in *L'Argot ancien* (1907), and in *Les Sources de l'Argot ancien* (1912) by L. Sainéan. Francisque Michel's *Études de philologie comparée sur l'argot* (1856) is important for its rich collection of material and its copious references to sources. Later works deserving attention are *Dictionnaire de la langue verte*, by Alfred Delvau (2nd ed. 1867), and *Dictionnaire de l'argot*, by Lorédan Larchey (1889). For modern slang, taken in a very comprehensive sense, the chief authority is Lucien Rigaud, *Dictionnaire de l'argot moderne* (1881). For the special slang of printers, *see* Eugène Boutmy, *Dictionnaire de l'argot des typographes* (1883). A collection of slang terms that gained currency during the Great War is contained in L. Sainéan's *L'Argot des Tranchées* (1915).

German: An admirable collection of the original documents for the history of thieves' and vagrant slang from the earliest period has been published by F. Kluge, under the title *Rotwelsch* (1901). An earlier book of great importance is by Avé-Lallemant, *Das deutsche Gaunertum* (1858). For modern popular slang *see* A. Genthe, *Deutsches Slang* (1892). University slang is ably treated in *Deutsche Studentensprache*, by F. Kluge (1895). (H. BR.; G. P. K.)

BRITISH SLANG

The following list gives well-established slang of a general type dating from the eighteenth century.

Abram-men, beggars pretending madness to palliate their thefts.
Adam-tiler, a pickpocket's ally.
Alsatia, White Friars, an old district of London.
Ambrol, navy word for admiral.
Babbler, a chatterbox.
Baggage, a worthless woman.
Balderdash, (a) unpleasant mixtures of wine, ale, etc.; (b) rubbish, trash, nonsense.
Bandy, crooked; as, *bandy*-legged.
Banter, ridicule.
Barnacle, a good job, easily got.
Bawbee, a halfpenny.
Bean, head.
Beldam, a scolding old woman.
Biff, a blow; *to biff*, to strike.
Bilk, to cheat.
Blab, to divulge secrets.
Blockhead, a silly fellow; fool.
Bob, a shilling.
Bobby-dazzler, anything flashing or brightly coloured.
Bog-landers, Irishmen.
Bone, to steal.
Booze, liquor.
Boss, (a) master; chief; (b) *to boss*, mess up something; *a boss shot*, a futile effort.
Bounce, bragging, boasting.
Brass, (a) impudence; "brazen-faced"; (b) money.
Browbeat, to bully.
Cackle, to tell a secret.
Cant, hypocrisy.
Carrots, a red-haired person.
Char, a task; work of any kind.
Chink, money.
Chit, a child.
Chop, to change; barter.
Clack, a woman's tongue.
Claret, blood; as, "tap his claret": make one's nose bleed.
Clink, gaol; a cold cell.
Clodhopper, a ploughman.
Clout, a handkerchief.
Cocksure, very certain.
Cod, *to cod*, to deceive.
Cold tea, brandy.
Corker, very good.
Cosset, to spoil with affection.
Cove, a man; fellow.
Coxcomb, a fool.
Crack, to boast; glorify.
Cully, a man; fop; rogue.
Cut out for, suited to.
Dab, an expert.
Dace, twopence.
Dag, a gun.
Darbies, handcuffs.
Dive, to pick a pocket.
Dowdy, coarse or ill-favoured.
Drub, to beat.
Dubber, a lock-picker.
Duds, clothes.
Dunderhead, a stupid fellow.
Egg on, to urge.
Famms, hands.
Fambles, hands.
Fib, (a) to beat; (b) a lie.
File, to rob.

Fin, hand.
Fleece, rob or plunder.
Flyers, shoes.
Fob, (a) a cheat, *to fob off,* to cheat; (b) a small pocket.
Fop, a fool; dandy.
Freshman, a novice in a university.
Gad, to go about aimlessly; idle.
Game, gamie, lame.
Giglamps, spectacles.
Glaziers, eyes.
Gob, the mouth.
Grinders, teeth.
Half seas over, almost drunk.
Heave, to rob.
Hedge, to make secure a desperate bet.
Hick, a foolish, easy person.
Hob, a plain country fellow.
Hodge, a country clown.
Hog, a shilling.
Hoof it, to walk.
Huckster, a sharp fellow.
Hussy, a reproach for a woman.
Jabber, useless chatter.
Jackanapes, a young rascal.
Jade, a lazy woman.
Jail-birds, prisoners.
Jolly, to tease.
Josh, to tease.
Kid, to delude; deceive.
Lace, to beat; strike.
Lag, a prisoner.
Lid, a hat.
Lift, to steal.
Loon, a fool or a knave.
Lubber, a heavy, dull fellow.
Lugs, the ears.
Mab, a slattern.
Minx, a forward girl or woman.
Moppet, a pretty, saucy girl.
Mumchance, one who sits mute.
Nab, (a) a hat, cap, or a head; (b) to take.
Nark, a police spy.
Neb, the bill of a bird.
Nincompoop, a fool.
Nob, the head.
Nub, the neck.
Numskull, a foolish person.
Oaf, a fool.
Ogles, eyes.
Old Harry, the Devil.
Old Nick, the Devil.
Pad, a highwayman.
Peeper, a looking-glass.
Peepers, eyes.
Phiz, face (from physiognomy).
Pickled, drunk.
Pig, sixpence.
Pinch, to steal.
Pins, legs.
Poke, a bag or sack.
Ponk, to stink; also, a bad smell.
Prig, (a) a thief; (b) to steal.
Puke, to be sick; vomit.
Quack, an unqualified doctor.
Rant, to talk big.
Rap, to exchange.
Reach-me-downs, a suit of ready-made ill-fitting clothes.
Ready, ready money; cash.
Rhino, ready money.
Ripper, something excellent.
Rub, to run away.
Rum, queer; strange.
Runt, a short, insignificant man.
Sack, (a) pocket; (b) *to get the sack,* to lose one's job.
Sawny, a fool.
Scab, a scoundrel.
Scout, a watch.
Shark, a sharper; trickster.
Sharp-set, very hungry.
Shaver, a young boy.
Shop, a prison.
Sice, sixpence.
Simkin or simp, a fool.
Sly-boots, a seemingly silly, but subtle, fellow.
Snaffle, to appropriate.
Sock, (a) a pocket; (b) to beat.
Split, inform against someone.
Sponge, *To sponge on someone,* to live or drink at another's cost.
Stumps, legs.
Swag, booty; plunder.
Swap, to change; barter.
Tanner, a sixpence.
Tar, a sailor.
Tomboy, a boyish girl.
Tippler, a drunkard.
Tope, to drink.
Truck, change or barter.
Tube, deep level railway.
Wag, a joking, humorous fellow.
Zany, an idiot, fool, or jester.

See *A New Dictionary of the Terms, ancient and modern, of the Canting Crew* (1690); Raymond Postgate, *Murder, Piracy and Treason* (Appendix and Bibl.) (1926).

British War Slang.—The slang which became current during the World War was characterized by novelty:

Anzac, from *A*ustralian and *N*ew *Z*ealand *A*uxiliary (or *A*rmy) *C*orps.
Aussie, an Australian soldier.
Big Bertha, the German gun that bombarded Paris from a distance of 76 miles.
Billy, a cooking tin or pannikin.
Blighty, England (from Hindustani, *bilati,* homeland).
Blimp, a small, non-rigid, streamline, dirigible airship (perhaps from limp balloon).
Brass hat, an officer of the general headquarters staff.
Bully, pressed beef.
Canuck, a Canadian soldier.
C.B., confined to barracks.
Chatty, verminous.
Coal-box, trench-mortar discharge.
Cold feet, funk; nervousness.
Conchy, conscientious objector.
Cushy, a safe job,
Cuthbert, a conscientious objector.
Daisy cutter, an explosive shell.
Doughboy, an American soldier.
Dug-out, a trench cave.
Dum-dum, a soft-nosed bullet.
Fag, a cigarette.
Fritzy, a German soldier.
Humdinger, a swift, good, splendid, fine something or other (borrowed slang).
Iron rations, emergency rations.
Jerry, enemy soldiers.
Joy-ride, "jumping" a ration-lorry, or an aeroplane, without official sanction.
Joy-stick, the altitude control of an aeroplane.
Napoo, no more (French).
No bon, no good (French).
Old Contemptibles, the 1914 British forces.
Packet, to get a, to be wounded.
Pigsticker, bayonet.
Pill-box, small blockhouse.
Rooty, bread (from Hindustani, *roti*) (Indian army slang)
Sausage, observation balloon
Swing the lead, to malinger.
T.B.D., torpedo-boat destroyer
V.A.D., a nurse of the Voluntary Aid Detachment.
Waacs, members of the *W*omen's *A*uxiliary *A*rmy *C*orps.
Whizz bang, a high-explosive shell.
Wrens, members of the Women's Royal Naval Service.

AMERICAN SLANG

All in, exhausted physically
All set, in readiness to begin
Applesauce, insincere talk; "bunk"
Attaboy (that's the boy) fine!
Back number, superannuated
Back-talk, impertinence
Balled up, confused; mixed up
Banana oil (ejac.) nonsense!
Bat, a spree
Bawl out, to rebuke sharply
Bean, head
Beanery, cheap eating-place
Beat it, get out; make a rapid exit
Beef (to), to complain
Beezer, head
Berry, dollar
Big boy, a term of admiration
Big cheese, the "boss" or chief
Blah, nonsense; piffle
Blink (on the), out of repair
Block, head
Blooey (to go), to explode
Blow in, to spend with great lavishness
Blues, to be woebegone
Blurb, publishers' advertisement
Bo (abbr. of hobo, *q.v.*): mate
Boloney, nonsense
Bone, dollar
Bonehead, a fool
Boob, a stupid person
Boost, a recommendation
Bootlegger, dealer in prohibited liquor
Boy-friend, fiancé, or close friend (used by opposite sex only)
Bottom dollar, last dollar
Break even, to come out of a game neither winner nor loser
Break (to make a) *faux pas*
Breaks (to get the), to be in luck
Bring home the bacon, come home victorious in any effort
Broke, penniless
Buck, dollar
Buck (pass the), to shift a responsibility to another
Buddy, close companion
Bull, police
Bulldoze, to intimidate; to bully
Bull (throwing the), boasting
Bum, vagrant
Bun, head
Bunk, nonsense; rubbish
Busted, without funds
Butt in, interfere
Cagey, wary of giving confidence
Call down (to), to correct
Call-down, a rebuke
Can, to discharge; to throw out
Canned music, that which is played by mechanical means.
Can you beat it? (equivalent to "Did you ever!")
Case-note, dollar
Caught with the goods, caught in the act
Chase yourself, get out
Cheap skate, a poor spender
Cheese it, run; look out
Chesty, puffed up; vain
Chicken feed, small money
Chow, food; a meal
Chump, a simpleton
Cinch (also *lead-pipe cinch,* and hence shortened to "a pipe," *q.v.*), a sinecure
Classy, handsome; stylish; chic
Cop, policeman
Crab, to spoil (as to *crab an act*)
Crack, a shot (figuratively, as *a dirty crack*—a mean hit)
Crash, severe blow; vb., to deal a heavy blow
Crook, thief
Crust, presumption
Cuckoo, crazy
Cute, petite; amusing; attractive.
Date, an appointment; *heavy date* an extra important appointment
Dead-beat, worthless fellow
Dead above the ears, brainless
Doggy, stylish
Dome, head
Dope, the facts in a situation; also drugs, as cocaine.
Dough, money
Down and out, at the end of one's resources
Double-cross, to betray.
Drag, influence.
Dry, opposed to liquor
Dub, a stupid person, a silly
Duck out, to escape
Dumbbell, a fool
Eats, food; a meal
Easy, gullible; easily duped
Edge, to have the; to have the advantage
Fade out, to disappear; take quick leave
Fake, an imposture
Fall down on, to fail at
Fall for, to be infatuated with
Fan, fanatic, ardent admirer
Fat-head, brainless person, a fool
Fire, to dismiss from a position
Fifty-fifty, divide equally
Fixin's, trimmings; extras, as at a meal
Fizzle, a failure
Flapper, young girl
Flat tire, a deflated scheme
Flivver, to pull a, to blunder
Flop, a failure
Four-flusher, one who promises without performing
Frame, to, to fabricate evidence
Frame-up, a trumped-up piece of evidence
Fresh, impertinent
Fritz, on the, out of repair
Frost, a failure
Gab, impudent talk
Gaff, chaffing; *standing the gaff*—standing the pace
Get away with, to carry through an action undetected
Get down to brass tacks, deal with the bare facts
Get the gate, be discharged
Get one's goat, try one's patience
Get one's hooks on, get hold of
Get the bulge, gain an advantage
Get wise to, to become aware of
Gink, chap
Girl-friend, fiancée or close friend
Give-away (usually dead give-away), betrayal
Give a ring, to telephone
Go fish!, Go along!
Go, to make a, to succeed
Go-getter, a practical, energetic person
Go over big, to, to succeed
Going some, doing well
Gold-digger, a woman who habitually wheedles money, gifts, etc., from gullible males
Good-night!, This is the end!
Grand, a thousand dollars
Gravy, profit
Grouch, a sour, peevish person
Grub, food
Guff, nonsense

Gush, to be effusive
Gyp, to cheat
Guy, fellow, as, a *regular guy*
Hand-picked, carefully selected
Hang, to get the, to understand
Hard-boiled, callous
Has-been, discarded favourite
Hash-house, cheap eating-place
Heebey-Jeebies, the nerves
Hick, a country bumpkin
Highbrow, intellectual (n. or adj.)
High-hat, supercilious
High stepper, one who leads a gay or fast life
Hike, a long walk
Hitch, ride; sometimes stolen, on a passing vehicle
Hitch-hike, long-distance walk interspersed with begged or proffered rides in passing vehicles
Hobo, tramp, often shortened to "bo"
Hock, to pawn; *in hock*—in pawn
Hold on, Wait a minute!
Hooey, bunk, falseness
Horn in, to intrude
Hot air, exaggerated statements
Hot dog, excl. of approval
Hot stuff, good work
Hunch, presentiment
I'll say, I agree
I'll tell the world, I'll say as much
Inside dope, confidential information
Iron-man, silver dollar
Jack, money
Jack up, to remind, to jog
Jag (to have a jag on), drunken spree; to be drunk
Jazz-baby, usually a young woman who is fond of jazz
Jazz-hound, a dance fiend
Jazz up, to make lively
Jinx, hoodoo
Joint, an establishment, as a dance-hall, restaurant, etc.
Jolly, to keep another person cheerful by saying what he wishes to hear
Josh, to tease
Junk, anything poor in quality
Kale, money
Keep your shirt on, keep cool
Kick, to complain
Kid (vb.), to tease
Knob, head
Knock, condemn or criticize
Lemon, undesirable person
Let down, to cease relations without warning
Let up, to cease
Limit, last endurable stage of any situation, as "Isn't that the limit?"
Line, to get a, to gather information about
Lit, inebriated
Live wire, energetic person
Lounge-lizard, man who haunts tearooms for flirtation
Low-brow, uncultured
Low-down (n.), all the important information
Make, on the, on the road to a successful career
Make a getaway, escape
Make the grade, accomplish the task in hand (origin of a motor-car on a hill)
Main squeeze, the chief
Mazuma, money
Melon, financial term, signifies distribution of unusual dividend
Miffed, piqued
Miss out, to let an opportunity slip by
Mixer, one who meets all types of persons easily
Monkey-business, foolish trifling
Monkey-shines, buffoonery
Moonshine, privately distilled whiskey
Nail, to arrest; to catch at the psychological moment
Neck, to embrace
Nerve, impudent cheek
Nifty, stylish; chic
Nix! No!
N.G., no good
Nothing doing, no chance whatever
Number, to get one's, to see through another's motives
Nut, idiot
Nutty, very enthusiastic about
Off one's base } badly mistaken
Off one's trolley }
O.K., approved
Old stuff, out of date
Once-over (also called the double-O), intense scrutiny
Outfit, group of people, especially a business organization
Pan out, to result
Pass out, lose consciousness
Pass up, to let slip
Peach, a pretty girl
Peeved, annoyed
Pep, energy, vim
Petting, amorous fondling
Petting party, social gathering with amorous fondling
Phoney, bogus; not genuine
Pickled, intoxicated
Pie-eyed, intoxicated
Piffled, half intoxicated
Pinch, arrest
Pipe, a simple task
Pipe (vb.), look at! (derisive)
Plant, factory
Played out, exhausted
Poppycock, nonsense
Poor fish, an ineffective person
Pronto, immediately
Pull, influence
Pull off, to initiate and carry through a plan
Punch, vigour
Punk, utterly worthless
Put across, to accomplish by one's own effort
Put the skids under one, get rid of one
Put wise, to acquaint with the facts in a situation
Put over, to accomplish
Put-up job, a conspiracy
Queen, a lovely girl
Queer, to, to compromise, damage
Racketeer, a gangster who extracts money for protection
Razz, to heckle
Razz (abbr. of raspberry), to get the, to be made fun of
Regular fellow (or guy), agreeable or "good" person
Ritzy, stylish
Rooked, cheated
Root, to shout for
Rooter, ardent defender
Rotten, worthless
Rough, unfair
Rough up, to treat harshly
Roughneck, rowdy
Rubberneck, a sightseer
Rube, a rustic
Rum-hound, one who drinks to excess
Run into the ground, to overdo
Rustle, to gather; to go in quest of, as *to rustle food*
Sap, a brainless person
Sand, grit; courage
Sec, second
Shake a leg, move on
Shine (take a shine to), to become suddenly fond of
Shoestring, on a, with very little capital
Shoot! Go ahead!
Sidestep, to evade
Simoleon, dollar
Simp, simpleton
Sit in, join with
Size up, to make a rapid estimate of
Skin, cheat (n. and vb.)
Skin-game, fraudulent enterprise
Skirt, woman, girl
Slob, an untidy, careless person
Slop, sentiment
Slush, sentiment
Small-time stuff, unimportant
Snap, sinecure
Snap out of it (or into it), to shift rapidly to or from some position or procedure
Snooty, critical
Sob sister, a woman reporter who writes over-sentimentally
Sock, a severe blow
Soft snap, a sinecure
Solid ivory, stupid, unintelligent
Soup and fish, formal dinner dress
Souse, an habitual drinker
Sparkler, diamond
Speakeasy, place where liquor is sold and drunk illegally
Spondulix, money
Squarehead, a Swede
Squeal, to betray an accomplice
Stand for, endure; tolerate
Stand-up, failure to meet an appointment
Steady, fiancé (both sexes)
Steep, exorbitant
Step on it, hurry up
Step out, go out on pleasure
Stewed, intoxicated
Strapped, without money; "broke"
String, to jolly
String to it, with a; under conditions or limitations (usually something is given "with a string to it")
Stuck with, foisted with something undesirable
Stuck on, infatuated by
Stuff, the (as "That's the stuff—that's the real thing"), the real thing
Stung, taken in; cheated
Stunt, trick, usually acrobatic
Sugar daddy, a rich elderly man who lavishes money and gifts on young women (also called sugar papa)
Swag, loot
Swat, to hit, also *a blow*
Swell, superfine; as a swell time, a swell girl, a swell idea.
Talk turkey, to speak frankly
Tear, a wild spree
Tell it to Sweeney, same as *Tell it to the Marines!* (an expression of incredulity)
Tickle the ivories, play the piano
Tip, a hint
Tip off, to inform
Tony, aristocratic
Up and coming, promising
Up on one's toes, alert, eager
Up to snuff, competent, up to expectation
Velvet, clear profit
Walk-over, an easy task
Wet, opponent of prohibition
Whale (as *a whale of a show*); a splendid specimen
Wire-puller, a person who contrives for his own ends
Whiz, a wonder
Wow, a great success
Wheels (to have), to be mentally unsound
Wild about, very fond of; infatuated by
Willies, the, an attack of "nerves"
Wise-crack, smart remark
Yank, to snatch, to drag away
Yegg, a thief
Yellow, cowardly
Yellow streak, a vein of cowardice

BIBLIOGRAPHY.—*See* Maitland's *Slang Dictionary* (1891); R. H. Thornton, *American Glossary* (1912); C. H. Durling, *The Jargon Book* (1919); G. M. Tucker, *American English* (1921); F. N. Scott, "List of American Slang" given in *Tract* No. 24 of the "Society for Pure English" (Oxford, 1926).

AUSTRALIAN SLANG

Abo, aboriginal, a journalese term.
Aussie, an Australian citizen and, during the World War, especially, an Australian soldier.
Baal, a term of dislike (native word).
Back-blocks, inland settlements and towns.
Bananalander, a Queensland citizen.
Billabong, a small off-shoot from a river which in wet weather rejoins the main stream lower down.
Billy or Billy-Can, a tin container used for cooking purposes.
Blackfellow, an Australian aborigine.
Bluey, a swagman's blanket.
Bonzer, something good—satisfactory.
Bosker, adjective of Bonzer.
Boss-Cockie, a small farmer employing labour, but also working himself.
Brumby, a wild horse.
Buckjumper, a refractory horse.
Budgeree, good or palatable (native word).
Bush, woods, forest.
Bushranger, an armed highwayman.
Chow, a Chinese.
Coo-ee, the Australian hail (native word).
Cornstalk, a citizen of New South Wales.
Corroboree, a noise, uproar (native word).
Cossie, a swimming costume.
Creek, a stream, brook.
Damper, a large scone.
Digger, friend, comrade,
Diggings, a gold-mining centre.
Dilly-bag, a small domestic bag.
Dingo, a native dog.
Dinkum, true; genuine.
Fossicker, one who looks for gold in rocky crevices.
Gazob, a fool.
Gin, a native woman.
Groper, a West Australian.
Gully, a rugged valley.
Gum-sucker, a citizen of Victoria.
Hard-hitter, a bowler hat, a derby.
Hide, impudence, cheek.
Humpy, a hut.
Jackaroo, a young man of good position who joins a station to learn sheep and cattle farming.
Joey, a young kangaroo.

John, a policeman.
Jumbuck, sheep.
Kid-stakes, foolery.
Knock-down, an introduction.
Larrikin, a hooligan.
Lolly, a sweetmeat.
Lubra, an aboriginal woman.
Mauldy, left-handed.
Maorilander, a New Zealander.
Never-never, remote unsettled districts.
Nuggety, short and sturdy.
Orchardist, a fruit-grower.
Outback, districts far inland from the coast.
Outer, a betting ground overlooking a racecourse.
Outlaw, a savage horse.
Overlander, a drover taking cattle from one state to another.
Poddy, a land-fed calf.
Pointer, an opportunist who takes mean advantages.
Possie, a job.
Push, a band of larrikins.
Ready up, a conspiracy.
Ringer, the quickest shearer of a gang.
Rouse-about, an odd-job man in a shearing shed.
Run, a track of grazing land.
Scrub, a stretch of bush undergrowth.
Shake-down, a makeshift bed.
Shanghai, a catapult.
Shanty, (a) a crude hut; (b) a "sly-grog" shop in the bush. A "blind tiger" or "speak-easy."
Shelf, an informer.
Shicker, intoxicants, "booze."
Shielah, a girl.
Springer, a cow approaching the milking period.
Squirt, a revolver.
Squatter, a "pastoralist"; an owner of a sheep- or cattle-run.
Station, a cattle-run—sheep-run.
Sticky-beak, an inquisitive person.
Stockman, a man in charge of cattle on a run.
Sundowner, an outback Swagman; *see* SWAGGIE.
Swag, a bundle containing tent, blanket, etc.
Swaggie, a sundowner; a wanderer with his kit, tramping from place to place.
Take-down, a thief—a cheat.
Tipslinger, a racecourse tipster.
To go bung, to collapse financially (as a bank).
To shake, to steal.
To sling off, to poke fun at.
To sool, to urge on, as dogs.
Too right, a term of agreement
Tray-bit, a threepenny bit.
Trooper, a mounted policeman.
Tucker, food.
Waddy, a heavy stick or club.
Woop-woop, a New South Wales word for country districts.
Wowser, a straight-laced person.
Yabber, to talk (native word).
Yacker, work (native word).
Yarraman, a horse (native word).
Ziff, a beard.

See Jice Doone, *Timely Tips for New Australians*, London, n.d.

SLATE, in geology, a fissile, fine-grained argillaceous rock which cleaves or splits readily into thin slabs having great tensile strength and durability. Some other rocks that occur in thin beds are improperly called slate, because they can be used for roofing and similar purposes. Stonefield slate, a thinly bedded limestone occurring near Oxford, is one of the best known. True slates do not, as a rule, split along the bedding, but along planes of cleavage, which may intersect the bedding at any angle, usually, in the case of good roofing slates, at high angles. The original material was a fine clay, sometimes with sand or volcanic dust, and the bedding of the sediment as originally laid down may be indicated by alternating bands, differing in colour or in lithological character, sometimes to be seen on the cleavage faces of the slates. Cleavage is a superinduced structure, the result of pressure acting on the rock at some time when it was deeply buried beneath the earth's surface. On this account slates are found chiefly among the rocks of the older geological systems, although some occur in regions where comparatively recent rocks have been folded and compressed as a result of mountain building movements in the earth's crust.

In thin sections for microscopical examination, slates show much colourless mica in small, irregular scales, which in the best average about two thousand to the inch in breadth, and six thousand to the inch in thickness. Green chlorite in flakes is also usually abundant, the principal other ingredient being quartz, in minute lens-shaped grains. In colour, slates may be black, blue, purple, red, green or grey; dark slates usually owe their colour to carbonaceous material or to finely divided sulphide of iron, reddish and purple varieties to the presence of oxide of iron in the form of haematite, and green varieties to the presence of much chlorite. Slates are widely used for roofing purposes, for not only are they easily prepared and fixed, but they are weatherproof and durable.

North Wales provides most of the slate used in the British Isles, but slate of economic importance also occurs in North Devon, the Lake District, Scotland (Ballachulish) and Ireland (Kilkenny). There are also important quarries in France (the Ardennes), Bohemia, Germany (near Coblenz) and in the United States; it is sometimes obtained from open quarries, and sometimes from underground workings or mines.

The material is sometimes removed by means of "channelling machines," which make cuts in the face of the rock allowing a block to be wedged off; or, when blasting is resorted to, advantage is taken of the joints and other planes of weakness in the rock. The masses, dislodged by whatever means had been adopted, are divided into blocks small enough to be sent to the sheds where they are split and dressed.

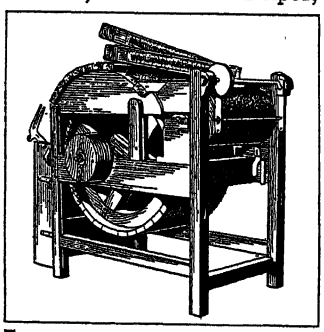
In "making" slates, the splitter takes blocks about 3 inches thick, and a chisel, placed in a certain position against the edge of the block is lightly tapped with a mallet; a crack appears in the direction of cleavage, and slight leverage with the chisel serves to split the block into two pieces with smooth and even surfaces. This is repeated until the original block is converted into 16 or 18 separate "slates," the thickness of which depends upon many circumstances, such as quality of rock, size required, and purpose for which it is to be used, the average thickness of a roofing tile of the best kinds of slate being about $\frac{1}{6}$ in. The slates are afterwards trimmed to size, either by hand, in which case they are cut between a fixed sharp edge and a movable knife acting on the principle of a printer's guillotine, or by means of machine-driven rotating knives.

A detailed bibliography of works relating to the origin, distribution and utilization of slate will be found in *The Slates of Wales* (National Museum of Wales, 1927). (F. J. N.)

SLATE CLUB. A society of persons who pay periodically small sums with the purpose of accumulating a fund which is shared out at a special time—in England, usually Christmas. The funds are not invested but merely retained by the secretary; the aim is thus "automatic saving." (*See* FRIENDLY SOCIETIES.)

SLATER, JOHN FOX (1815–1884), American philanthropist, son of John Slater (Samuel Slater's brother and partner), was born in Slatersville (R.I.), March 4, 1815. At 17 he entered his father's woollen mill in Hopeville (Conn.), of which he took charge in 1836. He helped to endow the Norwich Free academy. He died in Norwich (Conn.), May 7, 1884. In 1882 he had made over to a board of 10 trustees, incorporated in New York State, $1,000,000 for "the uplifting of the lately emancipated population of the Southern States, and their posterity, by conferring on them the benefits of Christian education." Its largest beneficiaries have been the Hampton Normal and Agricultural institute, Hampton (Va.), the Tuskegee Normal and Industrial institute of Tuskegee (Ala.), Spelman seminary in Atlanta (Ga.), Claflin university in Orangeburg (S.C.), and Fisk university, in Nashville (Tenn.). At Winston-Salem (N.C.), is the Slater State Normal and Industrial school, founded in 1892. Other State normal schools for negroes, as well as the school boards of certain Southern cities, have received assistance from the fund.

SLATER, SAMUEL (1768–1835), American textile manufacturer, was born in Belper, Derbyshire, England, on June 9, 1768. In 1783 he was apprenticed to a partner of Richard Arkwright in spinning cotton. Learning that the Pennsylvania legislature had granted £100 in 1789 to the inventor of a power carding machine, he removed to the United States in that year, but was unable because of British laws to bring with him drawings of cotton-spinning machinery. In Jan. 1790 he went to Pawtucket (R.I.), where he entered into a partnership with William Almy and designed from memory machines for cotton-spinning, and turned out some yarn. In 1799 he established in his mills one of the first Sunday schools in America.


THE CARDING MACHINE BUILT AFTER AN ENGLISH DESIGN BY SAMUEL SLATER, FROM THE ORIGINAL IN THE U.S. NAT. MUSEUM

In 1801 he built a factory in Rehoboth (Mass.), and with his brother John established in 1806 the manufacturing village of Slatersville (R.I.). He began the manufacture of woollen cloth in 1815–16 at Oxford, now Webster (Mass.), where he had built cotton mills in 1812. In his later years he was interested in other

textile mills, and in iron foundries in Rhode Island. He died at Webster (Mass.), April 21, 1835. He has been called the "father of American manufactures."

See G. S. White, *Memoir of Samuel Slater,* 2nd ed. (1846).

SLATIN, SIR RUDOLF CARL VON (1857–), Anglo-Austrian soldier and administrator in the Sudan, was born on June 27, 1857, at Ober St. Veit near Vienna. At the age of seventeen he made his first journey to the Sudan, reaching Khartum by the Nile route in October 1875 in company with Theodor von Heuglin (*q.v.*). Thence he went through Kordofan to Dar Nuba, exploring the mountains of that region. He returned to Khartum in consequence of a revolt of the Arabs against the Egyptian government. There Slatin met Dr. Emin (Emin Pasha) and with him purposed visiting Gordon at Lado, Gordon at that time being governor of the equatorial provinces. Slatin, however, was obliged to return to Austria without accomplishing his desire, but Emin went to Lado, and at Slatin's request recommended the young traveller to Gordon for employment in the Sudan. In 1878, while Slatin was serving as a lieutenant in the crown prince Rudolf's regiment in the Bosnian campaign he received a letter from Gordon inviting him to the Sudan, of which country Gordon had become governor-general. Slatin arrived at Khartum in January 1879. After a brief period during which he was financial inspector, Slatin was appointed mudir (governor) of Dara, the south-western part of Darfur, a post he held until early in 1881, when he was promoted governor-general of Darfur and given the rank of bey. While administering Dara, Slatin conducted a successful campaign against one of the Darfur princes in revolt, and as governor of Darfur he endeavoured to remedy many abuses. He had soon to meet the rising power of the mahdi Mohammed Ahmed (*q.v.*). Early in 1882 the Arabs in southern Darfur were in revolt. With insufficient resources and no succour from Khartum, Slatin gallantly defended his province. Though victorious in several engagements he lost ground. His followers attributing his non-success to the fact that he was a Christian, Slatin nominally adopted Islam. But all hope of maintaining Egyptian authority vanished with the news of the destruction of Hicks Pasha's army, and in December 1883 Slatin surrendered, refusing to make any further sacrifice of life in a hopeless cause. In the camp of the mahdi an attempt was made to use him to induce Gordon to surrender. This failing, Slatin was placed in chains, and on the morning of Jan. 26, 1885, an hour or two after the fall of Khartum, the head of Gordon was brought to the camp and shown to the captive. Slatin was kept at Omdurman by the khalifa, being treated alternately with savage cruelty and comparative indulgence. At length, after over eleven years' captivity, he was enabled, through the instrumentality of Sir Reginald (then Major) Wingate of the Egyptian Intelligence Department, to escape, reaching Egypt in March 1895.

In a remarkable book, *Fire and Sword in the Sudan,* written in the same year and issued in English and German in 1896, Slatin gave not only, as stated in the sub-title, "a personal narrative of fighting and serving the dervishes" but a connected account of the Sudan under the rule of the khalifa. Raised to the rank of pasha by the khedive, Slatin received from Queen Victoria the C.B. He served as staff officer in the campaigns of 1897–98 which ended in the capture of Omdurman and was made a K.C.M.G. and in 1906 was ennobled by the emperor of Austria. He was inspector-general of the Sudan from 1900 to the outbreak of the World War. His mastery of Arabic and his profound knowledge of the land and peoples proved invaluable in the work of reconstruction. In 1907 he was made an honorary major-general in the British army, and in 1912 was made G.C.V.O. During the World War he presided over the Austrian Red Cross for the Aid of Prisoners of War.

SLATING: *see* ROOFS.

SLATINGTON, a borough of Pennsylvania, 16 m. N.W. of Allentown. Pop. (1920), 4,014; and in 1930, 4,134. There are some 20 slate quarries in the neighbourhood, and the borough manufactures roofing and electrical slates and blackboards, and has knitting mills, silk mills, rug and garment factories. Slatington was settled about 1737 and incorporated in 1864.

SLAUGHTER-HOUSE or ABATTOIR. Slaughter-houses are of two kinds, those which belong to individual butchers (private) and those which belong to public authorities (public). Private slaughter-houses in existence in England before the passing of the Public Health Act 1875 were in most instances established without licence by the local authority, but after 1890 urban authorities adopting Part III. of the Public Health (Amendment) Act of that year could license for limited periods of not less than one year all slaughter-houses coming into existence after such adoption. In London, slaughter-houses have been licensed since 1855. In countries where the inspection of meat is compulsory, private slaughter-houses tend to be superseded by public abattoirs.

Public slaughter-houses are of great antiquity and owe their beginnings to Roman civilization. They existed in many large towns of Germany in mediaeval times under the name of *Kuttelhöfe,* some of which continued to exist within recent years. Their use, however, was not obligatory but shortly after the middle of the 19th century the prevalence of trichinosis compelled a return to the compulsory use of them (Schwarz, *Bau, Einrichtung und Betrieb öffentlicher Schlacht- und Viehhöfe*). In France, in the 15th and 16th centuries, numerous towns had public slaughter-houses. By decrees of Napoleon I. in 1807 and 1810 they were made compulsory in all large towns, the needs of Paris being determined by a Commission, which recommended the establishment of five abattoirs or public slaughter-houses. In 1838 the requirement was extended to all towns, and the slaughter-houses had to be situated at a distance from dwelling-houses. In 1867 the large abattoir of La Villette was constructed in Paris, two of the above five being closed. In 1898 the additional abattoir of Vaugirard was opened, and Villejuif alone remained open for the slaughter of horses for human food.

In Prussia there were 321 public slaughter-houses in 1897. A work published later (*Les Abattoirs publics,* by J. de Loverdo, H. Martel and Mallet, 1906) gives the number of public slaughter-houses as 839 in Germany, 84 in England, 912 in France and nearly 200 in Austria. In some countries slaughter-houses are primitive.

In the British dominions overseas advance is being made. New Zealand has a number of public slaughter-houses and vigorous inspection. Under the Meat Supervision Act of Victoria regulations have been made for Melbourne. Cattle are killed in public slaughter-houses and the carcases are stamped, thus showing in which slaughter-house they have been killed. These steps are necessitated by the frozen meat trade.

Construction.—The planning and construction of public slaughter-houses have been the subject of excellent treatises by German writers, among whom may be mentioned Dr. Oscar Schwarz, of Stolp, and Herr Osthoff, a former city architect of Berlin. The slaughter-house should be situated outside the town, or so placed as to be isolated, and approached by wide roads, so that if cattle are driven through them there should not be interference with the traffic. If possible, the slaughter-house should be connected with the railway system by a branch line, with a platform which has an impervious surface capable of being readily cleansed and disinfected. The most convenient shape of the site is a rectangle or square, having one side abutting on the principal road and another side bounded by the railway. A cattle-market is usually provided in connection with the slaughter-house, and the position should be such that cattle brought by train can be taken immediately into the cattle-market and from the market or the railway to the slaughter-house. The cattle-market should be entirely separate from the slaughter-house area. Osthoff states (*Schlachthöfe für kleine und mittelgrosse Städte*) that the area of the slaughter-house should be as follows:—

			Sq. Metres
Towns of	5,000– 7,000	inhabitants	0·40 per inhabitant.
„ „	7,000–10,000	„	0·35 „ „
„ „	10,000–50,000	„	0·30 „ „
„ „	over 50,000	„	0·25 „ „

In these figures it is assumed that the population derives the whole of its meat-supply from this source.

The parts required, according to Dr. Oscar Schwarz, are: (1)

an administrative block; (2) a slaughtering-hall, with a special room for scalding swine; (3) cattle lairs; (4) room for scalding and cleansing tripe and intestines; (5) an engine-house; (6) separate slaughtering-room, with lairs for animals suffering from, or suspected to be suffering from, contagious disease.

In small towns the slaughtering-hall and room for cleansing intestines may, to save cost of construction, be under the same roof. A necessary adjunct is a cold chamber, to which carcases can be removed from the slaughtering-hall. The actual slaughtering compartment has been built on two plans—one providing a separate slaughtering-room for each butcher, the other a common slaughtering-hall. The latter is greatly to be preferred, inasmuch as it is the only arrangement which gives adequate opportunity for inspection by the officials whose duty it is to examine the meat. The slaughter-house in Berlin was constructed on the separate-room system; but the system gave rise to difficulties of inspection. During recent years in Germany the practice has been to construct slaughter-houses with common halls. Schwarz gives the following as the most convenient arrangement of the buildings: The administrative building (with the house of the superintendent) at the entrance, so that from it the entrance and whole place can be seen. In the vicinity should be a weighing-machine for cattle. The centre of the area is occupied by the slaughtering-halls, and the lairs belonging to them are only separated from them by a road or passage way. The manure-house and tripe-house must be easily accessible from all the slaughtering-halls, but not in direct communication with them.

The manure-house must abut upon a road, to enable its contents to be removed without passing through the premises. Next to the tripe and pig-scalding houses is the engine-house. The building for diseased animals, with the slaughter-house for them, must be isolated from all other buildings. All buildings should be so arranged that they may be capable of extension as the population of the town increases. Cold chambers, although not absolutely essential for small slaughter-houses, are necessary when the slaughter-house is of any size. The cold chamber should be situated opposite the slaughtering-halls, so that carcases can be conveyed by overhead carriers directly from these halls to it. Great attention should be paid to adequate lighting and ventilation, the construction of walls, floors and fittings which are impermeable and can be readily cleansed, and the provision of an abundant water-supply. The floor of the slaughtering-hall is cement or granolithic pavement which must not be so smooth as to be slippery. The floor must have an adequate fall, so that the washings may discharge into the drainage.

Slaughter-houses in Germany pay their own expenses, the fees received for the use of the slaughter-house, and for examination of meat and stamping after examination, providing a sufficient sum for this purpose. The fees vary in different places.

The corporation of the City of London have erected a slaughter-house at their cattle market in Islington in which slaughtering is done in a large hall divided by partitions into separate compartments. The compartments are not let to separate butchers but are used in common. The partitions do not extend to the ceiling, but are sufficiently high to prevent the slaughtering in one compartment being seen by the occupants of other compartments, and thus they necessarily provide less opportunity for inspection than is afforded by the open-slaughtering halls of Germany. The accommodation is estimated as sufficient for the slaughter of 400 cattle, 1,200 sheep and 1,200 calves and pigs per day.

Slaughter-houses in U.S.A.—The centralization of the slaughtering and packing industries in the United States has not required slaughter-houses on the same plan as in Europe. Acts of Congress of 1890, 1891 and 1895 endeavoured to provide some amount of inspection, but sufficient appropriations were never made to carry it out, and there were also certain loopholes in the legislation. Although there were from time to time frequent cases of sickness directly traceable to the consumption of canned meats from the great packing centres, it was not until the publication of Upton Sinclair's *The Jungle* (1906), which dealt with the conditions in the Chicago packing yards, that steps were taken adequately to guard the public against insanitary conditions. A commission of inquiry was appointed by President Roosevelt, and as a result of its report there was passed in 1906 a national meat inspection law. This act required the department of agriculture to appoint inspectors to examine and inspect all cattle, sheep, swine and goats before being allowed to enter into any slaughtering, packing, meat-canning, rendering or similar establishments engaged in interstate commerce. All such animals found to show any symptoms of disease must be set apart and slaughtered separately. All carcases must be inspected and labelled as either "inspected and passed" or "inspected and condemned." Inspection and examination is now carried out very carefully at all stages of the industry, from inspection of the animals before they enter the slaughtering establishments up to the finished product.

The important feature of the Chicago and certain other western American cities slaughter-houses is their adaptation for rapidly dealing with the animals which they receive. At the Chicago slaughter-houses the cattle to be slaughtered are driven up a winding viaduct, by which, in certain of the houses, they eventually reach the roof. Each animal now passes into a narrow pen, where it is at once stunned by a blow on the head. It then falls through a trap-door in the pen into an immense slaughtering-room, where the hind legs are secured, and the animal hoisted to a trolley running on an overhead rail, which leads past numerous workmen, each deputed to carry out a special duty in preparing the carcase on its way to the cooling room which is reached in less than one hour after it has been killed. Any particular carcase or part thereof can be switched out of the line for special inspection without interfering with the onward movement of the others and can be switched back into line if passed by the inspectors. The method of dealing with sheep and swine is essentially the same. One firm alone deals daily with some 10,000 sheep, 12,000 hogs and 3,000 cattle.

Method of Killing.—In 1904 a British departmental (Admiralty) committee on the humane slaughtering of animals recommended that all animals should be stunned before being bled, and, with a view to sparing animals awaiting slaughter the sights and smells of the slaughter-house, that "cattle should, when possible, be slaughtered screened off from their fellows." The aforesaid committee state that they practically tested a large number of appliances designed for felling and stunning animals previous to "pithing," among which they mention the Bruneau and Baxter masks, the Greener patent killer, the Blitz instrument and the Wackett punch, all of which are suitable for quiet cattle or horses. In view of the difficulty of adjusting these instruments in the case of wild or restive animals, the committee express the opinion that the poll-axe when used by an expert is on the whole the most satisfactory implement, but they recommend that no man should be permitted to use the poll-axe on a living animal until he has gone through a thorough course of training, firstly upon a dummy animal and secondly upon dead bodies. Calves, the committee state should be stunned by a blow on the head with a club. With respect to the method of slaughter of sheep the committee discuss the method usually adopted in England, which is "to lay the sheep on a wooden crutch, and then to thrust a knife through the neck below the ears, and with a second motion to insert the point, from within, between the joints of the vertebrae, thus severing the spinal cord." Observations made for the committee by Professor Starling showed that the interval between the first thrust of the knife and complete loss of sensibility varied from five to thirty seconds, and they therefore recommended that sheep should be stunned before being stuck, a practice required in Denmark, many parts of Germany, and Switzerland. It is necessary that the sheep should be struck on the top of the head between the ears and not on the forehead. The insensibility produced by the blow was found to last fully twenty seconds, a period sufficiently long for the killing to be completed if the animal is laid on the crutch before being stunned. The stunning of pigs, the committee recommended, should be insisted upon in all cases, and not, as sometimes at present, only practised in the case of large pigs which give trouble or with a view to the avoidance of noise. Recently in England use of the "humane killer" has been advocated.

The Jewish method of slaughter by cutting the throat was con-

demned by the committee after careful observation, the chief objection being that it fails in the primary requirements of rapidity, freedom from pain and instantaneous loss of sensibility.

(S. F. M.; X.)

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SLAVE COAST in West Africa extends from the Gold Coast, that is the river Volta, eastward to the Niger delta; (*see* GUINEA). During the 16th, 17th and 18th centuries, this region was a principal resort of the Europeans engaged in the slave trade. The various districts are now known as Togoland, Dahomey, Lagos, etc. The coast forms the Bight of Benin.

SLAVERY. It appears to be true that, in the words of Dunoyer, the economic régime of every society which has recently become sedentary is founded on the slavery of the industrial professions. In the hunter period the savage warrior does not enslave his vanquished enemy, but slays him; the women of a conquered tribe he may, however, carry off and appropriate as wives or as servants, for in this period domestic labour falls almost altogether on their sex. In the pastoral stage slaves will be captured only to be sold, with the exception of a few who may be required for the care of flocks or the small amount of cultivation which is then undertaken. It is in proportion as a sedentary life prevails, and agricultural exploitation is practised on a larger scale, whilst warlike habits continue to exist, that the labour of slaves is increasingly introduced to provide food for the master, and at the same time save him from irksome toil. Of this stage in the social movement slavery seems to have been, as we have said, a universal and inevitable accompaniment.

But wherever theocratic organizations established themselves slavery in the ordinary sense did not become a vital element in the social system. The members of the lowest class were not in a state of individual subjection: the entire caste to which they belonged was collectively subject. It is in the communities in which the military order obtained an ascendancy over the sacerdotal, and which were directly organized for war, that slavery (as the word is commonly understood) had its natural and appropriate place. It is not merely that in its first establishment slavery was an immense advance by substituting for the immolation of captives, often accompanied by cannibalism, their occupation in labour for the benefit of the victor. This advantage, recalled by an old though erroneous[1] etymology, is generally acknowledged. But it is not so well understood that slavery discharged important offices in the later social evolution—first, by enabling military action to prevail with the degree of intensity and continuity requisite for the system of incorporation by conquest which was its final destination; and, secondly, by forcing the captives, who with their descendants came to form the majority of the population in the conquering community, to an industrial life, in spite of the antipathy to regular and sustained labour which is deeply rooted in human nature. As regards the latter consideration, it is enough to say that nowhere has productive industry developed itself in the form of voluntary effort; in every country of which we have any knowledge it was imposed by the strong upon the weak, and was wrought into the habits of the people only by the stern discipline of constraint. From the former point of view the freeman, then essentially a warrior, and the slave were mutual auxiliaries, simultaneously exercising different and complementary functions—each necessary to the community. In modern slavery, on the other hand, where the occupations of both parties were industrial, the existence of a servile class only guaranteed for some of them the possibility of self-indulgent ease, whilst it imposed on others the necessity of indigent idleness.

It was in the Roman State that military action—in Greece often purposeless and, except in the resistance to Persia, on the whole fruitless—worked out the social mission which formed its true justification. Hence at Rome slavery also most properly found its place, so long as that mission was in progress of accomplishment. As soon as the march of conquest had reached its natural limit, slavery began to be modified; and when the empire was divided into the several States which had grown up under it, and the system of defence characteristic of the middle ages was substituted for the aggressive system of antiquity, slavery gradually disappeared, and was replaced by serfdom.

We have so far dealt with the political results of ancient slavery, and have found it to have been in certain respects not only useful but indispensable. When we consider its moral effects, whilst endeavouring to avoid exaggeration, we must yet pronounce its influence to have been profoundly detrimental. In its action on the slave it marred in a great measure the happy effects of habitual industry by preventing the development of the sense of human dignity which lies at the foundation of morals. On the morality of the masters—whether personal, domestic or social—the effects of the institution were disastrous.

GREECE

We find slavery fully established in the Homeric period. The prisoners taken in war are retained as slaves, or sold (*Il.* xxiv. 752) or held at ransom (*Il.* vi. 427) by the captor. Sometimes the men of a conquered town or district are slain and the women carried off (*Od.* ix. 40). Not unfrequently free persons were kidnapped by pirates and sold in other regions, like Eumaeus in the *Odyssey.* The slave might thus be by birth of equal rank with his master, who knew that the same fate might befall himself or some of the members of his family. The institution does not present itself in a very harsh form in Homer, especially if we consider (as Grote suggests) that "all classes were much on a level in taste, sentiment and instruction." The male slaves were employed in the tillage of the land and the tending of cattle, and the females in domestic work and household manufactures. The principal slaves often enjoyed the confidence of their masters and had important duties entrusted to them; and, after lengthened and meritorious service, were put in possession of a house and property of their own (*Od.* xiv. 64). Grote's idea that the women slaves were in a more pitiable condition than the males does not seem justified, except perhaps in the case of the *aletrides,* who turned the household mills which ground the flour consumed in the family, and who were sometimes overworked by unfeeling masters (*Od.* xx. 110–119). Homer marks in a celebrated couplet his sense of the moral deterioration commonly wrought by the condition of slavery (*Od.* xvii. 322).

Historic Period—Sources of Slavery.—It is, however, in historic Greece, where we have ample documentary information, that it is most important to study the system. The sources of slavery in Greece were: (1) Birth, the condition being hereditary. This was not an abundant source, women slaves being less numerous than men, and wise masters making the union of the sexes rather a reward of good service than a matter of speculation (Xen. *Oecon.* 9. 5). It was in general cheaper to buy a slave than to rear one to the age of labour. (2) Sale of children by their free parents, which was tolerated, except in Attica, or their exposure, which was permitted, except at Thebes. The consequence of the latter was sometimes to subject them to a servitude worse than death, as is seen in the plays of Plautus and Terence, which, as is well known, depict Greek, not Roman, manners. Freemen, through indigence, sometimes sold themselves, and at Athens, up to the time of Solon, an insolvent debtor became the

[1] *Servus* is not cognate with *servare,* as has often been supposed, it is really related to the Homeric εἴρερο and the verb εἴρω, with which the Latin *sero* is to be connected. It may be here mentioned that *slave* was originally a national name; it meant a man of Slavonic race captured and made a bondman to the Germans. "From the Euxine to the Adriatic, in the state of captives or subjects, . . . they [the Slavonians] overspread the land, and the national appellation of the *Slaves* has been degraded by chance or malice from the signification of glory to that of servitude" (Gibbon, *Decline and Fall,* ch. lv.). The historian alludes to the derivation of the national name from *slava,* glory. *See* Skeat's *Etym. Dict., s.v.; see* also SLAVS.

slave of his creditor. (3) Capture in war. Not only Asiatics and Thracians thus became slaves, but in the many wars between Grecian States, continental or colonial, Greeks were reduced to slavery by men of their own race. Callicratidas pronounced against the enslavement of Greeks by Greeks, but violated his own principle, to which, however, Epaminondas and Pelopidas appear to have been faithful. (4) Piracy and kidnapping. The descents of pirates on the coasts were a perpetual source of danger; the pirate was a gainer either by the sale or by the redemption of his captives. If ransomed, the victim became by Athenian law the slave of his redeemer till he paid in money or labour the price which had been given for him. Kidnappers (*andrapodistae*) carried off children even in cities, and reared them as slaves. Whether from hostile forays or from piracy, any Greek was exposed to the risk of enslavement. (5) Commerce. Besides the sale of slaves which took place as a result of the capture of cities or other military operations, there was a systematic slave trade. Syria, Pontus, Lydia, Galatia, and above all Thrace were sources of supply. Egypt and Ethiopia also furnished a certain number, and Italy a few. Of foreigners, the Asiatics bore the greatest value, as most amenable to command, and most versed in the arts of luxurious refinement. But Greeks were highest of all in esteem, and they were much sought for foreign sale. Greece proper and Ionia supplied the petty Eastern princes with courtesans and female musicians and dancers. Athens was an important slave market, and the State profited by a tax on the sales; but the principal marts were those of Cyprus, Samos, Ephesus and especially Chios.

Employment of Slaves.—The slaves were employed either in domestic service—as household managers, attendants or personal escorts—or in work of other kinds, agricultural or urban. In early Attica, and even down to the time of Pericles, the landowners lived in the country. The Peloponnesian War introduced a change; and after that time the proprietors resided at Athens, and the cultivation was in the hands of slaves. In manufactures and commerce, also, servile gradually displaced free labour. Speculators either directly employed slaves as artisans or commercial and banking agents, or hired them out, sometimes for work in mines or factories, sometimes for service in private houses, as cooks, flute-players, etc., or for viler uses. There were also public slaves; of these some belonged to temples, to which they were presented as offerings, amongst them being the courtesans who acted as *hieroduli* at Corinth and at Eryx in Sicily; others were appropriated to the service of the magistrates or to public works; there were at Athens 1,200 Scythian archers for the police of the city; slaves served, too, in the fleets, and were employed in the armies—commonly as workmen, and exceptionally as soldiers.

The condition of slaves at Athens was not in general a wretched one. Demosthenes (*In Mid.* p. 530) says that, if the barbarians from whom the slaves were bought were informed of the mild treatment they received, they would entertain a great esteem for the Athenians. Plautus in more than one place thinks it necessary to explain to the spectators of his plays that slaves at Athens enjoyed such privileges, and even licence, as must be surprising to a Roman audience. The slave was introduced with certain customary rites into his position in the family; he was in practice, though not by law, permitted to accumulate a private fund of his own; his marriage was also recognized by custom; though in general excluded from sacred ceremonies and public sacrifices, slaves were admissible to religious associations of a private kind; there were some popular festivals in which they were allowed to participate; they had even special ones for themselves both at Athens and in other Greek centres. Their remains were deposited in the family tomb of their master, who sometimes erected monuments in testimony of his affection and regret. They often lived on terms of intimacy either with the head of the house or its younger members; but it is to be feared that too often this intimacy was founded, not on mutual respect, as in the heroic example of Ulysses and Eumaeus, but on insolent self-assertion on the one side and a spirit of unworthy compliance on the other, the latter having its *raison d'être* in degrading services rendered by the slave. Aristophanes and Plautus show us how often resort was had to the discipline of the lash even in the case of domestic slaves. Those employed in workshops, whose overseers were themselves most commonly of servile status, had probably a harder lot than domestics; and the agricultural labourers were not unfrequently chained, and treated much in the same way as beasts of burden. The displeasure of the master sometimes dismissed his domestics to the more oppressive labours of the mill or the mine. A refuge from cruel treatment was afforded by the temples and altars of the gods and by the sacred groves. Nor did Athenian law leave the slave without protection. He had, as Demosthenes boasts, an action for outrage like a freeman, and his death at the hand of a stranger was avenged like that of a citizen (Eurip. *Hec.* 288), whilst, if caused by his master's violence, it had to be atoned for by exile and a religious expiation. Even when the slave had killed his master, the relatives of the house could not themselves inflict punishment; they were obliged to hand him over to the magistrate to be dealt with by legal process. The slave who had just grounds of complaint against his master could demand to be sold; when he alleged his right to liberty, the law granted him a defender and the sanctuaries offered him an asylum till judgment should be given. Securities were taken against the revolt of slaves by not associating those of the same nationality and language; they were sometimes fettered to prevent flight, and, after a first attempt at escape, branded to facilitate their recovery. There were treaties between States for the extradition of fugitives, and contracts of mutual assurance between individuals against their loss by flight.

Emancipation.—The slave could purchase his liberty with his *peculium* by agreement with his master. He could be liberated by will, or, during his master's life, by proclamation in the theatre, the law courts or other public places, or by having his name inscribed in the public registers, or, in the later age of Greece, by sale or donation to certain temples—an act which did not make the slave a hierodulus but a freeman. Conditions were sometimes attached to emancipation, as of remaining for life or a definite time with the former master, or another person named by him, or of performing some special service; payments or rights of succession to property might also be reserved. By manumission the Athenian slave became in relation to the State a metic, in relation to his master a client. He was thus in an intermediate condition between slavery and complete freedom. If the freedman violated his duties to his patron he was subject to an action at law, and if the decision were against him, he was again reduced to slavery. He became a full member of the State only, as in the case of foreigners, by a vote in an assembly of 6,000 citizens; and even this vote might be set aside by a *graphē paranomōn.* Slaves who had rendered eminent services to the public, as those who fought at Arginusae and at Chaeronea, were at once admitted to the status of citizens in the class of (so-called) Plataeans. But it would appear that even in their case some civic rights were reserved and accorded only to their children by a female citizen. The number of freedmen at Athens seems never to have been great. (*See* further GREECE: *Ancient History.*)

Theoretic Views on Slavery.—It is well known that Aristotle held slavery to be necessary and natural, and, under just conditions, beneficial to both parties in the relation—views which were correct enough from the political side, regard being had to the contemporary social state. His practical motto, if he is the author of the *Economics* attributed to him, is—"no outrage, and no familiarity." There ought, he says, to be held out to the slave the hope of liberty as the reward of his service. Plato condemned the practice, which the theory of Aristotle also by implication sets aside as inadmissible, of Greeks having Greeks for slaves. In the *Laws* he accepts the institution as a necessary though embarrassing one, and recommends for the safety of the masters that natives of different countries should be mixed and that they should all be well treated. But, whilst condemning harshness towards them, he encourages the feeling of contempt for them as a class. The later moral schools of Greece scarcely at all concern themselves with the institution. The Epicurean had no scruple about the servitude of those whose labours contributed to his

own indulgence and tranquillity. The Stoic regarded the condition of freedom or slavery as an external accident, indifferent in the eye of wisdom; to him it was irrational to see in liberty a ground of pride or in slavery a subject of complaint; from intolerable indignity suicide was an ever-open means of escape. The poets—especially the authors of the New Comedy—strongly inculcate humanity, and insist on the fundamental equality of the slave. The celebrated "homo sum" is a translation from Alexis, and the spirit of it breathes in many passages of the Greek drama. A fragment of Philemon declares, as if in reply to Aristotle, that not nature, but fortune, makes the slave. Euripides, as might be expected from his humanitarian cast of sentiment, and the "premature modernism" which has been remarked in him, rises above the ordinary feelings of his time in regard to the slaves. As Paley says, he loves "to record their fidelity to their masters, their sympathy in the trials of life, their gratitude for kindness and considerate treatment, and their pride in bearing the character of honourable men. . . . He allows them to reason, to advise, to suggest; and he even makes them philosophize on the follies and the indiscretions of their superiors" (compare *Med.* 54; *Orest.* 869; *Hel.* 728; *Ion.* 854; *Frag. Melan.* 506; *Phrix.* 823).

(For the Helots in Laconia, *see* HELOTS.)

ROME

We have already observed that the Roman system of life was that in which slavery had its most natural and relatively legitimate place; and accordingly it was at Rome that, as Blair has remarked, the institution was more than anywhere else "extended in its operations and methodized in its details."

Sources of Slavery.—We must distinguish from the later slavery at Rome what Mommsen calls "the old, in some measure innocent" slavery, under which the farmer tilled the land along with his slave, or, if he possessed more land than he could manage, placed the slave—either as a steward, or as a sort of lessee obliged to render up a portion of the produce—over a detached farm. Though slaves were obtained by the early victories of Rome over her Italian neighbours, no large number was employed on the small holdings of those periods. But the extension of properties in the hands of the patricians, and the continued absences of citizens required by the expanding system of conquest, necessarily brought with them a demand for slave labour, which was increasingly supplied by captives taken in war. Of the number furnished from this source a few particulars from the time of the mature republic and the first century of the empire will give some idea. In Epirus, after the victories of Aemilius Paullus, 150,000 captives were sold. The prisoners at Aquae, Sextiae and Vercellae were 90,000 Teutons and 60,000 Cimbri. Caesar sold on a single occasion in Gaul 63,000 captives. But slavery, as Hume has shown, is unfavourable to population. Hence a regular commerce in slaves was established, which was based on the "systematically-prosecuted hunting of man," and indicated an entire perversion of the primitive institution, which was essentially connected with conquest. The pirates sold great numbers of slaves at Delos, where was the chief market for this kind of wares; and these sales went on as really, though more obscurely, after the successful expedition of Pompey. There was a regular importation to Rome of slaves, brought to some extent from Africa, Spain and Gaul, but chiefly from Asiatic countries—Bithynia, Galatia, Cappadocia and Syria.

There were other sources from which slavery was alimented, though of course in a much less degree. Certain offences reduced the guilty persons to slavery (*servi poenae*), and they were employed in public work in the quarries or the mines. Originally, a father could sell his children. A creditor could hold his insolvent debtor as a slave, or sell him out of the city (*trans Tiberim*). The enslavement of debtors, overwhelmed with usury in consequence of losses by hostile raids or their own absence on military service, led to the secession to the Mons Sacer (493 B.C.). The Poetelian law (326 B.C.) restricted the creditor's lien (by virtue of a *nexum*) to the goods of his debtor, and enacted that for the future no debtor should be put in chains; but we hear of debtors *addicti* to their creditors by the tribunals long after—even in the time of the Punic Wars.

Employment of Slaves.—There were *servi publici* as well as *privati*. The service of the magistrates was at first in the hands of freemen; but the lower offices, as of couriers, servants of the law courts, of prisons and of temples, were afterwards filled by slaves. The execution of public works also came to be largely committed to them—as the construction of roads, the cleansing of the sewers and the maintenance of the aqueducts. Both kinds of functions were discharged by slaves, not only at Rome, but in the rural and provincial municipalities. The slaves of a private Roman were divided between the *familia rustica* and the *familia urbana*. At the head of the *familia rustica* was the *villicus*, himself a slave, with the wife who was given him at once to aid him and to bind him to his duties. Under him were the several groups employed in the different branches of the exploitation and the care of the cattle and flocks, as well as those who kept or prepared the food, clothing and tools of the whole staff and those who attended on the master in the various species of rural sports. A slave prison (*ergastulum*) was part of such an establishment, and there were slaves whose office it was to punish the offences of their fellows. To the *familia urbana* belonged those who discharged the duties of domestic attendance, the service of the toilet, bath, table and kitchen, besides the entertainment of the master and his guests by dancing, singing and other arts. There were, besides, the slaves who accompanied the master and mistress out of doors and were chosen for their beauty and grace as guards of honour, for their strength as chairmen or porters, or for their readiness and address in remembering names, delivering messages of courtesy and the like. There were also attached to a great household physicians, artists, secretaries, librarians, copyists, preparers of parchment, as well as pedagogues and preceptors of different kinds—readers, grammarians, men of letters and even philosophers—all of servile condition, besides accountants, managers and agents for the transaction of business. Actors, comic and tragic, pantomimi, and the performers of the circus were commonly slaves, as were also the gladiators. These last were chosen from the most warlike races—as the Samnites, Gauls and Thracians. *Familiae* of gladiators were kept by private speculators, who hired them out; they were sometimes owned by men of high rank.

Several special examples and other indirect indications show that the wealthier Romans possessed large *familiae*. This may be inferred from the *columbaria* of the house of Livia and of other great houses. The slaves of Pedanius Secundus, who, in spite of a threatened outbreak of the indignant populace, were all put to death because they had been under their master's roof when he was murdered, were 400 in number. Pliny tells us that Caecilius, a freedman of the time of Augustus, left by his will as many as 4,116. The question as to the total number of slaves at Rome or in Italy is a very difficult one, and it is not, perhaps, possible to arrive with any degree of certainty at an approximate estimate. Gibbon supposes that there were in the Roman world in the reign of Claudius at least as many slaves as free inhabitants. But Blair seems right in believing that this number, though probably correct for an earlier period, is much under the truth for the age to which it is assigned. He fixes the proportion of slaves to free men as that of three to one for the time between the conquest of Greece (146 B.C.) and the reign of Alexander Severus (A.D. 222–235). The entire number of slaves in Italy would thus have been, in the reign of Claudius, 20,832,000.

Laws.—By the original Roman law the master was clothed with absolute dominion over the slave, extending to the power of life and death, which is not surprising when we consider the nature of the *patria potestas*. The slave could not possess property of any kind; whatever he acquired was legally his master's. He was, however, in practice permitted to enjoy and accumulate chance earnings or savings, or a share of what he produced, under the name of *peculium*. A master could not enter into a contract with his slave, nor could he accuse him of theft before the law; for, if the slave took anything, this was not a subtraction, but only a displacement, of property. The union of a male and female slave had not the legal character of a marriage; it was a cohabitation

(*contubernium*) merely, which was tolerated, and might be terminated at will, by the master; a slave was, therefore, not capable of the crime of adultery. Yet general sentiment seems to have given a stronger sanction to this sort of connection; the names of husband and wife are freely used in relation to slaves on the stage, and even in the laws, and in the language of the tombs. For entering the military service or taking on him any State office a slave was punished with death. He could not in general be examined as a witness, except by torture. A master, when accused, could offer his slaves for the "question," or demand for the same purpose the slaves of another; and, if in the latter case they were injured or killed in the process, their owner was indemnified. A slave could not accuse his master, except of adultery or incest (under the latter name being included the violation of sacred things or places); the case of high treason was afterwards added to these. An accused slave could not invoke the aid of the tribunes. The penalties of the law for crime were specially severe on slaves.

Treatment of Slaves.—Columella, like Xenophon, favours a certain friendliness and familiarity in one's intercourse with his farm slaves. Cato ate and drank the same coarse victuals as his slaves, and even had the children suckled by his wife, that they might imbibe a fondness for the family. But he had a strict eye to profit in all his dealings with them. He allowed the *contubernium* of male and female slaves at the price of a money payment from their *peculium*. Columella regarded the gains from the births as a sufficient motive for encouraging these unions, and thought that mothers should be rewarded for their fecundity; Varro, too, seems to have taken this view. The immense extension of the rural estates (*latifundia*) made it impossible for masters to know their slaves, even if they were disposed to take trouble for the purpose. Effective superintendence even by overseers became less easy; the use of chains was introduced, and these were worn not only in the field during working hours but at night in the *ergastulum* where the slaves slept. Urban slaves had probably often a life as little enviable, especially those who worked at trades for speculators. Even in private houses at Rome, so late as the time of Ovid, the porter was chained. In the *familia urbana* the favourites of the master had good treatment, and might exercise some influence over him which would lead to their receiving flattery and gifts from those who sought his vote or solicited his support. Doubtless there was often genuine mutual affection; slaves sometimes, as in noted instances during the civil wars, showed the noblest spirit of devotion to their masters. Those who were not inmates of the household, but were employed outside of it as keepers of a shop or boat, chiefs of workshops, or clerks in a mercantile business, had the advantage of greater freedom of action. The slaves of the *leno* and the *lanista* were probably in most cases not only degraded but unhappy. The lighter punishments inflicted by masters were commonly personal chastisement or banishment from the town house to rural labour; the severer were employment in the mill (*pistrinum*) or relegation to the mines or quarries. To the mines also speculators sent slaves; they worked half-naked, men and women, in chains, under the lash and guarded by soldiers. Vedius Pollio, in the time of Augustus, was said to have thrown his slaves, condemned sometimes for trivial mistakes or even accidents, to the lampreys in his fishpond. Cato advised the agriculturist to sell his old oxen and his old slaves, as well as his sick ones; and sick slaves were exposed in the island of Aesculapius in the Tiber; by a decree of Claudius slaves so exposed could not be reclaimed by their masters, in case of their recovery.

Though the Roman slaves were not, like the Spartan Helots, kept obedient by systematic terrorism, their large numbers were a constant source of danger. The law under which the slaves of Pedanius were put to death, probably introduced under Augustus and more fully enacted under Nero, is sufficient proof of this anxiety, which indeed is strongly stated by Tacitus in his narrative of the facts. There had been many conspiracies amongst the slaves in the course of Roman history, and some formidable insurrections. The growth of the *latifundia* made the slaves more and more numerous and formidable. Free labour was discountenanced. Cato, Varro and Columella all agree that slave labour was to be preferred to free except in unhealthy regions and for large occasional operations, which probably transcended the capacity of the permanent *familia rustica*. Cicero and Livy bear testimony to the disappearance of a free plebs from the country districts and its replacement by gangs of slaves working on great estates. The worst form of such predial slavery existed in Sicily, whither Mommsen supposes that its peculiarly harsh features had been brought by the Carthaginians. In Sicily, accordingly, the first really serious servile insurrections took place. The rising under Eunus in 133 B.C. was with some difficulty suppressed by Rupilius. Partial revolts in Italy succeeded; and then came the second Sicilian insurrection under Trypho and Athenio, followed by the Servile War in Italy under Spartacus (*q.v.*). Clodius and Milo used bands of gladiators in their city riots, and this action on the part of the latter was approved by Cicero. In the First Civil War they were to be found in both camps, and the murderers of Caesar were escorted to the Capitol by gladiators. Antony, Octavius, and Sextus Pompeius employed them in the Second Civil War; and it is recorded by Augustus on the Monumentum Ancyranum that he gave back to their masters for punishment about 30,000 slaves who had borne arms against the State.

Blair, in comparing the Greek and Roman systems of slavery, points with justice to the greater facility and frequency of emancipation as the great superiority of the latter. No Roman slave, he says, "needed to despair of becoming both a freeman and a citizen." Manumission was of two kinds—*justa* or regular, and *minus justa*. Of *manumissio justa* there were four modes: (1) by adoption, rarely resorted to; (2) by testament, already recognized in the Twelve Tables; (3) by *census*, which was of exceptional use, and did not exist later than the time of Vespasian; and (4) by *vindicta*, which was the usual form. In the last method the master turned the slave round, with the words "liber esto," in the presence of the praetor, that officer or his lictor at the same time striking the slave with his rod. The *manumissio minus justa* was effected by a sufficient manifestation of the will of the master, as by letter, by words, by putting the *pileus* (or cap of liberty) on the slave, or by any other formality which had by usage become significant of the intention to liberate, or by such an act as making the slave the guardian of his children. This extra-legal sort of manumission was incomplete and precarious; even after the *lex Junia Norbana* (A.D. 19), which assimilated the position of those so liberated to that of the Latin colonists, under the name of Latini juniores, the person remained in the eye of the law a slave till his death and could not dispose of his *peculium* by gift or testamentary disposition.

A freedman, unless he became such by operation of law, remained client of his master, and both were bound by mutual obligations arising out of that relation. These obligations existed also in the case of freedmen of the State, of cities, temples and corporations. The freedman took his former master's name; he owed him deference (*obsequium*) and aid (*officium*); and neglect of these obligations was punished, in extreme cases even with loss of liberty. Conditions might be annexed by the master to the gift of freedom, as of continued residence with him, or of general service or some particular duty to be performed, or of a money payment to be made. But the praetor Rutilius, about the beginning of the 1st century B.C., limited the excessive imposition of such conditions, and his restrictions were carried further by the later jurists and the imperial constitutions. Failing natural heirs of an intestate freedman, the master, now patron, succeeded to his property at his death; and he could dispose by will of only half his possessions, the patron receiving the other half. Freedmen and their sons were subject to civil disabilities; the third generation became *ingenui* (full citizens). Thus the slave element tended to merge itself in the general popular body.

It was often a pecuniary advantage to the master to liberate the slave; he obtained payment which enabled him to buy a substitute and at the same time gained a client. This, of course, presupposes the recognition of the right of the slave to his *peculium;* and the same is implied in Cicero's statement that a diligent slave could in six years purchase his freedom. Augustus set himself against the undue multiplication of manumissions, probably

considering the rapid succession of new citizens a source of social instability, and recommended a similar policy to his successor. The lex Aelia Sentia (about A.D. 3) forbade manumission, except in strictly limited cases, by masters under 20 years of age or of slaves under 30; and the lex Furia Caninia (about A.D. 7) fixed the proportion of a man's slaves which he could liberate by testament, and forbade more than 100 being so enfranchised, whatever might be the number of the *familia*. Under the empire the freedmen rose steadily in influence; they became admissible to the rank of equites and to the senate; they obtained provincial Governments, and were appointed to offices in the imperial household which virtually placed them at the head of administrative departments. (*See* article on NARCISSUS.) Freedmen of humbler rank, on the other hand, filled the minor offices in the administrative service, in the city cohorts, and in the army; and we shall find that they entered largely into the trades and professions when free labour began to revive. They appeared also in literature, *e.g.*, Tiro, the amanuensis of Cicero; Hyginus, the librarian of Augustus; Livius Andronicus, Caecilius, Statius, Terence, Publilius Syrus, Phaedrus and Epictetus.

In the 2nd century of the Christian era we find a marked change with respect to the institution of slavery, both in the region of thought and in that of law. Already the principles of reason and humanity had been applied to the subject by Seneca. But it was in the 2nd century, as we have said, that "the victory of moral ideas" in this, as in other departments of life, became "decisive. . . . Dio Chrysostom, the adviser of Trajan, is the first Greek writer who has pronounced the principle of slavery to be contrary to the law of nature" (Mark Pattison). And a parallel change is found in the practical policy of the State. The military vocation of Rome was now felt to have reached its normal limits; and the emperors, understanding that, in the future, industrial activity must prevail, prepared the abolition of slavery as far as was then possible, by honouring the freedmen, by protecting the slave against his master, and by facilitating manumissions. The general tendency both of the imperial constitutions and of the maxims of the legists is in favour of liberty. The practices of exposure and sale of children, and of giving them in pledge for debt, are forbidden. Diocletian forbade a free man to sell himself. Kidnappers (*plagiarii*) were punished with death. The insolvent debtor was withdrawn from the yoke of his creditor. While the slave trade was permitted, the mutilation of boys and young men, too often practised, was punished with exile and even with death. In redhibitory actions (for the annulment of sales), if a slave were returned to the seller, so must also be his parents, brothers and *personae contubernio conjunctae*. In the interpretation of testaments it was to be assumed that members of the same family were not to be separated by the division of the succession. The law also favoured in special cases the security of the *peculium*, though in general principle it still remained the property of the master. The State granted to public slaves the right of bequeathing half their possessions; and private persons sometimes permitted similar dispositions even to a greater extent, though only within the *familia*. Hadrian took from masters the power of life and death and abolished the subterranean prisons. Antoninus Pius punished him who killed his own slave as if he had killed another's. Already in the time of Nero the magistrates had been ordered to receive the slave's complaint of ill-treatment; and the *lex Petronia*, belonging to the same or an earlier period, forbade masters to hand over their slaves to combats with wild beasts. M. Aurelius gave to masters an action against their slaves for any cause of complaint, thus bringing their relation more directly under the surveillance of law and public opinion. A slave's oath could still not be taken in a court of law; he was interrogated by the "question"; but the emperors and jurists limited in various ways the application of torture, adding, however, as we have mentioned, to the cases in which it could previously be appealed to that of the crime of *majestas*. For certain alleged offences of the master the slave could bring an action, being represented for the purpose by an *adsertor*. Emancipation was facilitated. The power of imposing conditions on testamentary manumissions was restricted, and these conditions interpreted in the sense most favourable to freedom. The emperor could confer liberty by presenting a gold ring to a slave with the consent of the master, and the legal process called *restitutio natalium* made him a full citizen.

Influence of Christianity.—The rise of Christianity in the Roman world still further improved the condition of the slave. The sentiments it created were not only favourable to the humane treatment of the class in the present, but were the germs out of which its entire liberation was destined, at a later period, in part to arise. It is sometimes objected that the Christian Church did not denounce slavery as a social crime and insist on its abolition. We have seen that slavery was a fundamental element of the old Roman constitution. When the work of conquest had been achieved, it could not be expected that a radical alteration should be suddenly wrought either in the social system which was in harmony with it, or even in the general ideas which had grown up under its influence. The latter would, indeed, be gradually affected; and accordingly, we have observed a change in the policy of the law, indicating a change in sentiment with respect to the slave class, which does not appear to have been at all due to Christian teaching. But the institution itself could not be at once seriously disturbed. The results must have been disastrous, most of all to the slave population itself. Before that end could be accomplished, an essentially new social situation must come into existence. But in the meantime much might be done towards further mitigating the evils of slavery, especially by impressing on master and slave their relative duties and controlling their behaviour towards one another by the exercise of an independent moral authority. This was the work open to the Christian priesthood, and it cannot be denied that it was well discharged. Whilst the fathers agree with the Stoics of the 2nd century in representing slavery as an indifferent circumstance in the eye of religion and morality, the contempt for the class which the Stoics too often exhibited is in them replaced by a genuine sympathy. They protested against the multiplication of slaves from motives of vanity in the houses of the great, against the gladiatorial combats (ultimately abolished by the noble self-devotion of a monk) and against the consignment of slaves to the theatrical profession, which was often a school of corruption. The Church also encouraged the emancipation of individual slaves and the redemption of captives. And its influence is to be seen in the legislation of the Christian emperors, which softened some of the harshest features that still marked the institution. But a stronger influence of Christianity appears in Theodosius, and this influence is at the highest in the legislation of Justinian. Its systematic effort is, in his own words, "pro libertate, quam et fovere et tueri Romanis legibus et praecipue nostro numini peculiare est." Law still refused in general to recognize the marriages of slaves; but Justinian gave them a legal value after emancipation in establishing rights of succession. Unions between slaves and free women, or between a freeman and the female slave of another, continued to be forbidden, and were long punished in certain circumstances with atrocious severity. As witness, the slave was still subject to the question; as criminal, he was punished with greater rigour than the freeman. If he accused his master of a crime, unless the charge was of treason, he was burnt. But he could maintain a legal claim to his own liberty, not now merely through an *adsertor*, but in person. A female slave was still held incapable of the offence of adultery; but Justinian visited with death alike the rape of a slave or freedwoman and that of a free maiden. Already the master who killed his slave had been punished as for homicide, except in the case of his unintended death under correction; Constantine treated as homicide a number of specially enumerated acts of cruelty. Even under Theodosius the combats of the amphitheatre were permitted, if not encouraged, by the State authorities; these sports were still expected from the candidates for public honours. Combats of men with beasts were longest continued; they had not ceased even in the early years of the reign of Justinian. A new process of manumission was now established, to be performed in the churches through the intervention of the ministers of religion; and it was provided that clerics could at any time by mere expression of will liberate their slaves. Slaves who were admitted to holy orders, or who entered a monastery, became freemen.

under certain restrictions framed to prevent fraud or injustice. Justinian abolished the personal conditions which the legislation of Augustus had required to be satisfied by the master who emancipated and the slave who was manumitted, and removed the limitation of number. The liberated slave, whatever the process by which he had obtained his freedom, became at once a full citizen, his former master, however, retaining the right of patronage, the abolition of which would probably have discouraged emancipation.

Transition to Serfdom.—The slavery of the working classes was not directly changed into the system of personal freedom. There was an intermediate stage which has not always been sufficiently discriminated from slavery. We mean the régime of serfdom. In studying the origin of this transitional state of things, four principal considerations have to be kept in view. (1) As Gibbon observes, the completion of the Roman system of conquest reduced the supply of slaves. It is true that, when the barbarian invasions began in the 3rd century, many captives were made, who, when not enrolled in the army, were employed in agriculture or domestic service; but the regular importation was increasingly diminished. This improved the condition of the slave by rendering his existence an object of greater value to his master. It was clearly to the interest of each family to preserve indefinitely its own hereditary slaves. Hence the abolition of the external slave trade tended, in fact, to put an end to internal sales, and the slaves became attached to the households or lands of their masters. (2) The diminished supply of slaves further acted in the direction of the rehabilitation of free labour. A general movement of this kind is noticeable from the 2nd century onwards. Freemen had always been to some extent employed in the public service. In private service superior posts were often filled by freedmen; the higher arts—as medicine, grammar, painting—were partly in the hands of freedmen and even of *ingenui;* the more successful actors and gladiators were often freedmen. In the factories or workshops kept by wealthy persons slave labour was mainly employed; but free artisans sometimes offered their services to these establishments or formed associations to compete with them. We have seen that free persons had all along been to some extent employed in the cultivation of land as hired labourers, and, as we shall presently find, also as tenants on the great estates. How all this operated we shall understand when we examine the remarkable organization of the State introduced by Diocletian and his successors. (3) This organization established in the Roman world a personal and hereditary fixity of professions and situations which was not very far removed from the caste system of the East. The purpose of this was doubtless to resist by a strong internal consolidation the shock of the invasions, to secure public order, to enforce industrious habits, and to guarantee the financial resources of the State. Personal independence was largely sacrificed, but those still more important ends were in a great measure attained. This system, by diminishing the freeman's mastery over himself and his power to determine his occupation, reduced the interval between him and the slave; and the latter on the one hand, the free domestic servant and workshop labourer on the other, both passed insensibly into the common condition of serfdom. (4) The corresponding change, in the case of the rural slaves, took place through their being merged in the order of *coloni.* The Roman *colonus* was originally a free person who took land on lease contracting to pay to the proprietor either a fixed sum annually or (when a *colonus partiarius*) a certain proportion of the produce of the farm. Under the emperors of the 4th century the name designated a cultivator who, though personally free, was attached to the soil, and transmitted his condition to his descendants; and this became the regular status of the mass of Roman cultivators. The class of coloni appears to have been composed partly of tenants by contract who had incurred large arrears of rent and were detained on the estates as debtors (*obaerati*), partly of foreign captives or immigrants who were settled in this condition on the land, and partly of small proprietors and other poor men who voluntarily adopted the status as an improvement in their position. They paid a fixed proportion of the produce (*pars agraria*) to the owner of the estate, and gave a determinate amount of labour (*operae*) on the portion of the domain which he kept in his own hands (*mansus dominicus*). The law for a long time took no notice of these customary tenures, and did not systematically constitute them until the 4th century. It was, indeed, the requirements of the fiscus and the conscription which impelled the imperial Government to regulate the system. The coloni were inscribed (*adscripti*) on the registers of the census as paying taxes to the State, for which the proprietor was responsible, reimbursing himself for the amount. In a constitution of Constantine (A.D. 332) we find the colonus recognized as permanently attached to the land. If he abandoned his holding he was brought back and punished; and anyone who received him had not only to restore him but to pay a penalty. He could not marry out of the domain; if he took for wife a colona of another proprietor, she was restored to her original locality, and the offspring of the union were divided between the estates. The children of a colonus were fixed in the same status. They and their descendants were retained, in the words of a law of Theodosius, "quodam aeternitatis jure," and by no process could be relieved from their obligations. By a law of Anastasius, at the end of the 5th century, a colonus who had voluntarily come into an estate was by a tenure of 30 years for ever attached to it. The master (*dominus*) could inflict on his coloni "moderate chastisement," and could chain them if they attempted to escape, but they had a legal remedy against him for unjust demands or injury to them or theirs. In no case could the rent or the labour dues be increased. The colonus could possess property of his own, but could not alienate it without the consent of the master. Thus, whilst the members of the class were personally free, their condition had some incidents of a semi-servile character. They are actually designated by Theodosius, "servi terrae cui nati sunt." And Salvian treats the proposition "coloni divitum fiunt" as equivalent to "vertuntur in servos." This is, indeed, an exaggeration; the *colonatus* was not an oppressive system; it afforded real security against unreasonable demands and wanton disturbance, and it was a great advance on the system of the *familia rustica.* But the point which is important is that there was a certain approximation between the condition of the colonus and the slave which tended towards the fusion of both in a single class.

Besides the coloni there were on a great estate—and those of the 4th century were on a specially large scale—a number of predial slaves, who worked collectively under overseers on the part of the property which the owner himself cultivated. But it was a common practice to settle certain of the slaves (and possibly also of the freedmen) on other portions of the estate, giving them small farms on conditions similar to those to which the coloni were subject. These slaves are, in fact, described by Ulpian as *quasi coloni.* They had their own households and were hence distinguished as *casati.* In law these slaves were at first absolutely at the disposal of their masters; they had no property in the strict sense of the word, and could be sold to another proprietor and separated from their families. But the landlord's interest and the general tone of feeling alike modified practice even before the intervention of legislation; they were habitually continued in their holdings, and came to possess in fact a perpetual and hereditary enjoyment of them. By a law of Valentinian I. (377) the sale of these slaves was interdicted unless the land they occupied was at the same time sold. The legal distinction between the coloni and the slave tenants continued to exist after the invasions; but the practical difference was greatly attenuated. The colonus often occupied a servile mansus, and the slave a mansus originally appropriated to a colonus. Intermarriages of the two classes became frequent. Already at the end of the 7th century it does not appear that the distinction between them had any substantial existence.

The influence of the Northern invasions on the change from slavery to serfdom was, in all probability, of little account. The change would have taken place, though perhaps not so speedily, if they had never occurred. For the developments of the middle ages *see* SERFDOM and VILLEINAGE.

MODERN SLAVE TRADE

Not very long after the disappearance of serfdom in the most

advanced communities comes into sight the new system of colonial slavery, which, instead of being the spontaneous outgrowth of social necessities and subserving a temporary need of human development, was politically as well as morally a monstrous aberration.

Spanish Colonies.—In 1442, when the Portuguese under Prince Henry the Navigator were exploring the Atlantic coast of Africa, one of his officers, Antam Gonsalves, who had captured some Moors, was directed by the prince to carry them back to Africa. He received from the Moors in exchange for them ten blacks and a quantity of gold dust. This excited the cupidity of his fellow-countrymen; and they fitted out a large number of ships for the trade, and built several forts on the African coast. Many negroes were brought into Spain from these Portuguese settlements, and the colonial slave trade first appears in the form of the introduction into the newly discovered western world of descendants of these negroes. When Nicolas de Ovando was sent out in 1502 as governor of Haiti, whilst regulations, destined to prove illusory, were made for the protection of the natives of the island, permission was given to carry to the colony negro slaves, born in Seville and other parts of Spain, who had been instructed in the Christian faith. It appears from a letter of Ovando in 1503 that there were at that time numbers of negroes in Haiti; he requested that no more might be permitted to be brought out. In 1510 and the following years King Ferdinand ordered a number of Africans to be sent to that colony for the working of the mines.

Before this time Columbus had proposed an exchange of his Carib prisoners as slaves against live stock to be furnished to Haiti by Spanish merchants. He actually sent home, in 1494, above 500 Indian prisoners taken in wars with the caciques, who, he suggested, might be sold as slaves at Seville. But, after a royal order had been issued for their sale, Queen Isabella, interested by what she had heard of the gentle and hospitable character of the natives and of their docility, procured a letter to be written to Bishop Fonseca, the superintendent of Indian affairs, suspending the order until enquiry should be made into the causes for which they had been made prisoners, and into the lawfulness of their sale. Theologians differed on the latter question, and Isabella directed that these Indians should be sent back to their native country.

Bartolomé de las Casas, the celebrated bishop of Chiapa, accompanied Ovando to Haiti, and was a witness of the cruelties from which the Indians suffered under his administration. He came to Spain in 1517 to obtain measures in their favour, and he then made the suggestion to Charles that each Spanish resident in Haiti should have licence to import a dozen negro slaves. Las Casas, in his *Historia de las Indias* (lib. iii. cap. 101), confesses the error into which he thus fell. Other good men appear to have given similar advice about the same time, and, as has been shown, the practice was not absolutely new; indeed, the young king had in 1516, whilst still in Flanders, granted licences to his courtiers for the importation of negroes into the colonies, though Jimenes, as regent of Castile, by a decree of the same year forbade the practice. The suggestion of Las Casas was no doubt made on the ground that the negroes could, better than the Indians, bear the labour in the mines, which was rapidly exhausting the numbers of the latter. He has sometimes on this plea been exonerated from all censure; but, though entitled to honour for the zeal which he showed on behalf of the natives, he must bear the blame for his violation or neglect of moral principle. His advice was unfortunately adopted. "Charles," says Robertson, "granted a patent to one of his Flemish favourites, containing an exclusive right" of supplying 4,000 negroes annually to Haiti, Cuba, Jamaica and Porto Rico. "The favourite sold his patent to some Genoese merchants for 25,000 ducats"; these merchants obtained the slaves from the Portuguese; and thus was first systematized the slave trade between Africa and America.

England.—The first Englishman who engaged in the traffic was Sir John Hawkins (*q.v.*). The English slave traders were at first altogether occupied in supplying the Spanish settlements. Indeed, the reign of Elizabeth passed without any English colony having been permanently established in America. But in 1620 a Dutch ship from the coast of Guinea visited Jamestown in Virginia, and sold a part of her cargo of negroes to the tobacco-planters. This was the beginning of slavery in British America; the number of negroes was afterwards continually increased—though apparently at first slowly—by importation, and the field-labour was more and more performed by servile hands, so that in 1790 the State of Virginia contained 200,000 negroes.

The African trade of England was long in the hands of exclusive companies; but by an act of the first year of William and Mary it became free and open to all subjects of the Crown. The African company, however, continued to exist, and obtained from time to time large parliamentary grants. By the Treaty of Utrecht, the asiento, or contract for supplying the Spanish colonies with 4,800 negroes annually, which had previously passed from the Dutch to the French, was transferred to Great Britain; an English company was to enjoy the monopoly for a period of 30 years from May 1, 1713. But the contract came to an end in 1739, when the complaints of the English merchants on one side and of the Spanish officials on the other rose to such a height that Philip V. declared his determination to revoke the asiento, and Sir Robert Walpole was forced by popular feeling into war with Spain. Between 1680 and 1700 about 140,000 negroes were exported by the African company, and 160,000 more by private adventurers, making a total of 300,000. Between 1700 and the end of 1786 as many as 610,000 were transported to Jamaica alone, which had been an English possession since 1655. Bryan Edwards estimated the total import into all the British colonies of America and the West Indies from 1680 to 1786 at 2,130,000, being an annual average of 20,095. The British slave trade reached its utmost extension shortly before the War of American Independence. It was then carried on principally from Liverpool, but also from London, Bristol and Lancaster: the entire number of slave ships sailing from those ports was 192 and in them space was provided for the transport of 47,146 negroes. During the war the number decreased, but on its termination the trade immediately revived. When Edwards wrote (1791), the number of European factories on the coasts of Africa was 40; of these 14 were English, 3 French, 15 Dutch, 4 Portuguese and 4 Danish. As correct a notion as can be obtained of the numbers annually exported from the continent about the year 1790 by traders of the several European countries engaged in the traffic is supplied by the following statement: "By the British, 38,000; by the French, 20,000; by the Dutch, 4,000; by the Danes, 2,000; by the Portuguese, 10,000; total 74,000." Thus more than half the trade was in British hands.

The hunting of human beings to make them slaves was greatly aggravated by the demand of the European colonies. The native chiefs engaged in forays, sometimes even on their own subjects, for the purpose of procuring slaves to be exchanged for Western commodities. They often set fire to a village by night and captured the inhabitants when trying to escape. Thus all that was shocking in the barbarism of Africa was multiplied and intensified by this foreign stimulation. Exclusive of the slaves who died before they sailed from Africa, 12½% were lost during their passage to the West Indies; at Jamaica 4½% died whilst in the harbours or before the sale and one-third more in the "seasoning." Thus, out of every lot of 100 shipped from Africa 17 died in about 9 weeks, and not more than 50 lived to be effective labourers in the islands. The circumstances of their subsequent life on the plantations were not favourable to the increase of their numbers. In Jamaica there were in 1690, 40,000; from that year till 1820 there were imported 800,000; yet at the latter date there were only 340,000 in the island. One cause which prevented the natural increase of population was the inequality in the numbers of the sexes; in Jamaica alone there was in 1789 an excess of 30,000 males.

Movement Against the Slave Trade.—When the nature of the slave trade began to be understood by the public, all that was best in England was adverse to it. Among those who denounced it—besides some whose names are now little known, but are recorded in the pages of Clarkson—were Baxter, Sir Richard Steele

(in *Inkle and Yarico*), the poets Southern (in *Oroonoko*), Pope, Thomson, Shenstone, Dyer, Savage and above all Cowper (*see* his *Charity,* and *Task,* bk. 2), Thomas Day (author of *Sandford and Merton*), Sterne, Warburton, Hutcheson, Beattie, John Wesley, Whitfield, Adam Smith, Millar, Robertson, Dr. Johnson, Paley, Gregory, Gilbert Wakefield, Bishop Porteus, Dean Tucker. The question of the legal existence of slavery in Great Britain and Ireland was raised in consequence of an opinion given in 1729 by Yorke and Talbot, attorney-general and solicitor-general at the time, to the effect that a slave by coming into those countries from the West Indies did not become free, and might be compelled by his master to return to the plantations. Chief-justice Holt had expressed a contrary opinion; and the matter was brought to a final issue by Granville Sharp in the case of the negro Somerset. It was decided by Lord Mansfield, in the name of the whole bench, on June 22, 1772, that as soon as a slave set his foot on the soil of the British islands he became free. In 1776 it was moved in the House of Commons by David Hartley, son of the author of *Observations on Man,* that "the slave trade was contrary to the laws of God and the rights of men"; but this motion—the first which was made on the subject—failed.

The first persons in England who took united practical action against the slave trade were the Quakers, following the expression of sentiment which had emanated as early as 1671 from their founder George Fox. In 1727 they declared it to be "not a commendable or allowed" practice; in 1761 they excluded from their society all who should be found concerned in it, and issued appeals to their members and the public against the system. In 1783 there was formed among them an association "for the relief and liberation of the negro slaves in the West Indies, and for the discouragement of the slave trade on the coast of Africa." This was the first society established in England for the purpose. The Quakers in America had taken action on the subject still earlier than those in England. The Pennsylvanian Quakers advised their members against the trade in 1696; in 1754 they issued to their brethren a strong dissuasive against encouraging it in any manner; in 1774 all persons concerned in the traffic, and in 1776 all slave holders who would not emancipate their slaves, were excluded from membership. The Quakers in the other American provinces followed the lead of their brethren in Pennsylvania. The individuals among the American Quakers who laboured most earnestly and indefatigably on behalf of the Africans were John Woolman (1720–73) and Anthony Benezet (1713–84), the latter a son of a French Huguenot driven from France by the revocation of the Edict of Nantes. The former confined his efforts chiefly to America and, indeed, to his co-religionists there; the latter sought, not without success, to found a universal propaganda in favour of abolition. A Pennsylvanian society was formed in 1774 by James Pemberton and Dr. Benjamin Rush, and in 1787 (after the war) was reconstructed on an enlarged basis under the presidency of Franklin. Other similar associations were founded about the same time in different parts of the United States. The next important movement took place in England. Dr. Peckard, vice-chancellor of the University of Cambridge, who entertained strong convictions against the slave trade, proposed in 1785 as subject for a Latin prize dissertation the question, "An liceat invitos in servitutem dare." Thomas Clarkson obtained the first prize, translated his essay into English in an expanded form, and published it in 1786 with the title *Essay on the Slavery and Commerce of the Human Species*. In the process of its publication he was brought into contact with several persons already deeply interested in the question; amongst others with Granville Sharp, William Dillwyn (an American by birth, who had known Benezet), and the Rev. James Ramsay, who had lived 19 years in St. Christopher, and had published an *Essay on the Treatment and Conversion of the African Slaves in the British Sugar Colonies*. The distribution of Clarkson's book led to his forming connections with many persons of influence, and especially with William Wilberforce (*q.v.*). A committee was formed on May 22, 1787, for the abolition of the slave trade, under the presidency of Granville Sharp. It is unquestionable that the principal motive power which originated and sustained their efforts was Christian principle and feeling. The most earnest and unremitting exertions were made by the persons so associated in investigating facts and collecting evidence, in forming branch committees and procuring petitions, information and support of those who pleaded the cause in parliament. To the original members were afterwards added several remarkable persons, amongst whom were Josiah Wedgwood, Bennet Langton (Dr. Johnson's friend), and, later, Zachary Macaulay, Henry Brougham and James Stephen.

In consequence of the numerous petitions presented to parliament, a committee of Privy Council was appointed by the Crown in 1788 to enquire concerning the slave trade; and Pitt moved that the House of Commons should early in the next session take the subject into consideration. Wilberforce's first motion for a committee of the whole House upon the question was made on March 19, 1789, and this committee proceeded to business on May 12 of the same year. After an admirable speech, Wilberforce laid on the table 12 resolutions which were intended as the basis of a future motion for the abolition of the trade. The discussion of these was postponed to the next session, and in 1790–91 evidence was taken upon them. At length, on April 18 of the latter year, a motion was made for the introduction of a bill to prevent the further importation of slaves into the British colonies in the West Indies. Opinion had been prejudiced by the insurrections in St. Domingo and Martinique, and in the British island of Dominica; and the motion was defeated by 163 votes against 88. Legislative sanction was, however, given to the establishment of the Sierra Leone company, for the colonization of a district on the west coast of Africa and the discouragement of the slave trade there. It was hoped at the time that that place would become the centre from which the civilization of Africa would proceed; but this expectation was not fulfilled. On April 2, 1792 Wilberforce again moved that the trade ought to be abolished; an amendment in favour of gradual abolition was carried, and it was finally resolved that the trade should cease on Jan. 1, 1796. When a similar motion was brought forward in the Lords the consideration of it was postponed to the following year, in order to give time for the examination of witnesses by a committee of the House. A bill in the Commons in the following year to abolish that part of the trade by which British merchants supplied foreign settlements with slaves was lost on the third reading; it was renewed in the Commons in 1794 and carried there, but defeated in the Lords. Then followed several years during which efforts were made by the abolitionists in parliament with little success. But in 1806, Lord Grenville and Fox having come into power, a bill was passed in both Houses to put an end to the British slave trade for foreign supply, and to forbid the importation of slaves into the colonies won by the British arms in the course of the war. On June 10 of the same year Fox brought forward a resolution "that effectual measures should be taken for the abolition of the African slave trade in such a manner and at such a period as should be deemed advisable," which was carried by a large majority. A similar resolution was successful in the House of Lords. A bill was then passed through both Houses forbidding the employment of any new vessel in the trade. Finally, in 1807, a bill was presented by Lord Grenville in the House of Lords providing for the abolition of the trade, was passed by a large majority, was then sent to the Commons (where it was moved by Lord Howick), was there amended and passed, and received the royal assent on March 25. The bill enacted that no vessel should clear out for slaves from any port within the British dominions after May 1, 1807, and that no slave should be landed in the colonies after March 1, 1808.

In 1807 the African Institution was formed, with the primary objects of keeping a vigilant watch on the slave traders and procuring, if possible, the abolition of the slave trade by the other European nations. It was also to be made an instrument for promoting the instruction of the negro races and diffusing information respecting the African continent.

The act of 1807 was habitually violated, as the traders knew that, if one voyage in three was successful, they were abundantly remunerated for their losses. This state of things, it was plain,

must continue as long as the trade was only a contraband commerce, involving merely pecuniary penalties. Accordingly, in 1811, Brougham carried through parliament a bill declaring the traffic to be a felony punishable with transportation. Some years later another act was passed, making it a capital offence; but this was afterwards repealed. The law of 1811 proved effectual and brought the slave trade to an end so far as the British dominions were concerned.

French Abolition.—The abolition of the French slave trade was preceded by struggles and excesses. The western part of St. Domingo, nominally belonging to Spain, had been occupied by buccaneers, who were recognized and supported by the French Government, and had been ceded to France at the Peace of Ryswick in 1697. So vast was the annual importation of enslaved negroes into this colony before 1791 that the ratio of the blacks to the whites was as 16 to 1. In that year there were in French St. Domingo 480,000 blacks, 24,000 mulattoes and only 30,000 whites. The French law for the regulation of slavery in the plantations, known as the *Code Noir* (framed under Louis XIV. in 1685), was humane in its spirit; but we are informed that its provisions were habitually disregarded by the planters, whilst the free mulattoes laboured under serious grievances and were exposed to irritating indignities. A "Société des Amis des Noirs" was formed in Paris in 1788 for the abolition, not only of the slave trade, but of slavery itself. The president was Condorcet, and amongst the members were the duc de la Rochefoucault, the abbé Gregoire, Brissot, Clavière, Pétion and La Fayette; Mirabeau was an active sympathizer. The great motor of the parallel effort in England was the Christian spirit; in France it was the enthusiasm of humanity which was associated with the revolutionary movement. There were in 1789 a number of mulattoes in Paris, who had come from San Domingo to assert the rights of the people of colour in that colony before the national assembly. The Declaration of the Rights of Man in Aug. 1789 seemed to meet their claims, but in March 1790 the assembly, alarmed by rumours of the discontent and disaffection of the planters in San Domingo, passed a resolution that it had not been intended to comprehend the internal government of the colonies in the constitution framed for the mother country. Vincent Ogé, one of the mulatto delegates in Paris, disgusted at the overthrow of the hopes of his race, returned to San Domingo, and on landing in Oct. 1790 addressed a letter to the governor announcing his intention of taking up arms on behalf of the mulattoes if their wrongs were not redressed. He rose accordingly with a few followers, but was soon defeated and forced to take refuge in the Spanish part of the island. He afterwards surrendered, was tried and sentenced to be broken on the wheel. When the news of this reached Paris, it created a strong feeling against the planters; and on the motion of the abbé Gregoire it was resolved by the assembly on May 15, 1791 "that the people of colour resident in the French colonies, born of free parents, were entitled to, as of right, and should be allowed, the enjoyment of all the privileges of French citizens, and among others those of being eligible to seats both in the parochial and colonial assemblies." On Aug. 23 a rebellion of the negroes broke out in the northern province of San Domingo, and soon extended to the western province, where the mulattoes and blacks combined. Many enormities were committed by the insurgents, and were avenged with scarcely inferior barbarity. The French assembly, fearing the loss of the colony, repealed on Sept. 24 the decree of the preceding May. This vacillation put an end to all hope of a reconciliation of parties in the island. Civil commissioners sent out from France quarrelled with the governor and called the revolted negroes to their assistance. The white inhabitants of Cape François were massacred and the city in great part destroyed by fire. The planters now offered their allegiance to Great Britain; and an English force landed in the colony. But it was insufficient to encounter the hostility of the republican troops and the revolted negroes and mulattoes; it suffered from disease, and was obliged to evacuate the island in 1798. On the departure of the British the Government remained in the hands of Toussaint l'Ouverture (*q.v.*). Slavery had disappeared; the blacks were employed as hired servants, receiving for their remuneration the third part of the crops they raised; and the population was rapidly rising in civilization and comfort. The whole island was now French, the Spanish portion having been ceded by the Treaty of Basle. The wish of Toussaint was that San Domingo should enjoy a practical independence whilst recognizing the sovereignty and exclusive commercial rights of France. The issue of the violent and treacherous conduct of Bonaparte towards the island was that the blacks drove from their soil the forces sent to subdue them, and founded a constitution of their own, which was more than once modified. There can be no doubt that the Government of the Restoration, in seeking to obtain possession of the island, had the intention of re-establishing slavery, and even of reopening the slave trade for the purpose of recruiting the diminished population. But Bonaparte abolished that trade during the Hundred Days, though he also failed to win back the people of San Domingo, or, as it was now called by its original name, Haiti, to obedience. The Bourbons, when again restored, could not reintroduce the slave trade; the notion of conquering the island had to be given up; and its independence was formally recognized in 1825. (*See* HAITI.)

Progress of the Movement.—England had not been the first European Power to abolish the slave trade; that honour belongs to Denmark; a royal order was issued on May 16, 1792 that the traffic should cease in the Danish possessions from the end of 1802. The United States had in 1794 forbidden any participation by American subjects in the slave trade to foreign countries; they now prohibited the importation of slaves from Africa into their own dominions. This act was passed on March 2, 1807; it did not, however, come into force till Jan. 1, 1808. At the Congress of Vienna (Nov. 1814) the principle was acknowledged that the slave trade should be abolished as soon as possible; but the determination of the limit of time was reserved for separate negotiation between the Powers. It had been provided in a treaty between France and Great Britain (May 30, 1814) that no foreigner should in future introduce slaves into the French colonies, and that the trade should be absolutely interdicted to the French themselves after June 1, 1819. This postponement of abolition was dictated by the wish to introduce a fresh stock of slaves into Haiti, if that island should be recovered. Bonaparte, as we have seen, abolished the French slave trade during his brief restoration, and this abolition was confirmed at the second Peace of Paris on Nov. 20, 1815, but it was not effectually carried out by French legislation until March 1818. In Jan. 1815 Portuguese subjects were prohibited from prosecuting the trade north of the equator, and the term after which the traffic should be everywhere unlawful was fixed to end on Jan. 21, 1823, but was afterwards extended to Feb. 1830; England paid £300,000 as a compensation to the Portuguese. A royal decree was issued on Dec. 10, 1836, forbidding the export of slaves from any Portuguese possession. But this decree was often violated. It was agreed that the Spanish slave trade should come to an end in 1820, England paying to Spain an indemnification of £400,000. The Dutch trade was closed in 1814; the Swedish had been abolished in 1813. By the Peace of Ghent, Dec. 1814, the United States and England mutually bound themselves to do all in their power to extinguish the traffic. It was at once prohibited in several of the South American States when they acquired independence, as in La Plata, Venezuela and Chile. In 1831 and 1833 Great Britain entered into an arrangement with France for a mutual right of search within certain seas, to which most of the other Powers acceded; and by the Ashburton Treaty (1842) with the United States provision was made for the joint maintenance of squadrons on the west coast of Africa. By all these measures the slave trade, so far as it was carried on under the flags of European nations or for the supply of their colonies, ceased to exist.

Anti-slavery Movement.—Meantime another and more radical reform had been in preparation and was already in progress, namely, the abolition of slavery itself in the foreign possessions of the several States of Europe. When the English slave trade

had been closed, it was found that the evils of the traffic, as still continued by several other nations, were greatly aggravated. In consequence of the activity of the British cruisers the traders made great efforts to carry as many slaves as possible in every voyage, and practised atrocities to get rid of the slaves when capture was imminent. It was, besides, the interest of the cruisers, who shared the price of the captured slave-ship, rather to allow the slaves to be taken on board than to prevent their being shipped at all. Thrice as great a number of negroes as before, it was said, was exported from Africa, and two-thirds of these were murdered on the high seas. It was found also that the abolition of the British slave trade did not lead to an improved treatment of the negroes in the West Indies. The slaves were overworked now that fresh supplies were stopped, and their numbers rapidly decreased. In 1807 there were in the West Indies 800,000; in 1830 they were reduced to 700,000. It became more and more evident that the evil could be stopped only by abolishing slavery altogether.

An appeal was made by Wilberforce in 1821 to Thomas Fowell Buxton to undertake the conduct of this new question in parliament. An anti-slavery society was established in 1823, the principal members of which, besides Wilberforce and Buxton, were Zachary Macaulay, Dr. Lushington and Lord Suffield. Buxton moved on May 5, 1823, that the House should take into consideration the state of slavery in the British colonies. The object he and his associates had then in view was gradual abolition by establishing something like a system of serfdom for existing slaves, and passing at the same time a measure emancipating all their children born after a certain day. Canning carried against Buxton and his friends a motion to the effect that the desired ameliorations in the condition and treatment of the slaves should be recommended by the home Government to the colonial legislatures, and enforced only in case of their resistance, direct action being taken in the single instance of Trinidad, which, being a Crown colony, had no legislature of its own. A well-conceived series of measures of reform was accordingly proposed to the colonial authorities. Thereupon a general outcry was raised by the planters at the acquiescence of the Government in the principles of the anti-slavery party. A vain attempt being made in Demerara to conceal from the knowledge of the slaves the arrival of the order in council, they became impressed with the idea that they had been set free, and accordingly refused to work, and, compulsion being resorted to, offered resistance. Martial law was proclaimed; the disturbances were repressed with great severity; and the treatment of the missionary Smith, which was taken up and handled with great ability by Brougham, awakened strong feeling in England against the planters. The question, however, made little progress in parliament for some years, though Buxton, William Smith, Lushington, Brougham, Mackintosh, Butterworth and Denman, with the aid of Z. Macaulay, James Stephen, and others, continued the struggle, only suspending it during a period allowed to the local legislatures for carrying into effect the measures expected from them. In 1828 the free people of colour in the colonies were placed on a footing of legal equality with their fellow-citizens. In 1830 the public began to be aroused to a serious prosecution of the main issue. It was becoming plain that the planters would take no steps tending to the future liberation of the slaves, and the leaders of the movement determined to urge the entire abolition of slavery at the earliest practicable period. The Government continued to hesitate and to press for mitigations of the existing system. At length in 1833 the Ministry of Earl Grey took the question in hand and carried the abolition with little difficulty, the measure passing the House of Commons on Aug. 7, 1833, and receiving the royal assent on the 28th. A sum of 20 millions sterling was voted as compensation to the planters. A system of apprenticeship for seven years was established as a transitional preparation for liberty. The slaves were bound to work for their masters during this period for three-fourths of the day, and were to be liable to corporal punishment if they did not give the due amount of labour. The master was, in return, to supply them with food and clothing. All children under six years of age were to be at once free, and provision was to be made for their religious and moral instruction. Many thought the postponement of emancipation unwise. Immediate liberation was carried out in Antigua, and public tranquillity was so far from being disturbed there that the Christmas of 1833 was the first for 20 years during which martial law was not proclaimed in order to preserve the peace. Notwithstanding protracted and strenuous opposition on the part of the Government, the House of Commons passed a resolution against the continuance of the transitional system. When this was done the local legislatures saw that the slaves would no longer work for the masters; they accordingly cut off two years of the indentured apprenticeship, and gave freedom to the slaves in Aug. 1838 instead of 1840.

The example of Great Britain was gradually followed by the other European States, and some American ones had already taken action of the same kind. The immediate emancipation of the slaves in the French colonies was decreed by the Provisional Government of 1848. In 1858 it was enacted that every slave belonging to a Portuguese subject should be free in 20 years from that date, a system of tutelage being established in the meantime. This law came into operation on April 29, 1878, and the status of slavery was thenceforth illegal throughout the Portuguese possessions. The Dutch emancipated their slaves in 1863. Several of the Spanish American States, on declaring their independence, had adopted measures for the discontinuance of slavery within their limits. It was abolished by a decree of the Mexican republic on Sept. 15, 1829. The Government of Buenos Aires enacted that all children born to slaves after Jan. 31, 1813, should be free; and in Colombia it was provided that those born after July 16, 1821, should be liberated on attaining their eighteenth year.

Three of the most important slave systems still remained in which no steps towards emancipation had been taken—those of the Southern United States, of Cuba and of Brazil.

Slavery in the United States.—Slavery was far from being approved in principle by the most eminent of the fathers of the American Union. Washington in his will provided for the emancipation of his own slaves; he said to Jefferson that it was "among his first wishes to see some plan adopted by which slavery in his country might be abolished by law," and again he wrote that to this subject his own suffrage should never be wanting. John Adams declared his abhorrence of the practice of slave-holding, and said that "every measure of prudence ought to be assumed for the eventual total extirpation of slavery from the United States." Franklin's opinions we have already indicated; and Madison, Hamilton and Patrick Henry all reprobated the principle of the system. Jefferson declared in regard to slavery, "I tremble for my country when I reflect that God is just." The last-named statesman, at the first Continental Congress after the evacuation by the British forces, proposed a draft ordinance (March 1, 1784) for the government of the North-west Territory, in which it was provided that "after the year 1800 there shall be neither slavery nor involuntary servitude in any of the said states, otherwise than in punishment of crime." This proviso, however, was lost; but in the ordinance of 1787 (July 13) for the government of the territory of the United States north-west of the Ohio river, which was introduced by Nathan Dane and probably drafted by Manasseh Cutler, slavery was forbidden in the territory. At the Convention of Philadelphia in 1787, where the constitution was drafted, the sentiments of the framers were against slavery; but South Carolina and Georgia insisted on its recognition as a condition of their joining the Union, and even an engagement for the mutual rendition of fugitive slaves was embodied in the Federal pact. The *words* "slave" and "slavery" were, however, excluded from the constitution, "because," as Madison says, "they did not choose to admit the right of property in man" in direct terms; and it was at the same time provided that Congress might interdict the foreign slave trade after the expiration of 20 years. It must not be forgotten that either before or soon after the formation of the Union the Northern States—beginning with Vermont in 1777, and ending with New Jersey in 1804—either abolished slavery or adopted

measures to effect its gradual abolition within their boundaries. But the principal operation of (at least) the latter change was simply to transfer Northern slaves to Southern markets.

We cannot follow in detail the several steps by which the slave power for a long time persistently increased its influence in the Union. The acquisition of Louisiana in 1803, which gave a new field for the growth of the slave power, though not made

THE SALE OF ESTATES, PICTURES AND SLAVES IN THE ROTUNDA, NEW ORLEANS; FROM A STEEL ENGRAVING BY J. M. STARLING EXECUTED AFTER THE PAINTING BY W. H. BROOKE

in its interest, the Missouri Compromise (1820), the annexation of Texas (1845), the Fugitive Slave Law (1850), the Kansas-Nebraska bill (1854), the Dred Scott decision (1857), the attempts to acquire Cuba (especially in 1854) and to reopen the foreign slave trade (1859–60), were the principal steps—only some of them successful—in its career of aggression. They roused a determined spirit of opposition, founded on deep-seated convictions. The pioneer of the more recent abolitionist movement was Benjamin Lundy (1789–1839). He was followed by William Lloyd Garrison (1805–79), Elijah P. Lovejoy (1802–37)—a martyr, if ever there was one—Wendell Phillips, Charles Sumner, John Brown (b. 1800, hanged 1859), all of whom were in their several ways leading apostles or promoters of the cause. The best intellect of America outside the region of practical politics has been on the anti-slavery side. William E. Channing, R. W. Emerson, the poets Bryant, Longfellow, pre-eminently Whittier and Whitman, have spoken on this theme with no uncertain sound. The South, and its partisans in the North, made desperate efforts to prevent the free expression of opinion respecting the institution, and even the Christian Churches in the slave States used their influence in favour of the maintenance of slavery. But in spite of every such effort opinion steadily grew. Public sentiment in the North was deeply stirred by the *Uncle Tom's Cabin* (1852) of Mrs. Harriet Beecher Stowe, which, as Senior said, under the disguise of a novel was really a pamphlet against the Fugitive Slave Law. It gradually became apparent that the question could not be settled without an armed conflict. The election of Abraham Lincoln as president in Nov. 1860 was the signal for the rising of the South. The North at first took arms simply to maintain the Union; but the farsighted politicians from the first, and soon the whole nation, saw that the real issue was the continued existence or the total abolition of slavery. (*See* UNITED STATES.)

The war was practically closed by the surrender at Appomattox (April 9, 1865), but already in 1862 slavery in the territories had been abolished by Congress; on Sept. 22 of the same year Lincoln (*q.v.*) had issued the preliminary emancipation proclamation, followed on Jan. 1, 1863, by the emancipation of all slaves in the States in arms against the Union; and in Dec. 1865 a constitutional amendment was ratified abolishing and for ever prohibiting slavery throughout the United States.

Cuba.—The Spanish slave code, promulgated in 1789, is admitted on all hands to have been very humane in its character; and, in consequence of this, after Trinidad had become an English possession, the anti-slavery party resisted—and successfully—the attempt of the planters (1811) to have the Spanish law in that island replaced by the British. But notwithstanding this mildness of the code, its provisions were habitually and glaringly violated in the colonies of Spain, and in Cuba particularly the conditions of slavery were very bad. The slave population of the island was estimated in 1792 at 84,000; in 1817 at 179,000; in 1827 at 286,000; and in 1843 at 436,000. An act was passed by the Spanish legislature in 1870, providing that every slave who had then passed, or should thereafter pass, the age of 60 should be at once free, and that all yet unborn children of slaves should also be free. The latter, however, were to be maintained at the expense of the proprietors up to their eighteenth year, and during that time to be kept, as apprentices, to such work as was suitable for their age. This was known as the Moret Law, having been carried through the house of representatives by Señor Moret y Prendergast, then minister for the colonies. By the census of 1867 there was in Cuba a total population of 1,370,211 persons, of whom 764,750 were whites and 605,461 black or coloured; and of the latter number 225,938 were free and 379,523 were slaves. In 1873 the Cubans roughly estimated the population at 1,500,000—of whom 500,000, or one-third, were slaves. In 1885, it was stated that "the institution was rapidly dying—that in a year, or at most two, slavery, even in its then mild form, would be extinct."

Brazil.—There was a convention between Great Britain and Brazil in 1826 for the abolition of the slave trade, but it was habitually violated in spite of the English cruisers. In 1830 the traffic was declared piracy by the emperor of Brazil. England asserted by the Aberdeen Act (1845) the right of seizing suspected craft in Brazilian waters. Yet by the connivance of the local administrative authorities 54,000 Africans continued to be annually imported. In 1850 the trade is said to have been decisively put down. The planters and mine proprietors cried out against this as a national calamity. The closing of the traffic made the labour of the slaves more severe, and led to the employment on the plantations of many who before had been engaged in domestic work; but the slavery of Brazil had always been lighter than that of the United States. On Sept. 28, 1871, the Brazilian chambers decreed that slavery should be abolished throughout the empire. Though existing slaves were to remain slaves still, with the exception of those possessed by the Government, who were liberated by the act, facilities for emancipation were given; and it was provided that all children born of female slaves after the day on which the law passed should be free. They were, however, bound to serve the owners of their mothers for a term of 21 years. A clause was inserted to the effect that a certain sum should be annually set aside from fines to aid each province in emancipating slaves by purchase. Seven years before the passing of this act the emperor, whose influence had always been exerted in favour of freedom, had liberated his private slaves, and many Brazilians after 1871 followed his example. Finally, in 1888 the chambers decreed the total abolition of slavery, some 700,000 persons being accordingly freed.

Disguised Slave Trade.—In the colonies of more than one European country, after the prohibition of the slave trade, attempts were made to replace it by a system of importing labourers of the inferior races under contracts for a somewhat lengthened term; and this was in several instances found to degenerate into a sort of legalized slave traffic. About 1867 we began to hear of a system of this kind which was in operation between the South Sea islands and New Caledonia and the white settlements in Fiji. It seems to have begun in really voluntary agreements; but for these the unscrupulous greed of the traders soon substituted methods of fraud and violence. The natives were decoyed into the labour ships under false pretences, and then detained by force; or they were seized on shore or in their canoes and carried on board. The nature of the engagements to go and work on the plantations was not fully explained to them, and they were hired for periods exceeding the legal term. The area of this trade was ere long further extended. In 1884 attention was drawn in a special degree to the Queensland traffic in Pacific Islanders by the

"Hopeful" trials, and a Government commission was appointed to enquire into the methods followed by labour ships in recruiting the natives of New Guinea, the Louisiade archipelago and the D'Entrecasteaux group of islands. The result of the investigations, during which nearly 500 witnesses were examined, was the disclosure of a system which in treachery and atrocity was little inferior to the old African slave trade. These shameful deeds made the islanders regard it as a duty to avenge their wrongs on any white men they could entice upon their shores. The bishop of Melanesia, John Coleridge Patteson, fell a victim to this retaliation in the island of Nukapu on Sept. 20, 1871.

It now remains to consider the slavery of primitive origin which has existed within recent times, or continues to exist, outside of the Western world.

Russian Serfdom.—In Russia, a country which had not the same historical antecedents with the Western nations, properly so called, and which is, in fact, more correctly classed as Eastern, whilst slavery had disappeared, serfdom was in force down to recent days. The rural population of that country, at the earliest period accessible to our enquiries, consisted of (1) slaves, (2) free agricultural labourers and (3) peasants proper, who were small farmers or cottiers and members of a commune. The sources of slavery were there, as elsewhere, capture in war, voluntary sale by poor freemen of themselves, sale of insolvent debtors and the action of the law in certain criminal cases. In the 18th century we find the distinction between the three classes named above effaced and all of them merged in the class of serfs, who were the property either of the landed proprietors or of the State. They were not even *adscripti glebae*, though forbidden to migrate; an imperial ukase of 1721 says, "the proprietors sell their peasants and domestic servants, not even in families, but one by one, like cattle." This practice, at first tacitly sanctioned by the Government, which received dues on the sales, was at length formally recognized by several imperial ukases. Peter the Great imposed a poll-tax on all the members of the rural population, making the proprietors responsible for the tax charged on their serfs; and the "free wandering people" who were not willing to enter the army were required to settle on the land either as members of a commune or as serfs of some proprietor.

The system of serfdom attained its fullest development in the reign of Catherine II. The serfs were bought, sold and given in presents, sometimes with the land, sometimes without it, sometimes in families and sometimes individually, sale by public auction being alone forbidden, as "unbecoming in a European state." The proprietors could transport without trial their unruly serfs to Siberia or send them to the mines for life, and those who presented complaints against their masters were punished with the knout and condemned to the mines. The first symptoms of a reaction appear in the reign of Paul (1796–1801). He issued an ukase that the serfs should not be forced to work for their masters more than three days in each week. There were several feeble attempts at further reform, and even abortive projects of emancipation, from the commencement of the 19th century. But no decisive measures were taken before the accession of Alexander II. (1855). That emperor, after the Crimean War, created a secret committee composed of the great officers of State, called the chief committee for peasant affairs, to study the subject of serf-emancipation. Of this body the grand-duke Constantine was an energetic member. To accelerate the proceedings of the committee advantage was taken of the following incident. In the Lithuanian provinces the relations of the masters and serfs were regulated in the time of Nicholas by what were called inventories. The nobles, dissatisfied with these, now sought to have them revised. The Government interpreted the application as implying a wish for the abolition of serfdom, and issued a rescript authorizing the formation of committees to prepare definite proposals for a gradual emancipation. A circular was soon after sent to the governors and marshals of the nobility all over Russia proper, informing them of this desire of the Lithuanian nobles, and setting out the fundamental principles which should be observed "if the nobles of the provinces should express a similar desire." Public opinion strongly favoured the projected reform; and even the masters who were opposed to it saw that, if the operation became necessary, it would be more safely for their interests entrusted to the nobles than to the bureaucracy. Accordingly during 1858 a committee was created in nearly every province in which serfdom existed. From the schemes prepared by these committees, a general plan had to be elaborated, and the Government appointed a special imperial commission for this purpose.

The plan was formed, and, in spite of some opposition from the nobles, which was suppressed, it became law, and serfdom was abolished (Feb. 19–March 3, 1861). (*See* RUSSIA.) The total number of serfs belonging to proprietors at the time of the emancipation was 21,625,609, of whom 20,158,231 were peasant serfs and 1,467,378 domestic serfs. This number does not include the State serfs, who formed about one-half of the rural population. Their position had been better, as a rule, than that of the serfs on private estates; it might, indeed, R. D. M. Wallace says, be regarded as "an intermediate position between serfage and freedom." Amongst them were the serfs on the lands formerly belonging to the Church, which had been secularized and transformed into State demesnes by Catherine II. There were also serfs on the apanages affected to the use of the imperial family; these amounted to nearly three and a half millions. Thus by the law of 1861 more than 40 millions of serfs were emancipated.

(J. K. I.)

MOHAMMEDAN SLAVERY

The Koran, like the Mosaic code, recognizes slavery, and lays down regulations as to the treatment of slaves. These regulations have been interpreted in a more, or in a less, humane spirit by the different sects of Islam (*q.v.*) and the treatment accorded may also vary by custom and tradition in different countries, and in the administration of the law by individual kadis. In the larger and more modernized Mohammedan States, the slave trade has long been declared illegal. The Ottoman Porte was a signatory to the Berlin Act of 1885 (*see* p. 785) and enacted a law in 1889 declaring the illegality of the slave trade. Persia and Zanzibar joined her as signatories of the Brussels Act of 1890. In some of the minor Mohammedan States, however, as, for instance, the Hedjaz, the traffic has persisted up to the present time.

The Koran enjoins the good treatment of the slave, and manumission is encouraged as an act of piety. The child of a slave concubine by her master is free-born, and the mother is usually freed also. The slave "born in the house" is generally regarded as a member of the family and to sell such a slave, except for incorrigible misconduct, would be condemned by public opinion. The favourite slaves of a ruler often held high office as confidential advisers, as administrators of provinces, or as leaders in the army. The master is bound to care for his slave in sickness and old age, and to maintain his wife and family. Facilities were afforded for self-redemption and for ransom. The predial slave, on the other hand, gradually developed into a serf *adscriptus glebae*. He would usually be allowed to retain part of the usufruct of the estate for himself, or be permitted to work for one or more days in the week on his private holding.

Slavery in Africa.—After the trade in slaves to America and the West Indies from West Africa had been declared illegal, in the early part of the 19th century, a very considerable smuggling traffic was still carried on, until slavery itself was abolished in America after the Civil War. Strenuous efforts were made by Great Britain to suppress this traffic by war-ships at sea, and in 1861 Lagos was acquired as a depôt for the naval vessels employed on this service. The term "slave trade" which had hitherto been used to refer exclusively to this traffic, now bore a new meaning as referring either to the surreptitious export of slaves to Arabia, Persia and the Red sea littoral, from the north-eastern and eastern coasts of the Continent, or to the internal slave trade to satisfy the demand of the Mohammedan States in the north and west and Zanzibar, as well as that of the negro kingdoms of Uganda, Benin, Dahomey, etc. Of the slaves required by the latter, large numbers were sacrificed in Pagan ceremonials, and on the death of the king, or of their owners.

The existence of this internal slave trade first became known to Europe from the reports of the early explorers, in the middle

of the 19th century—more especially from the accounts of Dr. Livingstone, Sir Samuel Baker and Dr. Barth. The trade in the north is thus described by Dr. Ingram.

The central Sudan appeared to be one vast hunting-ground. Captives were brought thence to the slave market of Kuka in Bornu, where, after being bought by dealers, they were, to the number of about 10,000 annually, marched across the Sahara to Murzuk in Fezzan, from which place they were distributed to the northern and eastern Mediterranean coasts. Their sufferings on the route were dreadful; many succumbed and were abandoned. Rohlfs informs us that "any one who did not know the way" by which the caravans passed "would only have to follow the bones which lie right and left of the track." Negroes were also brought to Morocco from the western Sudan and from Timbuktu. The centre of the traffic in Morocco was Sidi Hamed ibn Musa, seven days' journey south of Mogador, where a great yearly fair was held. The slaves were forwarded thence in gangs to different towns, especially to Marrakesh, Fez and Mequinez. About 4,000 were thus annually imported, and an *ad valorem* duty was levied by the sultan, which produced about £4,800 of annual revenue. The control now exercised by the French over the greater part of the western Sudan has deprived Morocco of its chief sources of supply. The basin of the Upper Nile, extending to the great lakes, was another region infested by the slave trade; the slaves were either smuggled into Egypt or sent by the Red sea to Turkey. The khedive Ismail in 1869 appointed Sir Samuel Baker to the command of a large force with which he was "to strike a direct blow at the slave trade in its distant nest." The work begun by him was continued by Col. C. G. Gordon (1874–79), but under the Mahdi and the Khalifa the slave trade was revived. Since the reconquest of the eastern Sudan by an Anglo-Egyptian force in 1898 effective measures have been taken to suppress slave raiding and as far as possible slavery itself. The conquest of the central Sudan States by France—completed in 1910 by the subjugation on Wadai—has practically ended the caravan trade in slaves across the Sahara.

Benghazi in Cyrenaïca long remained a port for the surreptitious export of slaves, but the assertion of Italian sovereignty over Tripoli and its hinterland has effectually killed the traffic.

The Berlin and Brussels Acts.—The export from Zanzibar to Arabia and the Persian gulf persisted till the close of the century, and it was mainly with a view to the suppression of this traffic that a conference of the Powers signatory to the Berlin Act (to whom were added Persia, Zanzibar and the Congo Free State) was summoned at the instance of Queen Victoria to assemble at Brussels in 1889. The Berlin Conference of 1885 had been primarily concerned with the political and commercial relations of the Powers which were engaged in the "scramble for Africa." Its scope was limited to "the Conventional basin of the Congo," and in only two of its 38 articles was the subject of slavery referred to. In these (articles 6 and 9) the "Powers exercising sovereign rights or influence" within this zone, pledged themselves "to help in suppressing slavery and the slave trade."

The Brussels Conference, on the other hand, was solely directed to "putting an end to the crimes and devastations engendered by the traffic in African slaves, protecting effectively the aboriginal populations of Africa, and insuring for that vast continent the benefits of peace and civilization." It was recognized that "the maritime zone in which the slave trade still exists" had shifted from the west to the east coast of Africa, and that zone, in which special regulations as to rights of search, etc., were laid down, was defined as extending "between the coasts of the Indian ocean, including those of the Persian gulf, and of the Red sea from Beluchistan to Quillimane" a port in Portuguese East Africa S. lat. 18°, and thence southwards to S. lat. 26° and eastwards so as to include Madagascar. The general act, prefaced by the words "In the name of Almighty God," dealt in its 100 articles with measures for the suppression of the slave trade by sea and land, the restriction of the import of arms of precision, and ammunition between lat. 20° N. and lat. 22° S. of spirituous liquor with Africa. It marked a new era in the international recognition of the responsibilities of the civilized Powers towards the subject races. As early as 1873 Sir John Kirk, British consul-general in Zanzibar, had succeeded in inducing the sultan to declare that the export of slaves from the mainland was illegal, and in 1876 an edict was issued prohibiting their arrival at the coast from the interior. The edicts were, however, disregarded. For over half a century Great Britain had maintained a squadron in East-African waters for the suppression of the trade, but in 1883 H.M.S. "London," and her fleet of small vessels, adapted for pursuing the slave-dhows into the creeks and shallow waters, was withdrawn, and three vice-consuls (one in Lake Nyasa and two on the coast) were substituted. Naval action had proved wholly inadequate, and very costly both in lives and money, but British war-vessels continued to capture slave-dhows. Nor were the pledges of the signatory Powers to the Berlin Act, productive of any tangible results, for it was estimated that not 5% of the slaves exported were rescued.

The partition of Africa between the European Powers which took place at this time, rendered obsolete the provisions of the Brussels Act in so far as they related to the establishment of cities of refuge for fugitive slaves, armed vessels on the great lakes and fortified posts. With the assumption of control by Europe in Africa, the overseas slave trade rapidly came to an end except as regards Abyssinia, the only country which maintained its independence under its traditional rulers. It was in evidence before the slavery committee of the League of Nations in 1926 (*see* p. 786) that a considerable traffic in slaves from that country to the Hedjaz (Arabia) was still carried on, her Government being powerless to stop it.

Internal Slave Trade.—The second phase of the slave trade, viz., the raids for slaves to supply the internal demand from Mohammedan States and pagan kingdoms in Africa, was equally doomed to extinction by the advent of settled administration; but it did not disappear without a struggle. In the eastern Sudan the conquests of Baker and Gordon over the Turco-Egyptian slave raiders had been effaced by the sanguinary rule of the Mahdi, and it was not until he in turn had been conquered by Kitchener in 1898, that effective control could be exercised.

The consolidation of French rule in the north, and the final defeat of Samory and other powerful Mohammedan potentates in the west, put an end to the organized traffic in slaves, though as late as 1926 parties of tribesmen in the desert still defied authority. In Nigeria the power of the Mohammedan rulers who annually employed large armies in raiding for slaves, and had depopulated great regions, was broken in 1902–3, and slave-raiding was stopped. In the Congo region King Leopold declared war on Tippoo Tib, Rumaliza and other notable east-coast Arabs who had settled there and had become powerful despots, practically independent of Zanzibar. They were crushed after a severe struggle. In Nyasaland—a favourite hunting-ground of the Zanzibar slavers—a stand had been made by a Scottish trading company, and when control was assumed by Great Britain, the raids of Mlozi, Jumbe and other noted slavers were suppressed. The advent of Europe was probably only just in time to anticipate and prevent a Mohammedan domination in central Africa.

The Status of Slavery.—Before the close of the first decade of the 20th century a more or less effective administration had been established throughout Africa, under European control, except in Abyssinia and Liberia. The public opinion of the civilized world, no longer limited its reprobation to the slave trade but now condemned the institution of slavery—especially of slave-dealing—and the Powers in control in Africa took steps to suppress it with varying degrees of thoroughness. France boldly decreed compulsory emancipation in French West Africa, but was confronted with such widespread unrest in consequence that she was compelled to adopt more gradual measures. In the Portuguese possessions the prohibitions are understood to have been largely ineffective, and the Government itself was at one time accused of conniving at a system differing little from slavery in order to procure labour for the plantations of San Thomé and Principe. Germany declared emancipation from a prospective date.

Great Britain, taught by her experience in the West Indies and in India, recognized the evils attendant on compulsory emancipa-

tion, and adopted in most of her African dependencies the alternative measure of abolishing the legal status of slavery—as the East India company had done with success in 1843. She recognized that in many cases, especially among communities which had adopted the Mohammedan faith, or a Christianity based on the law of the Pentateuch as in Abyssinia, the institution had become so intimately interwoven with the social fabric, that sudden and enforced emancipation would bring ruin and misery to the slaves no less than to their owners.

If the legal status of slavery be abolished no court of law can recognize any rights based on the claim of any person to property in the person of another. Every slave can assert his freedom without any ransom or formality, and an owner is as liable to process of law for attempting to detain a slave against his will, or to capture a runaway as though he were free-born. On the other hand, it is not a crime for a master to retain a slave if both desire to remain in that relationship. It is permissive as contrasted with compulsory emancipation. This method was eminently successful in the Gold Coast and in Nigeria. It was not, however, adopted in Sierra Leone until Jan. 1, 1928, then it is estimated that about 200,000 slaves were by this method enabled to assert their freedom. Local ordinances have at the same time enacted that the acquisition of new slaves and all dealings in slaves are a penal offence, and that all children born after the date of the ordinance are free-born.

The Convention of 1919.—The aspirations of the Berlin and Brussels Acts had been limited to the suppression of the slave trade and had not attempted to deal with the institution of slavery. In Sept. 1919 a new convention was concluded at St. Germains by which the signatories pledged themselves "to endeavour to secure the complete suppression of slavery in all its forms" (art. 11). A new departure was thus inaugurated, and for the first time not only was the suppression of slavery as a social institution agreed upon in an international convention, but the fact that conditions of servitude might exist, which were tantamount to slavery gained international recognition; a recognition which was more fully accorded in the terms of the mandates which were soon after granted to the Powers which accepted the control of the former colonies of Germany and Turkey. This convention superseded the Berlin and Brussels Acts so far as its signatories (the Allies against the Central European Powers in the World War) were concerned. It dealt with the varied matters included in those acts but the liquor traffic and the arms traffic were relegated to separate conventions, while slavery and the slave trade occupied a single clause. Some doubt appeared to exist as to the wisdom of the cancellation of several of the slavery clauses of the Brussels Act, and as to the position of its remaining signatories. Advantage was, therefore, taken of the admission of Abyssinia to membership of the League of Nations—a country in which slavery was still a legal institution, and in which slave raiding and the slave trade had till recently been carried on, and were alleged to be still existing—to reopen the question as a matter of international concern.

Committee of 1924 and Convention of 1926.—A committee appointed by the League to investigate the subject met in July 1924 and again in the following year. It recommended *inter alia* a new convention—not confined to Africa—to which the adherence of all States whether members of the League or not should be invited. This proposal was accepted, and the British Government submitted a draft convention. All the members of the League and also Afghanistan, Ecuador, Egypt, Germany, Mexico, the Sudan, Turkey and the United States were invited to submit any suggestions, and "to assist one another forthwith in the abolition of the slave trade, slavery and conditions analogous thereto by all practicable means."

The "analogous conditions" says the official report "are intended to include all forms of debt slavery—the enslaving of persons disguised as the adoption of children, and the acquisition of girls by purchase disguised as payment of dowry, etc."—matters to which attention had been drawn in the committee's report. The convention which embodied the highest minimum standard to which it was anticipated that general acceptance could be secured, was ratified by 15 States, viz., Australia, Austria, the British Empire, Bulgaria, Denmark, Haiti, Hungary, India, Latvia, New Zealand, Norway, Portugal, Spain, the Sudan and South Africa. Belgium, France, Germany, Italy, and the Netherlands expected that they would be able to ratify at a later date. India made reservations in regard to the unadministered districts on her frontiers, and the territories of Indian rulers under the suzerainty of the British Crown.

Forced Labour.—"The convention (says the report) deals for the first time in international agreements with the question of forced labour." Art. v. is as follows:

"The High Contracting Parties recognize that recourse to compulsory or forced labour may have grave consequences and undertake, each in respect of the territories placed under its sovereignty, jurisdiction, protection, suzerainty or tutelage, to take all necessary measures to prevent compulsory or forced labour from developing into conditions analogous to slavery.

It is agreed that:

(1) Subject to the transitional provisions laid down in paragraph (2) below, compulsory or forced labour may only be exacted for public purposes.

(2) In territories in which compulsory or forced labour for other than public purposes still survives, the High Contracting Parties shall endeavour progressively and as soon as possible to put an end to the practice. So long as such forced or compulsory labour exists, this labour shall invariably be of an exceptional character, shall always receive adequate remuneration, and shall not involve the removal of the labourers from their usual place of residence.

(3) In all cases, the responsibility for any recourse to compulsory or forced labour shall rest with the competent central authorities of the territory concerned."

The terms used are a compromise between opposing views, and it was agreed that the question should be referred to a "committee of experts" to be summoned by the International Labour Office. The committee met in July 1927 and has not yet submitted its report. There is probably a consensus of opinion that in certain cases a State may find itself under the necessity of compelling labour for essential public works or services. There is also probably a predominant opinion that such labour should be fairly remunerated, though some hold the view that if compulsory labour is imposed under the guise of a tax—as a fiscal measure—it need not be restricted to urgent public services, and, of course, would not be remunerated—as the Central African mandates require. The second principle to be determined is whether it is permissible in any circumstances to use compulsion for the supply of labour, even though paid, in enterprises conducted for private profit. Abuses of the system known in South America as "peonage" fall under this category, by which labourers become involved in debt which they can never repay, and so become slaves for life. The Slavery Commission pointed out that this system merits particular condemnation when an alien employer deliberately adopts measures to secure by such means the life-long servitude of an ignorant and unsuspicious peasantry.

Slavery in Asia.—Following the adoption of the convention by the League of Nations several notable instances of the liberation of slaves have occurred. H.H. the Maharaj. of Nepal issued a very striking appeal to his people in Nov. 1924 for the liberation of the 51,419 slaves in his kingdom, which was completely successful. Compensation on a fixed scale was paid to those who claimed it. The governor of Burma despatched a series of expeditions into the unadministered and unexplored districts on the frontiers inhabited by the Naga tribes, and effected the release of all slaves. From Abyssinia it is reported that enlightened regulations have been framed in regard to slave raiding, slave trading and slavery and that many slaves have been set free. Since Abyssinia was admitted to membership of the League in Sept. 1923 on condition of reform in these matters, it becomes incumbent on the League to verify these reports—the more so that it was in evidence before the Slavery Committee in 1926 that a considerable traffic in slaves existed chiefly from Abyssinia to the Hedjaz (Arabia) and at the present time (1928) the Sudan Government has found it necessary to establish a sanctuary near

Kassala, and other "refugee colonies" for slaves who have escaped from Abyssinia.

From this brief outline it is evident that the standards and aspirations of the world after the World War show a fuller appreciation of the true interests of the "backward races" than was possible a couple of decades ago, and an intention to abolish finally the status of slavery throughout the world. (Lu.)

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SLAVERY CONVENTION. The Slavery Convention of the League of Nations, approved and adopted by the seventh Assembly in 1926 for submission to, and ratification by, the States Members of the League, had as its object to complete and extend the work of the Brussels Act and to give practical effect to the Convention of St. Germain. The Powers bind themselves to bring about "progressively and as soon as possible the complete abolition of slavery in all its forms," which include debt slavery, the so-called adoption of children, etc. The parties undertake to suppress the slave trade by sea, and to negotiate a Convention on the trade in slaves; also, to prevent forced labour developing into conditions analogous to slavery. Such labour may only be exacted for public purposes, apart from purely transitory arrangements. So long as forced labour for any other than public services survives, it is invariably to be of an exceptional character, to receive adequate remuneration, and not involve the labourers' removal from their homes. At the 1927 Assembly every Colonial Power agreed to ratify the Convention at an early date. (T. Bu.)

SLAVONIC LANGUAGES. The Slavonic languages belong to the Eastern or Satem division of the Indo-European family, and are very closely connected with the Baltic group, which embraces Lithuanian, Lettish and the now extinct Old Prussian. The phonetic and morphological affinities between the two groups are so striking that many scholars have postulated a Balto-Slavonic unity on a par with that existing between Indian and Iranian. Although a unity of this character is now disputed, largely because of the differences in vocabulary, verbal structure and formative elements employed, the common innovations and general parallelism of development make it probable that the two ethnic groups lived in close contiguity and influenced each other long after they had become separated from their original neighbours. Their contact probably persisted over a very long period, but a separation must have occurred centuries before the Christian era, each group thenceforward developing along its own lines. To-day the Slavs and the Balts are again in partial contact, but the influence each exercises over the other is almost wholly on the side of the Slavs, whose northern languages have affected the vocabulary of the Balts. Slavonic has considerably less in common with Teutonic, and the resemblances which may be observed in vocabulary are for the most part due to the adoption by Slavonic of Teutonic words which, with the objects of culture they denoted, became known to the less civilised Slavs.

With one branch of the Iranians, the Sarmatians, the Slavs remained in touch until after the Christian era and obtained from them some words, e.g., *Bogŭ*, *cf.* Persian *Baga* (god). The alteration of an original *s* after *i, u, r* and *k,* which is common to Slavonic and Iranian, is on a different footing from loans of vocabulary: it is a sound law which can be traced also in Indian and Baltic, and so argues an early differentiation of I.E. rather than an independent, common development of Slavonic and Iranian.

After the Baltic group had ceased to be connected with the Slavonic, we must imagine a long period when Slavonic was a bundle of dialects, showing in embryo some of the peculiarities of the future languages, but on the whole so much alike that we may say that a form occurring in one dialect was also common to the others. This stage may be called Common Slavonic (C.S.). Except for the few cases where Old Bulgarian (O.B.) has either definitely South Slavonic characteristics or peculiar characteristics of its own, as written down by Cyril it represents with great completeness Common Slavonic at the moment of its falling apart. In one respect, however, O.B. lends us no assistance for determining the pronunciation of a C.S. word: we have no direct means of ascertaining either the original word intonation or the sentence melody.

The period of time which elapsed until C.S. was formed out of I.E. is so long that great changes—the details of which can only be surmised—necessarily arose, but it is indicative of the absence of foreign cultural influences that there has not been any such discontinuity of linguistic tradition as has occurred in many other I.E. groups. The violent upheavals and ethnic amalgamations which have left so profound a mark on Teutonic, Italic and Greek, are lacking in Slavonic. The I.E. vocabulary continued to satisfy most needs of Slav speakers; losses were made good by new words

formed after the old models and with the help of the old methods of derivation the type of accentuation suffered no radical changes, and indeed all innovations were evolutionary rather than revolutionary. The Slav languages, even to-day, conform closely to the primitive type and present an uncommonly archaic aspect. They have progressed far less and have remained far nearer to each other than the Romance or Teutonic languages. Such differences as separate French from Spanish or Rumanian are quite unknown; with some preliminary practice a peasant from Slovakia, which of course enjoys the benefit of a central position in the Slavonic territory, is understood by a Slav from any other country.

Among the ruling principles which have determined the physiognomy of Slavonic speech are: the rigorous division of the vowels into a prepalatal and a postpalatal series—this having big consequences for the subsequent fate of the preceding consonants—and a system of word division which tolerated only open syllables. Except in initial position, the I.E. vowels generally underwent slight changes, but the loss of labialisation suffered by long *u*, and the levelling of short *o* and *a* under *ŏ*, are characteristically Slavonic. The change of short *ŭ* and *ĭ*, which were not kept distinct everywhere, led to great alterations in the syllabic character of words and has tended, especially in Polish, to produce difficult consonantal groups. The distinction between voiced and voiceless sounds continued without interruption, and the nasal and liquid consonants, when initial or intervocalic, also persisted unchanged. Numerous sibilants (of the type of English wi*tch* and wi*ts*) arose at different periods, after the separation from Baltic but before our earliest Slavonic records, and the combination of vowels with following nasal or liquid consonants, when the latter were followed by a consonant, conditioned the formation of nasal vowels. To sum up, the general persistence of vowels in positions where vowels already existed in an I.E. word, and the conservative behaviour of consonants make it possible to recognize, with a minimum knowledge of historical grammar, the fundamental connection of a Slavonic word with its corresponding I.E. prototype. *Nebese,* compared with its Greek equivalent *νέφους* is much the nearer to the form postulated for Indo-European. The complicated phenomena of vowel gradation (Ablaut), as presented by Slavonic, in the main answer to the Indo-European.

Morphology.—In the sphere of morphology the Slavonic languages have preserved much, but have also introduced many simplifications. Nouns have three genders, three numbers in O.B., Slovene and Sorb (other tongues have more or less numerous traces of the Dual) and, except in Bulgarian, seven cases—Nom., Voc. (not in Great Russian or Slovene), Acc., Gen., Dat., Instrumental and Locative. The Ablative has coincided with the Genitive.

The *-o-*, *-ā-* and *-i-* declensions have gained at the expense of the consonantal and *-ŭ-* stems, and phonetic or analogical change has caused many cases to coincide, especially in the dual. The adjective, when definite, receives a pronominal element, at first clearly distinguishable, but later unrecognizably merged in the body of the word. There is neither a definite nor an indefinite article. Of the two I.E. types of inflexion, the thematic and the athematic, the latter has lost ground to the former, and the *-s-* aorist early tended to be lost in favour of a more transparent thematic formation.

The verb, indeed, has lost most of the I.E. voices, moods and tenses. The passive only survives in the present and past participles; of the finite moods there are left but the indicative and optative (nearly always used as an imperative); its only old tenses are the present and the aorist, to which it has added an imperfect of its own. There is an infinitive and a supine, both representing cases of an original verbal noun. Of active participles there are a present and a past and a second past participle in *-l-* (*cf.* Latin *bibulus*), used in making compound tenses. The verb has two stems; from the present are formed the indicative present and imperfect, the imperative and the active and passive present participles. All other forms are based upon the infinitive stem. The primary personal endings continue those of I.E. in a form recognizable to-day, but the secondary endings have lost their final consonants by phonetic change. The aorist has no augment and has been replaced by a periphrastic formation with the *-l-* participle in nearly all the modern languages. The past participle passive is formed with *-t-* or *-n-*. (*Cf.* Latin *plenus* and *pletus.*) The I.E. future having been lost, futurity is expressed by auxiliary verbs as in the Romance languages. The passive is expressed either by the use of the passive participles or by the reflexive pronoun, which can refer to the 1st and 2nd persons as well as to the 3rd.

Syntax.—Syntactic peculiarities of the Slavonic languages are a tendency to use the genitive, under certain circumstances, instead of the accusative (which has often coincided in form with the nominative); the use of the genitive for the accusative or even nominative in negative clauses; the dative absolute and the dative as subject to an infinitive; the instrumental instead of the nominative as a predicate, and, in *oratio obliqua,* the preservation of the tense of the original statement, instead of our way of throwing it into the past.

In the use of the verbs the development of "aspects" makes up for the few tenses. All verbs fall into two great divisions, *imperfective,* which express the continuance of an action, without regard to its beginning and end, and *perfective,* which express the points of beginning or ending. The continuance of an action may be unbroken or may consist in a succession of like acts. Accordingly, imperfective verbs are divided into *durative* and *iterative,* and again the repeated acts expressed by the iterative can either, each of them, be momentaneous, or each have some continuance, or can even express the occasional repetition of groups of momentaneous actions.

Among perfective verbs we have (1) *momentaneous,* expressing action which has no continuance, (2) *finitive,* expressing not the continuance of the action, though there has been that, but its end or completion, and (3) *ingressive,* expressing the moment of beginning an action.

As perfective verbs do not express continuance, an idea implied in the present, they do not need a present form, which is therefore used for perfective futures. Similarly the aorist is usual with perfective, but the imperfect with imperfective verbs. If a durative verb is compounded with a preposition, it becomes perfective. (*Cf.* English "sit," which is usually imperfective, with "sit down.")

Some Slavonic languages (notably Czech) have extended the possibilities of the aspects still further, but others, *e.g.*, Slovene, have made simplifications and permit the union of a perfective infinitive with an auxiliary, to form the future.

The formation of the sentence is not naturally complicated, and the word order is almost as free as in the classical languages, but Slavonic has in times past been largely influenced by Greek, Latin and German with their involved periods; latterly there has been a tendency to follow the simpler models of French and English.

Such being the Slavonic languages as a whole and regarded in their relationship to I.E., they may now be considered in their relationship to each other. Some account of each language will be found under its name.

Divisions.—The Slavonic languages are usually divided into three groups:

(1) The Western, comprising Polabian, Polish, Sorb or Wendish, and Czechoslovak. Polabian, which was the language of the Slavs of the Elbe (*Laba* is the Slavonic name for the Elbe), is now dead, its speakers having been Germanized in the course of the last thousand years. It was spoken in the South-Eastern part of Holstein, in Mecklenburg and on the island of Rügen, in part of Hanover (where the last remnants of the language survived until the 18th century), in the northern part of Brandenburg and in Pomerania. Closely connected with Polabian is Polish, which has an old literary tradition. Kašube, spoken in the neighbourhood of Danzig, presents archaic features in the accentuation, and in its earlier form was the connecting link with Polabian. Sorb or Wendish, which is spoken on both sides of the Spree in Upper and Lower Lusatia, and is divided, according to the dialect used, into Upper and Lower Sorb, formerly occu-

pied a much larger area and formed a natural transition to Polabian, Polish and Czech. Czech and Slovak—really two separate but closely related literary languages, although the compound word Czechoslovak to express either one or both languages is winning acceptance—are spoken respectively in Bohemia and Slovakia. The dialects of Moravia bridge the two languages.

(2) The Eastern, comprising Great Russian, the scientific name of the language generally known as Russian simply; Little Russian, now usually called Ukrainian and formerly also called Ruthenian in those parts of old Austro-Hungary where it was spoken; and White Russian, which has recently been elevated into a literary language.

(3) The Southern, comprising Slovene, Serbo-Croat and Bulgarian. The Croat spoken near Zagreb (the so-called *kaj* dialect) is a transition dialect between Slovene and literary Serbo-Croat. Serb and Croat are identical languages, but the former is written in the Cyrillic and the latter in the Latin alphabet. The Macedonian dialects represent a midway stage between Serb and Bulgarian, the last of the Southern group. The language of the first Slavonic translators was an old form of Macedonian Bulgarian and, because of certain phonetic resemblances to Bulgarian, is called either Old Bulgarian or Old (Church) Slavonic, and is here abbreviated as O.B.

Without entering into the peculiarities of each Slavonic language, it may be said that on the whole the geographical classification of the Slavs is justified linguistically, though the lines of division are rendered less definite by the approximation of the languages which are contiguous in area, the special characteristics of each group being generally represented in dialects of the others, if not in the written languages. Also, within historic time, certain languages have influenced others through literary and political intercourse. O.B. has influenced all the Orthodox Slavs and the Croats, so that Russian is full of O.B. forms, pronounced *à la Russe*. Czech has almost overshadowed Slovak and early afforded literary models to Polish. Polish has overshadowed Kašube and much influenced Little and White Russian, and Great Russian in a less degree. Russian has in its turn supplied modern Bulgarian with a model. Again, other tongues have contributed; in Common Slavonic Germanic loan words already occur, and others have followed at various periods, especially in Czech, Polish and Slovene. Bulgarian and Serbo-Croat have incorporated many Turkish words; Russian added many Eastern words in the Tatar period and has absorbed the common vocabulary of Western civilisation since the time of Peter the Great (this tendency has been accentuated under the Bolshevik *régime*); but on the whole, though the Slav easily takes to a fresh language, he has kept his own free from any great admixture. The various Slavonic languages are treated under the national headings. But for Bulgarian *see* OLD SLAVONIC.

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SLAVS. The Slavs are the most numerous linguistic group in Europe. Outside Europe there are the Russians in Siberia, a mere extension of the main body, and emigrants in America.

Divisions and Distribution.—The Slavs are divided geographically and linguistically into three main groups, Eastern, North-Western and Southern.

The Russians form the Eastern group. They hold all the East European plain from the 27th meridian to the Urals, the Finnish and Tatar tribes making up but a small proportion of the population: to the east they stretch into central Siberia and thence in narrow bands along the rivers all the way to the Pacific; on the west the Ruthenians of Galicia form a wedge between the Poles and the Magyars and almost touch the 20th meridian.

The North-Western group includes the Poles, in the basin of the Vistula; the Kashubes on the coast north-west of Danzig; the High and Low Sorbs or Wends in Lusatia, Slavs completely surrounded by Germans, the Czechs and their eastern neighbours, the Moravians, now included in Czechoslovakia. Connecting up Ruthenians, Poles and Moravians, but most closely akin to the latter, are the Slovaks (*q.v.*). The now teutonized Slavs of central Germany, once stretched as far to the north-west as Rügen and Holstein and to the south-west to the Saale. They are generally called Polabs (*q.v.*), or Slavs on the Elbe.

The Southern Slavs, Slovenes (*q.v.*), Serbo-Croats and Bulgarians are cut off from the main body by the Germans of Austria proper and the Magyars, both of whom occupy soil once Slavonic, and have absorbed much Slavonic blood, and by the Rumanians of Transylvania and the Lower Danube. These Slavs occupy the main mass of the Balkan Peninsula downwards from the Julian Alps and the line of the Muhr, Drave and Danube. North of this all three races have considerable settlements in southern Hungary. Their southern boundary is very ill-defined, various nationalities being closely intermingled. To the south-west the Slavs march with the Albanians, to the south-east with the Turks, and to the south and along the Aegean coasts they have the Greeks as neighbours.

Linguistic Divisions.—Linguistically the separation is not sharp, though it coincides with the new political frontiers. Roughly speaking, the eastern half of the peninsula is held by the Bulgarians, the western half by the Serbo-Croats. This is the most divided of the Slavonic races; its members profess three forms of religion and use three alphabets—the Serbs and Bosnians being mostly Orthodox and using the Cyrillic alphabet, but including many Muslims; the Croats being Roman Catholics, writing with Latin letters; and the Dalmatians also Roman Catholics, but using, some of them, the ancient Glagolitic script for their Slavonic liturgy. The language also falls into three dialects independent of the religions, and across these lines run the frontiers of the political divisions. In the extreme north-west, in Carniola, in the southern parts of Styria and Carinthia, and over the Italian border in the province of Udine and the Vale of Resia live the Slovenes, much divided dialectically. Between the Slovenes and the Croats there are transition dialects, and about 1840 there was an attempt (Illyrism) to establish a common literary language. In Macedonia and along the border are special varieties of Bulgarian, some of which approach Serbian. Akin to the Macedonians were the Slavs, who once occupied the whole of Greece and left traces in the place-names, though they long ago disappeared among the older population. Akin to the Slovenes were the old inhabitants of Austria and south-west Hungary before the intrusion of the Germans and Magyars.

History.—This distribution of the Slavs can be accounted for historically. Though traditions (*e.g.*, the first Russian chronicle of Pseudo-Nestor) bring them from the basin of the Danube, most evidence goes to show that when they formed one people they were settled to the north-east of the Carpathians in the basins of the Vistula, Pripet and Upper Dněstr (Dniester). To the N. they had their nearest relatives, the ancestors of the Baltic tribes, Prussians, Lithuanians and Letts; to the E. Finns; to the S.E. the Iranian population of the Steppes of Scythia (*q.v.*); to the S.W., on the other side of the Carpathians, various Thracian tribes; to the N.W. the Germans; between the Germans and Thracians they seem to have had some contact with the Celts, but at first the Illyrians, Greeks and Italians probably came between. This location, arrived at by a comparison of the fragmentary accounts of Slavonic migrations and their distribution in historic time, agrees with the place taken by the Slavonic language among the other Indo-European languages (*see* below), and by what we know of the place-names of eastern Europe, seeing that within this area the place-names seem to be exclusively Slavonic, while outside it the oldest names belong to other languages.

In spite of the vast area which the Slavs have occupied in

historic times there is no reason to claim for them before the migrations a wider homeland than that above defined beyond the Carpathians; given favourable circumstances a nation multiplies so fast that a comparatively small race could cover a wide area in the course of four centuries. Therefore we need not seek for the Slavs among any of the populous nations of the ancient world. Various investigators have seen Slavs in Scythians, Sarmatians, Thracians, Illyrians, and in fact in almost all the barbarous tribes which have been mentioned in the east of Europe, but we can be sure that none of these were Slavs.

The Slavs made no considerable migration from their first home until the 1st century A.D. Their first Transcarpathian seat lay remote from the knowledge of the Mediterranean peoples. Herodotus (iv. 17, 51, 105) seems to mention the Slavs under the name of Neuri, on the upper waters of the Dnĕstr. They are in the right place for Slavs, and their lycanthropy suggests modern Slavonic superstitions; so we may equate Neuri and Slavs, though we have no direct statement of their identity. Other classical writers down to and including Strabo tell us nothing of eastern Europe beyond the immediate neighbourhood of the Euxine.

EARLY WRITERS

Pliny (*N.H.* iv. 97) is the first to give the Slavs a name which can leave us in no doubt. He speaks of the ***Venedi*** (*cf.* Tacitus, *Germania,* 46, *Veneti*); Ptolemy (*Geog.* iii. 5. 7, 8) calls them *Venedae* and puts them along the Vistula and by the Venedic gulf, by which he seems to mean the Gulf of Danzig: he also speaks of the Venedic mountains to the south of the sources of the Vistula, that is, probably the northern Carpathians. The name Venedae is clearly Wend, the name that the Germans have always applied to the Slavs. Its meaning is unknown. It has been the cause of much confusion because of the Armorican Veneti, the Paphlagonian Enetae, and above all the Enetae-Venetae at the head of the Adriatic. Though nowadays we have Slovenes just north of Venice, inscriptions in the Venetian language prove that it was not Slavonic. Other names in Ptolemy which almost certainly denote Slavonic tribes are the Veltae on the Baltic, ancestors of the Wiltzi, a division of the Polabs (*q.v.*), the Sulani and the Saboci, whose name is a Slavonic translation of the Transmontani of another source.

The sudden appearance in the 6th-century writers of definite names for the Slavs and their divisions means that by then the race had made itself familiar to the Graeco-Roman world, that it had spread well beyond its original narrow limits, and had some time before come into contact with civilization. This may have been going on since the 1st century A.D., and evidence of it has been seen in the southward movement of the Costoboci into northern Dacia (Ptolemy) and of the Carpi to the Danube (A.D. 200), but their Slavonic character is not established. A few ancient names on the Danube, notably that of the river Tsierna (*Černa,* black), have a Slavonic look, but a coincidence is quite possible. The gradual spread of the Slavs was masked by the wholesale migrations of the Goths, who for two centuries lorded it over the Slavs, at first on the Vistula and then in south Russia. We hear more of their movements because they were more immediately threatening for the Empire. In dealing with Ptolemy's location of the Goths and Slavs we must regard the former as superimposed upon the latter and occupying the same territories. This domination of the Goths was of enormous importance in the development of the Slavs. It explains the presence of a large number of Germanic loan words common to all the Slavonic languages, many of them words of cultural significance. "King, penny, house, loaf, earring" all appear in Slavonic, from the Goths, although the things must have been familiar before. On the other hand "plough" is said to be Slavonic, but that is not certain. When the Huns succeeded the Goths as masters of central Europe, they probably made the Slavs supply them with contingents. Indeed their easy victory may have been due to the dissatisfaction of the Slavs. Priscus (Müller, *F.H.G.* iv. p. 69, *cf.* Jord. *Get.* xlix. 258) in his account of Attila's camp mentions words which are probably Slavonic, though they have also been explained from German. After the fall of the Hunnish power the Eastern Goths and Gepidae pressed southwards and westwards to the conquest of the Empire, and the Lombards and Heruli followed in their tracks. When next we get a view of northern Germany we find it full of Slavs, *e.g.,* from Procopius (*B.G.* ii. 15), they held the Mark of Brandenburg by 512; a settlement effected without attracting the attention of any contemporary writer. The expansion of the Eastern Germans in the last centuries B.C. was made at the expense of the Slavs, who, while no more peaceful than the Germans, were less capable than they of combining for successful war, so that Goths and others were dwelling among them and lording it over them. The mutual competitions of the Germans drove some of these against the Empire, and when this had become weakened, so that it invited attack, some tribes and parts of tribes moved forward without any pressure from behind; this took away the strength of the German element, and the Slavs, not improbably under German organization, regained the upper hand in their own lands and even spread westwards at the expense of the German remnant.

Almost as uncertain is the exact time when the Southern Slavs began to move towards the Balkans. If already at the time of Trajan's conquests there were Slavs in Dacia, it would account for the story in Ps. Nestor that certain Volchi or Vlachi, *i.e.,* Romance speakers, had conquered the Slavs upon the Danube and driven them to the Vistula, for the place that the name of Trajan has in Slavonic tradition, and for the presence of an agricultural population, the Sarmatae Limigantes subject to the nomad Sarmatae on the Theiss. In any case, we cannot say that the Slavs occupied any large parts of the Balkan Peninsula before the beginning of the 6th century, when they appear in Byzantine history as a new terror; there seems to have been an invasion in the time of Justin, and another followed in 527 (Procopius, *B.G.* iii. 40 and *Hist. Arc.* 18). At the same time as the Slavs, the Huns, the Bulgars, and after 558 the Avars, were also making invasions from the same direction. The first and last disappeared like all nomads, but the Bulgars, making themselves lords of one section of the Slavs, gave it their own name. By 584 the Slavs had overrun all Greece, and were the worst western neighbours of the Eastern Empire. Hence the directions how to deal with Slavs in the *Strategicum* of the emperor Maurice (*c.* 600) and the *Tactics* of Leo.

By the end of the following century they were permanently settled throughout the whole of the Balkan Peninsula. These Southern Slavs, though divided into nationalities, are closely akin to one another. There is no reason to think the Serbo-Croats an intrusive wedge, although Constantine Porphyrogenitus (*De adm. Imp.* 30–33) speaks of their coming from the north in the time of Heraclius—the middle of the 7th century. Their dialects shade into one another, and there is no trace of any influence of the North-Western group. Constantine was probably led astray by the occurrence of the same tribal names in different parts of the Slavonic world. Meanwhile the Southern Slavs were cut off from the rest of the race by the foundation in the 6th century of the Avar kingdom in Pannonia, and after its destruction in the 7th, by the spread of the Germans south-eastwards, and finally by the incursion of another Asiatic horde, that of the Magyars, who have maintained themselves in the midst of Slavs for a thousand years. Their conquests were made chiefly at the expense of the Slovenes and the Slovaks, and from their languages they have borrowed many words in forms which have now disappeared.

Of the history of the Eastern Slavs, who were to become the Russian people, we know little before the coming of the Swedish Rus, who gave them their name and organization; we have but the mention of Antae acting in concert with the other Slavs and the Avars in attacking the Empire on the lower Danube, and scattered accounts of Muslim travellers, which show that they had reached the Don and Volga and stretched up northward to Lake Ilmen. The more southerly tribes were tributary to the Khazars.

CULTURE AND RELIGION

The general impression is one of a people which lived in small communal groups, so impatient of authority that they scarcely combined for their own defence, and in spite of indi-

vidual bravery only formidable to others when cemented together by some alien element: hence they all at one time or another fell under an alien yoke; the last survivals of Slavonic licence being the veče of Novgorod, and the Polish diet with its unpractical regard for any minority. The Slavs were acquainted with the beginnings of the domestic arts, and were probably more given to agriculture than the early Germans, though they practised it after a fashion which did not long tie them to any particular district—for all writers agree in telling of their errant nature. They were specially given to the production of honey, from which they brewed mead. They also appear to have been notable swimmers and to have been skilled in the navigation of rivers, and even to have indulged in maritime piracy on the Aegean, the Dalmatian coast and most of all the Baltic, where the island of Rügen was a menace to the Scandinavian and German sea-power. The Oriental sources also speak of some aptitude for commerce. Their talent for music and singing was already noticeable.

Of their religion it is strangely difficult to gain any real information. The word Bogŭ, "god," is reckoned a loan word from the Iranian Baga. The chief deity was the Thunderer Perún (*cf.* Lith. Perkúnas), with whom is identified Svarog, the god of heaven; other chief gods were called sons of Svarog, Dažbog the sun, Chors and Veles, the god of cattle. The place of this latter was taken by St. Blasius. A hostile deity was Stribog, god of storms. There seem to have been no priests, temples or images among the early Slavs. In Russia Vladimir set up idols and pulled them down upon his conversion to Christianity; only the Polabs had a highly developed cult with a temple and statues and a definite priesthood, perhaps in imitation of Norse or even Christian institutions. Their chief deity was called Triglav, or the three-headed; he was the same as Svętovit, apparently a sky god in whose name the monks naturally recognized Saint Vitus. The goddesses are colourless personifications, such as Vesna, spring, and Morana, the goddess of death and winter. The Slavs also believed, and many still believe, in Vily and Rusalki, nymphs of streams and woodlands; also in the Bába-Jagá, a kind of man-eating witch, and in Běsy, evil spirits, as well as in vampires and werewolves. They had a full belief in the immortality of the soul, but no very clear ideas as to its fate. It was mostly supposed to go a long journey to a paradise (raj) at the end of the world and had to be equipped for this. Also the soul of the ancestor seems to have developed into the house or hearth god (Domovój, Křet) who guarded the family. The usual survivals of pagan festivals at the solstices and equinoxes have continued under the form of church festivals.

Christianity Among the Slavs.—The means by which the various Slavonic nations were converted to Christianity has probably had more influence upon their subsequent history than racial distinctions or geographical conditions.

Wherever heathen Slavonic tribes met Christendom missionary effort naturally came into being. This was so along the Dalmatian coast, where the cities retained their Romance population and their Christian faith, from the 7th century the Croats were nominally Christian, and subject to the archbishops of Salona at Spalato and their suffragans. From the beginning of the 9th century from Merseburg, Salzburg and Passau the Gospel spread among the Slavonic tribes on the south-eastern marches of the Frankish empire, in Bohemia, Moravia, Pannonia and Carinthia. Despite the zeal of these missionaries, as Germans they belonged to a nation which was once more encroaching upon the Slavs, and as Latins (though the Great Schism had not yet taken place) they were not favourable to the use of their converts' native language. Still they were probably the first to reduce the Slavonic tongues to writing, naturally using Latin letters and lacking the skill to adapt them satisfactorily. Traces of such attempts are rare; the best are the Freisingen fragments of Old Slovene now at Munich.

In the eastern half of the Balkan Peninsula the Slavs had already begun to turn to Christianity before their conquest by the Bulgars. These latter were hostile until Boris, under the influence of his sister and of one Methodius (certainly not the famous one), adopted the new faith and put to the sword those that resisted conversion (A.D. 865). Though his Christianity came from Byzantium, Boris seems to have feared the influence of the Greek clergy and applied to the Pope for teachers, submitting to him a whole series of questions. The Pope sent clergy, but would not grant the Bulgarians as much independence as they asked, and Boris seems to have repented of his application to him. He raised the question at the Council of Constantinople (A.D. 870), which decided that Bulgaria was subject to the Eastern Church.

Cyril and Methodius.—In the same way Rostislav, prince of Greater Moravia, fearing the influence of Latin missionaries, applied to Byzantium for teachers who should preach in the vulgar tongue (A.D. 861). The emperor chose two brothers, sons of a Thessalonian citizen, Methodius and Constantine (generally known as Cyril by the name he adopted upon becoming a monk). The former was an organizer, the latter a scholar, a philosopher and a linguist. His gifts had been already exercised in a mission to the Crimea; he had brought thence the relics of S. Clement, which he finally laid in their resting-place in Rome. But the main reason for the choice was that the Thessalonians, surrounded as they were by Slavonic tribes, were well known to speak Slavonic perfectly. On their arrival in Moravia the brothers began to teach letters and the Gospel, and also to translate the necessary liturgical books and instruct the young in them. But soon (in 864) Rostislav was attacked by Louis the German and reduced to complete obedience, so that there could be no question of setting up a hierarchy in opposition to the dominant Franks, and the attempts to establish the Slavonic liturgy were strongly opposed. Hearing of the brothers' work Pope Nicholas I. sent for them to come to Rome. On their way they visited with Kocel, a Slavonic prince of Pannonia, about Lake Balaton, and he much favoured the Slavonic books. In Venice the brothers had disputes as to the use of Slavonic service-books; perhaps at this time these found their way to Croatia and Dalmatia.

On their arrival in Rome Nicholas was dead, but Adrian II. was favourable to them and their translations, and had the pupils they brought with them ordained. In Rome Constantine fell ill, took monastic vows and the name of Cyril, and died on the 14th of February 869. Methodius was consecrated archbishop of Pannonia and Moravia, about 870, but Kocel could not help him much, and the German bishops had him tried and thrown into prison; also in that very year Rostislav was dethroned by Svętopluk, who, though he threw off the Frankish yoke, was not steadfast in supporting the Slavonic liturgy. In 873 Pope John VIII. commanded the liberation of Methodius and allowed Slavonic services, and for the next few years the work of Methodius went well. In 879 he was again called to Rome, and in 880 the pope distinctly pronounced in his favour and restored him to his archbishopric, but made a German, Wiching, his suffragan. Methodius was succeeded by Wiching, who had a new pope, Stephen V. (VI.) on his side. So the Slavonic service-books and those that used them were driven out by Svętopluk and took refuge in Bulgaria, where the ground had been made ready for them. Boris, having decided to abide by the Greek Church, welcomed Clement, Gorazd and other disciples of Methodius. Clement, who was the most active in literary work, laboured in Ochrida and others in various parts of the kingdom.

In spite of the triumph of the Latino-German party, the Slavonic liturgy was not quite stamped out in the west; it seems to have survived in out-of-the-way corners of Great Moravia until that principality was destroyed by the Magyars. Also during the life of Methodius it appears to have penetrated into Bohemia, Poland and Croatia, but all these countries finally accepted the Latin Church, and so were permanently cut off from the Orthodox Serbians, Bulgarians and Russians. (X.; N. B. J.)

SLEAFORD, a market town in Lincolnshire, England, in a fertile and partly fenny district on the river Slea. Pop. of urban district (1931) 7,024. The fine church of St. Denis exhibits transitional Norman work in the base of the western tower. The nave is of beautiful late Decorated work with an ornate south porch. There is a splendid carved rood screen of oak. The chancel is Perpendicular. There are a few picturesque old houses. Malting and agriculture furnish the industries.

The discovery of numerous coins of the Constantine period,

the earthworks of the castle-area, and its proximity to the ford by which Ermine Street crossed the Witham, point to the probability of Sleaford (*Slaforde, Lafford*) being on the site of a Roman settlement or camp, and that the Saxons occupied the site before their conversion to Christianity is evident from the large cemetery discovered here. Domesday Book records that the manor had been held from the time of Edward the Confessor by the bishops of Lindsey, whose successors, the bishops of Lincoln, retained it until it was surrendered to the Crown in 1546. The quadrilateral castle, with its square towers and massive keep, was built by Alexander, bishop of Lincoln, and became one of the chief episcopal strongholds. Sleaford never became a borough, and the government was manorial, the bishops exercising jurisdiction. The townsfolk were organized in the guilds of Corpus Christi, St. John and Holy Trinity, accounts of which, date from 1477.

See *Victoria County History, Lincolnshire;* G. W. Thomas, "On Excavations in an Anglo-Saxon Cemetery at Sleaford, Lincolnshire," *Archaeologia*, vol. i. (London, 1887); Edward Trollope, *Sleaford and the Wapentakes of Flaxwell and Aswardhurn in the county of Lincoln* (London, 1872).

SLEEMAN, SIR WILLIAM HENRY (1788–1856), Indian soldier and administrator, born at Stratton, Cornwall, on Aug. 8, 1788, joined the Bengal army in 1809, and served in the Nepal War (1814–1816). He suppressed the Thugs or religious murderers in India, becoming superintendent of the operations against them in 1835, and commissioner for the suppression of Thuggi and Dacoity in 1839. During these operations more than 1,400 Thugs were hanged or transported for life, one of whom confessed to having committed over 700 murders. Detection was only possible by means of informers, for whose protection from the vengeance of their associates a special gaol was established at Jubbulpore. Sleeman was resident at Gwalior 1843–1849, and at Lucknow 1849–1856. He died at sea on his way home on Feb. 10, 1856.

See Sir H. Sleeman, *Rambles and Recollections of an Indian Official* (1844; 2nd edition, 1893), and *A Journey through Oudh* (1858).

SLEEP. Sleep is a normal condition of the body which occurs periodically. During sleep there is greater or less depression of most physiological activities, accompanied by a greater or less degree of unconsciousness. Until the present century, neither physiologists nor psychologists have been able to offer any explanation of the cause or nature of normal sleep.

Sleep as we know it in man is observed only in those animals which stand on a comparatively high level of development as regards their central nervous system. It is however possible that the periods of rest in the daily cycle of some invertebrates are of a nature akin to that of sleep. Amongst the vertebrates, even fishes show unmistakably a periodical sleep, and in birds this assumes all the characteristics of the typical sleep of a mammal.

Bodily Manifestations of Sleep.—The most striking manifestation of sleep is the partial or complete depression of the higher nervous activities, a state which is subjectively described as unconsciousness. However it is not only the higher parts of the central nervous system that are involved. Those parts which regulate posture and the tonic state of the skeletal muscles, and even those which regulate the respiratory movements and tone of the blood vessels are also found to be depressed during sleep.

As the result of an almost complete relaxation of the muscles, all signs of muscular activity diminish. The general metabolism is depressed and reaches the lowest level of the day. If we take the average daily metabolism of an adult as about 3,000 calories, only about 600 of these will be used during 8 hours of sleep, about 750 during 8 hours of the wakeful state at rest, and about 1,650 during 8 hours of mild muscular activity. As regards the state of metabolism we may, therefore, regard sleep as equivalent to almost complete rest of the skeletal muscles. Since the process of reconstruction of organs, *i.e.,* their recovery after a preceding period of activity, can take place only in the absence of these activities, it is natural that sleep should afford a better opportunity for recovery from fatigue than simple rest, in which the muscles are never in as complete relaxation as during sleep. Whether the metabolism of other organs is also diminished during sleep has not yet been ascertained. It is known, however, that all digestive processes, such as the secretion of the digestive juices, the movements of the gastro-intestinal tract and the absorption of food substances, proceed in a normal manner; but these functions are not so intimately dependent on the central nervous system as are those of the skeletal muscles.

Under normal conditions in the state of wakefulness, the regulatory functions of the nervous system are so delicately adjusted that they tend, by various mechanisms, to counteract any violent changes in the internal conditions of the body which would otherwise be caused by changes in the environment. A large number of the mechanisms involved in this "self preservation" of the organism are dependent on the proper functioning of the central nervous system, and in sleep, on account of the depression of this system, the compensatory activities of the organism are not at such a high pitch of efficiency as in wakefulness.

Temperature.—The temperature regulation is less efficient: the diminished production of heat is not completely compensated by a diminution of heat loss, and the temperature of the organism falls. Thus, exposure to cold may lead to a considerably greater change of body temperature in sleep than otherwise. This relatively greater cooling of the organism may probably start some time before actual sleep has commenced. This may be the cause of the subjective feelings of cold if sleep is delayed. It is well known that the temperature of man exhibits daily fluctuations; it is usually highest about 5 to 7 P.M. and falls during the night, reaching the lowest point early in the morning. These variations in temperature may amount to a degree or more Centigrade. They have been shown to be independent of the cosmic phenomena of day and night, and directly related to sleep and wakefulness. The most conclusive proof of this is that the temperature of people who work during the night and sleep during the day also falls during the periods of sleep, the highest temperature occurring at night which is, in these cases the period of greatest activity. The regulation of temperature is to a large extent due to muscular activity, and since this is depressed during sleep, the regulation of temperature is not at all adequate during periods of sleep. This compels us to seek warmer covering during sleep, while animals try to diminish their exposed surfaces by curling up, etc. Conversely, the animal is to a large extent hindered from falling asleep by any conditions which provoke an increase in metabolism, exposure to cold being one of them.

Respiration.—The respiration during sleep becomes slower and deeper. It is reported that it becomes predominantly costal, the diaphragmatic contractions becoming considerably weaker than they are normally. Often the respiratory movements become periodical in character, tending to rise and fall in strength. The depression of respiration is such that, although the production of carbon dioxide in sleep is considerably smaller, the concentration of carbon dioxide in the alveolar air is unmistakably increased. A similar increase during the wakeful state would cause an immediate augmentation of the respiratory activity. The nitrogen elimination remains unchanged, which means that the protein metabolism is not affected.

Heart Action.—The heart rate during sleep is slower, but it is not known whether this is due to an increased tone of the cardioinhibitory nerves, or to a diminished tone of the accelerator nerves. The vasomotor centre is also depressed, as the result of which the peripheral blood vessels dilate and the arterial blood pressure declines. The cutaneous blood vessels largely participate in this vasodilation so that in some cases pulsation of the veins can be observed during sleep. The blood pressure in very deep sleep exhibits little fluctuation, except for the usual respiratory variations, but in sleep which is not profound changes in the blood pressure have been observed which may exceed those which occur during ordinary resting conditions. The nature of these fluctuations is not clear. They may occur spontaneously and may possibly be dependent on the nervous activities associated with dreams. Interesting experiments were carried out on the volume occupied by a man's arm during sleep. It was found that the arm increased in volume on account of vasodilation. After the maximum dilation is reached, the arm remains more or less of the

same volume for a certain period, or else the volume diminishes very gradually. Shortly before the awakening, the arm begins to diminish more rapidly in size, doubtless owing to the contraction of its blood vessels. At the time of waking, it has practically the same volume as it had at the beginning of sleep. On account of dilation of the peripheral blood vessels during sleep, there is a considerable redistribution of blood; less blood is now available for the brain, and possibly less for some other internal organs.

Brain Circulation.—The state of the circulation of the brain has frequently been investigated. It has been observed that during sleep the surface of the exposed brain becomes pale (Johann Blumenbach 1752–1840). A careful research was conducted by A. E. Durham in 1860, in which he trephined a portion of bone in the parietal region of a dog and inserted a watch-glass in the opening to prevent the effects of atmospheric pressure. He found that during sleep the brain is relatively more anaemic. Other experiments confirmed these observations, and Mosso (1881) extended the experiments to man. He made observations on three persons who had lost a portion of the cranial vault, and in whom there was a soft pulsating cicatrix. The subjects were a woman of thirty seven years of age, a man of thirty seven years of age, and a child of about twelve years. By special arrangements, Mosso took simultaneous tracings of the pulse at the wrist, of the beat of the heart, of the movements of the wall of the chest in respiration, and of the movements of the denuded brain. Further, he obtained tracings showing changes in the volume of the hand and forearm; and he succeeded in showing that during sleep there is a diminished amount of blood in the brain, and at the same time an increased amount in the extremities. The blood flow through the retina is also diminished during sleep. The apparent explanation of the cerebral anaemia during sleep is that the blood vessels of the body dilate, and therefore receive more blood, while a smaller amount flows to the brain; it is not due to an active constriction of the cerebral blood vessels. Whilst muscular relaxation is general, there seems to be an increased contraction of certain sphincter muscles, such as the circular fibres of the iris and the fibres concerned in closing the eyelids; the pupils of the eyes are contracted and the eyeballs are rotated upwards.

Effect of Sensory Stimuli.—All kinds of stimuli may affect the sleeping individual and produce certain physiological effects without awakening him; they may cause movements, changes in respiration, dilation of the pupil, considerable changes in the cardiovascular system, and also they may provoke dreams. Measurements of the volume of a limb show that, during the application of various stimuli, the limb diminishes in volume more or less in proportion to the intensity of the stimulus. The probable explanation of this is that the sensory stimuli act reflexly upon the vasomotor centre in the medulla, and in this way cause contraction of the blood vessels. Thus Mosso found that a strong stimulus to the skin or to a sense organ—but not strong enough to awaken the sleeper—caused a contraction of the vessels of the forearm, an increase of blood pressure, and an increased flow of blood towards the brain. So sensitive is the whole organism in this respect, even during sleep, that a loudly spoken word, a sound, a touch, the action of light or any moderate sensory impression modified the rhythm of respiration, determined a contraction of the vessels of the forearm, increased the general pressure of the blood, caused an increased flow to the brain, and quickened the frequency of the beats of the heart. These observations show how a physiological explanation can be suggested of the influence of external impressions in modifying the dreams of a sleeper. Further, Mosso found that during very profound sleep these oscillations disappear: the pulsatory movements are uniform and are not affected by sensory impressions, and probably this condition exists when there is the unconsciousness of a "dead" sleep.

The Intensity of Sleep.—The intensity of sleep has been measured by the intensity of sound necessary to awaken the sleeper. Kohlschütter used for this purpose a pendulum falling against a metal plate. At intervals of half an hour during the period of sleep, the auditory stimuli produced in this way were increased in intensity until waking was caused. According to these observations, the greatest intensity is reached about an hour after the beginning of sleep. From the second or third hour onwards, the depth of sleep is very slight, the activities of the brain being just below the threshold of alertness. The period from the third hour to the moment of spontaneous awakening is, presumably, as important for the restoration of the brain to its normal waking condition as the deeper period of the first two–three hours. The recuperative power of sleep, therefore, does not appear to be proportional to its intensity. The change in the intensity of sleep varies greatly in different individuals. In many, especially in children, there is a second period of slightly increased intensity of sleep between the fourth and fifth hour. In children of four years with a normal period of sleep of about twelve hours, there is a marked increase in intensity about an hour before the awakening.

Theories of Sleep.—Confining ourselves to the more recent attempts to explain the cause of sleep, we have the following:

1. *The Accumulation of the Acid Products of Metabolism.*—It has been suggested that this accumulation took place during the period of activity and led to a diminution of the irritability of the central nervous system.

2. *Consumption of the Intramolecular Oxygen.*—According to this theory, the cells are able to store oxygen (intramolecular oxygen), which is used during activity more rapidly than it is formed, thus causing a state of partial anoxaemia. During sleep the intramolecular oxygen, that is the oxygen which is combined with the protoplasm to form the irritable living matter, is again replenished.

3. *Toxin Theory.*—It has been supposed that a special toxin, which might be called hypnotoxin, is formed during the waking hours and finally accumulates to such an extent that it diminishes the irritability of the central nervous system.

4. *Neuron Theory.*—This theory explains sleep as due to a temporary retraction of the dendrite processes of nerve cells which leads to a disruption of the continuity of the nerve paths in the central nervous system. All these theories have now been practically abandoned for lack of direct experimental evidence.

5. *Inhibitory Theory.*—During recent years a vast amount of experimental material relating to the genesis and intimate nature of sleep has been brought forward by Pavlov. Together with his co-workers, Pavlov has studied in animals reflexes which involve the co-operation of the higher nervous centres, *i.e.*, of the cortex of the hemispheres. For a description of this important branch of physiology, the reader is referred to the section on Brain and to original treatises.

Conditioned reflexes are based on the associative function of the brain. To give a simple example: if the feeding of an animal is repeatedly accompanied by some stimulus, *e.g.*, a note or other sound, some visual, olfactory, tactile or in fact any stimulus whatever, it is observed that when the stimulus is applied alone it evokes the same effect as feeding, namely the appropriate muscular and secretory responses. The magnitude of these responses depends on many conditions, one of which is the intensity of the accompanying stimulus. A strong sound, after it has been associated with feeding, when applied alone evokes a stronger secretory and motor response than does a subdued sound under the same conditions. Conditioned reflexes have been successfully employed for the purpose of determining the scope of various perceptions of animals, for instance the upper and lower limits of audition, colour vision, etc., and also for the determination of the precision in discrimination between closely resembling stimuli. If, for instance, one note is always accompanied by feeding while another is not, it will be found that only the first note will evoke the reflex. The second will have no visible effect.

Further studies however have shown that these apparently ineffective stimuli actually produce a considerable inhibition of that part of the brain on which they act. This state of inhibition lasts for some time and is of a measurable intensity. The transition of the cortex into an inhibitory state is very rapid in the case of conditioned stimuli which are not associated with some definite activity of the animal, and the inhibition is very profound. This inhibition remains as an after-effect and readily undergoes summation with the effect of any other inhibitory stimuli which may chance to affect the brain. The inhibition in these cases not only

becomes more intense but it also begins to involve other areas of the brain, areas which were not affected in the first instance but which now lose their excitability on account of this spreading inhibitory influence; on stimulation of these areas with appropriate conditioned stimuli, they give either no reflex effect or a greatly diminished one. A great number of conditions are known in which various conditioned stimuli acquire inhibitory properties and which on administration set up a state of diminished excitability and inhibition in the brain. On repetition of these inhibitory stimuli, a stage is reached when no conditioned reflex response can be obtained.

Such a state of widely spread inhibition is easily produced and is the common and everyday occurrence of sleep. The fundamental condition for the appearance and development of inhibition which is localised in some definite part of the brain is exactly the same as that of sleep. From the point of view of conditioned reflexes, the brain is never active as a whole. Areas of inhibition are intermixed with areas of excitation, and these always antagonise the tendency of the inhibition to spread over the whole brain. Even when the inhibition has attained a mastery over the brain, there may always remain areas which will be in an excitatory state, which is however not strong enough to keep the animal in a state of alertness.

Thus sleep is nothing but a state of inhibition which is always present in some areas of the brain, but which has now become diffused continuously (with practically no intervening fields of excitation) over the entire cortex and which has descended also to some of the lower parts of the brain. The development of inhibition is very rapid in the case of conditioned stimuli which do not lead to some activity; it must however be considered as only a special instance of a more general case, since a state of inhibition can also develop when the stimuli are associated with and followed by the respective activity.

Inhibitory Theory Considered.—The details of the experimental results obtained and of our normal everyday existence are in full agreement with the foregoing interpretation of sleep. Our daily work, for some a round of exceeding monotony and for others extremely rich and varied, in either case must in the end determine an appearance of sleep. A prolonged stimulation of one and the same point in the cortex by a conditioned stimulus ultimately leads to a great and profound inhibition, and this irradiates so as to involve the whole cortex and the lower parts of the brain. In the case of a varied activity, although no given point of the cortex attains such a profound depth of inhibition, yet the great number of inhibitory points leads to a widely distributed inhibitory state even without an intensive irradiation, and this also descends to affect some of the lower centres of the brain. A great number of quickly changing stimuli following in succession and leading to some activity of the animal may often exert a very prolonged and powerful resistance to the general dissemination of inhibition, thus delaying the onset of sleep. A well-established rhythm in the changes from wakefulness to sleep may facilitate this wide-spreading of the inhibition leading to sleep.

Since, as we know, the spread of inhibition is a gradual process, involving first a smaller and then a greater area, we should expect to find various transition stages between the fully alert state and complete sleep. Such transition stages actually exist, and they have been studied in considerable detail by observing the conditioned reflexes of the animal. Sleep in animals often exhibits the following peculiar form. As in fully developed sleep, the activity of the hemispheres is absent, all conditioned stimuli remain without effect, and different extraneous stimuli, unless exceptionally powerful, fail to evoke any reaction. Nevertheless the animal preserves an entirely alert posture; it stands with wide-open eyes, head up, extremities extended, not seeking support; sometimes it remains motionless for minutes and sometimes for hours. On changing the position of an extremity, the extremity retains the new position. Presentation of food gives no reaction, and the animal continues to remain still. As the result of careful observations of man and animals, it may be said that this transition state from the alert state to sleep is always present before the development of complete sleep, though only in a fleeting form.

A similar demarcation of excitable areas which have undergone complete inhibition may exist also between different large areas of the cortex itself, producing what may be called localised sleep. This form is frequently seen and can be produced experimentally. For instance, secretory activities may be present and of normal magnitude, while all motor activities are already inhibited. The inhibition in such a case must have spread over the motor area of the cortex so that the excitation induced by the conditioned stimulus could reach the glands but not the muscles. The above observations demonstrate that the extent of the spread of the diffused inhibition in the brain may be small or great, and that there may exist different transition stages in the depth of the inhibition or, in other words, different intensities of the diffused inhibition, sleep. Bearing in mind the fact that in alertness the strength of the conditioned reflex is determined, *ceteris paribus*, by the strength of the stimulus, we can proceed to study with some degrees of definiteness the different stages through which the diffused inhibition develops.

On measuring the strength of conditioned reflexes during the period of spontaneously developing or experimentally induced sleep, it is found that, before conditioned reflexes disappear altogether, they pass through a variety of stages in which the normal relation between the strength of response and the strength of stimulus is altered in some way. There is, for instance, a phase in which the animal responds to all conditioned stimuli, whether strong or weak, but the usually weak responses become somewhat stronger, and the strong ones become somewhat weaker. Reflexes which showed differences of about 100% in strength are now equalised. This phase is known as the phase of equalisation. With further development of sleep, it is found that the weak stimuli produce a definitely greater response (in some cases 100% greater) than the strong stimuli. This phase is known as the paradoxical phase. Finally, with a still further intensification of sleep, all conditioned reflexes vanish completely, and this is followed sooner or later by the relaxation of the muscles and the development of complete sleep. The process of awakening seems to go through the same stages.

Other changes in strength of conditioned reflexes have been observed. The question whether they can be arranged in a definite order, and if so in what order, must remain entirely open for the present. All these different states of activity of the hemispheres bear a strong resemblance to the different stages of what is generally known as hypnotism, which from the point of view of conditioned reflexes is merely a transition stage between alertness and complete sleep, a stage of a greater or less extent and a greater or less intensity of sleep. Inhibition or localised sleep is a phenomenon always present, under whatever conditions the animal or man may be. The state of alertness is only an expression of a predominance of excitation, while sleep is due to a predominance of inhibition. (G. An.)

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SLEEPER. A term used with many technical applications for a piece of timber, metal, etc., used as a support; in carpentry it is such a piece of timber laid on low cross walls as a plate to receive ground joists; in shipbuilding, a strengthening timber for the bows and stern frame. The most frequent use of the term is for a timber or steel support on which the chairs are fixed for carrying the rails on a railway; in America these are more commonly called "ties" (*see* Railways). It is an error to derive the word from "sleep." Its real source is the Norwegian *sleip*, meaning a roller or timber laid along a road. This word Skeat (*Etymol. Dict.*, 1898) connects with "slab." The French term *dormant* which is equivalent to "sleeper," is used for a part of the frame of a window or door which cannot be opened.

Sleeper is also used as an abbreviation for sleeping car.

SLEEPING-SICKNESS (*Trypanosomiasis*), a parasitic disease, familiar among West African natives since the beginning of the 19th century, and characterized by protracted lethargy, fever and wasting. It is caused by the *Trypanosoma gambiense,* a parasite which was discovered in the frog by Gruby in 1847, and in 1880 by Griffith Evans in horses afflicted with the disease called "surra" in India. In 1895 Surgeon-Major (afterwards Sir) D. Bruce found a trypanosoma similar to Evans's in cases of what was known in cattle as "tsetse-fly disease"; and though the trypanosoma had not then actually been found in man, Bruce suggested that this was akin to the human "sleeping-sickness" which had now extended into the Congo Free State, Uganda and elsewhere, and was causing great mortality, many Europeans having died of the disease. In 1903 Castellani found the trypanosoma in the cerebro-spinal fluid of human patients afflicted with the disease. The pathology of "sleeping-sickness" was vigorously taken up, and in June 1907 an international conference was held in London to organise research.

The problems were: (1) to determine whether the tsetse fly (*glossina palpalis*) was a direct or indirect conveyor of the parasite; (2) whether the parasite underwent necessary developmental changes in the tsetse fly; (3) if so, whether the developed germs were conveyed by the original fly or its larva when arrived at the imago stage; (4) how long an infected *glossina palpalis* remained infected; (5) whether other species of *glossina* were concerned; (6) the geographical distribution and habits of the fly; (7) whether and how far the spread of infection was the work of any of the vertebrate fauna (other than man); (8) to suggest preventive methods for exterminating the *glossina,* or protecting uninfected districts by segregation or otherwise; (9) to study the therapeutics of the disease.

Transmission of Infection.—It was at first believed that the transmission of *Trypanosoma gambiense* by the tsetse fly, *Glossina palpalis,* was direct or mechanical, and that a fly lost its power of infecting 24–48 hours after feeding on an infected man. Kleine (1909) showed that this is not the case. In a certain percentage of flies the germs ingested with the blood do not die but multiply exceedingly in the fly's gut, change in form, come forward and at last invade the salivary glands, where they resume their blood form. Modern treatment is by injection of organic arsenical compounds (atoxyl and arsacetin) or of tartar emetic, a salt of antimony.

During the process, which occupies 14–28 days or more, the fly is not infective, but when the germs are established in the salivary glands it regains its infectivity and may retain it for a long period, for at each feed germs are poured into the puncture. Unless the salivary glands contain the germs a fly is not capable of infecting, but only in a small proportion is this development completed; in nature the proportion of infected flies rarely exceeds one in 1,000. Conveyance is therefore indirect. Direct infection may occur in nature, but the failure of the disease to spread in the absence of tsetse, even though biting insects of many kinds are present, seems to show it must be rare, *e.g.,* hundreds of cases of sleeping-sickness were recorded in the West Indies among slaves brought from Africa, but there is no recorded instance of spread in the New World. The disease was formerly rife in the island of Principe in the Gulf of Guinea, where *G. palpalis* abounded, but no cases occurred in the neighbouring island of San Thomé, with the same insect fauna, but, like America, with no tsetse. Duke believes that when the disease is epidemic direct infection is the rule. There is no evidence that the fly can transmit the germs to its offspring. The fly has been shown to be capable of infecting for at least 96 days.

Other species of *Glossina, e.g., G. morsitans* and *G. tachinoides,* become similarly infected. But some species rarely attack man.

Trypanosoma Rhodesiense.—In 1909 a second species of trypanosome was discovered in a case of human infection from Rhodesia and called *T. rhodesiense.* It is found in areas infested not by *G. palpalis* but by *G. morsitans,* and was shown by Kinghorn and Yorke (1911) to be conveyed by this species and to undergo in it a similar development. *T. rhodesiense* infections are found in Nyasaland, Portuguese East Africa and Tanganyika Territory, besides northern Rhodesia, and, rarely, south of the Zambezi river. *T. rhodesiense* cannot be distinguished from *T. gambiense* by its appearance in human blood; after inoculation into animals microscopical differences can be detected; since such inoculations are rarely made it may be more often the cause of sleeping-sickness than is believed: its carrier is widely distributed. Indeed, a few cases have been found as far north as the Anglo-Egyptian Sudan; and near Mwanza, south of Lake Victoria, a small epidemic occurred in 1922, conveyed by a tsetse akin to *G. morsitans.* This type of human trypanosomiasis is rarely epidemic; cases occur in sporadic fashion. It is more acute and more rapidly fatal than the *T. gambiense* variety, and is more resistant to drugs. Whether or not *T. rhodesiense* is identical with *T. brucei* the parasite of *nagana,* first described by Bruce in Zululand (1893), is undecided. Bruce and Yorke consider them to be the same; Kleine makes a distinction. They cannot be separated by their appearance under the microscope, the symptoms and course of the illness produced in animals, or the manner and site of development in the tsetse. Both complete their development in the salivary glands.

T. brucei and *T. rhodesiense* are found in big game, especially waterbuck, bushbuck, reedbuck, haartebeest, on which *G. morsitans* feeds. These animals are, therefore, reservoirs of germs capable of infecting man, and much discussion has taken place as to the rôle played by big game in the spread of *T. rhodesiense,* some claiming that the passage of the parasite is game, fly, man; others that it is man, fly, man. The point is still undecided.

An experiment was made in East Africa during the World War in which blood was taken from transport animals infected with *T. brucei* and inoculated by Taute into himself, his colleague Huber and 127 natives. Though animals inoculated at the same time always became infected there was no single instance of infection in man. They concluded that man is immune to infection by *T. brucei.* This striking experiment, however, does not convince those who believe man to be susceptible but very resistant of *T. gambiense,* it is generally agreed that infected man is the chief reservoir of infection, though Bruce (1911) found that antelopes can be infected with this trypanosome by allowing infected *palpalis* to feed upon them, and they continue to harbour the trypanosomes in their blood for many months.

Treatment.—Sleeping-sickness is now treated by compounds of arsenic, especially *atoxyl* and *tryparsamide,* the latter a product of the Rockefeller Institute; by compounds of antimony, as tartar emetic; and by a drug of undisclosed composition called Bayer 205, or Germanin. The French and Belgians use *atoxyl* largely in the African villages, where doses are injected at the proper intervals by trained natives. A high degree of success is claimed, both curative and preventive, in that the blood is kept free from germs which might be taken up by the tsetse. *Antimonials* are used as a rule in conjunction or alternation with arsenicals. *Bayer 205,* first employed in the treatment of man in 1921, has remarkable successes to its credit in Europeans, especially in cases of the Rhodesian type which were refractory to other drugs; unless used with caution it has a harmful effect on the kidneys. It has been less successful in natives, perhaps because infection is usually detected in them at a later stage when the spinal cord and brain are affected, and at this stage treatment nearly always fails. French chemists have prepared the same or a similar drug. *Tryparsamide,* introduced about the same time, appears to be still more potent, and especially in cases in which the nervous system is involved, but it also has a serious effect in that it sometimes affects vision. Though sleeping-sickness in the European is nearly always a fatal disease if left untreated, in the natives of parts of Africa it is very chronic, does not interfere with the patient's activities, and almost certainly may end in natural recovery.

International Conference.—At the suggestion of the League of Nations an International Conference on Sleeping Sickness met in London in 1925. In its recommendations it laid down administrative measures which should be taken on both sides of the frontiers between infected countries for the control of the disease, and advised the dispatch to Uganda of a commis-

sion to study the problem. The commission started work in 1926 and in 1927 issued an interim report. The programme is divided into Epidemeological Studies and Laboratory Work. The conclusions so far are tentative only.

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(A. W. G. B.)

SLEEPY SICKNESS: *see* ENCEPHALITIS LETHARGICA.

SLEET, a precipitation of mixed rain and snow or of partly melted snow. Snow passing through a layer of comparatively warm air may be partly melted and reach the ground in a semi-liquid condition. If the ground is below freezing point, the sleet may become solid ice (*glazed frost*).

SLEIDANUS, JOHANNES (1506–1556), German historian, the annalist of the Reformation, was born at Schleiden, near Aix-la-Chapelle. He studied ancient languages and literatures at Liége and Cologne, and law and jurisprudence at Paris and Orleans. Whilst among the humanists of Liége, he had adopted Protestant opinions, and entering the service of Cardinal du Bellay, was employed in the futile negotiations of the French court to make an alliance with the German Protestants against the emperor Charles V. In 1542 he settled at Strassburg. Sleidanus had been accustomed to copy all papers bearing upon the Reformation to which he had access, and Martin Bucer proposed to Philip of Hesse to appoint him historian of the Reformation, giving him a salary and access to all necessary documents. Sleidanus began his great work, finishing the first volume in 1545. In that year he went to England in a French embassy to Henry VIII. While there he collected materials for his history. On his return he represented Strassburg at the diets of Frankfort and Worms, and went on to Marburg to explore the archives of Philip of Hesse. The war of the league of Schmalkalden interfered with this work, and also prevented the payment of Sleidanus, who received a yearly pension from Edward VI. In 1551 Sleidanus represented Strassburg at the council of Trent, being charged to act also for the imperial cities of Esslingen, Ravensburg, Reutlingen, Biberach and Lindau. He was afterwards appointed professor of law in Strassburg, and finished his great task in 1554, though lack of money and other misfortunes compelled him to delay printing. Sleidanus died in poverty at Strassburg in October 1556. The book appeared in the preceding year—*Commentariorum de statu religionis et reipublicae, Carolo V. Caesare, libri XXVI.;* it was translated into English by John Daws in 1560 and by G. Bohum in 1689. It was so impartial that it pleased no one, not even Melanchthon. It remains the most valuable contemporary history of the times of the Reformation, and contains the largest collection of important documents.

See H. Baumgarten, *Über Sleidanus Leben und Briefwechsel* (1878), and *Sleidans Briefwechsel* (1881); and A. Hasenclever, *Sleidan-Studien* (Bonn. 1905).

SLEIGH, SLED or **SLEDGE,** a vehicle on runners instead of wheels, for travelling over snow or ice. The sleighs used in COASTING are referred to in the article under that heading; but for ordinary means of conveyance horse-drawn sleighs are employed as carriages in countries such as Russia, Scandinavia and North America. In the Arctic regions dogs are harnessed to them.

SLEZSKÁ OSTRAVA, a town in Silesia, Czechoslovakia, lies near Moravská Ostrava (*q.v.*) on the Ostrava-Karvinná coal-field, and is a colliery town. Pop. (1921), 22,890.

SLIDELL, JOHN (1793–1871), American diplomatist, was born in New York in 1793. He graduated from Columbia college in 1810, studied law, and practised at New Orleans, La., where he settled in 1825. He belonged to the House of Representatives as a state's rights Democrat from 1843 to 1845, when he resigned and was sent by President Polk on a secret mission to Mexico, with power to adjust the difficulties growing out of the annexation of Texas to the United States, and to acquire by purchase both New Mexico (including the present Arizona) and Upper California. He was not, however, received by the Mexican government. From 1853 to 1861 he represented Louisiana in the Senate. He is supposed to have assisted Buchanan's nomination for the presidency in 1856. When Louisiana seceded in 1861, Slidell withdrew from the Senate, and late in 1861 was sent by the Confederate Government as commissioner to France. With James M. Mason (*q.v.*), the Confederate commissioner to England, he was taken from the British steamer "Trent" by Captain Charles Wilkes of the United States navy, and was imprisoned at Fort Warren in Boston harbour. In Jan., 1862, at the demand of England, the Confederate commissioners were released, and Slidell proceeded to France. His mission there was to secure the recognition of the Confederate States; in this he was unsuccessful, but he was able to secure supplies for the Confederate army and navy. After the war he settled in England, and his daughter married a French nobleman. He died in London on July 29, 1871.

See Samuel Abbott Green, *James Murray Mason and John Slidell in Fort Warren, Boston Harbor* (1912); Louis Martin Sears, "A Confederate Diplomat at the Court of Napoleon III.," in *American Historical Review*, vol. xxvi. p. 255–281 (1921); and Louis Martin Sears, *John Slidell* (1925).

SLIDE RULE, a rule consisting of graduated scales capable of relative movement, by means of which simple calculations may be carried out mechanically. In ordinary slide rules these operations include multiplication, division and extraction of square roots, as well as, in some cases, calculation of trigonometrical functions and logarithms. It is an instrument much used by engineers. (*See* CALCULATING MACHINES, MATHEMATICAL INSTRUMENTS.)

SLIGO, a county of Ireland in the province of Connaught. The area is 452,356 acres or about 707 sq.m. Pop. (1926) 71,393. The coast-line is very irregular, the principal inlets being Killala Bay and Sligo Bay. Among the islands are Inishmurray and Coney. In the north are the limestone elevations of Ben Bulbin (1,712 ft.) and Knocknarea (1,078), contrasting with the adjacent rugged gneiss mountains, among which are King's Mountain (1,527) and Gullogherboy (1,430). On the boundary with Leitrim, Truskmore reaches a height of 2,113 ft. In the west are the ranges of the Slieve Gamph and Ox Mountains, upwards of 1,300 and 1,600 ft. respectively. The Curlew Mountains, an abrupt ridge of limestone gravel, upwards of 800 ft. in height, with flattened summit, separate Sligo from Roscommon. The principal rivers are the Moy, flowing into Killala Bay; the Easky, flowing northward from Lough Easky; the Ballysadare; and the Garvogue, or Garavogue. Lough Gill (extending into Leitrim), Lough Arrow and Lough Gara exceed 3,000 acres in extent. The salmon, sea-trout and trout fishing are excellent.

The county was created by Sir Henry Sydney in 1579. At Drumcliffe (5 m. N. of Sligo) are the only round tower remaining in the county and a Celtic cross 13 ft. in height. The principal monastic ruins are the abbey of St. Fechan at Ballysadare, with a church of the 11th or 12th century; the abbey of Sligo; and a group of buildings on the island Inishmurray, which include a cashel or walled enclosure; three oratories; two holy wells; and also altars, pillar stones, inscribed slabs (one of which has an inscription partly in Latin), and several examples of beehive cells. This settlement is associated with Molaise, a saint of the early 6th century (not identical with the Molaise of Devenish in Loch Erne), and the remains still attract pilgrims.

In some parts the soil is a light sandy loam resting on a free-stone bottom, and in the lower districts a rich and deep mould prevails resting on a substratum of limestone. Owing to the moistness of the climate cattle feeding is found to be the most remunerative method of farming. Oats and potatoes are the principal crops, but the acreage devoted to them decreases. Coarse woollens and linens are manufactured for home consumption, and there are tanneries, distilleries, and breweries in the principal towns. Lead was mined at Ballysadare, and the clay-ironstone from the east of the county was at one time smelted. A considerable general trade is carried on at the ports of Ballina (on the Moy) and Sligo. The fisheries on the coast are valuable, and there are important salmon fisheries at the mouths of the

rivers. The town of Sligo is the chief centre.

The Great Southern lines from Limerick and from Dublin meet at Collooney Junction which is also used by the Sligo, Leitrim and Northern Counties line. The three routes unite in the section from Collooney to Sligo town. From Kilfree on the main Dublin line a branch serves Ballaghaderreen in Co. Mayo. The counties of Leitrim and Sligo together return 7 members to Dáil Eireann.

SLIGO, a seaport and county town of Co. Sligo, Ireland. Pop. (1926) 11,439. It lies on Sligo Bay and the river Garvogue, 134½ m. N.W. from Dublin by the Great Southern railway.

The Dominican Abbey, founded in 1252, was partly destroyed by fire in 1414 and again in 1642. Three sides of the cloisters remain, and the lofty quadrangular tower at the junction of the nave and chancel is entire. The east window is of the date of the original structure. The Roman Catholic cathedral (1869) for the diocese of Elphin is in the Norman style. There is also a Roman Catholic college.

A castle, built by Maurice Fitzgerald in 1242, was in 1270 taken and destroyed by O'Donnel; in 1310 it was rebuilt but was again partly destroyed in 1369 and 1394. Of this and the walls with which the town was fortified there are no remains. Early in the reign of James I. the town received a market and two annual fairs; in 1613 it was incorporated and received the privileges of a borough; and in 1621 it received a charter of the staple. In 1641 it was besieged by the Parliamentary forces, but was afterwards evacuated, and occupied by the Royalists till the termination of the war. In 1688 it declared in favour of James II., and, after being captured by the Enniskilleners, was retaken by General Sarsfield, but ultimately surrendered to the earl of Granard. The borough was disfranchised in 1870.

Three miles S.W. of the town, on Carrowmore, is a remarkable collection of megalithic remains, including dolmens, stone circles, and burial cairns, which has been taken to mark the site of the traditional battle of North Moytura. On Knocknarea (1,078 ft.), south of Sligo, is a cairn, which tradition sets down as the burial-place of Queen Mab (Meave of Connaught).

Sligo takes rank with Galway and Limerick as one of the three principal ports of the west coast of Ireland. A considerable export trade is carried on in grain, flour, pork and cattle; while coals, iron, timber and provisions are imported. There is a depth on the harbour bar of 15 ft. at low water, and there are commodious quays and basins. Vessels of 24 ft. draught have entered the harbour at high water. Harbour commissioners control the port. Brewing, flour-milling and saw-milling are the chief industries, and there is an important butter-market. Monthly fairs are held. Sligo is a centre of salmon and sea-fishing industries.

SLING, an implement for casting missiles, also, a hanging loop to support a wounded limb, a chain with hooks for raising or lowering heavy goods (from M.E. *slingen,* to fling, throw with a jerk, Icel. *slyngva, cf.* Ger. *schlingen,* to twist). The sling is probably the earliest device by which force and range were given to the arm of a thrower of missiles. Sling stones from the stone age are frequent. (*See* ARMS AND ARMOUR.) The type of weapon is of two kinds; the sling proper consists of a small strap or socket of leather or hide to which two cords are attached; the slinger holds the two ends in one hand, whirls the socket and missile rapidly round the head and, loosing one cord sharply, despatches the missile; the other type is the staff sling, in which the sling itself is attached to a short staff, held in both hands. This was used for heavier missiles, especially in siege operations during the middle ages. There are many references to slings and to slingers in the Bible; the left-handed slingers of Benjamin were famous (Judges xx. 16). The Assyrian monuments show the sling of the ordinary type and slingers were used in the ancient Egyptian army, but not before the 8th century B.C. The sling (Gr. σφενδόνη, Lat. *funda*) is not mentioned in Homer; Herodotus (vii. 158) speaks of the slingers in the army offered by Gelon to serve against the Persians; it seems to have been a weapon chiefly used by barbarian troops. The Acarnanians, however, were expert slingers (Thuc. ii. 81), and so also were the Achaeans, who later invented the sling which discharged a shaft with an iron bolt head (Livy xlii. 65, from Polybius). In the Roman army by the time of the Punic wars the slingers (funditores) were auxiliaries from Greece, Syria and Africa. The Balearic islanders, who were in Hannibal's army were always famous as slingers. In mediaeval times the sling was much used in the Frankish army, especially in defending trenches, while the staff-sling was used against fortifications in the 14th century. Till the 17th century, they were used to throw grenades.

SLINGING THE WEIGHT: *see* WEIGHT THROWING.

SLIPWAY. Inclined slipways, on which a vessel, resting in a cradle on wheels, can be drawn out of the water for cleaning or repairs, are used all over the world. In some American ports they are called *marine railways.* The contrivance is also known as a *patent-slip.* When gates and side-walls exclude the water from the upper part of the slipway, the contrivance is called a *slip-dock.* The word *slip* is applied to a paved causeway or *hard,* extending from high water to low tide level, on which small vessels may be hauled without the use of a cradle. *Graving slip* and *graving beach* are old terms for a hard or slip, and a beach on which vessels were placed for examination and graving when the tide receded. On *slips* in shipyards vessels are constructed and launched. The launching ways for lifeboats, over which the boat slides into the water or is hauled up, or with rails over which a launching trolley carrying the boat is run, are termed slipways. In American ports, for instance New York, the water spaces between piers, in which vessels berth, are called *slips* (*see* DOCKS). (N. G. G.)

SLIVEN, a town of southern Bulgaria, 105 m. E.N.E. of Philippopolis, picturesquely situated near the southern entrance of the trans-Balkan defile known as the Iron Gate. Pop. (1926), 29,235. Sliven lies on a branch of the Burgas-Philippopolis railway, and is the chief manufacturing centre in Bulgaria for the rough and fine homespuns known as *aba* and *shayak,* and its wine is locally celebrated. Extensive mulberry orchards have been planted in connection with the silk industry. Sliven, the Stlifanos of the Byzantine writers, was, on account of its strategic importance, frequently disputed in the middle ages between Byzantium and Bulgaria. After its capture by the Turks (1388) it was one of the privileged *voinik* towns (*see* BULGARIA); but these privileges were lost in the 16th century. In 1829 Sliven was occupied by the Russian army under Rudiger and Gorchakov.

SLOANE, SIR HANS (1660–1753), British collector and physician, was born on April 16, 1660, at Killyleagh in County Down, Ireland, where his father had settled at the head of a Scottish colony sent over by James I. He spent four years in the study of medicine in London, and then travelled through France, spending some time at Paris and Montpellier, taking his M.D. degree at the University of Orange in 1683. He returned to London with a considerable collection of plants and other curiosities, of which the former were sent to John Ray and utilized by him for his *History of Plants.* Sloane was elected into the Royal Society, and attracted the notice of Thomas Sydenham, who gave him valuable introductions to practice. In 1687 he went to Jamaica as physician in the suite of the duke of Albemarle. The duke died soon after landing, and Sloane's visit lasted only fifteen months; but during that time he got together about 800 new species of plants, the island being virgin ground to the botanist. Of these he published an elaborate catalogue in Latin in 1696; and at a later date (1707–25) he added two folio volumes. He became secretary to the Royal Society in 1693, and edited the *Philosophical Transactions* for 20 years.

In 1716 Sloane was created a baronet, being the first medical practitioner to receive an hereditary title, and in 1719 he became president of the College of Physicians, holding the office 16 years. In 1722 he was appointed physician-general to the army, and in 1727 first physician to George II. In 1727 also he succeeded Sir Isaac Newton in the presidential chair of the Royal Society; he retired from it at the age of 80. Sloane's memory survives more by his judicious investments than by anything that he contributed to the subject-matter of natural science or even of his own profession. His purchase of the manor of Chelsea in 1712 has perpetuated his memory in the name of a "place," a street and a

square. His great stroke as a collector was to acquire (by bequest, conditional on paying off certain debts) in 1701 the cabinet of William Courten, who had made collecting the business of his life. When Sloane retired from active work in 1741 his library and cabinet of curiosities, which he took with him from Bloomsbury to his house in Chelsea, had grown to be of unique value. On his death on Jan. 11, 1753, he bequeathed his books, manuscripts, prints, drawings, pictures, medals, coins, seals, cameos, and other curiosities to the nation, on condition that parliament should pay to his executors £20,000, which was a good deal less than the value of the collection. The bequest was accepted on those terms, and went to form the collection which was opened to the public at Bloomsbury as the British Museum in 1759 (*see* MUSEUMS). Among his other acts of munificence was his gift to the Apothecaries' Company of the botanical or physic garden, which they had rented from the Chelsea estate since 1673.

See Weld, *History of the Royal Society*, i. 450 (1848); and Munk, *Roll of the College of Physicians*, 2nd ed. i. 466 (1878).

SLOCUM, HENRY WARNER (1827–1894), American general, was born at Delphi, N.Y., on Sept. 24, 1827, and graduated at the U.S. Military Academy in 1852. When the Civil War broke out he became colonel of the 27th New York Volunteers, and was promoted major-general of volunteers (July 1862). He fought in all the Virginia campaigns from the first battle of Bull Run to Gettysburg, where he commanded the 12th Corps. With that corps he was transferred to the Tennessee valley, and took part in the battle of Chattanooga, and the Atlanta campaign, and succeeded to the command of the 20th Corps (late 11th and 12th). He resigned from the army in Sept. 1865, and was a Democratic representative in Congress in 1869–73 and again in 1883–85. He died at Brooklyn on April 14, 1894 where a monument to him by Frederick MacMonnies was unveiled, on May 30, 1905.

SLONIM, a small town of Poland, in the province of Nowogródek, 155 m. by rail S.E. of the city of Grodno and 20 m. from the railway from Moscow to Warsaw, on the high craggy banks of the Shchara. It derives its importance from the river, which is navigable and joins the Oginski canal, connecting the Niemen with the Dnieper.

SLOOP, a type of small sailing-vessels which have one mast rigged "fore and aft," carrying a mainsail, gaff-topsail, jib and fore staysail. There is little in rig to distinguish a sloop from a "cutter," and the terms are used indiscriminately; sometimes a distinction is drawn by a sloop having a fixed and a cutter a running bowsprit. In the sailing and early steam days of naval warfare, a "sloop" was a small corvette, ship-rigged, with all the guns mounted on the upper deck.

SLOTH, the name for a group of arboreal tropical American mammals belonging to the order Edentata (*q.v.*). Sloths are completely arboreal, living among the branches of trees, hanging beneath them, back downwards, and clinging with the hook-like organs to which the terminations of their limbs are reduced. When obliged to descend to the ground, which they rarely, if ever, do voluntarily, sloths (owing to the unequal length of their limbs and the peculiar conformation of their feet) crawl along a level surface with considerable difficulty. Though generally slow and inactive, they can on occasions travel with considerable rapidity along the branches, availing themselves of the swaying of the boughs by the wind to cross the larger gaps. They feed on leaves and young shoots and fruits. Sloths are nocturnal, silent and solitary animals, and produce but one young at birth. They show an almost reptilian tenacity of life. Sloths fall into two families, the Choloepidae, including only the unaus (*Choloepus*), with two functional toes on the fore-foot and three on the hind, and six or seven neck vertebrae; and the Bradypodidae (*Ai*), comprising the genera *Bradypus* and *Scaeopus*, with three functional toes on each foot and nine neck vertebrae. Sloths are remarkable in being the only mammals which do not invariably have seven neck vertebrae. Several other animals, such as the African potto-lemurs, and the Asiatic lorises, are popularly called sloths.

THE AI OR THREE-TOED SLOTH

SLOTTING MACHINES: *see* PLANING MACHINES.

SLOUGH, a market town in the Wycombe parliamentary division of Buckinghamshire, England, 18 m. W. of London by the Great Western railway and on a branch of the Grand Junction canal. Pop. of urban district (1931) 33,530.

SLOVAKIA, a province of Czechoslovakia covering an area of 18,895 sq.m., is largely mountainous territory within the western Carpathians but at its western and eastern ends encroaches upon the plains of the Morava-Danube and Tisa respectively. The mountain masses fall into four groups separated by lines of valleys and basins. From north to south these groups are, (1) the encircling arc, convex to the north, stretching from Devin on the Danube by the Little Carpathians, White Carpathians, West and East Beskids, to the Slovakia-Ruthenia frontier, (2) the ranges of Galgoc, Little Fatra and the High Tatra, (3) the Nitra, Great Fatra and Little Tatra groups and (4) the ranges and detached masses belonging to the Slovakian Ore Mts. (Slovenské Rudohoři). The outer girdle, composed of the sands and marls of the *flysch* formation, is the most continuous. Like the whole highland zone it shows a great variety of climates according to altitude and aspect and the only permissible generalisation is that conditions harden eastward. Human life in this zone is scattered and semi-nomadic concerned with forestry and shepherding on the slopes with small permanent settlements in the valleys. The central buttress of this arch is the High Tatra (*q.v.*) which overlooks southward the valley of the Váh; this is the major river of the highlands. Rising in the basin of Liptov on the northern flank of the Little Tatra it flows west through the basin of Turč and breaks across the Little Fatra and just beyond Žilina turns south to join the Danube at the port of Komárno. Adjoining the basin of Liptov is that of Spiš with the headwaters of the Hernad, another important route leading east and south to the Tisa. Parallel to the Váh the Hron separates groups (3) and (4) and supplies another highway to the Danube, important, but not comparable with the great Váh-Hernad corridor.

The inner groups of highland consist of a complex of crystalline rocks and altered Mesozoic limestones, highly folded and fractured and rich in ores and thermal springs. Each of the intermontane basins is settled and possesses industries based upon local supplies of raw material, *e.g.*, the working of flax, wool, wood and iron and the manufacture of pulp and glassware. Small supplies of lignite are obtained from Baňska Bystrica but the lack of coal is a disadvantage that is gradually being overcome by utilisation of the vast resources of water power. Where, as in the region of the middle Hron, volcanic outcrops give a softer tone to the landscape the cultivation of flax, hemp, fruit, rye and oats, with vine on the suitable slopes, assumes greater importance while from this district, once renowned for gold, silver and copper, certain ores are still obtained, *e.g.*, silver, manganese, antimony and iron. Baňska Štiavnica and Kremnica are the chief mining centres. In addition to industries mentioned there is widespread home-weaving and wood-carving, for commercial purposes, in the wooden houses of the highlands. Žilina and Košice are respectively the western and eastern centres of general trade. These are joined by railway, and are important junctions, the former for routes to Moravia, the Danube and via the Jablunka Pass to Silesia, the latter for routes to Hungary and Ruthenia. Apart from this main artery communication is poor, particularly between east and west, except in localised areas, *e.g.*, the High Tatra where small spas have been developed. Prešov in the Hernad valley, and Liptovský Svätý Mikulaš, the lumbering centre, are also important market towns.

The plainlands are part of the three great tectonic basins of Central Europe and approximate to them in general aspects. Gulfs of lowland stretch into the mountain zone along the courses of the Morava, Váh, Nitra, Hron, Hernad, Ondava and Laborce, with a narrow fringe of Tertiary and Recent deposits connecting them. The lowland is divisible into two parts, a western draining to the Danube, and an eastern to the Tisa. The former is a

fertile cereal zone passing through vineyards and orchards to upland pastures and gravitating towards Bratislava and Komárno. There a mild climate permits maize, wheat, barley, rye, fruit, wine, tobacco and sugar-beet in addition to the raising of cattle, horses and poultry. Brewing, milling, sugar-refining, tanning and the preparation of tobacco are the principal industries and they focus in Bratislava and its neighbourhood. The towns are pre-eminently cereal and cattle markets. Bratislava leads, but Sered is an important centre for timber trade, while the Váh valley, leading to the coal resources of Silesia, is a primary trade route.

Slovakia lags far behind the "Austrian" provinces of Czechoslovakia because for centuries it suffered neglect during the Hungarian hegemony. Transport and trade were centred upon Budapest and, though the province still looks in part to this city and the Danube for its natural markets, readjustment of outlook is slow but sure, and the Danube route between Bratislava and Parkáň gathers more and more of the trade while Prague gradually reasserts its traditional cultural and political leadership as communications improve and as the isolation of the highland, with its accompanying drag of primitive customs, traditions and costumes, is gradually overcome. Bratislava is the capital, the seat of a High Court of Justice and a Slovak University, but Košice fulfils certain similar functions for the eastern half of the province, *e.g.*, through its High Court of Justice. The total population of the province numbers 2,958,557, being about 69% Slovak, 21·5% Magyar, 4·7% German and 2·4% Jewish. The minorities, especially the Magyar, present a grave problem.

See E. Winter, *Die Deutschen in der Slowakei und in Karpathenrussland* (Münster, 1926); *see* also CZECHOSLOVAKIA.

SLOVAK LANGUAGE. The two languages of the Czechoslovak republic, namely Czech and Slovak (for which the combined designation Czechoslovak is in common use), are not identical, either in their literary form or in their dialects, in the same way as are Serb and Croat (to express which the compound Serbo-Croat is appropriately used). Slovak is, however, so closely allied to Czech that most scholars describe it as a dialect, although their view meets with many dissentient voices. In its early stages Czech presents great similarity with the sister language, which has retained with great fidelity the sound system of a past stage in the common development of the two languages, but Czech as written and spoken to-day in Bohemia diverges considerably from Slovak; the dialects spoken in Moravia, however, satisfactorily bridge over the differences, and only speakers of extreme dialects of Slovak are unintelligible to Czechs. The disagreement is least marked in vocabulary but appears prominently in the phonetics; in particular the itacism, so distinct a characteristic of Czech, is non-existent in Slovak, which has preserved the fuller diphthongs (*ia, ie, iu* etc.) of the other Slavonic languages; a further smaller point is that *dz,* from Common Slav *dj,* is used (as in Polish) where Czech has *z.* In one point only is there a divergence which goes back beyond the time of the common ancestry of the two languages; Slovak has not developed the *ř,* which is characteristic of Czech and in that language occurs since the beginning of its literature. The Slovak palatalization of *n, d, t* and *l* after *e,* which does not occur in modern literary Czech, is a further point of disagreement, although this would not be obvious from Slovak spelling which does not find it necessary to distinguish by diacritics consonants which are always softened in this position.

The alphabet is founded on the Czech, the accent is always on the first syllable and long vowels are indicated by acute accents. There are usually reckoned to be three groups of dialects, Western, Central and Eastern; the first being nearest to Czech, the last to Little Russian, while the Central dialects exhibit less decided features. The dialectical development shows some characteristics identical with those in South Slavonic and Russian. Not everywhere, for example, have C.S. *ŭ* and *ĭ* been confused, and instead of the *e,* which is the normal result in Slovak as in Czech, we find in Eastern dialects an *o* from the *ŭ,* thus agreeing with Russian. An agreement with South Slavonic is the occurrence of *raz-* and *la-* as well as *roz-* and *lo-* from C.S. *orz-* and *ol-*. Because of these and other phonetic and morphological reasons the grammarian Czambel, a keen opponent of the identity of Czech and Slovak, has asserted that Slovak should rightly be associated with South Slavonic. His views, which were influenced by considerations not wholly linguistic, have not found general acceptance.

Slovak books were rare before the War, but since the formation of a new and powerful State embracing the Czechs and the Slovaks, Slovak literature, which previously had had only local importance, bids fair to take a worthy place alongside of that of its better known partner. The *Survey of Modern Slovak Literature,* by Š Krčméry, in vol. vii., No. 19, pp. 160–170, of the *Slavonic Review* (London) gives useful literature statistics and a good account of the literature of the present century.

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SLOVAKS, a Slav people mostly living in the eastern part of Czechoslovakia. The Slovaks are not much mixed: they have isolated settlements throughout the western half of Hungary where there is a Slovak minority numbering (1929) 142,000, or 1·8% of the total population. The Slovaks seem to have occupied this territory in the 5th or 6th century A.D. and to have stretched far to the south. They are a race of peasants, living almost exclusively upon the land, which they till after the most primitive methods. Where this does not yield sufficient, they wander as labourers and especially as tinkers even as far as South Russia. They are fond of music, and their songs have been collected.

SLOVENE LANGUAGE. Slovene, the most westerly language of the South Slavonic branch, is quite distinct from Slovak, which is spoken in the Eastern part of Czechoslovakia and belongs to the Western branch. The Slovenes inhabit those districts of Yugoslavia which border on Austria and Italy; the capital of their territory is Ljubljana (German form, Laibach), in the province of Carniola. Outside the borders of Yugoslavia, the language is spoken in the neighbourhood of Trieste, in the villages round Klagenfurt, the capital town of the Austrian province of Carinthia, and by colonists in North America and elsewhere.

Slovene is most closely allied to Serbo-Croat. The Croat dialect round Zagreb, which, like literary Slovene, uses *kaj* for "what," whereas literary Serbo-Croat has *što,* is in this and in other features, phonetic, morphological and lexicographical, a transition speech uniting the extreme ends of the kingdom of the Serbs, Croats and Slovenes. The only traces now left of the linguistic ties which must have once united Slovene with West Slavonic are found in the preservation by certain Carinthian or Hungarian-Slovene dialects of Common Slav *tl* and *dl* (which everywhere else in South Slavonic have become *l*), in the survival of a prefix *vy-* and in the development of the semivowels into *e.*

The phonetic feature which distinguishes Slovene from every other Slavonic language, is the change of C.S. *ǫ* to *o.* The treatment of C.S. *tj* and *dj,* which become *č* and *j,* is also characteristic but is not isolated, as the change of *tj* to *č* is also the normal but quite independent development in Russian, whilst *j* from *dj* occurs in the *ča* dialect of Serbo-Croat. The two half-vowels *ŭ* and *ĭ* which only in long accented syllables become *a,* normally develop into the mixed vowel ə always written *e,* except in purely philological works, thus being indistinguishable from the *e*'s derived from C.S. *ě* and *e.* Except in Carinthia, which in this as in numerous other respects goes entirely its own way, C.S. *ě* generally has become a closed *e.*

There are numerous other vowel changes, particularly in unaccented syllables, but their existence would not be suspected by casual examination of a Slovene literary text, as the orthography is conservative and consequently unphonetic. There are, for instance, at least four distinct *e* and *o* sounds to be kept apart in pronunciation. The distinction of intonation, which is a feature of Serbo-Croat, has been preserved in Slovene also, but the innovations made by each language have been so different that the results seldom agree. There are considerable variations in

Slovene itself as to which syllable receives the accent, but there is less divergence with regard to the nature of the accent: short syllables allow one intonation, while long syllables have two (a rising and a falling).

The grammatical system presents certain archaisms: thus the dual has been kept in nouns and verbs, and the supine has not been ousted by the competition of the infinitive.

The vocabulary and style of the literary language are typically Slavonic and show little admixture—such few loans as occur being chiefly from Russian, Czech and Serb; but owing to the age-long subjection of the Slovene people the spoken dialects have been much more seriously affected by German, Italian and Hungarian, and in some border dialects (*e.g.*, Carinthian) there is a danger that Slovene may degenerate into a jargon.

Although the dialectical variations are much more considerable than in the other languages, it is possible to distinguish two main groups: the more important is the South-western, which includes the lowland (*dolenjski*) dialect of Carniola—used by Primus Trubar, the creator of the Slovene literary language. The North-eastern group includes some of the dialects of Carinthia and of the districts beyond the river Múr, and for philological reasons is of high importance.

The spelling in current use is modelled on Czech, but among the Slovenes of Hungary, where the literary use of the dialect was to some extent encouraged for religious purposes, the Hungarian system prevailed.

Bibliography.—The most complete dictionary is that of Mr. Pleteršnik (*Slovensko-nemški slovar,* Ljubljana, 2 vols., 1894–95) which marks the quality and intonation of the vowels. There are numerous smaller dictionaries (Slovene-French, Sl.-Italian, Sl.-Czech, etc.), but none has as yet appeared in which the Slovene words are translated into English. Grammars—*The Historical Grammar of the Slovene Language* (in Slovene) by F. Ramovš (Part II. on the consonants has so far appeared; Ljubljana, 1924) will be a monumental work when completed. A useful small work (in Slovene) is A. Breznik's *Slov. Gram. for Middle Schools* (Prevalje, 1921). Philological works —The *Ĉasopis za slov. jezik, književnost in zgodovino* (Periodical for Slov. Lang., Lit. and History, Ljubljana, 1920, *seq.*) is the chief review. Surveys of works on Slovene are issued with every number of the *Revue des Études slaves* (Paris). The *Jezikoslovni Spisi* (Philological Essays) of A. Breznik (Ljubljana, 1916–19) are valuable. *Les formes du duel en Slovène* and the accompanying *Atlas Linguistique,* by L. Tesnière (Paris, 1925) cover entirely new ground for any Slav language. Literature—"A Survey of Modern Slovene Literature" (*Slavonic Review*, vol. vi., pp. 618–634, 1928), by J. Vidmar, deals with the greatest names of the last hundred years.

SLOVENES, a Slavonic people. The chief mass of them lives in Yugoslavia, occupying Slovenia and the adjoining sections of Yugoslavia. The boundary on the east is difficult to fix, as the linguistic transition is gradual and a certain dialect of Croatian (marked by the use of *kaj*="what") may have been originally Slovene.

SLOW-WORM or **BLIND-WORM** (*Anguis fragilis*), a legless lizard, which is neither slow nor blind, nor is it a worm. The slow-worm is fairly common in Great Britain and ranges across Europe to western Asia. On account of the absence of legs it is often mistaken for a snake. It is quite harmless, feeding on worms, slugs, etc. Like many other lizards, it can break off its tail if seized thereby. (*See* Reptiles.)

SLUG. The name generally given to the members of a group of land molluscs related to the land snails but lacking an external shell. They include the families Limacidae and Arionidae of the Pulmonate Gastropoda. There are several other groups of less familiar Pulmonates (*e.g.*, the Daudebardiidae, Veronicellidae and Rathousiidae) which may be called "slugs." The name is indeed extended to all shell-less elongate Gastropods such as the "sea-slugs" (Nudibranchia: Oncidiidae).

The common slugs (*e.g.*, the black slug, *Arion ater* and *Agriolimax agrestis,* the field slug) are placed in the sub-order Stylommatophora of the Pulmonata. The shell is wholly internal and may be absent. The mantle is seen as a shield-shaped projection at the anterior end. In the living animal a small contractile orifice is seen on the right-hand edge of the mantle. This is the pneumostome or respiratory orifice through which air is drawn into the lung-like mantle-cavity. In *Limax* the shell is persistent, but it has no spiral apex; in *Arion* it is very degenerate and is reduced to a few calcareous granules. In the tropical Veronicellidae and Rathousiidae it is entirely absent. Most of the land slugs have two pairs of tentacles; the eyes are borne on the extremities of the posterior pair and the anterior pair carries the tactile organs.

A typical land slug such as *Arion ater* inhabits woods, fields, gardens, hedgerows and wilder places. It is more or less omnivorous and Ellis states that it feeds on green leaves, fruit, fungi and dead animal and vegetable matter. The sea-slugs are principally represented by a number of completely naked genera of Nudibranchiata Gastropods. The most striking of them are the Eolids, which are small, often brightly coloured animals. They are found in shallow waters and in rocky pools. (For the peculiar function of the cnidosacs of these animals, *see* Gastropoda.) Certain of the Oncidiidae are remarkable for the numerous eyes scattered over the dorsal surface which are stated to be a special adaptation in relation to the attacks of a littoral fish (*Periophthalmus*) which preys upon them. (G. C. R.)

SLUM. The expressions "Slum" and "Slum Conditions" scarcely admit of any exact definition. For practical purposes they are recognized as consisting of home conditions in which, owing either to the dilapidated, insanitary or unsuitable character of the housing provision, or to the overcrowding to which it is subjected, the conduct of healthy and decent family life is impossible. Such conditions exist even in the pleasantest villages, as well as in the cities and towns, and in all cases they are found to incur similar consequences to the health of their inhabitants, especially to the children.

The slum as found in the United States is fully discussed in the article Housing, U.S. section. The article below covers the slum conditions in Great Britain. For the progress of the work of slum clearance, *see* the par. under that head *s.v.* Housing. *See* also Social Architecture.

Origin and Character.—Insanitary houses consist substantially of two main groups, and the distribution of the types varies very much in different districts according to their past industrial history and housing standards. The first group consists of those houses in which the housing provision itself is of an insufficient standard with regard both to accommodation and conveniences; and the second consists of those which, whilst primarily suitable in themselves, have become what they are owing to a change in their manner of use. In these cases, for the most part, the houses have become split up and let out in separate tenements without material adaptations, so that what was originally a dwelling for one family has now come to be occupied by four, five or sometimes a larger number of families.

The first group includes most of the dilapidated and insanitary country cottages, and it is widely represented in the older cities, and in the towns that underwent rapid industrial development during the nineteenth century. It is very general also throughout Scotland. In the older cities and towns the houses are usually small and have been built in yards, alleys and courts, or on any other available space, without much semblance of order, or regard to light, ventilation and sanitation. In the more industrial towns they consist chiefly of closely-packed, back-to-back, houses, and represent the first unregulated exploits of the jerry-builder. The city of Leeds provides perhaps the most conspicuous example of this last class, and in Mr. Neville Chamberlain's Report to the Ministry of Health of the "Unhealthy Areas committee of 1921," it is recorded that this city has 72,000 back-to-back houses, which consist of 12,000 that are fairly substantial; of 27,000 built in blocks of eight, opening directly on to the street with the sanitary conveniences for each pair of blocks (16 houses) provided between them and only approached by the street; and of a further 33,000 houses which are described as "built in long continuous blocks opening directly on to the street . . . crammed together at the rate of 70 to 80 per acre"; in regard to which it is added: "It is difficult to suggest any method of dealing with them satisfactorily short of complete clearance." The Royal Commission on Housing in Scotland found that 539,000 houses, or rather more than half the houses in that country, had not more than two rooms.

The second group of slum houses is especially widely represented

in London, where, in the course of time, the character of the older and more closely-built districts has altered with the growth of population and the development of outside areas. There are miles of houses in London, now let as tenements, which originally consisted of single family dwellings—usually with a basement kitchen that is commonly the only room provided with a cooking range. In other respects also, despite the efforts of the sanitary authorities, the domestic and sanitary arrangements are commonly of a very inadequate character. An analysis of a group of houses of this kind in a typical street in the borough of Shoreditch yielded the following results in summary:

House	Number of lettings	Population	Number of water connections in the house	Number of water taps in the house
1 . .	6	20	2	2
2 . .	4	27	2	2
3 . .	4	24	2	2
4 . .	6	13	1	1
5 . .	8	10	1	2
6 . .	8	34	2	1
7 . .	5	29	2	1
8 . .	7	29	2	1
9 . .	7	34	2	1
10 . .	4	18	2	2
Totals .	59	238	18	15

In other, better-to-do, districts, such as Westminster, there are many cellar dwellings in houses or buildings which are not otherwise let in tenements.

The number of people affected by these two groups of housing conditions is not easy to ascertain, as the returns of the numbers of insanitary houses do not all provide the population statistics; whilst the returns of those that are styled "overcrowded" do not include all the dilapidated cottages and other bad houses which are not technically overcrowded. The standard of "overcrowding" adopted in England and Wales is "more than two persons" for each room, whilst in Scotland it is "more than three persons" for each room. Accepting these qualifications, however, there appear to be about a million houses in England and Wales that consist of not more than two rooms, and there are rather more than three million people returned as overcrowded. In Scotland, despite the fact that the overcrowding standard is lower, the proportion of those inhabiting unsatisfactory dwellings is greater. In the city of Glasgow, for example, 470,000 people, or more than 60 per cent. of the total population of the city live in homes of not more than two rooms, and nearly a quarter of them have only one room. In Scotland, as a whole, there are 2¼ million people, or somewhat less than half the population, living in two rooms or less, and of these, 400,000 have one room only. The Royal Commission found that at least 50 per cent. of the one-roomed houses, and 15 per cent. of the two-roomed houses, were so insanitary and dilapidated that they ought to be replaced.

Effects of Slum Life.—The effect upon the inhabitants of life under such conditions is difficult to imagine by those who have not examined them at first hand. The fact is that one or two gloomy rooms have to provide for all the purposes and events of family life. The character of the houses themselves is thus described in the Report of the Scottish Board of Health Commissioners on Glasgow Housing for 1926:

> The majority of the houses were dark, many of the tenants having to burn gas all day, winter and summer. Large numbers of tenements were built in the middle of hollow squares, hard up against high buildings on all sides, with no proper ventilation or light. Damp was present everywhere, the walls and ceilings in a large number of houses being literally soaking. Everywhere we noticed an almost total lack of sanitation, conveniences being few and for the most part out of repair, and in some cases leaking down the stairs and even into the houses. . . . Dilapidation is rife throughout the areas. Ceilings are falling down, woodwork is rotting away, there are holes in the walls of houses through which the street can be seen, and the plaster-work of the walls is loose and broken. The houses are a hunting-ground for vermin of every description. Fleas, of course, abound, but we found also that practically every property we inspected was absolutely bug-ridden. The tenants complained that they could get no peace from these pests, which drop upon their faces and crawl over their persons and beds at night, and which fall into their food during the day. The food itself will not keep in many of these tenements . . . owing to the damp and verminous condition of the holes in the walls in which it is kept.

Health statistics generally, mortality rates, the statistics of tuberculosis infection, of the defects of school children and of the analysis of the sicknesses of insured persons, all reveal, in common, the damaging results of life under these conditions. The following comparable table, as ascertained by Dr. Robertson, medical officer of health for Birmingham, for an overcrowded and a well-built area, seems fairly to represent the conditions generally found:

	Slum area	Well-built area
	%	%
Death rate	20	10
Infant death rate	152	69
Tuberculosis death rate	2·3	·79
Infantile diarrhoea under the age of 2 years, per 1,000	42	6

Remedial Methods.—A certain proportion of the bad houses is capable of improvement or restoration, although they would only then serve for a smaller number of inhabitants. In a very large proportion of these cases, however, the cost of repair or re-construction is so great that a private owner cannot look to regain it in the form of increased rent and this necessarily imposes a limit upon what can be expected. In many cases, also, the owners or leaseholders of poor houses are themselves people of small means and cannot command the necessary capital. Nevertheless much improvement has been effected by some local authorities, who have systematically and reasonably used their powers, to obtain improvements over a period of years. For example, the city of Manchester has finally secured the abolition of cellar dwellings, and in many towns a great reduction, or even the elimination, of back-to-back houses has been obtained.

The conduct of slum reclamation must necessarily be piecemeal, as it is impossible to dis-house any great number of people at a time during the process of reconstruction. The city of Liverpool presents, perhaps, the most conspicuous example of the valuable results obtained in the course of time by the progressive acquisition and reconstruction of bad portions of the city; where, by the accommodation of the dis-housed people in flats erected for their accommodation, it has been possible to adjust operations so as to avoid intensification of the pressure on surrounding streets.

Nevertheless, the policy of waiting until an area has become condemned until it can be acquired and so dealt with, has proved to be too limited to allow of general success, and the following conditions—chiefly based on the Report of the Unhealthy Areas Committee—seem to be essential: (1) A full use should continue to be made of all existing sanitary powers, in addition to the continued provision of new houses in open parts. (2) Unnecessary demolition should be restrained by the grant of power to "declare an area congested" and to prohibit the demolition of houses and the erection of other buildings therein without license. (3) Clearance and reconstruction should be a part of a comprehensive and carefully prepared planning scheme affecting not only the area itself but adjacent parts of the town or country. (4) The local authority should be competent to undertake sufficiently extensive acquisition so as to enable it to obtain a better ultimate return by the proper disposition on the ground, of dwellings and of commercial and business premises. (5) Pending such acquisition and reconstruction, authorities should be competent to "declare areas unhealthy" and to purchase them with the purpose of improving the housing conditions under a scheme of collective management and improvement. (6) Finally, apart from various technical proposals as to the methods of acquisition and compensation, it is agreed that in London and the larger cities there should be a combination of authorities responsible for the supervision and execution of reconstruction schemes, for the reasons that the district afflicted with slums is usually poor and unable to bear

the burden, and that an adequate town-planning scheme involves questions of transport and development which extend beyond the boundaries of individual authorities.

SLUMP: *see* Trade Cycle.

SLUTZK, formerly Pavlovsk, a town of Russia on the Slavyanka river, 17 m. south of Leningrad, in 59° 40′ N., 30° 25′ E. Pop. (1926) 6,231. It was a former summer resort of the aristocracy, and contains many villas and palaces, now used either as holiday colonies or children's schools, or converted into museums. Among the more famous sights are the castle (1782–1803), situated in a beautiful park, the English Pavlovsk park, laid out by Cameron, the Pavilion of Roses, built by Rossi in 1812 and formerly covered with roses, where Alexander I. celebrated his victory over Napoleon in 1814.

See *Guide to the Soviet Union* (Moscow, 1925, in English).

SLUYS (SLOIS), BATTLE OF, fought on June 24, 1340, one of the two sea-fights in which King Edward III. of England commanded in person, the other being that called Espagnols-sur-Mer (*q.v.*). The place of the encounter was in front of the town of Sluis, Sluys, or in French Écluse, on the inlet between West Flanders and Zeeland. In the middle of the 14th century this was an open roadstead capable of holding large fleets. It has now been silted up by the river Eede. A French fleet, which the king, in a letter to his son Edward the Black Prince, puts at 190 sail, had been collected in preparation for an invasion of England. It was under the command of Hue Quiéret, admiral for the king of France, and of Nicholas Béhuchet, who had been one of the king's treasurers, and was probably a lawyer. Part of the fleet consisted of Genoese galleys serving as mercenaries under the command of Barbavera.

Although English historians speak of King Edward's fleet as inferior in number to the French, it is certain that he sailed from Orwell on June 22 with 200 sail, and that he was joined on the coast of Flanders by his admiral for the North Sea, Sir Robert Morley, with 50 others. Some of this swarm of vessels were no doubt mere transports, for the king brought with him the household of his queen, Philippa of Hainault, who was then at Bruges. Edward anchored at Blankenberghe on the afternoon of the 23rd and sent three squires to reconnoitre the position of the French. The Genoese Barbavera advised his colleagues to go to sea, but Béhuchet, who as constable exercised the general command, refused to leave the anchorage. He probably wished to occupy it in order to bar the king's road to Bruges. The disposition of the French was made in accordance with the usual mediaeval tactics of a fleet fighting on the defensive. Quiéret and Béhuchet formed their force into three or four lines, with the ships tied to one another, and with a few of the largest stationed in front as outposts.

King Edward entered the roadstead on the morning of the 24th, and after manoeuvring to place his ships to windward, and to bring the sun behind him, attacked. The battle was a long succession of hand-to-hand conflicts to board or to repel boarders. King Edward makes no mention of any actual help given him by his Flemish allies, though he says they were willing, but the French say that they joined after dark. They also assert that the king was wounded by Béhuchet, but this is not certain, and there is no testimony save a legendary one for a personal encounter between him and the French commander, though it would not be improbable.

The battle ended with the almost total destruction of the French. Quiéret was slain, and Béhuchet is said to have been hanged by King Edward's orders. Barbavera escaped to sea with his squadron on the morning of the 25th, carrying off two English prizes. After the battle King Edward remained at anchor several days, and it is probable that his fleet had suffered heavily.

The story of the battle of Sluys is told from the English side by Sir Harris Nicolas, in his *History of the Royal Navy*, vol. ii. (London, 1847); and from the French side by M. C. de la Roncière, *Histoire de la marine française*, vol. i. (Paris, 1899). Both make copious references to original sources.

(D. H.)

SMALL ARMS, THE DEVELOPMENT OF. Roger Bacon recorded in the year 1248 the composition of gunpowder, and it is almost certain that he was its discoverer. The Chinese and other Eastern nations are believed to have used at an earlier date mixtures which were incendiary but not explosive.

Early History.—There is no trace of fire-arms before A.D. 1300, and it is believed that the first to use gunpowder for the propulsion of missiles was Bernard Schwarz, a German monk. The earliest missiles were arrows padded out to fit the bores of these weapons. The hand-gun, as opposed to the cannon, was derived from the latter and does not appear to have existed until late in the 14th century. At first it consisted of a short iron tube, prolonged behind into a rod which was used to manipulate it, and which was hitched under the arm when the piece was fired. The charge was inserted from the muzzle and when in position was ignited by applying a wick match to a touch-hole on the upper side of the rear end of the tube. Later, the touch-hole was made on the side of the tube, the priming pan being conveniently placed. The match was held in a hinged fork mounted on the stock, enabling it to be brought into contact with the powder in the priming pan. This match-lock, so arranged, was known as the "harquebus." It is easy to understand that this smouldering wick match and the powder in the priming pan were affected by rain, etc., so adding to the probability of missfires.

The next development was the wheel-lock. This was produced in Germany early in the 16th century and was used first with sporting weapons and pistols. In it, the cock was armed with pyrites, which, when lowered, pressed against the serrated edge of a steel wheel projecting through the bottom of the priming pan. When the trigger was pulled, the wheel revolved and sparks were struck, which ignited the priming in the pan. Thus was eliminated one component, *i.e.*, the match, so subject to the effect of damp.

Like the wheel-lock, rifling (Ger. *riffeln*, to groove), of the barrel was introduced early in the 16th century, some attributing the invention to Gaspard Koller, a gunmaker of Vienna, others to August Kotter, an armourer of Nuremberg. The advantages derived from spinning a projectile had been known from early times, but in those days difficulty in applying the principle to fire-arms was appreciable. Spiral grooving would spin a ball if the ball were gripped by it firmly from breech to muzzle. However, as the powder was foul and made of impure ingredients, it left a crust in the bore after each shot was fired, which necessitated the use of a ramrod to drive the next ball home into position against the charge. This was a laborious process and caused delay, so although rifling came into use on the Continent for sporting weapons, and pistols, etc., for target purposes, where accuracy was more important than rapidity of fire, many years passed before any material success attended it.

Not until about 150 years after its invention was the wheel-lock superseded by what eventually became the flint-lock. It also had a cock holding pyrites, and when the cock fell this struck against a piece of steel, throwing sparks into the priming pan. Flint was substituted for pyrites, in or about the year 1600, and the flint-lock approached its perfection when it was made so that the cock in falling not only struck the necessary sparks but simultaneously uncovered the priming pan which had up to that moment been protected against accidental dispersion and the weather. Later the flint-lock was adopted by the British army and this was the weapon in the hands of the troops not only during Marlborough's campaigns, but also those of Wellington.

Rifles: Later Developments.—As regards rifled barrels, no considerable use was made of the rifle in France till 1830, when the Chasseurs d'Orléans were armed with it for the invasion of Algiers. The American settlers had learnt to use their hunting rifles with such effect that, during the American War of Independence, the British army learnt that the only effective rejoinder was to pit rifle against rifle. The British Government consequently subsidized Continental Jägers armed with rifles to oppose the American riflemen. After the war these troops were dispersed, and, though they are represented by the 60th King's Royal Rifles, the senior rifle corps in the British army is the Rifle Brigade which was raised in 1800 as the 95th Regiment, and armed with a flint-lock weapon known as the "Baker rifle," weighing 9½ lb. The barrel was 30 in. long, the bore ·625 with seven grooves, making one quarter turn in its length, and sighted for 100 and

200 yards. Baker was a gunmaker in Whitechapel. A wooden mallet was at first supplied to force the ball down the barrel, which was loaded with great difficulty.

Percussion Ignition.—Shortly after this a development took place, which, after gunpowder, was probably the most important advance in the history of all fire-arms, namely, the invention of the percussion system of ignition by Alexander Forsyth. Had such a development not been made, rapid continuous fire from any type of gun would probably have remained an impossibility. Starting in 1793, Forsyth, after many trials and experiments, sometimes dangerous, eventually perfected a lock which was applied to a fowling-piece in 1805, and which proved successful. His principle was to employ a detonating powder, which, when hit a smart blow by a hammer, flashed through the touch-hole and ignited the powder in the barrel. He perfected the details of his system and mechanism, and in 1807 claimed that "the Forsyth patent gun-lock is entirely different from the common gun-lock. It produces inflammation by means of percussion, and supersedes the use of flints. Its principal advantages are, the rapid and complete inflammation of the whole charge of gunpowder in the chamber of the barrel, the prevention of the loss of force through the touch-hole, perfect security against rain or damp in the priming, no flash from the pan and less risk of accidental discharge of the piece," etc., etc. (*See* Maj.-Gen. Reid, *Alexander John Forsyth.*)

The percussion cap, which was a natural development of this system came into use about 1820. It was a great improvement. Though Forsyth's system was adopted fairly generally for fowling-pieces, it was viewed with suspicion by the military authorities, until, in 1834, his invention was officially tested by firing 6,000 rounds from six flint-locks, and a similar number from six percussion muskets in all weathers. The superiority of the percussion system was completely established and led, in 1836, to the arming of a second battalion of the Rifle Brigade with an improved weapon, the ·704 Brunswick rifle, in which this percussion system was embodied.

The Brunswick Rifle.—In this rifle barrel were two grooves, making one turn in its 30 in. of length, the twist thus being four times steeper than that in the Baker rifle. The projectile it fired was a ball, round which was a belt. The latter, travelling in the grooves, imparted a spin to the bullet. One of the advantages claimed for this rifle was that a more rapid spin could be imparted to the bullet, as, owing to its belt working in the grooves, there was no fear of this leaden ball stripping or riding over the rifling. Much thought was devoted to the questions of the most effective twist, and the best number of grooves, coupled with the desirability of increasing rapidity of loading by devising a projectile which would pass easily down the bore and would yet, when fired, expand into the grooving.

In 1826, Delvigne, a French infantry officer, invented a chamber with abrupt shoulders on which the spherical bullet was rammed down until, expanding, it fitted the grooves. The line of development which the bullets took was twofold, namely, making them long with rounded or ogival noses, and also cupping their bases, with or without metal or wooden plugs positioned inside these cups. The gases on meeting these bases expanded the cupped bullet, or else forced the plug to expand the bases of the bullet, and so sealed the bore.

The Minié Rifle.—The "Minié" rifle, in which this bullet was first demonstrated, had no devices in the bore for expanding the bullet, reliance being placed on the action of the gas pressure on the base of the bullet to "set up" the base, and so seal the bore. This principle has been adopted practically ever since for small arms. The Minié rifle was a success and was adopted by France and Belgium, the United States, also by the British Government in 1850–51, and was entitled the Regulation Minié Musket. This rifle was employed in the Kaffir War of 1851 and also in the Crimea. Its weight with bayonet was 10 lb. 8¾ oz., the barrel 39 in. long, having four grooves making one turn in 72 in., and the bore was ·702 inches. It was sighted for from 100 to 1,000 yards.

Dreyse Needle Gun.—Ten years before the adoption of the Minié rifle, however, Prussia led the way by adopting the Dreyse needle gun. This was a breech-loading bolt action, provided with a long needle carried in a slender rod which was actuated by a surrounding spring. On pulling the trigger the rod flew forward, and the needle, passing through a guide in the front of the bolt, struck a disc of detonating material, so igniting the charge. This was the system initiated in England by Forsyth in 1805. This early pattern suffered certain defects; for example, after a few rounds, owing to the escape of gas and flame between the breech and bolt, the rifleman could not continue firing from the shoulder. Also, the needles rusted and broke; yet the gain in rapidity of loading was considered to outweigh greatly the above defects, and this rifle was the general arm of the Prussian and German troops in the wars of 1848, 1866 and 1870.

The Enfield Rifle.—In 1855, the Enfield rifle, made in the Royal Small Arms Factory, was introduced into the British army, after it had been tested against others made by private firms, to which it was found to be superior; and in the Crimea it superseded the rifled musket and the Minié. In turn the Enfield rifle was tried at Hythe against one made under the auspices of Sir Joseph Whitworth in 1857, which proved to be much superior. This Whitworth rifle had a hexagonal bore of ·45 in. calibre rifled to one turn in 20 inches. Induced by the commander-in-chief, Lord Hardinge, Sir Joseph Whitworth had devoted himself to a long series of experiments to investigate the subject of rifling, which culminated in his demonstrating the advantages to be gained from spiral rifling, a small bore and an elongated projectile. Despite this, the Whitworth rifle, which embodied these features, was never generally introduced into the service, although advantage was taken of the lessons he taught. Between the years 1857 and 1861 four breech-loading carbines were introduced into the cavalry experimentally. These were Sharp's, Terry's, Green's and Westley-Richard's, and as a result of the opinions formed, and the example set by Prussia, committees were appointed in 1864 and 1866 by the British War Office, to report on breech-loading arms. In addition, gunmakers were invited to forward proposals for the conversion of the 1853 pattern Enfield rifle to the breech-loading method. Some 50 different suggestions for this conversion were investigated, and the one finally selected was that of Jacob Snider, an American, which was adopted in 1867.

The Snider Rifle.—Snider's conversion consisted of a breech-block, hinged to swing up and out to the right. Through this block passed the firing pin, with which was a spring holding the pin to the rear so that its end protruded towards the hammer. When the hammer fell by pulling the trigger, it drove the pin forward so that its point struck the percussion cap. The block, when hinged down, was kept closed by a spring and cam action underneath. With the converted Enfield rifle was employed the cartridge invented by Col. Boxer. This cartridge was made up of coiled metal and had a percussion cap in the centre of its base. The advantage derived from this cartridge was that, under the gas pressure of the explosion, the cartridge expanded and so sealed the breech against escape of gas or flame; also after discharge the metal contracted, thus permitting simple and quick extraction of the case. In 1866 France adopted the bolt action Chassepot, used later in the Franco-German War. Shortly afterwards, Sweden adopted the Hagström, Russia the Carte and Italy the Carcano rifles. All these were breech-loaders using paper cartridges containing their own means of ignition. The conversion of the Enfield to the Snider was admittedly a temporary expedient, and soon after its completion steps were taken to procure a new design of rifle. Having received rifles from many different firms and factories, a model was selected which embodied an action submitted by Martini, an American, as modified by the Royal Small Arms Factory, in combination with a barrel put forward by Henry, with which the Boxer cartridge was to be used. This was subsequently known as the Martini-Henry.

The Martini-Henry Rifle.—The bullet first used weighed 480 grains and was lubricated by a wax wad between it and the powder. The bore was ·45 in., with seven grooves twisting one turn in 22 in., and, after further improvement of both the car-

tridge and the action, this rifle was adopted in 1871, though at the time it was realized that its ejection was not sufficiently powerful. Its general design was a breech-block, hinged in rear, and containing a firing pin and spring. A lever underneath the butt, when operated by hand, moved this breech-block in a vertical arc round its axis, so opening and closing the breech, and at the same time cocking the hammer. In 1884–85 Germany and France converted their single-loading rifles to embody a magazine, consisting of a tube in the fore-end underneath the barrel. These improvements, and further experiments in England with reduced calibres, led the appropriate committee to recommend first the adoption of the small calibre, and later a magazine rifle of ·303 bore embodying the Lee breech bolt action and box magazine, with rifling of the Metford system, namely, seven shallow grooves twisting one turn in ten inches.

The Lee-Metford and Lee-Enfield Rifles.—This rifle became known as the Lee-Metford, and was adopted in 1888. Later, when cordite was introduced in 1893, the erosive effect of this propellent was found to be such that the rifling quickly disappeared. For this reason, a system of rifling known as the Enfield was adopted, which had five grooves of square section, twisting one turn in 10 in. and which has not since been changed for the British army rifle. On the change to this system of grooves, the rifle was re-named the Lee-Enfield. This was the rifle used in the Boer War of 1899–1902. A Lee-Enfield carbine, with a barrel shortened to reduce weight, was the firearm of the cavalry in that war. This shortening of the barrel caused a portion of the cordite charge to be unconsumed before the bullet left the bore, and the velocity of this weapon was appreciably below that of the rifle, which necessitated greater elevation of the carbine for corresponding ranges. The trajectories of the bullets fired from the carbine being very high and curved, the difficulty of hitting the mark was increased. In consequence, after that war a compromise was made, and a rifle, some 1 lb. 2½ oz. lighter, and 4½ in. shorter, was introduced for both cavalry and infantry in lieu of the Lee-Enfield. This was called the Short Magazine Lee-Enfield Mk. 1, and is, with minor improvements, the weapon which is still in the hands of the troops.

In general quite similar developments may be noticed in the military small arms of other principal nations. Thus in the United States of America the flint lock, muzzle loading rifle was introduced by the Germans and Swiss who settled in Pennsylvania, and starting as early as 1730 it became the chosen weapon of the frontiersman, and was used to some extent in the American Revolution and in the War of 1812. Its calibre varied from about ·32-inch to about ·60-inch, and its barrel was usually very long. It was popularly known as the "Kentucky" rifle. After the Revolution the government contracted from time to time for a small supply of quite similar rifles for military use until 1842 when the manufacture of military rifles was undertaken at the national armory at Springfield, Mass.

The majority of Continental troops in the Revolution were armed with the Charleville musket, Model of 1763, purchased from the French. This was a smooth bore, muzzle loading, flint lock weapon of ·69 calibre, firing a spherical lead ball weighing about 440 grains. An almost exact copy of this musket, known as the Model 1799, was afterwards manufactured at Springfield Armory, and was the first standard military small arm manufactured by the United States for its forces. This musket, with minor improvements, remained in general use until 1842, when a muzzle loading percussion lock rifle of ·58 calibre shooting a spherical bullet was adopted, this year seeing the definite adoption of both rifle and percussion lock by the United States forces. Certain minor improvements continued, the principal weapon used in the Civil War being the Model of 1861, a percussion lock muzzle loading rifle of ·58 calibre, shooting a 480 grain conical Minié bullet.

The year 1866 saw the adoption of the Springfield breech loading rifle, shooting a centre-fire metallic cartridge of ·50 calibre using a grooved and lubricated lead bullet of 450 grains with a powder charge of 70 grains of black powder, the muzzle velocity being 1,240 feet per second. In 1873 this Springfield breech loading, single shot rifle was further improved and the calibre was changed to ·45. The new cartridge, remaining the standard until 1892, consisted of a centre fire brass case containing 70 grains of F.G. black powder and a conical, grooved, lubricated, lead bullet of either 405 or 500 grains, the 405 grain bullet being usually used in the short barreled cavalry carbine, and the 500 grain bullet in the infantry rifle. The muzzle velocity of the rifle with 500 grain bullet was 1,315 feet per second.

In 1892 a small bore, smokeless powder, magazine rifle was adopted and manufactured at Springfield Armory. The breech action was a modification of the Krag-Jorgensen, the magazine containing 5 rounds. The cartridge was of ·30 calibre containing a 220 grain bullet with cupro-nickel jacket and lead core, and a charge of nitro-glycerine smokeless powder sufficient to give a muzzle velocity of 1,960 feet per second. This rifle was improved several times, chiefly to facilitate production, the later models being known as the Model 1896 and the Model 1898.

The Spanish-American war demonstrated the need of a higher muzzle velocity to flatten trajectory, and of a quicker method of charging the magazine. Accordingly a new rifle, the Model 1903, was developed at Springfield Armory, being a modification of the Mauser, the magazine being charged with a clip of 5 cartridges. This rifle was first issued to troops in 1905. The cartridge of the rimless type contained a 220 grain bullet, and gave a muzzle velocity of 2,300 feet per second. In 1906 the cartridge was changed to contain a 150 grain sharp pointed bullet with muzzle velocity of 2,700 feet per second, known as the Model 1906 cartridge, and all existing rifles were rechambered for the new cartridge. Again in 1926 the bullet was changed to one of boat tail or stream line form, weighing 172 grains and jacketed with a composition of copper 90 parts, zinc 10 parts, to avoid metallic fouling. The new cartridge, used in both rifles and machine guns, is known as the ·30 calibre Mark I., and gives a muzzle velocity of 2,660 feet per second. The Model 1903 rifle remains the standard service rifle of all the United States military forces.

During the World War the facilities for the manufacture of the Model 1903 rifle were not sufficient to produce it in the quantities required. Several large factories had been manufacturing the Enfield Model 1914 rifle under contract for the British government. It was possible to slightly change the 1914 rifle so that it would use the United States ·30 calibre Model of 1906 cartridge. The modified rifle, known as the U.S. Rifle Model of 1917, was manufactured in large quantities in these factories and about half of the United States troops in France were armed with it, the remainder using the Model 1903 rifle.

DEVELOPMENT OF THE MACHINE GUN

Side by side with this advance in the design of rifles, and starting from an early date in the history of small arms, there was taking place a gradual development of the mechanical means of producing an ever-increasing volume of fire. Until the development of the Spanish arquebus (about 1520) infantry fire was, from lack of range, inaccuracy, and slowness of delivery almost ineffective. In those days, cavalry was the battle-winning arm, and the cavalry charge the decisive manoeuvre. Weapons propelling projectiles being then so unfitted to repel these rapid moving cavalry charges, reliance was placed by the defenders on masses of pikes for close defence rather than on the fire-arm. Accordingly, for the attackers arose the problem of how best to overcome or counteract these masses of pikes. The first solution attempted was the "cart with gonnes" known as *ribaudequins*. In these, the barrels were connected to a combustion box common to all, and on ignition of the powder in the box, all the barrels were fired in a volley. Though originally intended to assist in the attack, these weapons also lent themselves to the defence. An historical instance of the employment in battle of these *ribaudequins* is that of Pedro Navarro, who commanded the Spanish forces at the battle of Ravenna in 1512. He disposed in front of his infantry, 30 carts, on each of which several large arquebuses were mounted. Thus was conceived the idea of one man, with assistance, delivering a fire greater in volume that he alone could otherwise have attained with his individual weapon, and the economizing of man power.

When, towards the latter half of the 15th century, the field artillery improved, and a cannon ball could be fired from a gun mounted on a mobile carriage, these *ribaudequins* gradually dropped out and eventually ceased to exist.

Soon after this, however, the same idea was re-employed in a more up-to-date form, known as *orgues*, or organ guns. In these, a number of musket barrels were mounted side by side in a frame on a wheeled carriage, the latter having also a number of pikes projecting to the front, and intended for the ultimate protection of the personnel against frontal attack or cavalry charges. These barrels were so arranged that they could be fired singly, by means of locks, or alternatively by a single lock, which ignited a quick match which in turn ignited the charges of all the barrels in rapid succession. However, with the further development of the artillery it was realized that these "organs" had the fatal defect of being neither powerful enough to engage, nor mobile enough to evade the hostile artillery. (An interesting resurrection of this old idea was employed in the World War when rifles were mounted in frames, laid to sweep approaches and trenches, and operated by one man.)

The usual competition to improve and outdo the armaments then employed began shortly afterwards, and inventions were numerous, if often impractical. An instance of the development that took place is embodied in a weapon still to be seen in the Tower of London, which would appear to have been made before the advent of the flint-lock in the first half of the 16th century. It is an arquebus of the period, with four chambers and a single barrel, a separate flash pan for each chamber, with the chambers revolving round a central axis.

In 1701 we find a wider view taken of the rôle that such a weapon should fulfil, when Beaufort de Mirecourt, a Lorrainer, laid down that such a weapon should have as its purpose the augmentation of infantry fire power, so as to place a numerically inferior army on an equality with one superior to it in numbers, etc. Then, in 1718, we find a patent granted to one Puckle, to produce a gun, which had one barrel but had also a revolving cylinder in which were seven or nine chambers. The equipment also consisted of moulds for making the necessary balls. It seems probable that there were two cylinders, for in his application for the patent he proposes "round balls for Christians, square balls for Turks." A very important development in all forms of fire-arms was made when in 1805 Alexander Forsyth invented the percussion system of igniting the charge.

This principle is to be seen embodied in another interesting old weapon which has been in the custody of the war department since 1830, and is at present housed in the Rotunda at Woolwich. When it was first made cannot now be ascertained. In it are three rows of barrels, 11 in the middle row and ten in each of the others. All are fixed, and the alignment and elevation are practically the same for all. The barrels are over 44 in. long, ·75 in. bore, with 11 grooves, twisting one turn in 30 inches. In rear of the barrel and clamped thereto is a plate on which are mounted chambers for each of the barrels. In rear of these chambers was a combustion box, with which each chamber was connected. This was charged with powder. A percussion cap, mounted on a nipple, when struck by a large hammer under the influence of gravity, ignited the powder in the combustion box and so ignited the powder in the barrel chambers, thus firing all 31 charges simultaneously. An accessory is a machine for loading and charging the plate of chambers. During the early half of the 18th century similar weapons were used in France.

In the same museum is a rifle battery, designed by Sir J. S. Lille, and made in 1854. It consists of two rows of six barrels one above the other and some 6 in. apart in each row. In rear of the barrels are cylinders, similar to the cylinders of the modern revolver. The cylinders in the top row contain ten chambers, and in those of the bottom there were twenty. Each chamber is provided with a nipple for a percussion cap. In rear of these cylinders were rods, on which were mounted hammers for each barrel. On rotating these rods by means of crank handles, the cylinders were caused to revolve, and the hammers fell in succession, starting from the right. This weapon was designed at the time of the Crimean War, but it is not known if it was ever employed in the field. From the foregoing it can be seen that a stage had been reached when a limited number of rounds, fired in rapid succession or as a volley, could be easily arranged, but the problem of rapidly reloading the discharged barrel was ever present, and so precluded the possibility of continuous fire. This great limitation to the utility of these weapons lasted until a system of loading them at the breech instead of the muzzle was introduced. Meanwhile, consequent on Forsyth's invention of the percussion cap in 1805, developments in ammunition had taken place. Gustavus Adolphus of Sweden in the 17th century had caused the gunpowder, which had hitherto been carried in flasks or bandoliers, to be made up into cartridges, which soon developed into the complete cartridge with bullet, charge and percussion cap all in one and contained in a paper case. Such cartridges, rough as they were, lent themselves to employment with breech-loading mechanisms, and in 1838 Dreyse embodied such a system in the Dreyse needle gun.

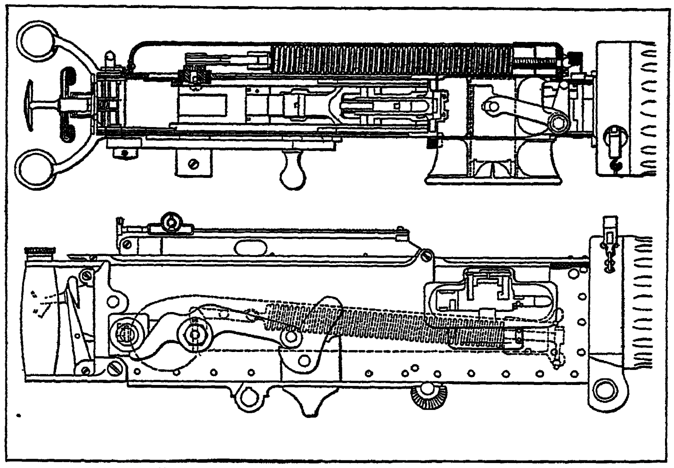

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FIG. 1.—THE .303" VICKERS MACHINE GUN

The Gatling Gun.—Twenty years after this came the first practical machine gun, invented by Gatling of Chicago. In this gun, a number of barrels (usually ten) were arranged round a central axis, and behind each barrel was a bolt, complete with firing pin and spring and extractor. The cartridges were carried in a hopper or slide above the gun, and fell by their own weight in front of the open breech of each barrel as it came round. By turning a crank handle at the side of the gun, barrels and bolts were revolved, each barrel being fired in succession when it arrived at a certain point in its circuit. Starting from that point, during the first semicircle the bolts were fully withdrawn and the cartridge case extracted; during the remainder of the circuit, the bolts closed the breech and fired the rounds.

This gun was employed in the American Civil War and later the ·45 Gatling was adopted by the British navy. With it a rate of fire of about 600 rounds per minute could be obtained. Its accuracy, however, could not have been of a high order as it is on record that at Gibraltar, 18 men selected from an infantry regiment, and armed with the single-loading Martini-Henry rifle, were able to make a better score on targets in a given time than a Gatling gun skilfully handled by 18 blue-jackets. An improved system (Accles) of feeding the gun was later invented, which made possible a rate of fire of 107 rounds in $2\frac{1}{2}$ sec. This improved system was produced too late for it to be adopted in the British service, which by that time was committed to other designs.

In Europe, the first machine gun to attract general attention was the Montigny Mitrailleuse, introduced into the French army just prior to the war of 1870. The French, disappointed with their shrapnel in the Italian War of 1859, desired a weapon, the projectiles from which would carry to ranges which the infantry, and the artillery firing case shot, could not reach. These guns were attached to batteries of artillery, and in their final form resembled outwardly an ordinary field gun with a wheeled carriage, limber and four-horse team. This mitrailleuse consisted of 37 rifle barrels, fitted in an outer casing, the whole revolving round

a common axis. The cartridges were carried in perforated plates To load the gun these plates were placed in grooves and locked in the breech, which was then forced home, each cartridge entering one of the chambers. The gun was fitted with a crank handle, which, when turned, revolved the barrels and fired each of the cartridges in succession, all 37 being discharged in one revolution.

Though tactically often badly employed in the field, and consequently put out of action by the German artillery, this gun proved that means could be provided which would enable a few men to pour a continuous stream of bullets on any spot, and thus be a factor in war too important to be overlooked. This gave a new impetus to inventors, and other guns were soon produced; the best known being those of Gardner, and Palmcratz and Nordenfelt. In the British Service, the Gardner superseded the Gatling. Guns of this description were made with one, two or five fixed barrels and could fire about 120 rounds per minute, provided that no troubles arose in the gravity fed supply of ammunition.

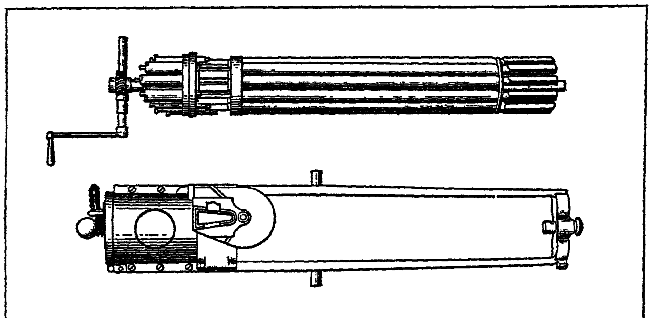


FIG. 2.—LIGHT GATLING GUN (.300 IN.) USED AT SANTIAGO, 1898

When later the Palmcratz-Nordenfelt rifle calibre machine was perfected, it was submitted to trial and proved to be the most reliable quick-firing gun yet produced, and eventually it became the machine gun, not only of the British service, but also of the services of most of the leading Powers. Like the Gardner, this gun also had two or five barrels fixed side by side, and was actuated by a lever worked backwards or forwards. The mechanism was simple and strong, and its maximum rate of fire a little over 600 rounds per minute. The cartridges were contained in a magazine situated above the breech action, from which they fell by gravity into position in front of whichever breech was open, and were subsequently fired through the action of the lever closing the breech.

The Maxim Gun.—Then in 1889 came the great development made by Sir Hiram Maxim. In all the guns hitherto produced, functioning was obtained by the hand operating a crank or lever. In the Maxim functioning was truly automatic, the recoil of the one barrel employed being utilized to perform all the operations necessary for loading, firing and ejecting. In this way the firer was spared the exertion hitherto expended on cranks and levers, which latter also had a tendency to cause unsteadiness of the gun, and loss of alignment. There were several new features in this gun which were true inventions. The rows of barrels, hitherto exposed to the air in other guns, were reduced to one single barrel which, for the greater part of its length, was enveloped by water in a casing. The method of feeding the gun with ammunition was also new, namely, a fabric belt holding 250 rounds in lieu of the older gravity feeding magazines, etc. The locking of the action against the force of the discharge was a further new and most ingenious feature.

The first gun that was made performed perfectly and fired at a rate of between 600–700 rounds a minute. So struck was the well-known Chinese envoy Li Hung Chang when witnessing a demonstration of this gun consuming ammunition at this rate, that he remarked "That won't do for China, it's much too expensive in ammunition." This gun was adopted by Germany and Russia and was their principal machine gun in the World War. In the British army it was adopted in 1889 and in the navy in 1892. In the hands of the latter it was employed in many fights, and it was the only small calibre machine gun used in the Boer War. At the outbreak of the World War it had been superseded in the British cavalry by its lighter offspring, the Vickers (which is referred to later) but the change over had not extended to the infantry when the war began. In the British services it is now obsolete, its place being taken on land, on the sea and in the air by the Vickers ·303.

Light Machine Guns.—When in the World War trench warfare set in and the power of manoeuvre disappeared, it was no longer possible to establish a superiority of fire by skilful tactics. Hence arose a greater demand for automatic weapons to increase the volume of fire, should occasion demand, and also to economize in riflemen. In the battles fought in the early days of trench warfare, the muddy state of the ground, the obstacles to be surmounted, and the heavy weight of the existing machine gun and its mounting frequently prevented the gun teams from getting the gun forward into the positions ordered. For such a task, lightness and mobility were even more important than accuracy and capacity for sustained fire. Hence the demand arose for a light machine gun, which thus took its place in the equipment of the modern army. Several different kinds were employed and are referred to later.

THE MODERN MILITARY RIFLE

The modern rifle is so constructed as to constitute a complete offensive and defensive arm for one man, of such a size and weight that one man can carry it, together with its ammunition and accessories and the other essentials that a soldier is required to carry over the ground and for the distances he is expected to cover in war. The weight of the military rifles of most countries averages about 9 lb. without the bayonet which weighs about 14 oz. All modern military rifles are breech-loaders with "bolt" systems and have magazines carrying 5–10 rounds. In all cases, except in the rifles of Greece and Russia, the double pull trigger system is employed. In this system, the mechanism is so arranged that, after a long light pull of the trigger, a greater resistance is suddenly felt. From this point on a heavier pull is required until the firing pin is released and flies forward to fire the round. The light pull is called the "first," and the other the "second" pull.

Usually the barrels taper towards the muzzle, either evenly or in steps, these latter being thought to break up or damp down the vibrations of the barrel caused by the explosion and which affect the accuracy of the shooting. In length the barrels run from about 24–32 in., the bores vary between ·256 and ·315 in. and the weights between 2 lb. 3 oz. and 3 lb. 3 oz.

The function of the bolt is to support the cartridge in the chamber during the explosion and so seal the bore against the escape of gas. On the right of the bolt, and usually towards the rear end is the bolt lever for its manipulation. The bolt is of steel, hollowed out to contain a firing pin and a spring (mainspring), with which to fire the round. Mounted on the bolt and projecting beyond it is the extractor, which grips either the rim or cannelure at the base of the cartridge, when the bolt is fully forward.

When the bolt is drawn to the rear, the cartridge case is removed from the chamber and its ejection from the rifle takes place during this backward movement. When the bolt is fully back, a round is pushed by a spring from the magazine and so held that when the bolt is again pushed forward, it drives this round in front of it into the chamber. During this forward motion of the bolt, the firing pin within it, coming in contact with a sear which is operated by the trigger, is arrested. The bolt continues to go forward, compressing the mainspring which actuates the firing pin. The firing pin is then in the cocked position, and if the trigger be pulled the sear will disengage from the firing pin and the latter will fly forward to fire the round. Bolts are always designed with locking devices, so that when the bolt is fully forward it is firmly held to the breech, supporting the cartridge and sealing the bore against the pressure of gas. These locking devices must be strong, as the gas pressure generated by the explosion in modern military rifles may reach as high as 20 tons to the square inch. In short, it may be said that the heart of the whole rifle lies in the bolt and its components. Though breech actions are all of the bolt principle, there are, nevertheless, wide

and varied differences in such bolts. There are two main bolt systems namely "rotating" bolts, and "straight pull" bolts. Of these, the former are most common. Rotating bolts are those which, before they can be unlocked and drawn to the rear, must be rotated.

Primary Extraction.—On the explosion of the charge the cartridge case expands and grips the walls of the chamber, thus helping to seal the bore. When the pressure drops, the case should contract, but it may not do so sufficiently to ensure its easy extraction from the chamber. A rotating action has the advantage that, by means of sloping surfaces, a very powerful leverage can be exerted on turning the bolt by its lever, thus loosening the cartridge case in the chamber, before pulling the bolt to the rear. This loosening operation is called "primary extraction." Straight pull bolts can perhaps be operated a trifle more quickly without removing the rifle from the shoulder, but withdrawal of the bolt may be difficult, as there is no primary extraction.

Bolt Locking.—The locking devices most commonly employed take the form of studs, or lugs on the bolt, which when the latter is turned enter recesses in the body of the rifle, *i.e.*, the part into which the barrel screws and within which the bolt moves. These locking lugs on the bolt may thus be situated (*a*) towards the front or (*b*) towards the rear of the bolt and (*c*) variously situated. Theoretically, rear locking rifles are inferior to front locking, as the whole length of the bolt, back to the rear face of the lugs, is under compression, and fracture is more probable over this length. Moreover, the recesses for the lugs are towards the rear of the body; thus under the force of each explosion there is a tendency for the bolt to compress and the body to elongate, which may in time cause imperfect support of the cartridge in the chamber.

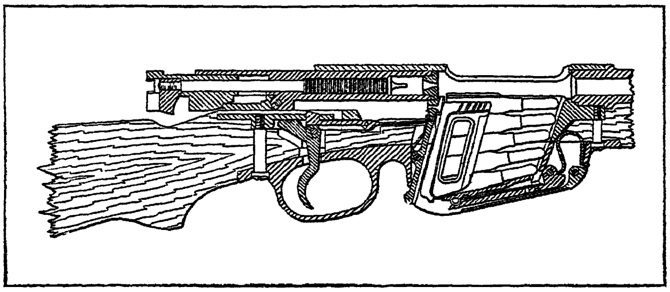
The British Lee-Enfield rifle has a rear locking bolt, but, though rear locking is weak in theory, this action did most satisfactorily all that was asked of it in the severest test that any rifle has had to undergo, namely the World War.

Furthermore, it was claimed for this rifle that the ease with which the bolt can be manipulated enables a higher rate of aimed fire to be delivered from it than from any other hand operated, bolt action rifle. Due to this rapidity of fire the Germans, in the first encounters of the war, attributed to the British Army many more machine guns than in fact they possessed.

The Swiss Schmidt-Rubin is a rifle with a rear locking bolt. The Krag-Jorgensen rifles of Norway and Denmark are types of (*c*), having one lug in front and another in rear and at a right angle to it. The large majority of military rifles are, however, locked in front, some, *e.g.*, U.S.A., having a third lug in rear. Some bolts are made in one piece throughout their length, others have a detachable bolt-head and are known as two-piece bolts. The merit of the two-piece bolt is that, should the bolt contract under the successive explosions of ordinary usage, a cheap and effective repair can be made by fitting a new bolt-head and so obviate condemning the whole bolt.

Sights.—The sights of military rifles should be strong, simple and easily legible; quickly adjustable, and not liable to movement due to the jar of recoil. They should also be sufficiently far from the eye and from each other to allow of quick and accurate aim being taken. The foresights are usually either a vertical "blade" or triangular "barleycorn." The backsights for alignment with these foresights are notches of either "U" or "V" shape respectively, or a circular aperture, which may be mounted on either vertical tangent or ramped radial sights.

Loading and Magazines.—Most nations now carry their ammunition in chargers or clips, which usually hold five rounds. When a charger is used, it is placed in guides on top of the body, thus permitting all five rounds to be pushed into the magazine in one movement, the bolt being first brought to its rearmost position. The charger is then removed, and, in action, thrown away. When a clip is used it is placed complete with its rounds in the magazine, at the bottom of which is a spring pushing the rounds upwards. When the last round has been taken from it, the clip falls out by its own weight through a hole in the bottom of the magazine. This hole is liable to permit of the entry of mud or dirt into the metal mechanism, however. The most common magazines in army use take the form of a vertical box underneath the bolt when in the forward position. A platform, mounted on a spring, keeps an upward pressure on the column of cartridges ensuring that the top round is always in position for the bolt to drive it forward into the chamber. The French Lebel rifle is now



"TEXT-BOOK OF SMALL ARMS," BY PERMISSION OF THE CONTROLLER OF H. M. STATIONERY OFFICE

FIG. 3.—MANNLICHER RIFLE, AUSTRIAN

so fitted, but not until 1915 was it converted, prior to which the rounds were held in a tube underneath the barrel, and were pushed to the rear by a spring plunger.

The box magazine in a different form is employed in the Krag-Jorgensen rifle of Norway and also in the Mannlicher-Schoenauer of Greece. In the Krag-Jorgensen the box is on the right and the rounds are pressed by a spring lever underneath the bolt and come round and up into position towards the left of the bolt face when it is withdrawn. In the Greek rifle the magazine platform rotates round an axis and against a spring. The rounds are loaded from the top, the platform yielding to the pressure of the loader's hand. When the bolt is to the rear this platform is caused by the spring to rotate in the opposite direction so feeding the rounds.

All rifles except those of France and Denmark are provided with a safety catch or bolt. This, when applied, prevents the firing pin from going forward if the trigger be pulled. Also, in most, its application prevents the bolt from being turned.

Types of Rifles.—Subject to minor variations, the military rifles of the principal nations are of the following distinctive types: Short Lee-Enfield (British), Mauser (German) Mannlicher (Austrian) *see* fig. 3, Lebel (French), Krag-Jorgensen (Norwegian and Danish), Schmidt-Rubin (Swiss) and Nagant Three Line (Russian). Including the United States of America the Mauser type is possessed by 22 different States. Details of the rifles of various different nations are given in the table on p. 808. All of the rifles shown in the table on p. 808 have rotating bolts with two exceptions, namely, the Austrian Mannlicher 1895 pattern and the Swiss Schmidt-Rubin.

SPORTING RIFLES

Modern sporting rifles using smokeless cordite, nitro-glycerine or nitro-cellulose powders are various and differ according to the requirements they are wanted to fulfil. Dangerous and non-dangerous game call for different requirements and the former can be subdivided into thick-skinned animals, such as elephant, rhinoceros, buffalo and bison; and thin-skinned, such as lion, tiger and leopard. For dangerous game a heavy bullet of big diameter with sufficient velocity to give a paralyzing blow is essential, but in addition high penetrative power is also required when engaging thick-skinned beasts.

Modern sporting rifles run from ·600 in. down to ·240 in. in bore and their ammunition also varies in weight and velocity of bullet, as well as its capacity to penetrate or expand on impact.

In the United States many sporting rifles of medium caliber and velocity are manufactured with tubular magazines under the barrel, and a breech action operated either by means of a finger lever or a sliding forearm. Such rifles will handle cartridges of medium breech pressure, suitable for American game, very effectively, but are not satisfactory for heavier cartridges necessary for the larger game of other continents, nor do they usually

Designation and date of pattern	Magazine system and capacity	Charger or clip	Weight	Weight of bayonet	Length	Bayonet length	Calibre mm./in.	Rifling no. of grooves	Twist in inches	Sights type	Sighted from–to
Great Britain: S.M.L.E. III	Detachable vertical box. 10 rounds	Charger	8 lb. 10½ oz.	1 lb. 1 oz.	3′ 8½″	1′ 4·2″	7·70/·303	5	10	"U" notch and blade	200–2,000 yd.
Austria: Mannlicher, 1895 (Bulgaria, Hungary)	Fixed vertical box. 5 rounds	Clip	8 lb. 5½ oz.	10¼ oz.	4′ 2″	9¼″	8·00/·315	4	9·842	"V" notch and barleycorn	300–2,600 m.
Belgium: Mauser, 1889	Fixed vertical box. 5 rounds	Charger	8 lb. 13 oz.	15 oz.	4′ 2½″	1′ 5″	7·65/·301	4	9·842	"V" notch and barleycorn	500–2,000 m.
Czechoslovakia: Mauser, 1924	Fixed vertical box. 5 rounds	Charger	9 lb. 2¼ oz.	14½ oz.	3′ 7″	11½″	7·90/·311	4	9·45	"V" notch and barleycorn	300–2,000 m.
Denmark: Krag-Jorgensen, 1889	Fixed horizontal box. 5 rounds	Neither	9 lb. 12 oz.	8½ oz.	4′ 4¾″	10¼″	8·00/·315	6	11·811	"V" notch and barleycorn	300–1,900 m.
France: Lebel, 1907–15	Fixed horizontal box. 5 rounds. (modified, 1916)	Clip	9 lb. 3 oz.	14½ oz.	4′ 3½″	1′ 5·3″	8·00/·315	4	9·451	Square notch and broad grooved block foresight	400–2,400 m.
Germany: Mauser, 1898	Fixed horizontal box. 5 rounds	Charger	9 lb.	14 oz.	4′ 1½″	1′ 8·35″	7·90/·311	4	9·5	"V" notch and barleycorn	400–2,400 m.
Greece: Mannlicher-Schoenauer, 1903	Fixed vertical box, rotary platform. 5 rounds	Charger	8 lb. 5½ oz.	10½ oz.	4′ 0¼″	10″	6·50/·256	4	7·874	"V" notch and barleycorn	400–2,400 m.
Holland: Mannlicher, 1895	Fixed vertical box. 5 rounds	Clip	9 lb. 4 oz.	11 oz.	4′ 3″	10″	6·50/·256	4	7·874	"V" notch and barleycorn	400–2,400 m.
Italy: Mannlicher-Cacano	Fixed vertical box. 6 rounds	Clip	9 lb. 0 oz.	13 oz.	4′ 2¾″	11¾″	6·50/·256	4	Increasing breech to muzzle 19¼–8¼	"V" notch and barleycorn	600–2,000 m.
Japan: Mauser, 1905, or year '38	Fixed vertical box. 5 rounds	Charger	8 lb. 12 oz.	1 lb.	4′ 3″	1′ 2½″	6·50/·256	6	9	"V" notch and barleycorn	400–2,400 m.
Norway: Krag-Jorgensen, 1910	Fixed horizontal box. 5 rounds	Neither	8 lb. 15 oz.	8½ oz.	4′ 2″	10¼″	6·50/·256	4	7·87	"U" notch and barleycorn	100–2,200 m.
Portugal: Mauser Verguiero, 1904	Fixed vertical box. 5 rounds	Charger	8 lb. 13 oz.	12½ oz.	4′ 0″	11¼″	6·50/·256	4	7·78	"V" notch and barleycorn	200–2,000 m.
Rumania: Mannlicher, 1893	Fixed vertical box. 5 rounds	Clip	8 lb. 12½ oz.	13 oz.	4′ 0½″	9¾″	6·50/·256	4	8	"V" notch and barleycorn	600–2,000 m.
Russia: Mosin-Nagant, 1900	Fixed vertical box. 5 rounds. With interrupter. 5 rounds	Charger	8 lb. 15 oz.	12 oz.	4′ 3·8″	1′ 4·2″	7·62/·30	4	9·501	"V" notch and barleycorn	400–2,700 paces
Spain: Mauser, 1896	Fixed vertical box. 5 rounds	Charger	9 lb. 6¾ oz.	14¾ oz.	4′ 0¾″	9¾″	7·00/·276	4	8·6	"V" notch and barleycorn	400–2,000 m.
Sweden: Mauser, 1906	Fixed vertical box. 5 rounds	Charger	8 lb. 14½ oz.	9¾ oz.	4′ 1½″	7¼″	6·50/·276	4	7·87	"V" notch and barleycorn	300–2,000 m.
Switzerland: Schmidt-Rubin, 1909	Detachable vertical box. 6 rounds	Charger	10 lb.	1 lb.	4′ 3½″	10¾″	7·50/·295	4	10·5	"U" notch and blade	300–2,000 m.
Turkey: Mauser, 1905	Fixed vertical box. 5 rounds	Charger	9 lb. 6 oz.	1 lb. 6 oz.	4′ 1″	1′ 8½″	7·65/·301	4	9·84	"V" notch and barleycorn	400–2,000 m.
U.S.A.	Fixed vertical box. 5 rounds	Charger	8 lb. 8 oz.	1 lb.	3′ 7¼″	1′ 4″	7·62/·300	4	10	"U" notch and aperture and blade	200–2,850 yd.

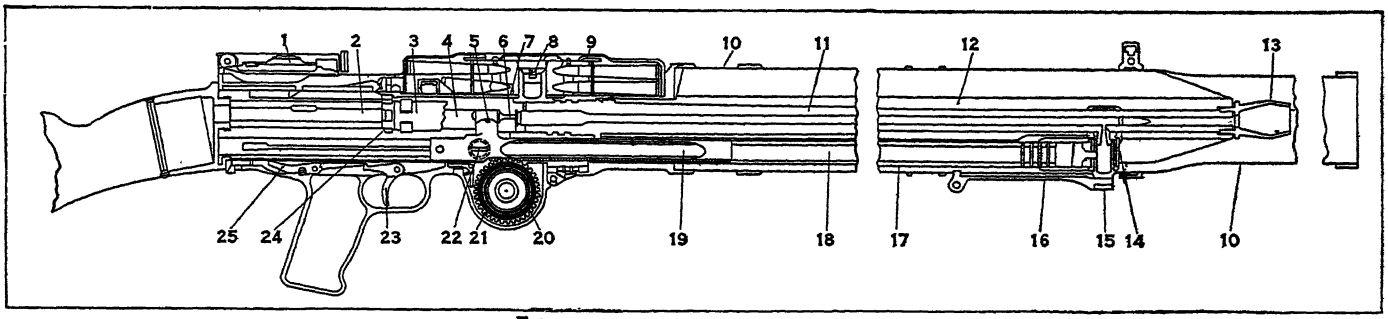


FIG. 4.—LEWIS GUN (LENGTH 50IN.)
(1) Back sight, (2) Receiver, (3) Bolt, (4) Extractor, (5) Stricker fixing pin, (6) Stricker, (7) Feed operation arm, (8) Magazine latch, (9) Magazine top plate, (10) Radiator casting, (11) Barrel, (12) Radiator, (13) Barrel mouthpiece, (14) Gas chamber, (15) Gas regulator cup, (16) Gas regulator key, (17) Gas cylinder, (18) Piston, (19) Rack, (20) Main spring, (21) Gear, (22) Charging handle, (23) Trigger, (24) Feed operating stud, (25) Stear

quite equal in accuracy the magazine rifles built on military bolt actions.

Such rifles usually take the form of either single barrel, double barrel or single barrel magazine weapons, the latter usually being on the lines of one of the well-known types such as Lee-Enfield, Mauser, Mannlicher and Ross.

Miniature rifles are used for instructional and competitive target shooting at short ranges and also for small game shooting, etc. The most usual bore is ·22 in., taking a rim-fire cartridge. Care should be exercised when using these in the field in closely cultivated countries, as this little bullet is capable of an extreme range of 1,250 yards.

Miniature rifle shooting has now become a favorite sport in Great Britain and the United States. It can be carried on almost anywhere as quite safe ranges can be built in or close to the larger cities. Firing is done up to 200 yards. In the United States a ·22 calibre miniature rifle similar to the Model 1903 military rifle has been issued to all troops, and has been found to be a very great aid and economy in target practice.

AUTOMATIC RIFLES

The term "automatic" when applied to a weapon implies the continuance of fire without cessation, on the trigger being pressed. "Semi-automatic" implies the firing of not more than one round for each pull of the trigger. Accordingly, the former may be described as a self-firer, and the latter a self-loader. In both cases the operations of extracting and ejecting the fired round and reloading the next one are derived from the power of the explosion. For military purposes, the self-loader is the more suitable, as with the self-firer a great deal more ammunition will often be expended than the circumstances require and there will be difficulty in keeping the firer supplied with ammunition. An automatic or semi-automatic rifle, to be carried by the soldier and handled like an ordinary military rifle, should not exceed about 10 lb. in weight.

The vibration and recoil of such a light weapon, during a "burst" of continuous fire, is such that it is impossible to hold the rifle so that the aim is maintained throughout. Thus, in practice, the first shot of the burst is the only one fired while the rifle is aimed on the mark, the rest being uselessly expended. In these circumstances the self-firer has no advantage over the self-loader and is more wasteful in ammunition. From the foregoing reasons it can be seen that though the term automatic rifle is used, the semi-automatic or self-loading rifle is the one usually intended. For such a rifle to rank as a complete offensive and defensive weapon, as does the military rifle, it must take the same ammunition and give the same ballistic results. Also it should lend itself to effective use in close combat when fitted with a bayonet.

Though a great deal of work has been devoted over a number of years and in various countries to endeavouring to produce a really reliable weapon, no army has yet adopted this form of fire-arm, although Germany in the World War, made and used a certain number of the Mondragon rifle, which originated in Mexico. With all the experience now available, and the continuance of experimental work and development, a really satisfactory weapon may perhaps become an accomplished fact. The problem, however, is one of great difficulty because, while such a rifle has necessarily to be almost of the same weight as the military rifle, it has to comprise, in addition to the parts present in that rifle, the extra parts required for the automatic operations, and these, to be durable, must add appreciably to the weight. In the past, gas and recoil operating systems have been tried, and also special ammunition, but although inventions have been numerous no rifle of this nature has been found sufficiently free from defect to warrant its adoption.

LIGHT MACHINE GUNS

A light machine gun is a truly automatic (self-firing) fire-arm which is portable but which is too heavy to be adapted for use as a close-combat weapon. The increased weight (17–28 lb.) makes the recoil energy less than that of the rifle, and as a rest is provided at the front end the continuous fire delivered remains reasonably accurate under ordinary conditions. To make the best use of this weapon much ammunition must be carried and it is accordingly manned by a team, one man carrying the gun and the others ammunition, spares and accessories.

Light Machine Guns in the World War.—Though the quest for the automatic rifle had started some years before the World War, up to 1914 the main armament of infantry in all armies was the rifle (with bayonet), and the machine gun averaging 40–50 lb. in weight, on a fixed mounting. The requirements which were encountered in the World War and which led to the introduction of the light machine gun are given above.

All these weapons are operated either by the gas or by the recoil generated by the charge, and all are now air cooled. All gas-operated weapons are practically identical in principle and where differences occur they are usually only in matters of detail. Usually, the gas is diverted through a hole in the barrel into a cylinder, where it strikes the head of a piston and drives it to the rear. Towards the rear of the piston are embodied devices which connect it to the "feeding" arrangements and also to those for sealing the breech and firing the round. The piston, when driven to the rear, compresses a spring which, having absorbed the thrust, returns it to its forward position. As the piston travels to the rear the following operations are performed—extraction and ejection of the fired round, and the presentation of the new round ready for insertion into the chamber. When the spring forces the piston forward, the bolt (mounted on the piston) drives the round into the chamber. During this movement, locking devices come into play and lock the bolt to the breech, thus sealing it and supporting the bolt against the explosion. This occurs before the finish of the piston's travel, so that the striker, carried on the piston, only strikes the cartridge cap after locking has taken place, and the weapon is accordingly "mechanically safe." Unlocking takes places after the piston has been driven a short distance to the rear, by which time the bullet is out of the barrel. In this respect also the weapon is "mechanically safe." A typical gas-operated light machine gun is the Lewis (*see* fig. 4) or Browning.

In recoil operated light machine guns, the mechanical systems employed are more varied than are those used in gas-operated

weapons, and there is no general principle to which they closely adhere. A feature common to all, however, is the recoiling barrel which overcomes the resistance of antagonistic springs. These, at the finish of its backward travel, return the barrel to its forward position. The length of recoil varies in different guns from about 1 in. to 5 in.; consequently they are classified as "long" or "short" recoil. (The length of the recoil is shown in the table below.) Another common feature is that the barrel and bolt (or lock) are mechanically locked together for a certain length of the recoil, thereby sealing the breech until the bullet is clear of the barrel. In "long recoil" actions, the bolt, having come back with the barrel, is held in its rearmost position, with the extractor engaged behind the rim of the cartridge which is still in the chamber. Accordingly, as the barrel moves forward under the influence of the springs which have been overcome in the backward travel, the round is withdrawn from the breech and ejected. The Chauchat, now obsolescent in the French army but adopted in that of Belgium, is a type of the "long recoil" gun.

In "short recoil" actions, such as that of the Bergmann gun of approximately one inch barrel movement, a form of mechanism is provided whereby the bolt, locked to the barrel for a certain length of recoil (created by firing) is unlocked and withdrawn about 3 in. from the barrel after the latter has completed its inch of recoil. In this separation of bolt and barrel, extraction and ejection of the empty case is effected, and a new round is inserted into the chamber. The Madsen action does not conform to the above description, as in this case the separation of breech from bolt is effected on recoil by guiding the bolt away from the barrel in a vertical plane, the bolt being pivoted in rear to permit this movement.

In "short recoil" guns, the recoil and the return of the barrel is the source of power for operating the mechanism which brings about the feeding of the cartridges into the gun, in the same way as does the piston in gas-operated weapons. Normally, with such guns the rounds are contained in a belt which is mechanically led through the gun, the rounds being withdrawn from it during its passage. In "long recoil" weapons, the system of feed is usually by magazine, the rounds being pushed by a spring inside the magazine into the space which is created when the bolt remains back as the barrel goes forward.

The Sub-machine Gun.—The sub-machine gun is a kind of automatic pistol, but heavier, more powerful, and with a longer range than the usual pattern of pistol. It is capable of a high rate of fire and is lighter than other automatics. The ammunition is similar to pistol ammunition. In the Thompson sub-machine gun the breech is sealed by the agency of inertia together with the adherence of inclined surfaces to those portions of the mechanism which support the bolt against the gas pressures generated within the barrel.

Some of the principal light machine guns employed during the World War and some of the newer types are tabulated below with a few details.

Locking Actions.—As the locking action is perhaps the most important part of the mechanism of any automatic weapon, a short description is given of the well-known method employed in the Vickers gun and also the unusual methods employed in the Schwarzlose (*see* fig. 6) and Revelli guns.

The Vickers.—The lock is connected to a crank by (1) a side lever head, whose axis we shall call *a*, and (2) a connecting rod, whose axis we shall call *b*. The axis of the crank we shall call *c*. In the locked position, axis *b* is slightly below axis *a* and *c*, and the crank, under *b*, bears on the crank stops. The rearward thrust of the cartridge on explosion thus passes through *a*, *b* and *c*. As *b* is lower than *a* and *c*, it cannot under pressure rise above the line *ac* and so unlock the action. It must tend downwards. However, the crank is already bearing on the crank stops under *b*,

TABLE I. *Light Machine Guns Used in the World War*

Country . . .	Britain		France			Germany			U.S.A.
Guns . . .	Lewis	Hotchkiss	Chauchard	Darne	Lewis	Madsen	Bergmann	Parabellum	Browning
Weight . . .	26½ lb. 18½ lb.*	28 lb.	19 lb.	15 lb. 14 oz.*	Same as British	20 lb.	25 lb. 12 oz.	22 lb.	15 lb. 14 oz.
How fed . . .	47 rd. magazine†	30 rd. strip 50 rd. belt** (Used in tanks)	20 rd. semi-circular box magazine‡	Belt¶		40 rd. box magazine§	Belt**	Belt**	20 rd. box magazine‡
How operated .	Gas	Gas	Recoil 5 in.	Gas		Recoil 2 in.	Recoil $1\frac{1}{8}$ in.	Recoil $\frac{7}{8}$ in.	Gas
How locked . .	Locking lugs on rotating bolt	Rotating threaded nut locks with threads on breech block	Locking lugs on rotating bolt	Bolt forced up by piston to lock in front of resistance shoulders		Breech block pivoted to open and close the breech	Locking block forced down into recess in bolt	Toggle joint as on Vickers machine gun	Hinged block rising in front of resistance shoulders in body

*Used in aircraft. †Horizontal on top of gun. **Into right side. ‡Vertically underneath. ¶Into left side. §Vertically on top.

TABLE II. *New Light Machine Guns Recently Adopted or Likely To Be Adopted*

Country . . .	Swiss, 1924	Japan	Russia	Denmark	Italy	Belgium	France	Czecho-slovakia
Gun	Fusil Furrer	Nambu	Fedorou* and various	Eriksen	Sia	Chauchard	Chatteller-Ault	Praga
Weight . . .	18 lb.	22¾ lb. (with bipod mounting)	11 lb.	24 lb.	23½ lb.	18 lb.	20 lb. (with bipod mounting)	$17\frac{5}{8}$ lb.
How fed . . .	30 rd.† magazine	Hopper taking 6 clips of 5 rounds each	25 rd. belt	50 rd. magazine	25 rd. magazine	20 rd. magazine	25 rd. vertical magazine	20 rd. magazine
How operated .	Recoil (long)	Gas	Recoil	Gas	Gas	Gas	Gas	. .
Locked or inertia .	Locked	Locked	Locked	Locked	. .	Locked	Locked	. .

*More a sub-machine gun than a light machine gun. †Into right side.

		Austria	France	Germany	Great Britain	Italy	United States
Pattern		Schwarzlose	Hotchkiss	Maxim (1908)†	Vickers Mk.I.‡	Revelli	Browning
Calibre		·315	·315	·311	·303	·256	·300
Weight, lb.	Empty	44	52	40½	30	37½	31½. Air service 24½
	With water for cooling	49¾	..	48½	40	48½	37
Cooling system		Water	Air	Water	Water	Water	Water
How operated		Cartridge* projection	Gas	Recoil assisted by gas	Recoil assisted by gas	Combination of recoil, inertia, and cartridge projection	Recoil
How fed		Belt, 250 rd.	Metal strips, 30 rd.	Belt, 250 rd.	Belt, 250 rd.	Magazine, 50 rd.	Belt, 250 rd.¶
Locking system		Inertia, heavy breech action having elbow joint and strong spring	Link on bolt dropping to lock in recess in body	Toggle joint	Toggle joint	Rotating wedge temporarily locking two moving parts	Locking block rising to engage with breech block
Mounting		Tripod, 43¾ lb.	Tripod, 70 lb.	4 legged sledge, 83 lb. Tripod, 65½ lb.	Tripod, 52 lb.	Tripod, 49½ lb.	Tripod, 54 lb. (1917)
How transported		Pack	One horse carriage and pack	Wagon or pack	Wagon or pack	Wagon or pack	Pack
Sighted up to (yd.)		2,620	2,190	2,190	2,900	2,190	2,800

*Rearward thrust of cartridge projects breech block to rear.
†During the World War the Erfurt gun was made. It was very similar to the 1908 gun, but weighed less: empty, 31 lb.; full, 37 lb. Tripod 51½ lb.
‡Mark II. gun is for aircraft. It is air cooled and uses a metal disintegrating link belt (any length).
¶Belts for aircraft are of metal disintegrating links.

hence no movement here is possible and so the locking action is effected.

Except that the crank revolves downwards instead of upwards, the system of locking in the Maxim gun is practically identical with that employed in the Vickers.

Inertia Sealing of the Breech in the Schwarzlose.—There is no positive locking in the gun, reliance being placed in heavy moving parts and a strong spring, to induce sufficient inertia to seal the breech. With a view to ensuring the exit of the bullet from the barrel before the inertia is overcome, the barrel is abnormally short.

The mechanism includes a massive, heavy breech block *a*, connected by a crank link to the upper axis of a crank. The lower axis of the crank works in bearings in the body-casing of the gun and has no backward or forward movement. In rear is a strong spring pushing the bolt forward. The thrust on the face of the breech block pulls the crank link to the rear. It, in turn, pulls the crank to the rear.

However, owing to the set of the crank in relation to the lower non-recoiling axis, much resistance to the rearward motion of the breech block is set up. Thus it is that, coupled with the heavy resistance offered by the strong antagonistic spring and the weight of the moving parts, sufficient inertia is created to prevent the breech from opening prematurely.

The Revelli.—On explosion, a barrel with a sleeve *a* recoils, and the gases, acting through the cartridge head, impart a rearward movement to a breech block *b*. At this stage, the breech block and sleeve are held together by a claw, on a rotating wedge. The rearward movement of the Revelli breech block causes the wedge to rotate to the rear. In so doing, the claw, which passes through a slot in the sleeve, bears against the latter at the shoulder, and helps to force the sleeve and barrel rearward. After *a* and *b* have moved about 4 mm., the claw is entirely disengaged from the breech block, which continues to the rear under its own momentum. The wedge in rotating compresses a strong spring, so the tip of the claw bears against the under side of the breech block, and is prevented from regaining its forward position. Hence the sleeve cannot do so until the recess in the breech block returns to within 4 mm. of its forward position.

MODERN MACHINE GUNS

The machine gun is an automatic small-arm weapon, usually provided with a fixed mounting and capable of sustained accurate fire. A heavy machine gun does not differ materially from an ordinary machine gun in design, but as its calibre may be from 0·5 to 0·9 in., it is necessarily of a heavier and stronger make. The weight of a machine gun, however, if in the hands of infantry or cavalry, is limited by the consideration that, by whatever means it may be transported, it must in the last resort be "man-handled" into position often over considerable distances and under difficult conditions. On the other hand, lightness and portability are desirable only in so far as they are consistent with strength, for to a large extent it is on the strength and, therefore, weight of the mechanism that the ability of a gun to sustain fire depends.

Mounting.—The fixed mounting with which the machine gun is provided increases the accuracy of all ordinary shooting, and thus enables the gun to be used either for indirect fire or for fire over the heads of friendly troops, when supporting an attack or covering a retirement. To support rigidly a machine gun weighing from 40 to 50 lb., the mounting must be strong and fairly heavy, otherwise the combination will be top heavy and unsteady, and the shooting in consequence will be inaccurate. The mounting must permit of the gun being traversed through as wide an arc as possible, and also permit alterations to be made in elevation.

Machine guns for ground use normally have a rate of fire of about 450–500 rounds per minute, but, owing to the necessary replenishment of empty belts or magazines, etc., the number of rounds actually fired per minute is much less. In aircraft a higher rate of fire is desirable and is usually obtained.

Cooling Systems.—For sustained fire an efficient cooling system for the barrel is essential. The higher the temperature of the barrel, the less its resistance to wear. There are two systems in use, namely, radiation in air and water-cooling. Heavy barrels with radiating rings are sometimes employed for ground use (*e.g.*, the French Hotchkiss). The water-cooling system is the most common. The barrel for nearly the whole of its length, is surrounded by water contained in a casing which, with recoiling barrels, is fitted with glands to prevent leakage. Inasmuch as prolonged rapid fire causes the water to boil, a steam escape is

necessary. Accordingly a flexible tube is usually attached to the steam escape whereby the steam is led to a portable condensing chamber, and converted back into water for use again in the gun. The water increases the weight of the gun by about 9 lb., and for this reason light machine guns rely on radiation for their cooling.

Mechanical Safety.—All automatic weapons are required to be "mechanically safe," that is, the design must be such that the gun cannot be fired unless the action is fully closed and the cartridge properly supported. Even then, it should only be able to fire by means of the trigger mechanism, which itself must be proof against heavy jarring. Safety catch ("applied safety") devices should operate directly on the firing pin or striker, and should preclude the possibility of this ever being able to reach the cartridge by accident.

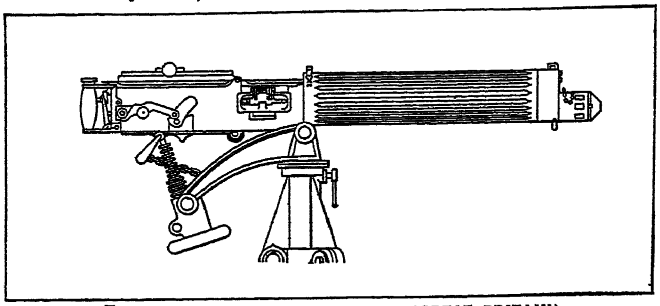


FIG. 5.—VICKERS MACHINE GUN (GREAT BRITAIN)

For the automatic operation of machine guns power may be obtained in three distinct ways, viz., from the gases generated by the explosion of the charge, from the recoil of the barrel, and from the backward thrust of the cartridge on explosion. In some types of gun two of these principles of operation are combined. The French Hotchkiss gun is gas operated, on principles which have been explained in connection with light machine guns.

Barrel Recoil Only.—In the U.S.A. Browning water-cooled gun, when a round is fired, the barrel, barrel extension, and breech-block move backwards locked together for $\frac{5}{8}$ inch. A locking block is forced down clear of the breech-block, and the latter travelling further to the rear compresses the mainspring. A lever working in a slot on the breech-block operates a slide, which, by means of pawls, feeds the belt of cartridges into the gun. On the breech-block is carried the extractor which takes a round from the belt as the breech-block goes backwards, and places it in guides on the front of the block. When the breech-block is driven forward by the mainspring, the lever and slide move to grip a new round, and the round already in position is placed in the chamber. The trigger action inside the breech-block is cocked during the backward movement. This action is so designed that the trigger is unable to operate the sear unless the breech-block is fully forward and therefore locked. The gun is thus mechanically safe.

Recoil and Gas.—In the Vickers gun (*see* fig. 5) gas is trapped at the muzzle and rebounds on to a muzzled cup screwed to the barrel, thus augmenting the recoil. For about $\frac{1}{2}$ in. of recoil the barrel and lock are held together in the locked position. By this time the bullet is clear of the barrel and the unlocking begins. Attached to trunnions on the barrel are side-plates which move with it. Over the breech is the feed block into which the cartridge belt is fed by a slide similar to that used in the Browning, but operated by a lever in the left side-plate. Further to the rear and between the side-plates is the crank with the connecting rod to which the lock is attached. The crank is prolonged outside to the right of the gun and on it is mounted a crank-handle. This latter is so shaped that on coming into contact with a "roller" during the recoil it is rotated upwards and to the rear. This causes similar movement of the crank and by this means the lock is withdrawn from the breech. A strong spring on the left of the gun called a fuzee spring is put into tension by the rotating of a fuzee to which the spring is attached at the left hand of the crank. The barrel and side-plates are returned to their forward position by a secondary movement due to the crank-handle and roller, but the lock is brought forward by the rotating action given to the crank by the fuzee spring. On the face of the lock is the extractor. When the lock goes to the rear the extractor drops, but rises again to its full height when the lock is fully forward. During rapid fire when the extractor is up it is gripping a live round in the feed-block, and supporting the round in the chamber. When the lock travels to the rear the extractor drops, and the spent round is extracted and ejected through the bottom of the gun, and the live round is brought to the same level as the chamber. As the lock goes forward the live round is placed in the chamber and the extractor completes the cycle by rising again to grip another live round in the feed-block. The firing pin and spring, sear and trigger, etc., are contained within the lock. A firing lever operates the trigger and so long as this firing lever is pressed, this cycle of operations will continue as described.

Cartridge Projection.—The Austrian Schwarzlose (*see* fig. 6) is inertia operated, *i.e.*, the backward thrust of the cartridge drives to the rear a heavy breech-block against a strong spring, which in turn pushes it forward. To ensure against the cartridge gripping the chamber too tightly and so having insufficient thrust, provision is made to oil each cartridge before its insertion into the chamber. The cartridge belt is led from the right on a toothed wheel situated below and in the rear of the barrel. This wheel is rotated by the movements of the breech-block. A claw at the bottom of the breech-block draws a cartridge from the belt on to the rotating wheel and this places the round in front of the breech-block to be driven forward into the chamber. A heavy firing pin passes through the breech-block and is pressed forward by the mainspring. An arm is connected to the firing pin and it has on it a bent or step which engages on a similar bent on the breech-block when the firing pin is cocked. A trigger bar when drawn to the rear by a thumb piece at the end of the gun raises this arm and when the bents are disengaged the firing pin flies forward to fire the round. Ejection is to the left and is effected by a plunger on the right side of the breech-block.

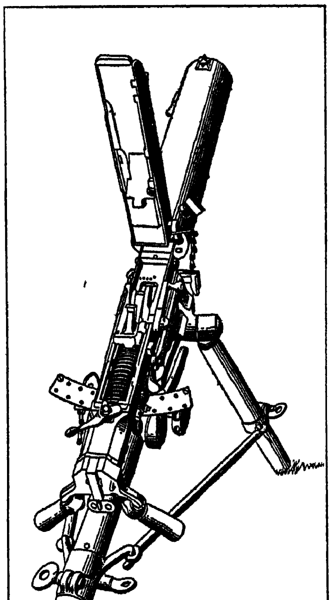


FIG. 6.—SCHWARZLOSE MACHINE GUN (AUSTRIA)

Recoil and Cartridge Projection.—The Italian Revelli uses a combination of barrel recoil and cartridge projection. A sleeve is attached at the rear of the barrel. Inside this sleeve lies the breech-block and inside the latter is the firing pin and mainspring. This spring drives the breech-block and the firing pin forward. On firing, barrel, sleeve and breech-block move together to the rear a distance of 4 mm., after which the breech-block goes on free for about 6 in., compressing the mainspring. The locked motion of these principal components is explained above under "Locking Actions." A sear which engages with the firing pin is operated by a thumb piece plunger at the rear of the gun, which, when pressed, disengages the sear and firing pin. A secondary sear is also provided which prevents the gun from being fired if the moving parts are not fully forward and the gun is thus mechanically safe.

This is the only well-known water-cooled machine gun which is not belt fed. The cartridges are contained in a magazine holding 50 rounds, there being ten compartments, each with platform and spring. The breech-block on going forward takes the top round from the first compartment and when this is emptied the magazine is caused to move to the right so bringing the next compartment into action and so on until the fiftieth round is fired, when

the magazine is knocked clear of the gun. A secondary mechanical safety device consists of a small plunger protruding into the inside of the breech-block. The firing pin on going forward meets this and drives it out and towards the left. A recess is made in the body casing so positioned as to take this plunger when the breech-block is fully forward. If the latter is not fully forward,

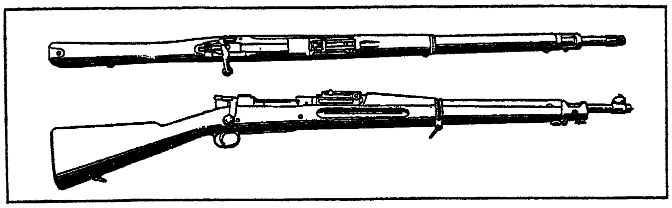


FIG. 7.—SIDE AND TOP VIEWS OF U.S. 30 CALIBRE RIFLE

the plunger cannot move into the recess and its tail prevents the firing pin from protruding.

FUTURE DEVELOPMENTS

From the soldier's or hunter's point of view there exist certain features of small arms and their ammunition upon which it would be desirable to improve. To both the requirement of seeing without being seen is ever present. The flash of the explosion is, however, unmistakable, especially at night, and at once discloses the presence and the position of the firer. Possibly in the future a special powder or other means will be devised which will reduce or even eliminate the flash of the discharge. Such powders have been produced in the United States, Silence, too, especially if coupled with a flashless discharge, would increase the probability of the firer remaining undetected. In the past, attempts have been made to reduce the noise of the explosion by means of a silencer, but apparently they have not met with such success as to have merited adoption.

Metallic Fouling.—"Metallic fouling" in the barrel is another and ever-present trouble. It is produced by the bullet envelopes, usually composed of an alloy of copper and nickel, which, when travelling at a high velocity, are prone to leave behind small particles of the envelope adhering to the bore, thus spoiling its true cylindrical form and so causing inaccuracy in the shooting. Metallic fouling when steel envelopes are used, is practically negligible, but a difficulty with these which has not as yet been generally overcome is to manufacture a steel or other substance which, while being tough enough not to leave particles in the bore or to erode it unduly, will yet be soft enough to permit of its expanding sufficiently to "bottom" in the grooves of the rifling, and so prevent escape of gas past the bullet and avoid the troubles that arise from such a cause. This expansion of the base of the bullet is known as "set up."

In the United States metallic fouling has now been practically eliminated by the substitution of a jacket metal composed of copper 90 parts, zinc 10 parts, for the usual cupro-nickel jacket.

Stream-line Bullets.—A bullet of stream-line contour has of recent years come into prominence, and is employed by Switzerland and in the United States. Its great merit is that, owing to its shape, it far outranges the bullet having a cylindrical body and tail. Owing however to its tapering tail, which precludes the possibility of "set up," the difficulty of sealing the grooves against the gas pressure developed has not as yet been so generally overcome, that such bullets, made in mass production, will continue to shoot accurately as the barrels suffer wear.

Armour-piercing.—Armoured vehicles are no doubt still in the early stages of development, and the means to counteract them is yet to seek. It seems unlikely that reliance can be placed in the machine gun of the usual bore for this purpose, and that other or heavier weapons, possibly of an automatic nature, will be developed which will be able more adequately to deal with such vehicles. Allied to this problem is that of increasing the penetrative power of armour-piercing bullets. For penetration, a hard projectile having a high velocity is essential, but a difficulty still to be overcome is the tendency of the very hard bullet to splinter without penetrating.

Capacity to vary the rate of automatic fire has much to recommend it and should be capable of accomplishment. Until now, the only machine gun in which such a regulator is embodied is the French St. Etienne (Puteaux), since superseded by the Hotchkiss.

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SMALL HOLDINGS. The term "small holding" was first given an arbitrary definition by the British Parliament in the Small Holdings Act of 1892. This empowered county councils to acquire land for the provisions of "small holdings"—*i.e.*, holdings of not more than 50 acres in extent, or exceeding £50 in annual rateable value. (This sum was increased in 1926 to £100.) But "legal definitions and arbitrary size limits have no relation—or at most a very rough relation—to economic facts." All holdings of agricultural land fall into one of three classes from the economic point of view, viz.—

1. Those which are cultivated personally by persons whose living is earned otherwise.
2. Those which are cultivated by the occupier (whether owner or tenant) and his family without help—or with only the occasional help—of hired labour.
3. Those which can only be cultivated with the regular help of hired labour.

The term "small holding" is sometimes applied to the first class—to which however in Great Britain the term "allotment" is more generally applied—but it is to the second class that it is properly confined. In other words a small holding is a "subsistence" or "family" holding. It is, throughout the Continent, and over the greater part of the rest of the world where settled agriculture exists, the predominant form of land occupancy. There are in most continental countries a number of large farms (although post-war legislation has in some countries markedly reduced them) but small holdings represent the agrarian system of the greater part of Europe, as well as of India, Japan and China. In England under the feudal system, the typical holding was that of the villein, consisting of a number of detached strips in the common-field, but there were from the first in most manors, but more so in some parts of the country than others, a number of separate small holdings in exclusive occupation. As copyhold tenure gradually extended the number of small holdings increased.

The Decline of British Small Holdings.—For centuries in England, throughout the prolonged modification and ultimate disappearance of the feudal system, there was probably, on the whole, a gradual increase in the number of independent small holdings, mostly owned by the occupiers, or, in the case of copyhold holdings, held in quasi-ownership. The progress of the movement was interrupted from time to time, notably by the Black Death and in the enclosing and land-grabbing period of the 15th and 16th centuries. But it is generally agreed by economic historians that on the whole the distribution of agricultural land in small holdings, or "family" farms, continued more or less progressively down to the last great enclosure movement, which began in the latter part of the 18th century.

In a modern work on enclosure it is stated that "the movement for the enclosure of arable open and common fields has been a movement for the sweeping away of small holdings and small properties." This might be expressed differently as it is hardly justifiable to suggest that the abolition of small holdings was the chief object of enclosure. But whatever may have been the intention there is no doubt that the result was a drastic reduction in the number of small holdings. Thousands of small holdings consisted of a few acres of land attached to a cottage which gave rights of common. The common provided pasturage for cattle (in limited numbers) and for a horse or donkey, and without this the successful carrying on of the small holding was impossible. When the common was enclosed an allotment of land pro-

portionate to his interest was made to the commoner, but this in many cases was little more than a mockery. The piece of land allotted might be far from his cottage, and as the obligation to fence it rested on the allottee it was of little value and an offer from a larger landowner to buy it was usually accepted. Thus the small holding disappeared and the small holder became a labourer.

The Revival of Small Holdings.—As the conscience of the nation began to awaken after the period of callous materialism which distinguished the industrial revolution, the social and agrarian consequences of the decline of small holdings aroused attention. A few landowners provided facilities for the acquisition of small holdings by offering land in convenient quantities on easy terms. Associations were also formed by well-meaning, but in some cases ill-advised, persons to stimulate the formation of "colonies" of small holdings, the most famous being the National Land Company started by Feargus O'Connor in 1845. This company bought five estates in different counties—Oxford, Gloucester, Worcester and Hereford—cut them up into two, three and four acre lots with a house on each, and made the necessary roads and fences. Shares were offered, each carrying the right to ballot for priority in the allotment of land. In three years more than £90,000 was subscribed by 70,000 persons. The financial basis was unsound and in 1851 the company was dissolved and the estates passed into the hands of a receiver. Miss Jebb set out the reasons for failure as follows: (1) the fact of the original settlers being all townsmen ignorant of agriculture; (2) that they were established under conditions in which it would have been impossible even for an agriculturist to gain a livelihood; (3) the purchase of unsuitable estates, partly owing to the want of practical knowledge on the part of the directors themselves and partly to the great hurry in which land was bought to satisfy the clamours of shareholders; (4) the financial difficulties which arose partly from the scare of the shareholders on finding that the company was illegally constituted. Many other efforts were made, with varying success to provide land for small holdings but the difficulties were great.

One misconception was common among those whose personal knowledge of rural England was restricted. Many of them seemed to think that a small holding was an exotic plant and that the possibility of establishing it in this country required demonstration. In fact in many districts small holdings are indigenous. The nature of the country, soil, situation and climate have determined from time immemorial that only small farms can be successfully managed. Typical districts of this character are the West Riding and large parts of Devon, Cornwall and Lancaster. In the West Riding 70% of the holdings are under 50 acres. The Evesham district of Worcestershire and parts of the eastern counties afford instances of groups of small holdings which have been naturally formed in recent times by the influence of new economic conditions.

State Action.—On the basis of the report of a departmental committee of 1899, which reported in 1890, the Small Holdings Act was passed in 1892. It gave power to county councils to purchase land and adapt it for small holdings which were to be let or re-sold on a deferred payment system. One-fifth of the purchase money was to be paid down and the rest with interest to be paid off in a term not exceeding fifty years. Any elector could petition the county council alleging a demand for small holdings. The council were then to appoint a small holdings committee to enquire into the demand and if it was found to be made "in good faith and on reasonable grounds" to take measures to acquire suitable land in the district. They were empowered to spend a sum not greater than the proceeds of a rate of 1d in the £. Money could be borrowed from the public works loan commissioners at 3½%. If unable to purchase land the council were empowered under certain conditions to take it on lease. The results of this legislation were in fact disappointing.

The Act of 1908.—A much more comprehensive enactment was the Small Holdings and Allotments Act, 1908. This introduced the principle of central initiative and supervision. The Board (now the Ministry) of Agriculture was empowered to appoint small holdings commissioners who were to ascertain the extent to which there was a demand for small holdings in the several counties, or would be a demand if suitable land were available, and the extent to which it was reasonably practicable to satisfy the demand. With this object the commissioners were to confer with county councils and after due deliberation were to report to the board whether it was desirable to adopt a scheme for the provision of small holdings in the county. If they so reported a scheme was to be prepared by the county council, or in their default, by the commissioners, specifying, *inter alia* (a) the localities in which land was to be acquired for small holdings; (b) the approximate quantity of land to be acquired, and the number, nature and size of the small holdings to be provided in each locality; (c) whether and to what extent grazing or other similar rights should be attached to the small holdings. A scheme when adopted and approved by the board was to be carried out by the county council concerned, the board having power, if the council declined or neglected to do so, to carry it out and to charge the cost to the county fund.

County councils were by this act given power to acquire land compulsorily for small holdings if they were unable to obtain land suitable for the purpose on reasonable terms by agreement. The financial limitation of the Act of 1892—*i.e.*, that the annual charge on the county should not exceed the amount produced by a rate of 1d in the £—was continued. Under this act about 14,000 small holders were settled on the land as tenants of county councils. One-sixth of the holdings were provided with houses. The sinking fund was included in the rent paid by the occupier and criticism was aroused by the fact that the occupier had thus to pay the purchase money, although the land remained the property of the County Council.

Ex-service Small Holdings.—The outbreak of the World War suspended operations under the Act of 1908 and the commissioners were given other duties. After the war the subject was regarded from a new angle. The main object of the Small Holdings Colonies Act 1916 and 1918 was to provide small holdings on specially favourable terms for ex-service men, and particularly to promote the establishment of "colonies," *i.e.*, groups of small holdings, which would facilitate co-operation among the small holders. Difficulties arose in connection both with the acquisition and equipment of suitable land and also from the total unacquaintance, in many cases, of applicants with rural conditions. Another act—the Land Settlement Facilities Act—was passed in 1919 to give further powers and simplify the somewhat complicated administrative machinery.

The net result of the effort was that a number of ex-service men were settled on the land at a lavish expenditure of public money, the total cost to the exchequer being about £10,000,000. The purchase of land began just when extravagantly high prices were being realized in the boom of 1919–20. The average rate of interest on loans was 6½%, and the cost of building and general equipment was at its maximum, and about double that of pre-war times. Many ex-service men, disappointed and discouraged by the delays, withdrew their applications. Those who obtained holdings were in many cases wholly inexperienced in farming, and had at once to face a period of steadily falling prices which ruined many old-established farmers.

The Act of 1926.—The scheme for the settlement of ex-service men on the land under the Act of 1919 came to an end on March 31, 1926. Under the scheme 16,500 small holdings were provided by county councils and county borough councils on an area of 256,000 acres. But it was explained by the minister of agriculture as the justification for further legislation, that there were known to be not less than 6,000 approved applicants who had not been provided with land, and that there was a further latent demand, the extent of which could not be estimated. There was, however, the minister stated, "no practical possibility under present financial conditions, of satisfying the demand for further small holdings either under the Act of 1919, or the Small Holdings and Allotments Act, 1908, owing to the statutory requirement that councils must only provide holdings on a self-supporting basis."

The previous acts although providing certain facilities for the purchase of small holdings were mainly directed to the provision

of holdings to be let to the small holders. They tended to discourage purchase and encourage tenancy by the fact that a small holder wishing to buy his holding had to pay its full value over a term of years, with interest at the current rate on the deferred payments, whereas a tenant occupies his holding at a fair rent, which may bear no relation to the capital value and still less to the actual cost of providing it. The object of this act was to offer applicants desirous of becoming owners terms equally favourable to those open to tenants. The act continued the existing powers and duties of county councils but authorized them if necessary to incur losses, which would be met up to 75% by the Treasury. The holdings may be let or sold. If let a "full fair rent," *i.e.*, the amount a tenant might reasonably be expected to pay if the landlord did the repairs, is charged. If sold the price paid takes the form of an annuity equal to the "full fair rent" of the holding, payable in half-yearly instalments for a term of 60 years.

Cottage Gardens.—The terms "small holdings" and "allotments" have long been in use, but the Act of 1926 instituted a new class. County councils are empowered to provide holdings comprising a dwelling house together with not less than 40 perches and not more than three acres of agricultural land which can be cultivated by the occupier of the dwelling house and his family. "Cottage holdings" are to be sold to the occupiers in consideration of the payment of an annuity equal to the "full fair rent" for a period of 60 years. Only a *bona fide* agricultural labourer or person employed in a rural industry is qualified to become a purchaser. The county council has to be satisfied that he has the intention, knowledge and capital to cultivate satisfactorily the land forming part of the cottage holding. The term "rural industry" is defined as an industry carried on in or adjacent to a village, being an industry ancillary to the industry of agriculture or horticulture.

Public Landownership.—One result of the English small holdings legislation is that county councils are now extensive owners of agricultural land. The power of acquisition was conferred in 1908 and in the aggregate a considerable area is under the control and administration of the councils. At the end of Nov. 1924, 384,052 acres were in the possession of the English counties, the amount ranging from 27,861 acres held by Norfolk and 26,257 acres held by Somerset to 219 acres held by Westmoreland. Of the total area administered by the English counties about four-fifths is owned by them, the other fifth being held on lease. In Wales about 58,000 acres are administered under the act, making altogether about 442,000 acres in England and Wales. Nothing more forcibly demonstrates the progress of public opinion than this large transfer of agricultural land from private to public ownership and the fact that it has been done by general consent.

The Economics of Small Holdings.—The relative advantages of large and small farms have long provided a field for animated controversy. The arguments in favour of the large farm are forcible. They are given in a recent work and may be quoted:—

> In the production of all commodities for which there is a large and constant demand the tendency is to make the fullest possible use of machinery. The profitable use of machinery depends on the relation of its output to its prime cost. If it can be used up to its maximum capacity the maximum profit from its use is obtained. In the case of agricultural machinery and implements it is impossible to use them to their maximum capacity because farming operations, unlike those of manufacture, cannot be continuous but are dependent on uncontrollable conditions such as the time of year and the weather. A steam plough for example, is capable of working every day in the year but it can only be used on a certain number of days. On a "medium-sized" farm its use is restricted not only by such conditions but also by the limited area on which it can be usefully employed. By extending the area of the holding the farmer has sufficient land to use the plough to its maximum capacity at all times when conditions permit. This applies to the whole mechanical equipment of the farm, though with less force to stationary engines which can supply motive power for various operations, some of which, like chaff-cutting, can be done at all times of the year. Somewhat similar considerations apply to manual as to mechanical power. With a large staff labour can be more effectively organized and work specialized. Shortly, the advantage of the large-scale farm, as of the large-scale manufactory or shop, is that overhead expenses are charged to a larger output.

The small holder has none of these advantages. He is frequently inadequately equipped with implements and machinery. For times of pressure such as hay-time or harvest he often has insufficient labour, both horse and manual, and has consequently to arrange with a neighbour for mutual help. If he is the tenant of a public authority or of a good landlord his cottage, buildings, fences, etc., are probably kept in good order, but if, as often happens, the owner is himself (or herself) a "small" landlord the condition of the small holding is likely to be very bad. Usually the small holder has limited capital and in marketing his produce—unless he is fortunate enough to sell it direct to the consumer—he is generally handicapped in competition with larger farmers. His life is as a rule one of unremitting toil, from dawn to dark. Yet multitudes of small holders are contented and happy in their lot, and so long as they can make a modest living do not complain.

The reason is primarily psychological. A man will work for himself without stint, whereas if he is working for another he, unconsciously or consciously, regulates his work by his remuneration. The incentive of personal reward proportionate to personal effort goes far to explain the small holder's attitude. The sociological advantages of small holdings in maintaining a class attached by the strongest of ties to the land are evident. Notwithstanding what has been said about large-scale farming small holdings have certain economic advantages of which the chief is the close personal supervision of the farmer himself. There is no doubt, that, especially where stock is kept, this is an important factor. Again the labour difficulties to which reference has been made lead the small holder to deal, so to speak, in small lots in arranging his cropping and to avoid "putting all his eggs in one basket." Thus if his gains are small his losses are never very serious.

The economic effect of the size of holdings has not been investigated. It is one of the many questions which the new science of agricultural economics (*q.v.*) must take up. The subject is complicated because in comparing one farm with another, or even one group of farms with another, it is difficult to isolate a single factor—size—from all other factors which affect output and profit. But it is commonly considered among agricultural economists on both sides of the Atlantic that "both the capital invested and the output per acre are larger on the smaller farms, but that expenses per acre are also heavier, while the output per man tends to increase with the size of the holding." The relative advantages of ownership and tenancy of small holdings have been warmly discussed in England. The position has been somewhat curious. Up to the latest act, that of 1926, the legislature definitely discouraged the purchase of holdings, while, whenever the question was tested, all the evidence tended to show that with few exceptions there was no desire to become owners and that tenancy was preferred. There were, however, many who strenuously maintained that the preference for tenancy was attributable to the unattractiveness of the terms for purchase.

That ownership provides an incentive which is absent when a man is putting his labour into land not his own has long been accepted as a self-evident proposition. Arthur Young's dictum that "the magic of property turns sand into gold" has been regarded as demonstrating the fact. Plausible as the theory is, in practice there is no evidence that there is any general superiority in production or otherwise on holdings that are owned over those that are rented. Some investigations on the point have been made, mainly in the United States. The results are not conclusive but they fail to indicate that ownership is a dominant factor. This is another subject waiting further study by agricultural economists.

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SMALL ISLES, a parish of islands of the Inner Hebrides, Inverness-shire, Scotland. It consists of the islands of Canna, Sanday, Rum, Eigg and Muck, lying, in the order named, like a crescent with a trend from north-west to south-east, Canna

being the most northerly and Muck the most southerly. They are separated from Skye by Cuillin Sound and from the mainland by the Sound of Ardnamurchan. The surface is moorland, pasture and mountain. They are rich in sea-fowl, and the fisheries include cod, ling and herring. Steamers call regularly at Eigg, Rum and Canna. Antiquarian remains at Canna include a weather-worn sculptured stone cross and the ruins of a chapel of St. Columba. On the north-east coast of Eigg is a cave with a narrow mouth, opening into a hollow 255 ft. long. In it Macleod of Skye, towards the end of the 16th century, ordered 200 Macdonalds to be suffocated, their bones being found long afterwards.

SMALLPOX or **VARIOLA,** an acute infectious disease characterized by fever and eruption, which, after passing through various stages of papule, vesicle and pustule, dries up, leaving more or less distinct scars.

By far the most common cause of conveyance of the disease is contact with the persons or the immediate surroundings of those already affected. The direct cause is unknown. The disease is probably communicable from its earliest manifestations, but it is generally held that the most infectious period extends from the appearance of the eruption till the drying up of the pustules. No age is exempt from susceptibility. One attack of smallpox as a rule confers immunity, but there are numerous exceptions to this rule. Overcrowding and all insanitary surroundings favour the spread of smallpox where it has broken out; but the most influential condition is the amount of protection afforded to a community by previous attacks and by vaccination (*q.v.*). Such protection, although for a time most effectual, tends to become exhausted unless renewed. Hence in a large population there is always likely to be an increasing number of individuals who have become susceptible to smallpox. This probably explains its occasional and even apparently periodic epidemic outbreaks in large centres, and the well-known fact that the most severe cases occur at the beginning—those least protected being necessarily more liable to be first and most seriously attacked.

Symptoms.—The following description applies to an average case. Onset of the symptoms is preceded by a period of incubation, believed to be from ten to fourteen days. The invasion is sudden and severe, in the form of a rigor followed by fever (the *primary fever*), in which the temperature rises to 103° or 104° Fahr. or higher. A quick pulse, intense headache, vomiting and pain in the loins and back are among the most characteristic initial symptoms. These symptoms continue for three entire days. During their course there may occasionally be noticed, especially on the lower part of the abdomen and inner sides of the thighs, rashes resembling scarlet fever and measles, less frequently a fine haemorrhage or petechial eruption develops. These "prodromal rashes," appear to be more frequent in some epidemics than in others. On the third or fourth day the characteristic eruption begins to appear. It is almost always first seen on the face, particularly about the forehead and roots of the hair, in the form of dusky red erythematous spots which in the course of a few hours develop into true papules more or less thickly set together. The eruption spreads over the face, trunk and extremities in the course of a few hours—continuing, however, to come out more abundantly for one or two days. It is always most marked on the exposed parts. On the second or third day after the appearance of the papules they change into vesicles filled with clear fluid and show a slight central depression, giving the characteristic umbilicated appearance. The clear contents of these vesicles gradually become turbid, and by the eighth or ninth day they are changed into pustules. The fully developed pocks increase in size and lose the central depression.

Accompanying this change there are often marked inflammation and swelling of the skin, which render the features unrecognizable. The eruption is also present but in a modified form on the mucous membranes, that of the mouth and throat being affected early, and the swelling produced here is a source of danger, from obstruction in the upper air-passages. The mucous membrane of the nostrils may be similarly affected. The eyes may also be involved, to the danger of permanent impairment of sight. The fever which ushered in the disease quickly returns to normal on the first appearance of the eruption but when the vesicles become converted into pustules, there is a return of the fever (*secondary* or *suppurative fever*), sometimes accompanied by great restlessness, delirium or coma. On the eleventh or twelfth day the pustules begin to dry up and the febrile symptoms decline. Great itching of the skin attends this stage. The scabs produced by the dried pustules gradually fall off and reddish brown spots remain, which leave permanent white depressed scars—this "pitting" so characteristic of smallpox being specially marked on the face. Convalescence in this form of the disease is as a rule uninterrupted. In the majority of the cases developing in the United States during recent years no secondary fever has been seen.

Varieties.—When the pocks are separated from each other, with clear spaces between, the disease is called discrete or distinct smallpox; when the pocks run together, confluent smallpox. There are two forms of haemorrhagic smallpox: 1, always fatal when haemorrhage into the skin and mucous membranes occur (Purpura variolosa, black smallpox); 2, benign when the haemorrhage takes place inside the pustule (Variola hemorrhagica pustulasa).

Recent Investigations.—Since about 1910 much knowledge of the nature of this disease has accrued in the course of attempts to discover the causal organism. This has been sought, though fruitlessly, in many direct investigations of the rash and of the blood by microscopical examination and by attempts to inoculate animals. The failure is explained, in part, by the discovery that the virus of vaccinia and smallpox belong to the group of filter-passing viruses (*see* FILTER-PASSING VIRUSES). Considerable interest centres around the discovery of the so called *Cytoryctes variolae* and *vaccinae* described by Guarnieri in 1892. Jenner believed that cowpox (vaccinia) and smallpox (variola) have the same origin and nature. But attempts to inoculate the cow with smallpox matter failed and Jenner's opinion was not substantiated until Monckton Copeman and others proved that the virus of smallpox can be inoculated in the cow by a process of transmission or passage and that in the cow, under these conditions, typical lesions of vaccinia are produced. But although vaccinia is the same disease as smallpox, during its passage through the cow it has lost the power of producing bacteriemia in man though it induces the typical lesion at the site of inoculation and by means of this local lesion, protects the vaccinated individual against the major infection from which the vaccine matter was derived.

Establishment of the homologous relationship between variola and vaccinia widened the field of investigators into the nature of the contagium of smallpox by providing a material, viz., vaccine lymph, which is at once abundant and easily produced. By experiments on the rabbit, which is susceptible to vaccinia, the immunity conferred by vaccinia has been studied and it has been shown that specific antibodies are produced in the blood and tissues of the vaccinated animal similar to those produced in typhoid fever and cholera, and that the antibodies in vaccinia and variola are apparently identical. It has been claimed, though on insufficient grounds, that this identity affords a means of certain diagnosis of the disease in doubtful cases of smallpox.

Serum Therapy.—In so far as the therapeutic application of the knowledge thus acquired is concerned, it has been shown that the serum of animals immune to vaccinia not only has protective power against vaccinia but also is possessed of curative properties because it destroys the virus of vaccinia *in vitro*. Whether this curative property is susceptible of increase by means of a graduated increase of dose of virus has not been investigated. In France, the serum of convalescent smallpox patients has been used in treatment and it is claimed that an undoubted curative result was obtained in cases which from clinical experience would almost certainly have proved fatal. But so far the virus of smallpox has not been obtained in quantity sufficient to permit of the attempt to manufacture a therapeutic serum, nor has it been shown that the immunity of an animal to vaccinia can be raised to a degree which might make its serum of value in the treatment of smallpox.

Polyvalent vaccines and serum prepared from pyogenic organisms have been used with some success in the treatment of severe confluent smallpox. This treatment is based on the assumption

that the severity of the later stage of the illness in confluent smallpox, *i.e.*, the stage of maturation or pustulation of the rash with the secondary fever of the disease, is closely associated with a secondary pyogenic infection.

Incidence in Europe During Recent Years.—The mode of spread of smallpox may be illustrated by a short account of the incidence of the disease in Europe from 1910 to 1924. It is convenient to divide the period into three quinquennia:—1. 1910–4, the period preceding the World War; 2. 1915–9, the period of the War; 3. 1920–4, the period of gradual recovery from the War.

During the first quinquennium no satisfactory arrangement existed among the European powers for the interchange of information concerning the incidence of epidemic diseases, and particularly from large areas where the disease is endemic and vaccination negligible, such as Spain, the Balkan States, Turkey and Russia, information concerning the rise and fall in incidence or even of serious epidemic extensions of the disease was scanty and unreliable. During this quinquennium the disease was very prevalent in Italy where a severe epidemic occurred in 1911–2. On the other hand, in France, Belgium, Austria, Germany, Denmark, Holland and the Scandinavian countries, smallpox was a rare disease as it had been since the beginning of the century. In England and Wales no extensive epidemic had occurred since the outbreak of 1902–3–4 and in the five years' period before the War only 88 deaths from smallpox were recorded in Great Britain.

With the outbreak of war in 1914, the decline was arrested and the movement of armies and migration of civil population to and from the endemic centres in the east of Europe rapidly made itself felt by an uncontrolled and increasing spread of smallpox which reached its greatest intensity in 1919. At the end of 1914 and throughout 1915 severe epidemic smallpox carried by prisoners of war from Russia and refugees occurred in the states of the old Austrian Empire which bordered on Russia and also in the Balkans. Similar agencies scattered the infection throughout Germany and in 1916–7 there were outbreaks in Hamburg and other western towns. The incidence of the disease in Germany rose continuously throughout the years of the War. Over 2,000 cases were recorded during 1917 and upwards of 5,000 during 1919. The infection reached Sweden on more than one occasion and a few cases occurred in Norway. In the Netherlands at least one serious outbreak occurred.

The experience of France during the war period was remarkable. The serious epidemic which swept over the country during the war of 1870–1 had not been forgotten and the French army of the World War was efficiently protected by vaccination. The invading German troops were also protected and no doubt acted as a screen to France on the east. Throughout the country, with the exception of districts on the Mediterranean coast and bordering on the Spanish frontier, the incidence amongst the civil population was low during the War. The freedom of France was reflected in the freedom of England during this period. The British army, like the French, was vaccinated and therefore in contrast to the experience of England in 1870–71, and in spite of the enormous volume of cross-channel traffic, only a small amount of smallpox infection reached England through France. In the later years of the War the revolution in Russia sent many refugees into England who brought the infection via Scandinavia and the Murmansk coast. But the close guard maintained on the North Sea ports of Britain and the vigilance of her public health authorities prevented any serious attack on the civil population in spite of the increasing neglect of vaccination among the people.

Post-War Incidence.—In the third quinquennium, 1920–4, the bureau for the service of epidemiological intelligence and public health statistics was initiated under the authority of the League of Nations for the purpose of collection and interchange of information concerning epidemic diseases. The annual report from this source for 1924 deals with 29 European, 17 African, 20 American, 16 Asiatic countries and Australasia, and shows that in Europe smallpox incidence has diminished year by year since 1919. The effects of the War on the incidence of the disease in Russia and neighbouring countries, viz.: Czechoslovakia, Rumania, Austria, Poland, Finland and Germany reached their culminating point in 1919 and since that year the decline in prevalence in all these countries has been continuous and rapid. Similarly in Italy, where 34,365 cases were recorded in 1919, only 190 cases occurred in 1924. Although Spain continues to be the chief endemic centre in the west of Europe, the recorded deaths from smallpox in that country fell from 3,620 in 1919 to 1,214 in 1924. During the quinquennium England and Switzerland were the only European countries in which the incidence rose. In Switzerland the figure for 1924 shows a fall but in England the increase was progressive to the end of the period as seen by the following table:—

Number of cases of smallpox recorded .	1919	1920	1921	1922	1923	1924
In England and Wales .	294	263	315	973	2,485	3,765
In Switzerland . .	3	2	596	1,153	2,126	1,234

In both countries the mild type of the disease, associated with the almost complete absence of fatality, led to the concealment of cases and an increasing neglect of vaccination.

Variation of Epidemic Type.—Outbreaks of smallpox, like those of other infectious diseases, vary in their lethal power. In 1789 Jenner described an outbreak which occurred about seven years before in Gloucestershire, "of so mild a nature that a fatal instance was scarcely ever heard of . . . I watched its progress upward of a year without perceiving any variation in its general appearance. I consider it then as a variety of smallpox."

Observers in different parts of the world have directed attention to the occurrence of outbreaks which apparently resemble the one described by Jenner. An outbreak in South Africa was described by de Korté in 1904, under the name of Amaas or Kaffirpox, another by Ribas in Brazil in 1910, under the name of Alastrim, and others of a similarly mild character have been recorded in the United States, the West Indian Islands, Australia, and, as mentioned above, in England and Switzerland.

The opinions of many modern observers differ from that of Jenner who was satisfied in calling his outbreak a "variety of smallpox." That the form of disease observed in so many parts of the world belongs to the smallpox group is common ground. But some observers hold that it is more closely allied to chickenpox than to smallpox; others differentiate it from both diseases and regard it as a newly identified member of the group, while others maintain that it is a hybrid of smallpox and chickenpox, a true varioloid-varicella. On the other hand the weight of medical opinion in England inclines to the view that the disease is simply a mild type of smallpox.

Differentiation of the smallpox eruptions similar in type has become more certain and rapid through the work of Ricketts. Ricketts' thesis is that the focal rash of smallpox has a characteristic distribution governed by two complementary factors, viz.: exposure to irritation and protection against irritation, which determine a relative increase and decrease of the incidence of the rash on any part of the skin surface. These factors are independent of the course of the disease and of the evolutionary changes which constitute the features of the rash. They are also independent of modification of these changes resulting from variation in immunity possessed by the patient or of variation in the toxic power of the infecting virus. They have the further advantage of being objective and therefore less liable to confusion in interpretation than any others. They begin to be established with the beginning of the outcrop of the rash, are fully established when eruption is completed and remain unchanged as long as the rash lasts.

Blaxall, Cleland and Ferguson, Green and Gordon in England, and Leake and Force in America, have experimented on lower animals with material from the mild disease and also with material from severe cases of acknowledged smallpox, in order to determine what differences, if any, exist between the two conditions and in their immunological relations to each other and to vaccinia. The results of these investigations have been sum-

marised by Ledingham, and confirm the opinion that the mild disease as it exists in England is smallpox of which the virus has lost a degree of its toxicity for man but retains its important properties for other animals. The distinction between the two viruses is one of lethal power only and the factors which govern this property are unknown. Over five years' experience in England of a widespread infection by the mild type of smallpox has afforded very little, if any, evidence of a tendency to increase in virulence. But in the absence of knowledge of the cause of variation in lethal power or of the natural conditions which may favour its occurrence, it is unsafe to assume that a low degree of virulence is a permanent feature of this type of smallpox and on that assumption to relax the stringency of administrative precautions against the disease.

Smallpox cases as reflected in the U.S. Public Health Reports show a seasonal fluctuation, with an upward tendency in the U.S. during 1927–28. In analogous centres of civilization in Europe and the United States, the former shows a greater control of the disease due to the fact that state officials in Europe have an organized system of inspection and the machinery for compulsory carrying out of regulations, not yet established in the United States. Vaccination of children and revaccination of adults is stressed by French and American authorities as essential to the restraint of the disease.

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SMALTITE, a mineral consisting of cobalt diarsenide, $CoAs_2$. It crystallizes in the cubic system with the same hemihedral symmetry as pyrites; the rare crystals have usually the form of cubes or cubo-octahedra; but more often the mineral is found as compact or granular masses. The colour is tin-white to steel-grey, with a metallic lustre. Hardness 5·5; specific gravity 6·5. The cobalt is partly replaced by iron and nickel, and as the latter increases in amount there is a passage to the isomorphous species chloanthite ($NiAs_2$). It occurs in veins with ores of cobalt, nickel, copper and silver. Smaltite was early used in the preparation of smalt for producing a blue colour in porcelain and glass. (L. J. S.)

SMART, CHRISTOPHER (1722–1771), English poet, was born at Shipbourne, Kent, on April 11, 1722. His father was steward for the Kentish estates of William, Viscount Vane, younger son of Lord Barnard of Raby Castle, Durham. Christopher Smart went to school at Maidstone, and at the Durham grammar school of Durham. He spent part of his vacations at Raby Castle, and his gifts as a poet gained him the patronage of the Vane family. Henrietta, duchess of Cleveland, allowed him a pension of £40 which was paid until her death in 1742. At Cambridge, where he was entered at Pembroke College in 1739, he spent much of his time in taverns, and got badly into debt, but in spite of his irregularities he became fellow of his college, praelector in philosophy and keeper of the common chest in 1745. In November 1747 he was compelled to remain in his rooms for fear of creditors. About 1752 he left Cambridge for London, though he kept his name on the college books. He wrote in London under the pseudonym of "Mary Midnight" and "Pentweazle." He had a hand in many journalistic undertakings, and completed a prose translation of Horace. Some criticisms made by "Sir" John Hill on his *Poems on Several Occasions* (1752) provoked his satire of the *Hilliad* (1753), noteworthy as providing the model for the *Rolliad.*

In 1751 Smart had shown symptoms of mental aberration, which developed into religious mania, and between 1756 and 1758 he was in an asylum, where he was visited by Johnson, who thought him sane. The poem written by him in the asylum, "A Song of David," is his only famous work, and has been compared by some critics to the work of Blake. After his release Smart produced other religious poems, but none of them shows the same inspiration. For some time before his death, which took place on May 21, 1771, he lived in the rules of King's Bench, and was supported by small subscriptions raised by Dr. Burney and other friends.

From the *Poems of the late Christopher Smart* (1791) the "Song to David" (pr. 1763) was excluded. It was reprinted in 1819, and in an abridged form is included in T. H. Ward's *English Poets,* vol. iii.; it was reprinted in 1895, and in 1901 with an introduction by R. A. Streatfeild.

SMART, SIR GEORGE THOMAS (1776–1867), English musician, was born in London, his father being a music-seller. He was a choir-boy at the Chapel Royal, and became violinist, organist, teacher of singing and conductor. From 1811 onwards Sir George Smart was one of the chief musical leaders and organizers in England, conducting at the Philharmonic, Covent Garden, the provincial festivals, etc., and in 1838 he was appointed composer to the Chapel Royal. He was a master of the Handelian traditions, was personally acquainted with Beethoven and a close friend of Weber, who died in his house. Much of his church music is still heard in the churches. He died in London on Feb. 23, 1867.

SMART, JOHN (*c.* 1740–1811), English miniature painter, was born in Norfolk; he became a pupil of Cosway, and is frequently alluded to in his correspondence. This artist was director and vice-president of the Incorporated Society of Artists, and exhibited with that society. He went to India in 1788 and obtained a number of commissions in that country. He settled down in London in 1797 and there died. He married Edith Vere, and is believed to have had only one son, who died in Madras in 1809. He was a little man, of simple habits, and a member of the Society of Sandemanians. Many of his pencil drawings still exist in the possession of the descendants of a great friend of his only sister. Several of his miniatures are in Australia and belong to a cadet branch of the family. His work is entirely different from that of Cosway, quiet and grey in its colouring, with the flesh tints elaborated with much subtlety and modelled in exquisite fashion. He possessed a great knowledge of anatomy, and his portraits are drawn with greater anatomical accuracy and possess more distinction than those of any miniature painter of his time.

See *The History of Portrait Miniatures,* by G. C. Williamson, vol. ii. (1904). (G. C. W.)

SMEATON, JOHN (1724–1792), English civil engineer, was born near Leeds on June 8, 1724, the son of an attorney. He was educated at Leeds grammar school, and employed in his father's office, but in 1742 became apprentice to an instrument maker. In 1750 he set up in business on his own account. Besides improving various mathematical instruments used in navigation and astronomy, Smeaton experimented in regard to other mechanical appliances, amongst the most important being a series on which he founded a paper—for which he received the Copley medal of the Royal Society in 1759—*An Experimental Inquiry concerning the Native Powers of Water and Wind to turn Mills and other Machines depending on a Circular Motion.* In 1754 he studied the canal works of foreign engineers in the Low Countries. He rebuilt Eddystone lighthouse in 1759, and prepared designs for engineering projects, including the construction of canals (especially the Forth and Clyde canal), and harbours, the drainage of fens, the repair and erection of bridges, though capital was not always available to carry out his schemes. He also designed many windmills, pumps, and other mechanical appliances. He devoted much of his time to astronomical studies and observations, on which he read various papers before the Royal Society. He died at Austhorpe on Oct. 28, 1792, and was buried in the parish church of Whitkirk.

He published the *Narrative of the Building of the Eddystone Lighthouse* (1791). See J. Holmes, *A Short Narrative of the Genius, Life and Works of the late Mr. John Smeaton* (1893); and S. Smiles, *Lives of the Engineers* (rev. ed. 5 vols., 1874).

SMEDEREVO (German, *Semendria*), an important commercial town, and capital of the Smederevo department of Serbia, Yugoslavia. Pop. (1921), 6,296. It is a walled town on the Danube, and is a regimental and artillery headquarters. There

is a good quay, and grapes, white wine, oils, livestock, pigs and cereals are exported. The only manufacture is that of railway trucks. Smederevo is believed to stand on the site of the Roman settlement *Mons aureus,* and there is a tradition that its famous vineyards were planted by the Roman emperor Probus (A.D. 276–282). In the 15th century when the Serbian prince, George Brankovich, became lord of Tokay in Hungary, he planted vines from Smederevo on his estates there, and from these came the famous white wine of *Tokay.* Close to the river is a mediaeval castle, with nineteen square towers, built by George Brankovich in 1430, with a large cross built in, in red bricks. Under the surface of the walls are representations of three heads showing only the eyes, nose and mouth, and probably connected with the sacrificial practice of entombing individuals during the building. Smederevo was the capital of Serbia from 1430, when Belgrade was captured by the Turks, to 1459. Kara George, the leader of the first Serbo-Turkish rising, was murdered here in 1817, and the town, which has no modern defences, was bombarded in the World War (1914–18).

SMELL AND TASTE. The flavours of our food are mingled tastes and smells in which we seldom distinguish sharply one set of sensations from the other. If the nose is closed by being firmly held between the fingers, and food is then put into the mouth, taste is the only sense excited. Under such restrictions we can recognize four classes of sensations, all tastes, sour, sweet, saline, and bitter, and possibly two others, alkaline and metallic. These tastes singly or in combination yield all that may be said to be contributed by this sense to the flavours of our food. Such a contribution is relatively small and shows that flavour, contrary to common opinion, is much more a matter of smell than of taste.

TASTE

Four Chief Tastes.—In man taste may be excited from most surfaces of the mouth and the pharynx, the chief exceptions being the floor of the mouth, the gums, the hard palate, and the inner surfaces of the cheeks. The principal region for taste is the upper surface of the tongue, and the four principal tastes are differently distributed on this surface. Sour is best developed on the sides of the tongue, saline on the sides and tip, bitter at the base, and sweet at the tip.

All surfaces of the mouth from which taste may be elicited are provided with taste-buds and such buds are limited to these parts. Each taste-bud is a microscopic group of cells bud-shaped in outline whose free, bristle-like ends project into a pore that opens on the surface of the tongue; the deep ends of these cells are associated with nerve fibres that lead to the brain. There is no special nerve of taste but the fibres concerned with this sense enter the brain through at least two nerves, the seventh or facial nerve for those from the tip and sides of the tongue and the ninth or glosso-pharyngeal nerve for those from the base of that organ.

Sour tastes are excited by acids in watery solution. When an acid is dissolved in water its molecules break up into part-molecules or ions and in aqueous solutions of acids one of these is always a hydrogen ion. Hence hydrogen ions are believed to be the exciting agents for the sour taste. In a similar way the saline tastes are believed to be called forth by chlorine, bromine, and iodine ions which are produced when the appropriate salts are dissolved in water. The two remaining tastes are as a rule not excited by ions but by whole molecules, the bitter tastes chiefly by the alkaloids such as quinine, strychnine, and the like, and the sweet tastes by the alcohols, and particularly by the sugars. Sweet tastes are also excited by saccharine which, though an organic compound, is chemically quite unrelated to the alcohols or to the sugars, and by the inorganic substance lead acetate which in consequence of this peculiarity is often called sugar of lead.

Taste-buds.—When taste-buds are tested locally some are found to be excited only by acid solutions and to give rise only to the sensation sour; others are exclusively saline and still others sweet. The same rule probably holds for the bitter taste but thus far the exclusive relation of a special set of taste-buds with this sensation has not been fully demonstrated.

It seems probable, however, that there is a particular type of taste-bud for each of the four or more classes of taste sensations. These types of taste-buds must differ chemically one from another. Thus the free tips of sour buds must be so constituted chemically as to react with acid solutions but not with solutions of salts, of sweet substances, or of bitter substances, and a corresponding relation must obtain in the other types of taste-buds. Ordinarily one class of chemical substances may be expected to be the means of excitation for one class of taste-buds and such seems to be generally true, but it is conceivable that on the basis of the analysis just given a single substance may be so constituted as to excite two or more classes of buds and thus possess an equal number of tastes. This appears to be true of parabrombenzoic sulphinide which is sweet when applied to the tip of the tongue and bitter at its base.

The Functions of Taste.—Taste is thus essentially a chemical sense in which the materials tasted are in aqueous solution and as such react with the taste-buds, the classes of which are as numerous as the classes of taste sensations. Taste, therefore, is in reality a complex sense in which there are at least four subsenses each with independent terminals and separate sensations. It would be entirely appropriate to speak of a sense of sour, of sweet, of saline and of bitter.

Taste is naturally a most important sense for the choice of food; by means of it animals are enabled to select from the various materials available to them what is appropriate for their nourishment. Organs of taste are therefore commonly found in or about the mouths of most creatures especially in close relation with those parts by which the food is crushed and its juices thereby freed. In some fishes, as for instance the catfishes, taste-buds occur not only in the mouth but on the long oral tentacles and even over much of the body.

The organs of taste are also of great importance in initiating digestive operations. Through them may be excited the flow of salivary juice and of other digestive secretions; the act of swallowing and other movements of the digestive organs, all of which constitute very important steps in the appropriation and assimilation of food, may also be started directly or indirectly through taste.

SMELL

The Olfactory Organ.—The organ of smell in man is located in the nose. The delicate membranous lining of the uppermost part of the nasal chamber is different in colour from that of the rest of the chamber and is the true olfactory organ. The area covered by this organ in each nasal chamber is approximately one square inch. From this membrane nerve fibres gather together, thus constituting the first or olfactory nerve, and make their way directly into the brain. Each nerve fibre comes from a sense cell which forms a part of the olfactory organ and all such cells reach through this organ to its outer or exposed face. Here each cell terminates in six to eight relatively long filaments, the so-called olfactory hairs which float in the thin layer of aqueous mucus that covers the olfactory surface. This mucus is in direct contact with the air of the nasal cavity in which is carried the odorous particles.

In ordinary breathing the respiratory air passes in and out through the lower part of the nasal chamber without passing up into the region of the olfactory organ. Hence under such circumstances we are not as a rule cognizant of odours. If, however, our suspicions are aroused we ordinarily sniff, an operation that draws the passing air into the upper part of the nasal chamber and thus brings it into contact with the olfactory surface. Here the odorous particles may be caught on the moist mucous surface to make their way ultimately to the olfactory hairs.

Two Kinds of Response.—As may be inferred from this account the lower portion of the nasal chamber is respiratory and only its uppermost part is olfactory. Nevertheless the whole surface of the chamber is in a way sensitive, for the fifth or trigeminal nerve is distributed throughout it. This nerve, once supposed to have to do with smell, is now definitely known to be

concerned with irritants. If the olfactory nerve in a dog is destroyed, the animal will still sneeze when vapour of ammonia enters its nostrils. The same is true of human beings who through disease have lost the olfactory nerve but who still retain the trigeminal nerve. Many persons who fail to recognize the more delicate odours of flowers, food, and the like are nevertheless readily cognizant of even minute quantities of chlorine, ammonia and other like substances. These materials are not odorous materials in the proper sense of the word but are irritants and affect the terminals of the fifth nerve, not those of the first nerve. True smell has to do with relatively delicate perfumes and odours and is mediated by the first nerve in contrast with irritants which stimulate the fifth nerve. It is therefore of considerable importance in the study of olfaction to distinguish between these two nervous activities.

No one has succeeded in classifying odours with anything like the precision that has been attained for tastes.

Exceeding Delicacy of Olfactory Sense.—Odorous sensations are called forth by an almost immeasurably small amount of material. A musk bean can give out the odour of musk for years without appreciably changing in weight. One of the most strongly odorous substances known is mercaptan, a liquid with the penetrating smell of garlic. When this liquid is evaporated in the atmosphere so that 50 cubic centimetres of air, enough for a single whiff, contain only $\frac{1}{460,000,000}$ of a milligram of mercaptan, the presence of this material can still be detected by smell. Although mercaptan from the standpoint of olfaction is an exceptionally effective agent, it is nevertheless true that in all other instances the actual amount of a given substance needed to excite smell is almost unbelievably small.

In consequence of this immense efficiency of the olfactory sense animals rely upon it in many of their most delicate responses. *See* SMELL AND TASTE, SENSES OF, below.

Material Basis of Smell.—The artistry of smell finds its expression in perfumes. From time immemorial man has supplemented the natural odours of his body by numerous extractives mostly from the stores of nature. These perfumes as a rule increase in delicacy with the advancement of civilization. They are used either as a means of counteracting innate objectionable odours or of adding attractiveness to the individual carrier Odours have also played an important part in the refinements of life as seen in the aroma of good tobacco and the bouquet of fine wine.

It has been supposed by some investigators that smell was induced not by material particles from the odorous substances but by exceptional and peculiar emanations from these sources. Evidence on the whole does not favour this view, but it seems more probable that what excites smell are the material particles themselves from the odorous substance. Even in very high dilutions enough of these particles seem always to be present to account for smell. Thus in the $\frac{1}{460,000,000}$ of a milligram of mercaptan, the amount necessary for a single whiff of this substance, there are estimated to be not fewer than 200,000,000,000 molecules of the substance concerned. It is these molecules dissolved in the mucous covering of the olfactory organ that attack the olfactory hairs and thus initiate nervous changes leading to the sensation of smell. Smell, like taste, is a chemical sense in that odorous materials in solution activate the living olfactory cells.

Difference Between Smell and Taste.—If smell as well as taste is a chemical sense, why are these two senses so different? This is by no means an easy question, but perhaps the most ready answer to it can be found in the peculiarities of the stimulating materials. Most substances that we smell we do not taste and most substances that we taste we do not smell. Thus sugar has a sweet taste but no odour. If we mince onion and, holding the nose, place it in the mouth we experience a sweetish taste indistinguishable from that of minced sweet apple. Apple and onion both contain sugar which has a sweet taste but no odour. The characteristic odours of onion and of apple are smells which do not affect taste. This is true of many pure substances; they are either tasted or smelled but not both. There are substances, however, that have both taste and smell. Ethyl alcohol has a sweetish taste and a characteristic ethereal odour. Again substances that we taste are predominantly soluble in water; those that we smell are more generally soluble in oil, in fact the essential oils are among the most characteristic sources of odours. But here, too, the distinction is not without exceptions.

Perhaps the most important difference between the two senses is a quantitative one; we taste only relatively strong solutions; we smell very dilute ones. This can best be demonstrated with substances that have both taste and smell. Thus ethyl alcohol can just be tasted at a concentration that is 24,000 times greater than that at which it can just be smelled, and this relation is true of most other such combinations. Quantitatively we smell extremely minute amounts of material; we taste only relatively large amounts.

As a consequence of this quantitative difference between taste and smell these two senses are commonly used in very unlike ways. In taste the stimulating material is in the mouth and we ordinarily locate it there. Again, in smell the stimulating material is likewise in the cavity harbouring the sense organ but we do not think of it as there; we project it into the exterior to the object from which the odorous particles come. In this respect smell is like sight; we do not see things in our eyes but in the exterior. Taste and other like senses are therefore called inner senses and their organs interoceptors, while the organs of smell are classed as distance sense organs or exteroceptors. What is true of the sense organs of man in this respect is true of those in other animals. These lower creatures react to taste as an affair of the mouth and to smell as something in the external environment.

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SMELL AND TASTE, SENSES OF.—The senses of smell and taste are distinguished from the rest as "chemical senses," because their sensory cells respond to chemical stimuli. In vertebrates the two senses are completely separated. *See* SMELL AND TASTE above.

In invertebrates a similarly sharp distinction between the sense of smell and that of taste is, in most cases, impossible. Insects alone possess separate sense organs which react to different chemical qualities. According to Schaller's investigations, this applies also to aquatic insects (*Dytiscus*). This is important as, formerly, it was denied that aquatic insects, in general, have a sense of smell. In gastropods, crustaceans, cuttlefishes and worms tastes and odours are perceived by the same sense organ, so that in these cases there is neither an anatomical nor a chemical differentiation. Under these circumstances, most naturalists consider it more correct to speak of only one unified chemical sense in such animals. It has an olfactory and a gustatory component. It is uncertain, and will probably always remain undecided, whether two qualitatively different kinds of sensory cells share in the constitution of such a sense, so that special olfactory and special gustatory cells are situated side by side in the same organ, or whether one and the same cell responds to both tastes and odours.

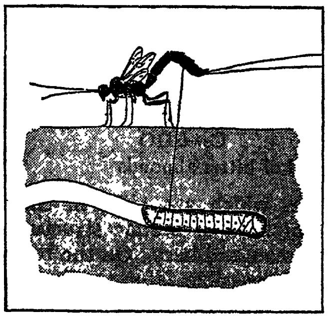
Biologically speaking, in all such cases the olfactory component naturally appears as the more important, and is much more in the foreground. It is used in the seeking out of food and mates, in the recognition of enemies, and so on, while the taste component is used only in testing the food. The use of the term "olfactory sense" in such cases is, therefore, not to be altogether rejected, as will appear from the following.

THE BIOLOGICAL SIGNIFICANCE OF THE OLFACTORY SENSE

In the lower animals, just as in mankind and mammals, the sense of smell plays a part in the most varied activities of life. The most widespread use to which it is put is the finding of food. This is already very marked in Coelenterates. If we put a little meat juice into an aquarium containing sea-anemones, we may be sure that, in a short time, all the anemones will be most beautifully expanded. The turbellarian worms (planarians) also have

a very acute olfactory sense. If we wish to collect a number of these animals, it frequently suffices to place the body of a frog, cut up, in a running brook. All the planarians which are downstream from this place scent the bait, and creep upstream to it.

Gastropods also find their food with the help of their very acute olfactory sense. If we offer a juicy fruit or a lettuce leaf enclosed in a glass to a (Roman) vineyard snail (*Helix pomatia*), it takes no notice of it at all. From this it had been concluded previously (by Yung) that the animals were almost blind, but it only follows that they use their eyes for a different purpose, namely for the perception of the direction whence the light comes (compare article on SIGHT), while they find food by means of their olfactory sense. As soon as we put the fruit uncovered on the table, so that it can give out its scent unhindered, it is found very quickly.



FROM "TIERBAU AND TIERLEBEN" (TEUBNER)

FIG. 1.—ICHNEUMON-FLY

Depositing eggs in larva of pine-borer (after Doflein)

Very characteristic examples of the searching out of food with the aid of the olfactory sense are furnished by insects. Among the Lepidoptera the female usually lays her eggs on the leaves of plants, which are, later on, devoured by the caterpillar; there is no doubt but that in this unfailing, maternal instinct, she is directed by the olfactory sense. The sense of smell in ichneumon-flies is truly wonderful. As is well known, these insects lay their eggs in the larvae of other insects, which they find out even under the most difficult conditions. (*See* fig. 1.)

On the other hand, it is just among insects that we find, also, many examples of the seeking out of the female by the male by the aid of the olfactory sense. The most noted examples again occur among Lepidoptera. In silk-moths (Bombycidae), the great development of the olfactory sense is shown by the structure of the large, broad, feathery antennae. (*See* fig. 2.) Standfuss placed a female of the Emperor moth (*Saturnia pavonia*), which had just emerged from the cocoon, at his window, in the heart of the town, and, within 6½ hours, was able to catch 127 males, which had been attracted to her. These interesting experiments have since been repeated by numerous investigators. Mell marked a number of males of the large Chinese silk-moth (*Actias selene*), and released them at different points on a railway to seek out the female, which had been placed in a gauze cage on the veranda of his house. 40% found their way back from a distance of 4 kilometres, 26·6% from a distance of 11·6 kilometres. To human beings this olfactory power seems to border on the marvellous, the more so, in that we ourselves can perceive not the slightest odour from the female moth in question. The idea has been entertained, therefore, that these insects emit, perhaps, some kind of ray, but Forel showed that the males are attracted also to the place on which, a short time previously, a female had settled. This proves definitely that it has to do with a material scent.

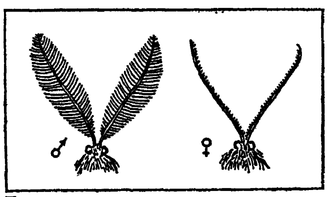


FIG. 2.—ANTENNAE OF THE SILK-MOTH (AGULIA TAU)

It is a remarkable thing that, so far, only a few instances are known of the lower animals detecting enemies by the aid of the sense of smell, and these occur in certain molluscs. We can surely induce the scallop (*Pecten*), to swim away if we bring its greatest enemy, the starfish, into its vicinity.

Among social insects the sense of smell is frequently of decisive significance in the social life of the members of a community. Certain ants (*Myrmica*) know their comrades definitely only through their sense of smell. Forel showed that they fall upon one another with the greatest fury if their olfactory organs, the antennae, are cut off. It has long been known that bees which enter a strange hive are immediately put to death, because the scent of a foreign hive clings to them. Bees possess, in addition, a peculiar scent-organ on the end of the abdomen, which can be protruded, and is often used by them as a means of communicating with each other. According to von Frisch, when a worker has discovered a rich supply of food in some place, she performs a peculiar dance, which causes the other bees to follow her. They are led to the food store by means of the scent trail.

THE LOCATION OF THE SENSE OF SMELL

The sense of smell is, usually, only very indefinitely located in invertebrates. In these animals, the sensory cells which react to chemical stimuli are clearly distributed over large areas of the skin. This applies particularly to Coelenterates, the more lowly of the worms, and the Echinoderms. In the last-mentioned animals, particularly in starfishes and ophiuroids, the chemical sense can be proved to be present in the thousands of ambulacral feet. Some ophiuroids bury themselves in the sand, leaving only the extremities of the arms projecting. The animals scent meat placed near them by means of the ambulacral feet which are situated in these parts.

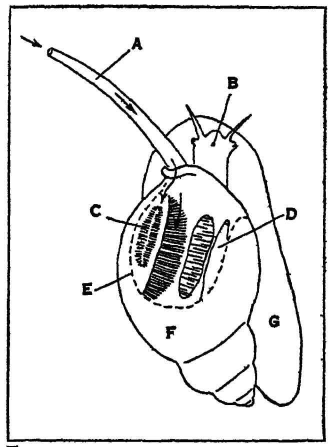


FIG. 3.—GILL-BREATHING GASTROPOD: (A) SIPHON, (B) HEAD, (C) OSPHRADIUM, (D) ANUS, (E) MARGIN OF MANTLE CAVITY, (F) GILLS, (G) FOOT

Even animals as highly organised as cuttlefishes show a wholly diffuse distribution of their chemical sense. (Giersberg.) It can be traced right into the extremities of the arms, the suckers being the most sensitive parts. On the other hand, the sensory pits situated behind the eyes, which, in former works, were described, without hesitation, as olfactory organs, have nothing to do with the chemical sense.

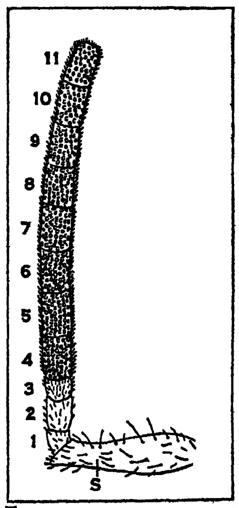


FIG. 4.—FEELER OF WORKER-BEE: JOINTS 4-11 BEAR THE OLFACTORY ORGANS (AFTER VON FRISCH)

The gill-breathing gastropods have, near the gills, an "osphradium," an oval thickened patch of epithelium, having many transverse folds (fig. 3). In some gastropods it has been proved experimentally that the osphradium is used in searching out food (Copeland). The animals used for the experiments, *Allectrion obsoleta* and *Busycon canaliculatus*, when crawling, wave their long respiratory siphon, by means of which they inhale water, rapidly to and fro. If, in this process, they inhale water which has an odour agreeable to them, they immediately swerve from their path, and are able to find the piece of food whence it emanates. This behaviour does not take place if the osphradium is removed by an operation. *Nassa reticulata*, which is common in European seas, buries itself almost completely in the sand in daytime, leaving only its long siphon projecting. If pieces of some bivalve are placed in the aquarium, in a very short time all the *Nassae* leave their retreats, and search for the food.

In insects, the feelers are the olfactory organs. Forel had proved already that, in these animals, the sense of scent is completely wanting after loss of the feelers. Later, v. Frisch in particular has occupied himself with this problem. He found that the olfactory organs of the bee are situated in the last eight joints of the feelers. Seven of these joints can be cut off without the bees' perception of odours being greatly damaged. When the eighth is cut off, however, all sense of smell is lost. In *Dytiscus* the olfactory sense is located in the end joint of the maxillary palp, as well as in the feelers.

The microscopic structure of the olfactory organs in the feelers

of insects is shown in fig. 5. The most important parts are the pore-plates, besides which the olfactory pegs and the pit-pegs are to be distinguished. The chitin is extraordinarily thin at the point where the sense organ is situated. A fine bundle of nerve fibres connects the organ immediately with the surface. The knowledge that these particular structures are the olfactory organs is not, by any means, drawn solely from their form. Von Frisch was able to prove definitely in the bee that the pore-plates are present only on those joints, the amputation of which is followed by the disappearance of the olfactory sense.

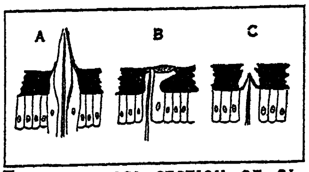


FIG. 5.—CROSS SECTION OF OLFACTORY ORGANS ON FEELERS OF INSECTS: (A) OLFACTORY PEG, (B) PORE-PLATE, (C) PIT-PEG (AFTER VON FRISCH)

In the higher Crustacea the chemo-receptors are situated on the outer ramus of the 1st antenna, on the mouth parts, and, indeed, also in the mouth cavity. On the antennae they take the form of olfactory hairs or olfactory pegs. These are very fine cylindrical structures, which are traversed, just as are the olfactory pegs of insects, by a bundle of the finest fibres, which appear to be extensions of the more deeply seated sensory cells.

In *Crangon* the 1st antennae occupy a particularly favourable position. When the animal is buried in the sand, they alone project from it, and thus to them falls the task of scenting possible prey. For this reason normal animals react to meat juice very much quicker than those which have no antennae. On the other hand, it can be shown that the antennae are not more sensitive than the more concealed sensory cells of the mouth parts, indeed, in certain respects, the antennae appear to be of even less importance. Stimulation of the antennae only never causes the typical food reaction, in which the crustaceans leave their hiding places, and seek the meat; to cause this, it is necessary for the mouth parts also to be stimulated.

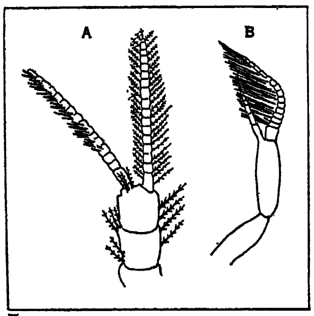


FIG. 6.—OLFACTORY ORGANS OF CRUSTACEA; 1ST ANTENNA OF (A) CRANGON (AFTER SPIEGEL), (B) UROLYCHUS NITIDUS (AFTER MARCUS)

The olfactory organ of the blood-sucking ticks (*Ixodes*) is in a particularly remarkable position. It is situated on the tibiae of the fore-legs, and is usually called "Haller's organ." Ticks, however, use their fore-legs, not for running, but as feelers; they elevate them and stretch them out in front of them. The olfactory organ, naturally, primarily aids the insect in finding its host. Such a faculty is particularly necessary to such creatures as the pigeon ticks (*Argas reflexus*) which, by day, hide away in some part of the dove-cote, and attack their hosts only by night. If the front legs are amputated, they lose all sensitiveness to chemical stimuli. (Hindle and Merriman.) They will then suck their fill of any warm liquid which may be offered to them in a suitable manner.

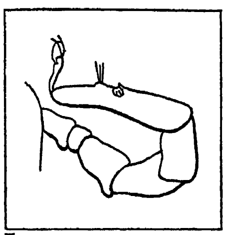
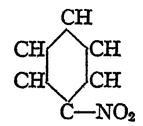


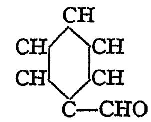
FIG. 7.—FRONT LEG OF THE TICK (IXODES RICINUS)

THE PHYSIOLOGY OF THE OLFACTORY SENSE

On the physiology of the olfactory sense in invertebrates, we are directed chiefly by the works of von Frisch, which deal with the olfactory sense of bees. He trained the bees to a particular odour, and, by this means, was able to establish the fact that they distinguish oil of orange-peel with certainty from 43 other ethereal oils. It may be concluded from this that, in nature, they are largely directed by the scent of the honey-bearing flowers. The most remarkable point is the extraordinary similarity shown by the olfactory sense of the bee to that of man. Substances which smell alike to man and are confused by him one with another, bees, in general, also are unable to distinguish.

We must conclude from this that the similarity or difference of the odours is conditioned by the particular character of the odorous molecule. According to Henning's hypothesis the quality of an odour depends not so much on the chemical composition of the odorous molecule as on the intramolecular combination of the groups of atoms, and, therefore, for example, mankind and bees confuse nitrobenzol with oil of bitter almonds.


Nitrobenzol


Oil of bitter almonds

Para- and meta-cresolmethyl ether, which are alike in their chemical composition, have a different kind of atomic structure, and are clearly distinguished by both man and bees. On the basis of this hypothesis it may, perhaps, be possible later to give an exact classification of the odorous substances for the whole animal kingdom.

At present, we do know very little about the nature of the chemical substances to which the other invertebrates react. Spiegel showed that for the shrimp, *Crangon,* the water-soluble constituents of fish muscle have a far greater attraction than those which are ether-soluble, which to the human nose are much the stronger. Particularly remarkable is the surely established fact that *Crangon* can smell glycogen, although, to human beings, this substance has neither taste nor smell.

THE SENSE OF TASTE

Among invertebrates, as we have already mentioned, a separate sense of taste has been demonstrated only in insects. In these creatures, we find spatially distinct olfactory and gustatory organs, which respond to different stimuli. Up to the present time, the insects which have been most studied are the honey-bee and the water beetle, *Dytiscus* (Schaller). The organs of taste are situated in the mouth cavity itself, as well as on the maxillary and labial palps, but not, however, on the olfactory antennae.

In the sense of taste, also, a remarkable agreement between that of man and that of insects is to be observed. The substances appreciated by the sense of taste are substantially the same in the two widely differing organisms. Sugar exercises a strong attraction. According to Minnich, the admiral butterfly (*Pyrameis atlanta*) is about 256 times as sensitive to cane sugar as man. It is a striking fact that insects do not accept all the kinds of sugar which taste sweet to us. The honey-bee responds only to cane sugar, the analysis products of which are d-glucose and d-fructose, as well as maltose.

Other sweet substances such as mannose, galactose or mannite and glycocoll are declined. In the same way, the bee-keeper has long known that bees will not take saccharine. Salt, bitter and sour substances, as well as lyes, always repel them; this is known to apply also to those animals which are without a separate sense of taste (Crustacea and gastropods).

It is of interest that the admiral butterfly, already mentioned several times, bears its organs of taste, not in the mouth, but on the tips of the feet (tarsi).

A marked reaction to tastes can be proved also in numerous animals which possess no separate gustatory sense. Bitter substances, in particular, are very generally declined (worms, gastropods, ascidians and holothurians). It is characteristic that the threshold of stimulation, that is to say, the minimum concentration to which the animal responds, is considerably lower in invertebrates than in fishes. Hanstroem connects this with the fact that the receivers of chemical stimuli in invertebrates are primary sensory cells, while those of vertebrates are of the type known as secondary sensory cells, in which the cell is in connection with the nerve only by contact.

The attraction exercised by sugar may be observed very frequently. Gastropods, in particular, are very greedy for sugar. It can be proved, however, that in these animals the sense-organs

by means of which they perceive it are not situated in the mouth itself, for when they are crawling on the surface of the water they will eat anything, impartially, which may be placed directly on the mouth. The gustatory cells are situated, apparently, on the anterior margin of the foot, which, in crawling, is the first part to come in contact with the substratum. Leeches, which have been studied by Loehner, also react very plainly to tastes. The experiments were so arranged that the animal first of all sucked blood which it found in a test-tube closed by an animal membrane. As soon as it had commenced to suck, the blood was replaced by some other liquid of the same degree of warmth. Pure water calls forth no reaction; if, however, too highly flavoured, concentrated substances are placed before it, the animal immediately leaves off. In the case of common salt this happened first when it was present in the proportion of 7%; with cane sugar when present in the proportion of 5%, with quinine sulphate at 1%. Salts and sugar are naturally contained in blood, but in a much lower degree of concentration. (W. v. Bud.)

SMELT (*Osmerus eperlanus*), the typical fish of the salmonoid family *Osmeridae,* which includes also the capelin (*Mallotus villosus*) and the candlefish (*Thaleichthys pacificus*). Except the curious *Plecoglossus* of the rivers of Japan, the *Osmeridae* are northern marine fishes, small and predacious. It breeds, unless land-locked, in salt or brackish water, and though it often enters rivers it does not ascend beyond tidal influence. Like other British salmonoids it spawns in winter. The smelt ranges from Scandinavia to the English Channel; it is a slender, silvery fish, with olive-green back. It grows to a length of 13 inches.

SMELTING: *see* Metallurgy.

SMERDIS (Pers. *Bardiya;* by Ctesias, *Pers.* 8, called *Tanyoxarces;* by Xenophon, *Cyrop.* viii. 7. 11, who takes the name from Ctesias, *Tanaoxares;* by Justin i. 9, *Mergis;* in Aeschylus, *Pers.* 774, *Mardos*), a Persian king. Smerdis was the younger son of Cyrus the Great who, according to Ctesias, on his deathbed appointed him governor of the eastern provinces. (*Cf.* Xen. *Cyrop.* viii. 7, 11.) Before Cambyses set out to Egypt, he secretly caused him to be murdered (Darius in the Behistun Inscr. i. 10), being afraid that he might attempt a rebellion during his absence. His death was not known to the people, and so in the spring of 522 a usurper pretended to be Smerdis and proclaimed himself king on a mountain near the Persian town Pishiyauvāda. Owing to the despotic rule of Cambyses and his long absence in Egypt, "the whole people, Persians, Medes and all the other nations," acknowledged the usurper, especially as he granted a remission of taxes for three years (Herod. iii. 68). Cambyses began to march against him, but seeing that his cause was hopeless, killed himself in the spring of 521 (but *see* further Cambyses). The real name of the usurper was, as Darius tells us, Gaumāta, a Magian priest from Media; this name has been preserved by Justin i. 9 (from Charon of Lampsacus?), but given to his brother (called by Herodotus Patizeithes), who is said to have been the real promoter of the intrigue; the true name of the usurper is here given as *Oropastes;* by Ctesias as *Sphendadates.*

The history of the false Smerdis is narrated by Herodotus and Ctesias according to official traditions; Cambyses before his death confessed to the murder of his brother, and in public explained the whole fraud. But, as Darius said, nobody had the courage to oppose the new king, who ruled for seven months over the whole empire. Contracts dating from his reign have been found in Babylonia, where his name is spelt *Barziya.* He transferred the seat of government to Media; and here in a castle in the district of Nisaya he was surprised and killed by Darius and his six associates in October 521. His death was annually celebrated in Persia by a feast called "the killing of the magian," at which no magian was allowed to show himself (Herod. iii. 79, Ctes. *Pers.* 15).

In the next year, another pseudo-Smerdis, named Vahyazdāta, rose against Darius in eastern Persia and met with great success. But he was finally defeated, taken prisoner and executed (Behistun Inscr. iii. 40 ff.; perhaps he is identical with the King Maraphis "the Maraphian," name of a Persian tribe, who occurs as successor in the list of Persian kings given by Aeschylus, *Pers.* 778).

See Darius (I.) and Persia, *Ancient History.* (Ed. M.)

SMETANA, FRIEDRICH (1824–1884), Czech composer and pianist, was born at Leitomischl in Bohemia on March 2, 1824. He studied under Proksch, at Prague, and later at Leipzig. On returning to Prague, he became Konzertmeister to the Emperor Ferdinand. In 1848 he married Katharina Kolar, pianist, and with her founded a music school at Prague. At the same time he met Liszt, who subsequently influenced him greatly, and with whom he afterwards stayed at Weimar. In 1856 Smetana went to Gothenburg as conductor of the Philharmonic Society. There he remained five years, when, owing to his wife's ill-health, he returned to Prague after a successful concert tour. The death of his wife at Dresden on their return caused Smetana to change his plans, and he went back to Sweden; but the opening of the Interim theatre in 1866, and the offer of its conductorship, brought him home again. In Sweden he had written *Hakon Jarl, Richard III.,* and *Wallenstein's Lager,* and had completed his opera *Die Brandenburger in Böhmen* (Jan. 5, 1866). In the same year he produced his best-known opera, *Die verkaufte Braut* ("The Bartered Bride"). The "grand prize" opera *Libuse,* was written for the opening of the National Theatre at Prague, on June 11, 1881. In 1874 Smetana lost his sense of hearing. To celebrate his sixtieth birthday a fête was arranged by the combined Bohemian musical societies; but on that day Smetana lost his reason and was removed to a lunatic asylum, where he died on May 12, 1884. Smetana was the founder of the Czech school of composers. He exercised a great influence over the younger men of his generation and is still held in great esteem. A great deal of his pianoforte music is interesting, the *Stammbuchblätter,* for example; while his symphonic poems in six parts, entitled *Mein Vaterland* (*Vlast*), and his beautiful string quartet, *Aus meinem Leben,* have made the tour of the civilized world.

Other operas are *Zwei Wittwen, Dalibor, Der Kuss, Das Geheimnis, Certova Stena,* and *Die Teufelsmauer.*

SMETHWICK (smĕth'ĭk), municipal, county and parliamentary borough, Staffs., England, 3 m. W. of Birmingham on the G.W. and L.M.S. railways. Pop. (1931) 84,354. There are large glass, chemical and machine works; nuts and bolts are made, and lighthouse fittings are a specialty. Adjoining Smethwick is the district of Soho, made famous by James Watt (*c.* 1770). The town of Smethwick is a modern growth about an ancient village, the name of which appears in Domesday. The borough was incorporated in 1899, became a county borough in 1907 and a parliamentary borough in 1918. It returns one member.

SMETONA, ANTANAS (1874–), Lithuanian statesman and journalist, was born on Aug. 10 1874, in the Ukmerge district, Lithuania, and made his law studies at St. Petersburg (Leningrad), graduating in 1902. Smetona edited the first Lithuanian daily, *Vilniaus Zinios* (Vilna news), and the democratic party organ, *Lietuvos Ukininkas.* In 1905 he was elected a member of the presidium of the Vilna (Wilno) diet, which proclaimed Lithuanian autonomy. On the convocation of the *tautos taryba,* or national council, during the German military occupation of the country, he was unanimously elected its president, and in the spring of 1919 first president of the newly-proclaimed independent state of Lithuania, a post which he held till the spring of 1920, when the constituent assembly was convened at Kaunas (Kovno). In 1921 Smetona served as chairman of the Lithuanian delegation at Riga during the negotiations on the settlement of the Latvian-Lithuanian boundary dispute. Early in 1923, when the insurrection broke out in the Memel territory against the German directorate, Smetona was requested by the Lithuanian Government to compose the trouble in co-operation with the Allied representatives. In the same year he joined the teaching staff of the newly established university as lecturer on philosophy. After the military *coup d'état* at Kovno on the night of Nov. 16–17, 1926, Smetona was elected (Dec. 17, 1926) by the new parliament to be president of the republic for a three years' term.

SMILES, SAMUEL (1812–1904), Scottish author, was born at Haddington, Scotland, on Dec. 23, 1812. He was the eldest of eleven children left, on their father's death, to be supported by their mother on slender means. To her spirit and example must

be attributed some of the enthusiasm for self-reliance and self-education, that was later embodied in Dr. Smiles's writings and led to their popularity and influence. He qualified in medicine at Edinburgh, but early abandoned medical practice for journalism. From 1838 till 1844 he edited the weekly *Leeds Times;* 1845 till 1854 he was secretary of the Leeds and Thirsk railway, and from 1854 till 1866 of the South Eastern railway. At Leeds he came in contact with George Stephenson, whose *Life* by him, published in 1857, passed through five editions in its first year and was the precursor of a long series of biographies of leaders in the world of industry. In 1859 had appeared his most successful book, *Self-Help,* which was translated into 17 languages. The book's success suggested others of similar purpose, like *Character* (1871), *Thrift* (1875), *Duty* (1880). Smiles died in Kensington in his ninety-second year, on the 16th of April 1904.

His *Autobiography* was edited (1905) by T. Mackay.

SMILLIE, JAMES DAVID (1833–1909), an American painter, born in New York city on Jan. 16, 1833. His father, James Smillie (1807–1885), a Scottish engraver, emigrated to New York in 1829, was elected to the National Academy of Design in 1851, did much, with his brother William Cumming (1813–1908), to develop the engraving of bank-notes, and was an excellent landscape engraver. The son studied with him and in the national academy of design; engraved on steel vignettes for bank-notes and some illustrations, notably F. O. C. Darley's pictures for Cooper's novels; was elected an associate of the National Academy in 1865—the year after he first began painting—and an academician in 1876; and was a founder (1866) of the American water-colour society and of the New York etching club. He died on Sept. 14, 1909.

SMILLIE (smĭ'lĭ), **ROBERT** (1859–), British politician, born March 17, 1859 in Belfast, of Scottish parents. He started work in a factory at 11 years of age, worked in a Clyde shipyard and later as a miner in the Lanarkshire pits. He was president of the Scottish Mine-workers' Association (1894–1918, and 1921–) and of the Miners' Federation of Great Britain (1912–21). Under his leadership the great strike of coal miners of 1912 was conducted and a national minimum wage secured. He was a member of the royal commission on mines set up in 1919 and presided over by Justice Sankey. He is (1928) a member of the general council of the Trades Union Congress. Though best known as a miners' leader, Smillie possessed strong internationalist sympathies, and was an ardent pacifist during the World War. After seven unsuccessful contests he was elected M.P. for Morpeth in 1923. In 1924 he published *My Life for Labour.*

SMITH, ADAM (1723–1790), British economist, the son of Adam Smith, comptroller of the customs at Kirkcaldy (Fifeshire), Scotland, and of Margaret Douglas, was born at Kirkcaldy on June 5, 1723, some months after the death of his father. When three years old, he was carried off by a party of "tinkers," but was soon rescued. Educated at Kirkcaldy under David Miller, he proceeded to the university of Glasgow in 1737, where he attended the lectures of Dr. Hutcheson; and in 1740 went to Balliol College, Oxford, with a Snell exhibition. He remained there until 1746 devoting himself to moral and political science and to ancient and modern languages, and labouring to improve his English style by translation, particularly from the French. Returning to Kirkcaldy, he resided there two years with his mother, continuing his studies, and in 1748 he removed to Edinburgh, where, under the patronage of Lord Kames, he gave lectures on rhetoric and belles-lettres. About this time began his acquaintance with David Hume, which afterwards ripened into friendship.

In 1751 he was elected professor of logic at Glasgow, and in 1752 he succeeded Thomas Craigie in the chair of moral philosophy. This position he had for nearly twelve years. In 1759 Smith published his *Theory of Moral Sentiments,* embodying the second portion of his university course, to which was added in the 2nd edition an appendix with the title, "Considerations concerning the first Formation of Languages." After the publication of this work his ethical doctrines occupied less space in his lectures, and a larger development was given to the subjects of jurisprudence and political economy. Stewart gives us to understand that he had, as early as 1752, adopted the liberal views of commercial policy which he afterwards preached; and this view is supported by the fact that such views were propounded in that year in the *Political Discourses* of Hume.

In 1762 the senatus academicus of Glasgow conferred on him the honorary degree of doctor of laws, but in 1763 on becoming tutor to the young duke of Buccleuch, he resigned his professorship, and went abroad with his pupil in February 1764. After spending eighteen months at Toulouse, they toured the south of France and visited Geneva, returning to Paris about Christmas of 1765. Smith frequented the society of Quesnay, Turgot, d'Alembert, Morellet, Helvétius, Marmontel and the duc de la Rochefoucauld, and was influenced by his contact with the members of the physiocratic school. Smith afterwards described Quesnay as a man "of the greatest modesty and simplicity," and declared his system of political economy to be, "with all its imperfections, the nearest approximation to truth that had yet been published on the principles of that science." Returning home in October 1766, Smith spent the next ten years at Kirkcaldy.

He was occupied on his great work, *Inquiry into the Nature and Causes of the Wealth of Nations* (1776), which there is some reason for believing he had begun at Toulouse. After its publication, and only a few months before his own death, Hume wrote to congratulate his friend—"*Euge! belle!* dear Mr. Smith, I am much pleased with your performance, and the perusal of it has taken me from a state of great anxiety. It was a work of so much expectation, by yourself, by your friends, and by the public, that I trembled for its appearance, but am now much relieved. Not but that the reading of it necessarily requires so much attention, and the public is disposed to give so little, that I shall still doubt for some time of its being at first very popular, but it has depth, and solidity, and acuteness, and is so much illustrated by curious facts that it must at last attract the public attention." Smith attended Hume during a part of his last illness, and soon after the death of the philosopher there was published, along with his autobiography, a letter from Smith to W. Strahan (Smith's publisher) in which he gave an account of the closing scenes of his friend's life and expressed warm admiration for his character.

The greater part of the two years which followed the publication of the *Wealth of Nations* Smith spent in London, enjoying the society of Gibbon, Burke, Reynolds and Topham Beauclerk, etc., but on being appointed commissioner of customs in Scotland, he went to live at Edinburgh with his mother and his cousin, Jane Douglas. Much of his income is believed to have been spent in secret charities, and he kept a simple table at which, "without the formality of an invitation, he was always happy to receive his friends." "His Sunday suppers," says M'Culloch, "were long celebrated at Edinburgh." One of his favourite places of resort in these years was a club of which Dr. Hutton, Dr. Black, Dr. Adam Ferguson, John Clerk the naval tactician, Robert Adam the architect, as well as Smith himself, were original members, and to which Dugald Stewart, Professor Playfair and other eminent men were afterwards admitted. Another source of enjoyment was his small but excellent library. In 1787 he was elected lord rector of the university of Glasgow, and in the same year he probably visited London. From the death of his mother in 1784, and that of Miss Douglas in 1788, his health declined, and after a painful illness he died on July 17, 1790.

In accordance with his wishes the majority of his manuscripts were destroyed. Of the pieces preserved by his desire the most valuable is his tract on the history of astronomy, which he himself described as a "fragment of a great work." Among the papers destroyed were probably, as Stewart suggests, the lectures on natural religion and jurisprudence which formed part of his course at Glasgow, and also the lectures on rhetoric which he delivered at Edinburgh in 1748. To the latter Hugh Blair seems to refer when, in his work on *Rhetoric and Belles-Lettres* (1783), he acknowledges his obligations to a manuscript treatise on rhetoric by Smith, part of which its author had shown to him many years before, and which he hoped that Smith would give to the public. Smith had promised at the end of his *Theory of Moral Sentiments* a treatise on jurisprudence from the historical point

of view.

As a moral philosopher Smith cannot be said to have won much acceptance for his fundamental doctrine, which is, that all our moral sentiments arise from sympathy, "which leads us to enter into the situations of other men and to partake with them in the passions which those situations have a tendency to excite."

It is on the *Wealth of Nations* that Smith's fame rests. But it must at once be said that it is contrary to fact to represent him, as some have done, as the creator of political economy. The subject of social wealth had always in some degree, and increasingly in recent times, engaged attention, and its study had even indisputably assumed a systematic character. From being an assemblage of fragmentary disquisitions on particular questions of national interest it had taken the form, notably in Turgot's *Réflexions*, of an organized body of doctrine. Smith took up the science when it was already considerably advanced; and it was this very circumstance which enabled him, by the production of a classical treatise, to render most of his predecessors obsolete.

Even those who do not fall into the error of making Smith the creator of the science often separate him too broadly from Quesnay and his followers, and represent the history of modern economics as consisting of the successive rise and reign of three doctrines—the mercantile, the physiocratic and the Smithian. The last two are, it is true, at variance in some even important respects, but if we regard them as historical forces, they must be considered as working towards identical ends. They both urged society towards the abolition of the previously prevailing industrial policy of European governments; and their arguments against that policy rested essentially on the same grounds.

There has been much discussion on the question—What is the scientific method followed by Smith in his great work? By some it is considered to have been purely deductive, a view which Buckle has perhaps carried to the greatest extreme. That the inductive spirit exercised no influence on Scottish philosophers is certainly not true. What may justly be said of Smith is that the deductive bent was not the predominant character of his mind, nor did his great excellence lie in the "dialectic skill" which Buckle ascribes to him. What strikes us most in his book is his wide and keen observation of social facts, and his perpetual tendency to dwell on these and elicit their significance, instead of drawing conclusions from abstract principles.

Some have represented Smith's work as of so loose a texture and so defective in arrangement that it may be justly described as consisting of a series of monographs; but this is an exaggeration. The book, it is true, is not framed on a rigid mould, nor is there any parade of systematic divisions and subdivisions. But, as a body of exposition, it has the real unity which results from a mode of thinking homogeneous throughout.

Rent, Wages and Profit.—Smith sets out from the thought that the annual labour of a nation is the source from which it derives its supply of the necessaries and conveniences of life. He does not contemplate labour as the only factor in production; but by emphasizing it at the outset he at once strikes the note of difference between himself on the one hand, and both the mercantilists and the physiocrats on the other. The improvement in the productiveness of labour depends largely on its division; and he proceeds accordingly to give his unrivalled exposition of that principle, of the grounds on which it rests, and of its greater applicability to manufactures than to agriculture, in consequence of which the latter relatively lags behind in the course of economic development. The origin of the division of labour he finds in the propensity of human nature "to truck, barter or exchange one thing for another." He shows that a certain accumulation of capital is a condition precedent to this division, and that the degree to which it can be carried is dependent on the extent of the market. When the division of labour has been established, each member of the society must have recourse to the others for the supply of most of his wants; a medium of exchange is thus found to be necessary and money comes into use. The exchange of goods against each other or against money gives rise to the notion of value.

This word has two meanings—that of utility, and that of purchasing power; the one may be called value in use, the other value in exchange. Merely mentioning the former, Smith goes on to study the latter, and endeavours to find a measure of value, and the forces regulating exchange value. He maintains that labour is the real measure of the exchangeable value of all commodities. "Equal quantities of labour at all times and places, are of equal value to the labourer." "Labour alone, therefore, never varying in its own value, is alone the ultimate and real standard by which the value of all commodities can at all times and places be estimated and compared. It is their real price; money is their nominal price only." Money, however, is in men's actual transactions the measure of value, as well as the vehicle of exchange; and the precious metals are best suited for this function, as varying little in their own value for periods of moderate length; for distant times, corn is a better standard of comparison. In relation to the earliest social stage, we need consider nothing but the amount of labour employed in the production of an article as determining its exchange value; but in more advanced periods price is complex, and consists in the most general case of three elements—wages, profit and rent. Wages are the reward of labour. Profit arises as soon as stock, being accumulated in the hands of one person, is employed by him in setting others to work, and supplying them with materials and subsistence, in order to make a gain by what they produce. Rent arises as soon as the land of a country has all become private property.

Smith then discusses the three elements of rent, wages and profits in detail. He goes on to point out that, as they are the elements of price, so they are the constituents of income; and the three great orders of every civilized society, from whose revenues that of every other order is ultimately derived, are the landlords, the labourers and the capitalists. The relation of the interests of these three classes to those of society at large is different. The interest of the landlord always coincides with the general interest: whatever promotes or obstructs the one has the same effect on the other. So does that of the labourer. But "the interest of the third order has not the same connection with the general interest of the society as that of the other two; . . . it is always in some respects different from and opposite to that of the public."

Capital.—The subject of the second book is "the nature, accumulation and improvement of stock." A man's whole stock consists of two portions—that which is reserved for his immediate consumption, and that which is employed so as to yield a revenue to its owner. This latter, which is his "capital," is divisible into the two classes of "fixed" and "circulating." The first is such as yields a profit without passing into other hands. The second consists of such goods, raised, manufactured or purchased, as are sold for a profit and replaced by other goods; this sort of capital is therefore constantly going from and returning to the hands of its owner. The whole capital of a society falls under the same two heads. Its fixed capital consists chiefly of (1) machines, (2) buildings which are the means of procuring a revenue, (3) agricultural improvements and (4) the acquired and useful abilities of all members of the society (since sometimes known as "personal capital"). Its circulating capital is also composed of four parts—(1) money, (2) provisions in the hands of the dealers, (3) materials and (4) completed work in the hands of the manufacturer or merchant. Next comes the distinction of the gross national revenue from the net—the first being the whole produce of the land and labour of a country, the second what remains after deducting the expense of maintaining the fixed capital of the country and that part of its circulating capital which consists of money.

Smith explains the gain to the community arising from the substitution of paper money for that composed of the precious metals; and here occurs the remarkable illustration in which the use of gold and silver money is compared to a highway on the ground, that of paper money to a wagon way through the air. In proceeding to consider the accumulation of capital, he is led to the distinction between productive and unproductive labour. A broad line of demarcation is drawn between the labour which results in commodities or increased value of commodities, and that which renders services: the former is productive, the latter unproductive. "Productive" is by no means equivalent to "useful"; the labours

of the magistrate, the soldier, the churchman, lawyer and physician, are, in Smith's sense, unproductive. Productive labourers alone are employed out of capital; unproductive labourers, as well as those who do not labour at all, are all maintained by revenue. In advancing industrial communities, the portion of annual produce set apart as capital bears an increasing proportion to that which is immediately destined to constitute a revenue, either as rent or as profit. What is annually saved is as regularly consumed as what is spent, but by a different set of persons, by productive labourers instead of idlers or unproductive labourers; and the former reproduce with a profit the value of their consumption. The only mode of increasing the annual produce of the land and labour is to increase either the number of productive labourers or the productive powers of those labourers. With regard to price paid for the use of capital Smith says: "In some countries the interest of money has been prohibited by law. But, as something can everywhere be made by the use of money, something ought everywhere to be paid for the use of it," and will in fact be paid for it; and the prohibition will only heighten the evil of usury by increasing the risk to the lender.

As to the different employments of capital, the quantity of productive labour put in motion by an equal amount varies extremely according as that amount is employed—(1) in the improvement of lands, mines or fisheries, (2) in manufactures, (3) in wholesale or (4) retail trade. In agriculture "Nature labours along with man," and not only the capital of the farmer is reproduced with his profits, but also the rent of the landlord. It is therefore the employment of a given capital which is most advantageous to society. Next in order come manufactures; then wholesale trade —first the home trade, secondly the foreign trade of consumption, last the carrying trade. All these employments of capital, however, are not only advantageous, but necessary, and will introduce themselves in the due degree if left to individual enterprise.

These first two books contain Smith's general economic scheme; and we have stated it as fully as was consistent with the brevity here necessary, because from this formulation of doctrine the English classical school set out, and round it the discussions of more modern times in different countries have in a great measure revolved.

The longest and most elaborate of the masterly historical sketches given by Smith occupies the third book; it is an account of the course followed by the nations of modern Europe in the successive development of the several forms of industry. It affords a curious example of the effect of doctrinal prepossessions in obscuring the results of historical inquiry. Whilst he correctly describes the European movement of industry, and explains it as arising out of adequate social causes, he yet, in accordance with the absolute principles which tainted his philosophy, protests against it as involving an entire inversion of the "natural order of things." First agriculture, then manufactures, lastly foreign commerce; any other order than this he considers "unnatural and retrograde."

Freedom of Trade.—The fourth book is principally devoted to the elaborate and exhaustive polemic against the mercantile system which has exercised a powerful influence on economic legislation. When protection is now advocated, it is commonly on different grounds from those which were in current use before the time of Smith. Though regarding the eventual establishment of free trade in England as unlikely, he is nevertheless in favour of it, but, believing in the necessity of adequate defence, he commends the navigation acts. Whilst objecting to the prevention of the export of wool, he proposes a tax on that export as somewhat less injurious to the interest of growers than the prohibition, whilst it would "afford a sufficient advantage" to the domestic over the foreign manufacturer. This is, perhaps, his most marked deviation from the rigour of principle. The wisdom of retaliation in order to procure the repeal of high duties or prohibitions imposed by foreign governments depends, he says, altogether on the likelihood of its success in effecting the object aimed at, but he does not conceal his contempt for the practice of such expedients. The restoration of freedom in any manufacture, when it has grown to considerable dimensions by means of high duties, should, he thinks, from motives of humanity, be brought about only by degrees and with circumspection—though the amount of evil which would be caused by the immediate abolition of the duties is, in his opinion, commonly exaggerated. The case of infant industries on which J. S. Mill justified protection, is referred to by Smith; but he is opposed to the admission of this exception for reasons which do not appear to be conclusive. He is perhaps scarcely consistent in approving the concession of temporary monopolies to joint-stock companies undertaking risky enterprises "of which the public is afterwards to reap the benefit."

He is less absolute in his doctrine of governmental non-interference when he comes to consider in his fifth book the "expenses of the sovereign or the commonwealth." He recognizes as coming within the functions of the state the erection and maintenance of those public institutions and public works which, though advantageous to the society, could not repay, and therefore must not be thrown upon, individuals or small groups of individuals. He remarks in a just historical spirit that the performance of these functions requires very different degrees of expense in the different periods of society. Besides the institutions and works intended for public defence and the administration of justice, and those required for facilitating the commerce of the society, he considers those necessary for promoting the instruction of the people. He thinks the public at large may with propriety not only facilitate and encourage, but even impose upon almost the whole body of the people, the acquisition in youth of the most essential elements of education. The expense of the institutions for religious instruction as well as for general education, he holds, may without injustice be defrayed out of the funds of the whole society, though he would apparently prefer that it should be met by the voluntary contributions of those who think they have occasion for such education or instruction.

To sum up, it may be said that the *Wealth of Nations* certainly operated powerfully through the harmony of its critical side with the tendencies of the half-century which followed its publication to the assertion of personal freedom and "natural rights." It discredited the economic policy of the past, and promoted the overthrow of institutions which had come down from earlier times, but were unsuited to modern society. As a theoretic treatment of social economy, and therefore as a guide to social reconstruction and practice in the future, it is provisional, not definitive. But when the study of its subject comes to be systematized on the basis of a general social philosophy more complete and durable than Smith's, no contributions to that final construction will be found so valuable as his.

The following may be referred to for biographical details: Dugald Stewart, *Biographical Memoir of Adam Smith,* originally read (1793) before the Royal Society of Edinburgh, and afterwards prefixed to Smith's *Essays on Philosophical Subjects;* J. A. Farrer, *Adam Smith* (1881); R. B. Haldane, *Life of Smith* (1887); and the very full and excellent *Life of Adam Smith* by John Rae (1895). Additional particulars are given in Brougham's *Men of Letters and Science,* Burton's *Life of Hume* and Alexander Carlyle's *Autobiography;* and some characteristic anecdotes of him will be found in *Memoirs of the Life and Works of Sir John Sinclair* (1837). For comments on his *Theory of Moral Sentiments, see,* besides Stewart, as cited above, Dr. T. Brown's *Philosophy of the Human Mind,* lects. 80 and 81; Sir J. Mackintosh's *Dissertation on the Progress of Ethical Philosophy;* and the art. ETHICS in the present work. On the *Wealth of Nations,* see the prefaces to M'Culloch's, Rogers's, Shield Nicholson's and Cannan's editions of that work; Rogers's *Historical Gleanings* (1869); the art. "Smith" in Coquelin and Guillaumin's *Dictionnaire de l'économie politique;* Bagehot's *Economic Studies* (1880); Cossa's *Guide to the Study of Political Economy* (Eng. trans., 1880), chap. v. and E. Cannan, *Theories of Production and Distribution 1776–1848* (1893). *See* also Professor Shield Nicholson's *Project of Empire* (1909), which is a critical study of the Economics of Imperialism, with special reference to the ideas of Adam Smith; and Professor W. J. Ashley's essay in *Compatriots, Club Lectures* (1905) on "Political Economy and the Tariff Problem." *See* also Professor W. J. Ashley's *Select Chapters and Passages from the*

"*Wealth of Nations*" (1895); C. W. Hasek, *The Introduction of Adam Smith's Doctrines into Germany* (N.Y. 1925).

SMITH, ALEXANDER (1830–1867), Scottish poet, son of a lace-designer, was born at Kilmarnock on Dec. 31, 1830. His parents being too poor to send him to college, he was placed in a linen factory to follow his father's trade of a pattern designer. His early poems appeared in the *Glasgow Citizen*. He became by appointment secretary to Edinburgh University in 1854. As a poet he was one of the leading representatives of what was called the "Spasmodic" School. Smith, P. J. Bailey and Sydney Dobell were satirized by W. E. Aytoun in 1854 in *Firmilian: a Spasmodic Tragedy*. In the same year Sydney Dobell came to Edinburgh, and an acquaintanceship at once sprang up between the two, which resulted in their collaboration in a book of *War Sonnets* (1855), inspired by the Crimean War. After publishing *City Poems* (1857) and *Edwin of Deira* (1861), a Northumbrian epic poem, Smith turned his attention to prose. He died on Jan. 5, 1867.

A memoir of Smith by P. P. Alexander was prefixed to a volume entitled *Last Leaves*.

SMITH, ALFRED EMANUEL (1873–), American politician, was born in New York city on Dec. 30, 1873, in the so-called Old Fourth ward under the Brooklyn Bridge. He was the elder of two children, a boy and a girl, of poor but respectable parents belonging to the city's Irish colony. The father, who had been a rather unsuccessful truckman, died in 1886, and his son's education at St. James's parochial school, near his home, was interrupted when he was in the 8th grade. Leaving school, however, did not depress him, as he had been little interested in his books.

Forced to help support his mother and sister, the boy attempted for a time to continue his father's trucking business. This did not pay and he abandoned it for employment with an oil supply house. Then he became a checker at the Fulton fish market, where he remained for seven years. Even as a small boy Smith had given indications of talent in elocution and amateur dramatics, and, despite long hours at work, he continued his interest in theatricals and at one time considered a stage career. He was a sociable youth with a gift for telling stories, for clog dancing and singing, and was exceedingly popular in the Fourth ward.

Smith's political career began in 1895 when the Tammany district leader made him an investigator in the city commissioner of jurors' office. This meant a salary of $800 a year. In the autumn of 1903 he was elected to the New York State Assembly on the Democratic ticket.

He went to Albany, the capital of New York State, with little or no formal education but with an alert mind and an intimate knowledge of the city district he represented. After a year or so of discouragement he began to make a name for himself and by 1911 was the Democratic leader. In 1913 he was speaker of the Assembly, an office secondary only to that of governor in power. He served continuously from 1904 to 1915. During the first ten years Smith gave small indication of the political independence he was to show as governor of New York. Industrious and intelligent, he was nevertheless a routine politician who obeyed the orders of Charles F. Murphy, the Tammany Hall "boss." Smith's defeat was constantly demanded by reform movements. By 1911, however, his viewpoint had been broadened through his appointment to a commission which investigated factory conditions. In 1915 he was sent as a delegate to the Constitutional Convention held at Albany to revise the State's fundamental law.

Tammany Hall rewarded Smith in 1915 for his long service as a poorly paid assemblyman by making him sheriff of New York county, a lucrative post because of the fee system, abolished after his term. In 1917 he was elected president of the board of aldermen in New York on the ticket with John F. Hylan. He resigned to run for governor in 1918. He was governor for four terms, the first man in the history of the State to have this honour. He showed extraordinary ability as a vote-getter. In 1918 he defeated Charles S. Whitman by 14,000 votes, when it was generally believed that he did not have a chance of winning. In 1920 he ran against Nathan L. Miller and was defeated in the Republican Presidential landslide, but polled 1,000,000 more votes in his State than did the Democratic presidential nominee. He became head of the United States Trucking Corporation, but in 1922 was drafted to run again. This time he defeated Miller, seeking re-election, by 1,397,633 to 1,011,725—the largest majority ever given a gubernatorial candidate in New York. In 1924 he defeated Theodore Roosevelt by 1,627,111 to 1,518,552. In 1926 he defeated Ogden L. Mills by 1,523,717 to 1,276,239. As governor, Smith fought for adequate housing, improved factory laws, proper care of the insane, child welfare and State parks. He effected a reorganization of the State Government on a consolidated and business-like basis. One of his first acts as governor was to call a special session of the legislature to ratify the Federal suffrage amendment. He repeatedly demonstrated his leadership by forcing Republican legislatures to accept his recommendations.

Smith was the first Roman Catholic to have received serious consideration as a presidential candidate. His religion, combined with his long record as an opponent of Prohibition, resulted in the deadlock at the Democratic National Convention of 1924. His nomination was opposed by the Protestant dry faction led by William G. McAdoo. On the 103rd ballot John W. Davis was nominated. Despite this defeat and despite criticism that he was unacquainted with national problems, Smith was the leading Democratic candidate for the nomination for president in 1928.

At the Houston Convention of the party on June 28th he was placed in nomination by Franklin D. Roosevelt (*q.v.*). The first ballot taken gave him the necessary two-thirds vote of the delegates. The victory was due to Smith's personal influence, his perfected organization and the determination of the Democrats to forget party differences and unite behind their strongest candidate as the only hope of challenging the Republican hold on the government. Though the western and southern Democratic delegates managed to bury the hatchet at the convention they could not persuade the people to do so in the election, and the opposition to Smith in the rural districts of closely contested States in the West and South doubtless defeated him in the election. Smith carried on an aggressive campaign, making several extended speaking tours into the South and West, but when the electoral votes were counted it was found he had lost 444 to 87. The popular vote was much closer, 21,943,328 to 15,430,718. (H. F. Pr.)

See *Up to Now*, An Autobiography (1929).

SMITH, ALFRED HOLLAND (1863–1924), American railway official, was born in Cleveland (O.), April 26, 1863. After having served in various capacities with the New York central railroads he was in 1890 appointed superintendent of the Kalamazoo division of the Lake Shore and Michigan southern railway. In 1902 he became general superintendent, in 1906 vice-president, and in 1914 president of the New York central system.

When the American railways were taken over by the U.S. Government on Dec. 27, 1917, he was appointed assistant director-general and worked out the form of central and regional administration under which the railways were managed during the 26 months of Government operation. He was re-elected president of the New York central lines in June 1919. He died in New York city March 8, 1924.

SMITH, ANDREW JACKSON (1815–1897), American soldier, was born in Bucks county, Pa., on April 28, 1815, and graduated at West Point in 1838. On the outbreak of the Civil War, he became a colonel of volunteer cavalry in the Federal army, rising early in 1862 to the rank of brigadier-general U.S. Volunteers. He took part in the first attack on Vicksburg and the capture of Arkansas Post, and the final Vicksburg campaign. Later, in the Red river expedition of Gen. N. P. Banks, he received the brevet of colonel for his services at the action of Pleasant hill. In May 1864 he became lieutenant-colonel U.S.A. and major-general U.S. Volunteers. He bore a conspicuous share in the crowning victory of Nashville (*q.v.*). Just before the close of the war he was breveted brigadier-general U.S. army for his services at the action of Tupelo, Miss., and major-general U.S.A. for Nashville. In 1869 he became postmaster of St. Louis, where he died on Jan. 30, 1897.

SMITH, CHARLES FERGUSON (1807–1862), American soldier, graduated from West Point academy in 1825, and a few years later became an instructor there, rising eventually to be commandant. As a battalion commander he distinguished himself in the Mexican War, at Palo Alto, Resaca, Monterrey and Churubusco. He commanded the Red river expedition of 1856, and served under Albert Sidney Johnston in Utah (1857–60). On the outbreak of the Civil War in 1861 he accepted a commission as brigadier-general of Union volunteers, and found himself under the command of Grant, who had been his pupil at West Point. This difficult situation was made easy by Smith's loyalty to his young chief, and the old soldier led his division of raw volunteers with success at Ft. Donelson.

His ripe experience, dignity, and unselfish character made him Grant's mainstay in the early days. He went up the Tennessee with the first expedition, but at Savannah (Tenn.), met with a serious accident. His senior brigadier led his division at the battle of Shiloh and he died on April 25, 1862. The early close of his career in high command deprived the Union army of one of its best leaders, and his absence was nowhere more felt than on the battlefield of Shiloh, where the Federals paid heavily for the inexperience of their generals. A month before his death he had been made major-general of volunteers.

SMITH, CHARLOTTE (1749–1806), English novelist and poet, eldest daughter of Nicholas Turner of Stoke House, Surrey, was born in London on May 4, 1749. She left school when she was twelve years old to enter society. She married in 1765 Benjamin Smith. Charlotte Smith's first publication was *Elegiac Sonnets and other Essays* (1784), dedicated by permission to William Hayley, and printed at her own expense. For some months Mrs. Smith (her husband was imprisoned for debt in 1782) and her family lived in a tumble-down château near Dieppe, where she produced a translation of *Manon Lescaut* (1785) and a *Romance of Real Life* (1786), borrowed from *Les Causes Célèbres.* On her return to England Mrs. Smith carried out a friendly separation between herself and her husband, and thenceforward devoted herself to novel writing. Her chief works are:—*Emmeline, or the Orphan of the Castle* (1788); *Celestina* (1792); *Desmond* (1792); *The Old Manor House* (1793); *The Young Philosopher* (1798); and *Conversations introducing Poetry* (1804). She died at Tilford, near Farnham, Surrey, on Oct. 28, 1806. She had twelve children, one of whom, Lionel (1778–1842), became lieutenant-general, and was governor of the Windward and Leeward Islands.

The best account of Mrs. Smith is by Sir Walter Scott, and is based on material supplied by her sister, Mrs. Dorset, with a detailed criticism of her work by Scott (*Misc. Prose Works,* 1841, i. 348–359). Charlotte Smith is best remembered by her charming poems for children, but *The Old Manor House* still repays reading.

SMITH, EDMUND KIRBY (1824–1893), Confederate general in the American Civil War, the son of Colonel Joseph Lee Smith (1776–1846), an American lawyer and soldier, who served in the War of 1812, was born at St. Augustine (Fla.), on May 16, 1824. He graduated at West Point in 1845, being assigned to the infantry. In the Mexican War he was breveted 1st lieutenant, and captain for gallantry. He was assistant professor of mathematics at West Point from 1849–52 and was later engaged in Indian warfare on the Texas frontier. In 1861 he attained the rank of major.

When Florida seceded he resigned his army commission and entered the Confederate service as a lieutenant-colonel. He was made a brigadier-general on June 17, 1861, and was wounded at the battle of Bull Run (*q.v.*). In command of the Confederate forces in the Cumberland gap region, he took part in Gen. Bragg's invasion of Kentucky (1862), and inflicted upon the Federal forces a severe defeat at Richmond (Ky.), on Aug. 30. From Feb. 1863 to the fall of the Confederacy he was in command of the trans-Mississippi department, and was successful in making this section of the Confederacy self-supporting. He instituted a regular system of blockade-running, and met and defeated the Red river expedition under Gen. N. P. Banks in 1864.

Kirby Smith and his troops surrendered in May 1865, being the last armed forces of the Confederate States to do so. After the war, he was president of the Atlantic and Pacific Telegraph company, president of the Western Military academy, chancellor of the University of Nashville, and from 1875 to his death professor of mathematics at the University of the South, Sewanee (Tenn.). He died at Sewanee on March 28, 1893.

SMITH, FRANCIS HOPKINSON (1838–1915), American author, artist and engineer, was born in Baltimore (Md.), Oct. 23, 1838, a descendant of Francis Hopkinson (*q.v.*). He became a contractor in New York city and did much work for the Federal Government, including the stone ice-breaker at Bridgeport (Conn.), the foundation for the Bartholdi statue of Liberty in New York harbour, the Race Rock lighthouse off New London (Conn.), and many life-saving stations. A charming record of his vacation wanderings is afforded by his various volumes of travel, illustrated by himself. Smith's novels and stories are especially felicitous in portraying the old South. Among them are *Colonel Carter of Cartersville* (1891); *Caleb West, Master Diver* (1898); *The Fortunes of Oliver Horn* (1902), which has reminiscences of his artist friends; *The Romance of an Old Fashioned Gentleman* (1907); *Peter* (1908); and *Kennedy Square* (1911). His *Novels, Stories and Sketches* appeared in the Beacon edition (1902, *seq.*). Smith died at New York city, April 8, 1915. Tribute and criticism are given by T. N. Page (*Scribner's Magazine,* Sept. 1915).

SMITH, GEORGE (1789–1846), British publisher, founder of the firm of Smith, Elder & Co., was born in Scotland in 1789. From Elgin, where he was apprenticed to a bookseller, he migrated to London, where he found employment first with Rivingtons, and afterwards with John Murray. In 1816 Smith and another Scot, Alexander Elder, began business at 158 Fenchurch Street as booksellers and stationers; and in 1819 they became publishers also. Here GEORGE SMITH (2) (1824–1901), the most famous member of the firm, was born on March 19, 1824; and in the same year the business was removed to 65 Cornhill. Smith removed the publishing business, when it came under his sole control, to 15 Waterloo Place. For over thirty years Smith was the friend and publisher of Ruskin, and it was with him that *Jane Eyre* found a publisher. The firm issued works by Darwin, Ruskin, Thackeray, Robert and Mrs. Browning, Wilkie Collins, Matthew Arnold, Miss Martineau, James Payn, Trollope and Mrs. Humphry Ward. In January 1860 the first of George Smith's three great undertakings was begun, the *Cornhill Magazine* being issued in that month under the editorship of Thackeray. The second venture was the founding in 1865 of the *Pall Mall Gazette.* (*See* NEWSPAPERS.) The third and most important was the publication of the *Dictionary of National Biography,* the first volume of which was issued in 1882; it was completed in 1901, in 66 volumes; and this monumental work, since carried on by successive supplements, was the crowning effort of a successful career. George Smith died at Byfleet, near Weybridge, on April 6, 1901.

See the memoir (1901) of George Smith (2) prefixed to vol. i. of the supplement to the *Dictionary of National Biography;* reminiscences contributed to the *Cornhill Magazine* (Nov. 1900–Feb. 1901) by George Smith; an article by Sir Leslie Stephen in the same magazine (May 1901); and the special number of the *Cornhill* in January 1910, published on its 50th anniversary.

SMITH, GEORGE ("George Smith of Coalville") (1831–1895), English philanthropist, was born near Tunstall, Staffs., on Feb. 16, 1831, the son of a bricklayer, and was self-educated. He became the manager of a brick and tile works at Coalville, where he had discovered valuable seams of clay, but was dismissed in 1872 because he advocated (and secured) legislation in the interest of the labourers and especially of the children in the industry. His representations also led to the passage of the Canal Boats bills (1878 and 1884) for the education of canal boat children and for the improvement of sanitary conditions on board. He was less successful in his efforts on behalf of gipsy children. Smith died at Crick, near Rugby, on June 21, 1895.

See E. Hodder, *George Smith of Coalville, the Story of an Enthusiast* (1896).

SMITH, GEORGE (1840–1876), English Assyriologist, was born on March 26, 1840, at Chelsea, London. Through the interest

of Sir Henry Rawlinson, Smith, who was a bank-note engraver by trade, was appointed assistant in the Assyriology department of the British Museum, and the earliest of his successes was the discovery of two inscriptions, one fixing the date of the total eclipse of the sun in the month Sivan in May 763 B.C., and the other the date of an invasion of Babylonia by the Elamites in 2280 B.C. In 1872 Smith achieved world-wide fame by his translation of the Chaldaean account of the Deluge. In the following January the *Daily Telegraph* arranged with Smith that he should go to Nineveh and carry out excavations with a view to finding the missing fragments of the Deluge story. This journey resulted in the discovery of the missing tablets, and of fragments which recorded the succession and duration of the Babylonian dynasties. In 1874 Smith again left England for Nineveh, this time at the expense of the Museum, and continued his excavations at Kouyunjik. In March 1876 the trustees of the British Museum despatched Smith once more to excavate the rest of Assur-banipal's library. He died at Aleppo Aug. 19, 1876.

SMITH, SIR GEORGE ADAM (1856–), Scottish divine, was born in Calcutta on Oct. 19, 1856, where his father, George Smith, C.I.E., was then principal of the Doveton college. He was educated at Edinburgh in the Royal high school, the university and New college. After studying at Tübingen and Leipzig and travelling in Egypt and Syria, he entered the ministry of the Free Church of Scotland and was appointed professor of Old Testament subjects in the Free Church College at Glasgow 1892. In 1909 he was appointed principal and vice-chancellor of the University of Aberdeen; in 1922 he was appointed Baird lecturer at Glasgow. In 1916 he was knighted. From 1916 to 1917 he was moderator of the General Assembly of the United Free Church of Scotland.

Among his works are *The Book of Isaiah* (2 vols. 1888–90); *The Book of the Twelve Prophets* (2 vols., 1896–97); *Historical Geography of the Holy Land* (1894); *Life of Henry Drummond* (1898); *Modern Criticism and the Preaching of the O. T.* (3rd Edn., 1902); *Jerusalem* (2 vols., 1908); *The Early Poetry of Israel* (1912); *Atlas of the Hist. Geog. of the Holy Land* (1915); *Jeremiah* (1923).

SMITH, GERRIT (1797–1874), American reformer and philanthropist, was born in Utica (N.Y.), on March 6, 1797. About 1828 he became an active worker in the cause of temperance, and in his home village, Peterboro, he built one of the first temperance hotels in the country. He became an abolitionist in 1835, after seeing an anti-slavery meeting at Utica broken up by a mob. In 1840 he took a leading part in the organization of the Liberty Party, and in 1848 and 1852 he was nominated for the Presidency by the remnant of this organization that had not been absorbed by the Free Soil Party. An "Industrial Congress" at Philadelphia also nominated him for the Presidency in 1848, and the "Land Reformers" in 1856. In 1840 and in 1858 he was a candidate for the governorship of New York on an anti-slavery platform. In 1853 he was elected to the U.S. House of Representatives as an independent. At the end of the first session he resigned his seat. After becoming an opponent of land monopoly, he gave numerous farms of 50 ac. each to indigent families, and also attempted to colonize tracts in northern New York with free negroes; but this experiment was a failure. Peterboro became a station on the "underground railroad"; and after 1850 Smith furnished money for the legal expenses of persons charged with infractions of the fugitive slave law. With John Brown, to whom he gave a farm in Essex county (N.Y.), he became very intimate, and from time to time supplied him with funds, though it seems without knowing that any of the money would be employed in an attempt to incite a slave insurrection. Under the excitement following the raid on Harper's Ferry, he became temporarily insane, and for several weeks was confined in an asylum in Utica. He favoured a vigorous prosecution of the Civil War, but at its close advocated a mild policy toward the late Confederate States, declaring that part of the guilt of slavery lay upon the North. He even became one of the securities for Jefferson Davis, thereby incurring the resentment of Northern Radical leaders. He died on Dec. 28, 1874, while on a visit to relatives in New York city.

See O. B. Frothingham, *Gerrit Smith: a Biography* (1879).

SMITH, GOLDWIN (1823–1910), British historian and publicist, was born at Reading on Aug. 13, 1823. He was educated at Eton and Magdalen college, Oxford, and became a fellow of University college. He was assistant secretary to the royal commission on the subject of university reform in 1850, and secretary to the commissioner appointed by the act of 1854. In 1868, when the question of reform at Oxford was again growing acute, he published a brilliant pamphlet, entitled *The Reorganization of the University of Oxford.* His aspiration that colonists and Americans should be attracted to Oxford has been realized by Mr. Rhodes's will. His principal historical writings—*The United Kingdom: a Political History* (1899), and *The United States: an Outline of Political History* (1893)—make no claim to original research, but are remarkable examples of terse and brilliant narrative.

The outbreak of the American Civil War proved a turning-point in his life. He warmly championed the cause of the North, and his pamphlets, especially one entitled *Does the Bible sanction American Slavery?* (1863), played a prominent part in converting English opinion. Visiting America on a lecture tour in 1864, he received an enthusiastic welcome, and was entertained at a public banquet in New York. In 1868 he threw up his career in England and settled in the United States, where he held the professorship of English and Constitutional History at Cornell University till 1871. In that year he removed to Toronto, where he edited the *Canadian Monthly,* and subsequently founded the *Week* and the *Bystander.*

He did not, however, cease to take an active interest in English politics. He stated that "if he ever had a political leader, his leader was John Bright, not Mr. Gladstone." Speaking in 1886, he referred to his "standing by the side of John Bright against the dismemberment of the great Anglo-Saxon community of the West, as I now stand against the dismemberment of the great Anglo-Saxon community of the East." These words form the key to his views of the future of the British Empire. He always maintained that Canada, separated by great barriers, running north and south, into four zones, each having unimpeded communication with the adjoining portions of the United States, was destined by its natural configuration to enter into a commercial union with them, which would result in her breaking away from the British empire, and in the union of the Anglo-Saxons of the American continent into one great nation. These views are most fully stated in his *Canada and the Canadian Question* (1891).

Goldwin Smith died at his residence, The Grange, Toronto, on June 7, 1910.

See Arnold Haultain, *Goldwin Smith, his Life and Opinions* (1913), which includes Smith's journal during his first visit to America in 1864.

SMITH, HENRY BOYNTON (1815–1877), American theologian, was born in Portland (Me.) on Nov. 21, 1815. He graduated at Bowdoin college in 1834; studied theology at Andover, where his health failed, at Bangor, and after a year (1836–37) as librarian and tutor in Greek at Bowdoin, in Paris, Halle and Berlin. He returned to America in 1840, was temporary instructor for a few months at Bowdoin, and in 1842 became pastor of the Congregational church of West Amesbury (now Merrimac, Mass.) where for several terms he combined with his church duties teaching at the Andover theological seminary. In 1847–50 he was professor of moral philosophy and metaphysics at Amherst; in 1850–54, Washburn professor of church history; and in 1854–74, Roosevelt professor of systematic theology, at Union theological seminary. He died in New York city Feb. 7, 1877. A leader of the "new school" Presbyterians, he always made it clear that his ideal philosophy was Christocentric.

From notes of his lectures, W. S. Karr prepared several volumes of Dr. Smith's theological writings, including *Introduction to Christian Theology* (1883) and *System of Christian Theology* (1884). Besides writing encyclopaedia and magazine articles, Dr. Smith was editor of the *American Theological Review. See* biographies by his wife (1881) and by L. F. Stearns (1892).

SMITH, SIR HENRY GEORGE WAKELYN, BART. (1787–1860), British general, son of John Smith, surgeon, of Whittlesey, Cambridgeshire, was born at that place on June 28, 1787. Harry Smith (as he consistently preferred to be called throughout his life) was educated privately and entered the army

in 1805. His first active service was in South America in 1806, and he subsequently served through the Peninsular War from the concentration at Salamanca in Nov. 1808 to the battle of Toulouse on April 10, 1814. He married in 1812 a young Spanish girl, Juana Maria de Los Dolores de Leon, who remained with him throughout the rest of the war, accompanying the baggage train, sleeping in the open on the field of battle, riding freely among the troops, and sharing all the privations of campaigning. "Juanita" was idolized by the soldiers. At the close of the war Harry Smith volunteered for service in the United States, where he was present at the battle of Bladensburg (Aug. 24, 1814), and witnessed the burning of the capitol at Washington, which, as he said, "horrified us, coming fresh from the duke's humane warfare in the south of France." Returning to Europe he was brigade-major at Waterloo; and in 1828 was ordered to the Cape of Good Hope, where he commanded a division in the Kaffir War of 1834–36. In 1835 he accomplished the feat of riding from Cape Town to Grahamstown, a distance of 600 m., in less than six days; and was appointed governor of the new province of Queen Adelaide, where he gained unbounded influence over the native tribes. But though supported by Sir Benjamin D'Urban, the high commissioner, the ministry in London reversed his policy and—to quote Smith's own words—"directed the province of Queen Adelaide to be restored to barbarism." Smith himself was removed from his command, his departure being deplored alike by the Kaffirs and the Dutch; and numbers of the latter, largely in consequence of this policy of Lord Glenelg, began the migration to the interior known as "the great trek."

Harry Smith was now appointed deputy-adjutant-general of the forces in India, where he took part in the Gwalior campaign of 1843 (for which he received a K.C.B.) and the Sikh War of 1845–46. He was in command of a division under Sir Hugh Gough at the battles of Moodkee and Ferozeshah, where he conspicuously distinguished himself, but was insufficiently supported by the commander-in-chief. After the second of these actions Smith was appointed to an independent command, and on Jan. 28, 1846, he inflicted a crushing defeat on the Sikhs at Aliwal on the Sutlej. At Sobraon on Feb. 10 he again commanded a division under Gough. For the great victory of Aliwal he was awarded the thanks of parliament, and was created a baronet. In 1847 he returned to South Africa as governor of Cape Colony and high commissioner, to grapple with the difficulties he had foreseen 11 years before (*see* CAPE COLONY: *History*). He took command of an expedition to deal with the disaffected Boers in the Orange River Sovereignty, and fought the action of Boomplaats on Aug. 29, 1848. In Dec. 1850 war broke out with the Kaffirs; Smith was insufficiently supplied with troops from England; and Lord Grey recalled him in 1852 before the Kaffirs had been completely subdued. He protested strongly against the abandonment of the Orange River Sovereignty to the Boers, which was carried out two years after his departure, and he actively furthered the granting of responsible government to Cape Colony. His Spanish wife was his constant companion in his second as in his earlier sojourn in South Africa, where her memory is recalled by the town of Ladysmith in Natal, as is that of her husband by Harrismith in the Orange Free State; while Aliwal North, founded in 1849 and named after his great Indian victory, further commemorates Smith. On his return to England he held a military appointment for some years, and died in London on Oct. 12, 1860. Juana, Lady Smith, survived till 1872.

See *Autobiography of Sir Harry Smith,* edited by G. C. Moore Smith (1901); R. S. Rait, *Life of Viscount Gough* (1903); Wilmot and Chase, *Annals of the Cape Colony* (1869); J. Noble, *South Africa* (1877); Theal's *History of South Africa,* vol. iv.

SMITH, HENRY JOHN STEPHEN (1826–1883), English mathematician, was born in Dublin on Nov. 2, 1826. When he was two years old his father died, and his mother left Ireland for England. After being privately educated he entered Rugby school in 1841, and Balliol College, Oxford, in 1844. He was elected a fellow of Balliol in 1850 and Savilian professor of geometry in 1861. He was elected F.R.S. in 1861. He served on various royal commissions, and from 1877 was the chairman of the managing body of the meteorological office. He died at Oxford on Feb. 9, 1883.

Smith published a few papers on geometry and then began a study of the existing work on the theory of numbers. The results of his researches are contained in his *Report on the Theory of Numbers,* which appeared in the British Association volumes from 1859 to 1865. His further original researches on the subject were communicated to the Royal Society in two memoirs upon "Systems of Linear Indeterminate Equations and Congruences" and upon the "Orders and Genera of Ternary Quadratic Forms" (*Phil. Trans.,* 1861 and 1867). He also established the principles on which the extension to the general case of *n* indeterminates depends, and obtained the general formulae. A brief abstract of his methods and results appeared in the *Proc. Roy. Soc.* for 1864 and 1868. As corollaries to the general formulae he adds the formulae relating to the representation of a number as a sum of five squares and also of seven squares. After 1864 he devoted himself chiefly to elliptic functions, and published papers in the *Proc. Lond. Math. Soc.* and elsewhere.

His *Collected Papers,* prefaced by several biographical notices, were edited by J. W. L. Glaisher (Oxford, 1894).

See the *Spectator* of Feb. 17, 1883, by Lord Justice Bowen; J. W. L. Glaisher's memoir in the *Monthly Notices of the Roy. Ast. Soc.* (vol. xliv., 1884).

SMITH, JAMES (1775–1839), and **HORACE** (1779–1849), authors of the *Rejected Addresses,* sons of a London solicitor, were born, the former on Feb. 10, 1775, and the latter on Dec. 31, 1779, both in London. The occasion of their happy *jeu d'esprit* was the rebuilding of Drury Lane theatre in 1812, after a fire in which it had been burnt down. The managers had offered a prize of £50 for an address to be recited at the reopening in October. The brothers Smith had the idea of making the most popular poets of the time figure as competitors and issuing a volume of unsuccessful addresses in parody of their various styles. They divided the task between them. James took Wordsworth, Southey, Coleridge and Crabbe, while Moore, Scott and Bowles were assigned to Horace. Both had a hand in Byron. Seven editions were called for within three months. *Rejected Addresses* is a classic in the literature of parody. The only other undertaking of the two brothers was *Horace in London* (1813). James Smith made another hit in writing *Country Cousins, A Trip to Paris, A Trip to America* and other lively skits for Charles Mathews who said he was "the only man who can write clever nonsense." James was reputed one of the best of talkers in an age when the art was studied, and it was remarked that he held his own without falling into the great error of wits—sarcasm. But in his old age the irreverent *Fraser's* put him in its gallery of living portraits as a gouty and elderly but painstaking joker. He died in London on Dec. 24, 1839.

After making a fortune as a stockbroker, Horace Smith wrote about a score of historical novels—*Brambletye House* (1826), *Tor Hill* (1826), *Reuben Apsley* (1827), *Zillah* (1828), *The New Forest* (1829), *Walter Colyton* (1830), etc. But he was more of an essayist than a story-teller. Three volumes of *Gaieties and Gravities,* published by him in 1826, contain many witty essays both in prose and in verse, but the only single piece that has taken a permanent place is the "Address to the Mummy in Belzoni's Exhibition." Shelley said of Horace: "Is it not odd that the only truly generous person I ever knew who had money enough to be generous with should be a stockbroker? He writes poetry and pastoral dramas and yet knows how to make money, and does make it, and is still generous." Horace Smith died at Tunbridge Wells on July 12, 1849.

See Beavan, *James and Horace Smith* (1899).

SMITH, JEREMIAH, JUNIOR (1870–), American lawyer and economist, was born at Dover, N.H., on Jan. 14, 1870. He graduated at Harvard university in 1892 and the Harvard law school in 1895. In 1895 he became secretary to Mr. Justice Gray of the U.S. Supreme Court, but in 1896 started the practice of law in Boston. He was a captain in the Quartermaster Corps A.E.F., in France in 1918. At the conclusion of hostilities he was appointed counsel to the treasury department in Europe and was associated in that capacity with the U.S. peace commission, acting also as

an adviser in financial matters. After the signature of the Treaty of Versailles he resumed practice in Boston. During 1924–26 he was commissioner general of the League of Nations in Hungary, being successful in stabilizing the currency and placing Hungarian finance on a sound basis. On the completion of his work, July, 1926, he returned to practice in Boston. He generously refused to accept any remuneration except his expenses; and the sum of approximately $60,000 thus saved was designated by the Government as a scholarship fund for sending Hungarian students to the United States.

SMITH, JOHN (1579–1631), the best known of the early settlers of Virginia, was born of excellent parentage at Willoughby, in Lincolnshire, England. He attended school but was an unwilling scholar, the call of the sea making itself heard in his consciousness. Hence when about 16 years of age he started on his adventures. These he pursued on land and sea, with a short interruption, for ten years, and to his lot fell a great number of unusual experiences and hairbreadth escapes.

It is unfortunate that our main source of information in reference to this period of Smith's life is the testimony of Smith himself, but where it has been possible to check his narrative it has been found substantially correct. Hence, argue his friends, why not accept his credibility as a whole? It is a notable fact that probably the closest student of Smith's works, Edward Arber, who in 1884 edited John Smith's works for the *English Scholar's Library,* gives his adherence unreservedly to this credibility. Professor Arber's hope, however, to establish Smith's reputation beyond dispute was vain, for very shortly after the appearance of Arber's edition Mr. Alexander Brown brought out his two books, *The First Republic in America* and *The Genesis of the United States,* in both of which Smith is heavily attacked. His animus against Smith arose from the fact that an exaltation of Smith appeared to him to carry with it a belittling of those engaged with Smith in the effort to establish a settlement at Jamestown, an effort engaged in by many leading Englishmen of the time, and of such importance as to merit disassociation from it of the idea that its success was at any time dependent on any one man.

When Smith finally returned to England in 1605, he was only twenty-six years of age, but his varied experiences had matured him early, and he had graduated from the ranks of the mere fighter and entered those of the pioneer and the colonizer. He threw himself with energy into colonization schemes. He embarked heart and soul in the London Company enterprise—first in securing the charter and then in securing colonists. Not only did he go himself, but he spent his money in getting others to go. It is a great compliment to Smith that the Council of the company in London chose him to be a member of the Council in Virginia. His selection shows that, though young, he was already a man of mark.

The colonists set out from England Dec. 19, 1606, and did not reach Virginia till April 26, 1607. When the box containing the names of the members of the Council was opened, and it was found to contain Smith's, he was not permitted to take his seat, being under arrest on a charge of conspiracy on the trip over. Later, however, he was cleared, and his principal accuser fined £200. He was admitted a member of the Council June 26, 1607.

The actual landing of the colonists at Jamestown was made on May 14, and on May 22 Captain Newport with a party including Captain Smith made explorations up the James River, reaching the site of Richmond at the falls. Beyond this he desired to march inland but was dissuaded by the Indian chief whose town was at the falls. Reaching Jamestown on the return on May 27, the party found that the Indians had the day before made an attack on the English when they were busy planting their corn, unsuspicious and unprepared. It was by means of the guns of the three ships lying close inshore that the enemy was forced to retire. In this fight was disclosed at least one of the advantages of Jamestown as the place of settlement, whatever points there may have been in its disfavour. The channel of the river there runs very close to the shore. Moreover, Jamestown Island was at that time a peninsula with a narrow, easily defensible neck, which was later, when Smith became president, protected by a block house.

On June 21 Captain Newport sailed away to England leaving 105 people at Jamestown with provisions for thirteen or fourteen weeks, under the command of the Council, with Edward Maria Wingfield as president, elected by the Council itself. Now a serious defect of organization soon become apparent. It was the Council that had the authority, not the president, who, however, presided at the deliberations of that body and had an additional vote in case of a tie. This form of government was absolutely bad. Too much time was taken up in wrangling in the Council, too much feeling was engendered between individual councillors. The situation—scanty provisions and sickness within the stockade among inexperienced and largely unsuitable colonists and, without, lurking and hostile savages—called for concentration and not dispersion of power. The strong hand was needed.

It fell to Smith's lot to trade with the Indians for provisions that were to keep the settlers alive till the return of Captain Newport. These difficult and dangerous trading expeditions he conducted with success. He always returned to Jamestown safe and with good supplies. Others, all too frequently, when these duties later devolved on them, either returned not at all or with empty baskets. Smith, no doubt, used all means in these expeditions—professions of friendship, cajolery, force, fraud, as well as fair trading. Several of these expeditions he made up the Chickahominy. On Dec. 10 he started out to discover the source of the Chickahominy, for it was thought that probably this source was in a ridge whose westerly flowing streams might have their outlet in the South Sea. It was on this trip that he was captured by the Indians and the best-known incident of his life occurred, namely, his rescue by Pocahontas, who when, according to the orders of Powhatan, her father, the great chief of a confederacy of Indians, he was led forth to execution in retaliation for the killing by him of an Indian in the fight in which he was captured, threw herself upon him and by her entreaties prevailed with her father to spare his life. This was the act of a kindhearted, simple little Indian maiden of twelve or thirteen years of age who had been entertained by Smith with stories and sights of marvels in the time he had been at her father's residence before the execution had been decided on. He was then adopted as a member of the tribe. Later he was permitted to return to Jamestown. He faced another danger, however, when he returned. His enemy Gabriel Archer, who had in his absence been made a member of the Council, promptly charged him under the Levitical law with the death of his companions. On this absurd charge he was actually tried and sentenced to be hanged. But the hanging was averted by the arrival of Captain Newport from England. When Newport with his "First Supply" arrived on the 9th of Jan. 1608, only 38 of the colonists remained of the original 105. When Newport again left the colony on April 10, he took with him Captains Wingfield and Archer. On April 20 arrived the "Phoenix," Captain Francis Nelson, the consort of Newport's ship of the "First Supply." Newport's ship and Nelson's ship had brought 120 colonists.

In the early summer of 1608 Smith set out on his famous exploration of the Chesapeake Bay and its tributaries. He explored both sides of the bay far up to its head and went up the Potomac River as far as the site of the present city of Washington and up the Rappahannock as far as the site of Fredericksburg. At one time he was so violently hurt by a stingray that he found it necessary to return to Jamestown to be treated by a surgeon. On this trip—or two trips—the party travelled three thousand miles in an open boat and met many adventures. One hardly knows which more to admire, the determined endurance of Smith and his men or the careful collection of data which went later into a narrative of the expedition and into a truly remarkable map.

When Smith returned from Stingray Point to get his surgeon, he found the colonists clamouring that Ratcliffe should be deposed from the presidency and Smith put in his place. This was accordingly done by the Council, but Smith asked his friend Scrivener to act for a time, and he resumed his explorations. He remained in Jamestown only from the 21st to the 24th of July. He returned from the second voyage on Sept. 7, 1608, and

three days later assumed the duties of president. His activities were incessant. In October came Captain Newport with the "Second Supply" consisting of seventy colonists. The population of Jamestown now numbered about 200, of whom, owing to improved conduct of affairs, no more than six or seven succumbed to disease before the arrival of the "Third Supply" the following year.

Newport's instructions from the Council in London, impatient for quick returns on the company's investment, were to find gold, discover the passage to the South Sea, search for Raleigh's missing colonists, crown Powhatan (in order to gain his favour), and to employ certain Poles and Dutchmen in making pitch, tar, glass, and soap-ashes. Smith was opposed to these objects, with a varying degree of intensity, as diverting energy which should be expended in making the colony self-supporting, first and foremost in the matter of the food supply. As for Powhatan, he knew that his favour and support were important, that trade with the Indians for supplies was essential, but he was opposed to the use of any great amount of flattery. It was only another case, however, in which a distant and imperfectly informed higher authority had to be obeyed by the able administrator on the spot. Hence Smith bent his energies toward carrying out the instructions. But when Newport returned to England, Smith sent, with his celebrated map already referred to, a letter to the Council setting forth plainly his views as to these instructions and as to all questions affecting the good of the colony. His letter is most important, stressing the necessity of sending over competent toilers to make the colony self-supporting.

During the winter Smith found it necessary to make several expeditions among the Indians to obtain corn to stave off famine and was always successful, though it was sometimes necessary for him to force the Indians to trade. He had many narrow escapes from disaster. His courage, his resourcefulness, and his knowledge of Indian character, however, brought him through. After his return from the last expedition, with what seemed to be enough corn to last for a long time, he compelled the lazy among the colonists to do their share of work, and many necessary things were done in Jamestown and the vicinity. Forty acres of corn were planted. Now the rats at Jamestown, however, ate up large quantities of the precious corn, and Smith experimented by sending parties off to live on oysters and fish, and even billeted some among the friendly Indians in the neighbourhood of Jamestown. Despite everything untoward that had happened and the shortage of food, Smith could feel in the spring and summer of 1609 that a solid foundation was being laid for the future wellbeing of the colony. His authority was now supreme because all the other members of the Council had died or returned to England.

On July 10, 1609, there arrived a ship under Captain Samuel Argall, to fish for sturgeon and to trade, and Captain Smith found it advisable to commandeer the provisions brought out, with the understanding, of course, that they would be paid for by the company. The ship brought out letters much less welcome to Smith than the supplies. In them he was much criticized for what the Council was pleased to think his harsh treatment of the Indians and for failure to send back to England more valuable cargoes. Smith bridled at the injustice. His letter to the Council sent by Newport the preceding November had had little effect. News was also brought that the London Company had obtained a new charter, providing for a reorganization of the plan of government of the colony. There was to be a governor-general, who was, or whose deputy was, to be in real control. Lord De la Warr was to be this governor; nine supply ships were coming over. Smith understood, of course, that this change in the government was wise, but he did not relish being set aside, and he honestly thought that he with his experience, especially with his knowledge of the Indians, was the best man that could be found for the position. And almost certainly he was correct, though it may be argued that Smith had by his overbearing and impatient manner with his equals—though not with his inferiors—in station made so many enemies among influential members of the company and colony that the time had come for a new man to be put in control, who would be sure, however, to profit by the experience of his predecessor.

Lord De la Warr did not at first intend to come to Virginia himself till much later but to remain in England and there give attention to its affairs. He was to be represented in Virginia by Sir Thomas Gates, lieutenant-governor. The "Sea Venture," carrying Sir Thomas Gates, lieutenant-governor, Sir George Somers, admiral, Sir Thomas Dale, high marshal, and Captain Christopher Newport, vice-admiral, was wrecked on one of the Bermuda Islands, and the arrival in Virginia of these high officials was much delayed. This vessel also carried instructions. The other ships were dispersed and much distressed by the same storm that wrecked the "Sea Venture," but four of them sailed up the James on August 11 and others came in later, all in a very dilapidated condition. These ships brought Ratcliffe, Martin and Archer, former members of the Council in Virginia. When these demanded that Smith give up his office, he refused, since neither the new governor nor the lieutenant-governor was at hand, nor had he been officially informed of the changes made. He chose, however, to recognize Martin as a member of the Council, though maintaining that the other two were not now legally members, and a few days before his year's term as president was to expire on Sept. 10, he named Martin as his successor, who immediately, however, resigned in favour of Smith. Smith now sent Martin to make a settlement among the Nansemond Indians and he himself went to inspect a settlement he had previously sent Captain West to make at the falls of the James. He found affairs going badly. When he was returning to Jamestown, he was dangerously burned by an explosion of gunpowder and his return to England was necessitated. With him went charges drawn up by his enemies in Virginia, which, however, were not pressed. But Smith was never employed again by the London Company. He had made too many enemies.

When he left, the harvest was newly gathered and the colony was otherwise in a sufficiently stable condition to ensure its steady growth if only a competent administrator had been in charge. We cannot, however, go further into the history of the colony except to say that things at once went to pieces. The winter of 1609–10 is known as the "starving time." The colony was only saved from extinction by the arrival in the spring of Sir Thomas Gates and a little later of Lord De la Warr.

Though Captain Smith saw no more service with the Virginia Company of London, he, when he recovered his health, carried on his work in the interests of colonization and in the establishment of fisheries. With two ships he made a fishing and exploring voyage in 1614, and, as he had done in the case of the Chesapeake Bay country, made a surprisingly accurate map of the New England coast from the Penobscot to Cape Cod. He called the country "New England" and he assigned the name "Plymouth" to the mainland opposite Cape Cod.

Smith gained the favour of Sir Ferdinando Gorges, one of the principal members of the Virginia Company of Bristol. Under his patronage he made in 1615 two attempts to reach New England for purposes of settlement, the first of which failed on account of stress of weather, and the next attempt was frustrated by his being captured by pirates. In 1617 he made another unsuccessful attempt. He had been given by the Virginia Company of Bristol the vain title of admiral of New England. In 1618 he endeavoured without success to enlist the support of Lord Bacon for his colonization plans. In 1619 he offered to pilot the Pilgrim Fathers to North Virginia, that is, New England, but the offer was not accepted. After this he was mainly engaged in producing pamphlets, books, and maps, the design of which was to excite an interest in the colonization of America and now especially that part of it he had named New England. He died in June, 1631. He was buried in St. Sepulchre's Church, London.

Smith's principal writings, the titles being given in modern spelling and abbreviated form and in the order of their publication, are as follows: *A True Relation* (1608); *A Map of Virginia* (1612); *A Description of New England* (1616); *New England's Trials* (1620); *The General History of Virginia, New England, and the Summer Isles* (1624); *An Accidence for All Young Seamen* (1626); the same work recast and enlarged and given the title

A Sea Grammar (1627); *The True Travels* (1630); *Advertisements for the Unexperienced Planters* (1631).

The best edition of Smith's works is that edited by Professor Edward Arber, and published in Birmingham, England, in 1884. In this are also printed most of the pamphlets of his contemporaries, including those unfriendly to Smith, so that the reader may be able to examine without trouble all the first-hand accounts of the settlement of Jamestown. The latest biography is by E. K. Chatterton. This was published in 1927 as one of the *Golden Hind Series,* which contains the biographies of the great Elizabethan seamen and explorers who gave lustre to that age. This book contains a full bibliography of Smith's own writings, and a very extensive list of the writings in reference to him. An engraving was made of Captain John Smith from life by Simon van der Pass, which has been reproduced many times. There is in the Virginia State Library a recently acquired portrait of an Englishman dressed in Turkish costume, which experts pronounce an original portrait of Captain Smith. (H. R. McI.)

SMITH, JOHN RAPHAEL (1752–1812), English painter and mezzotint engraver, son of Thomas Smith of Derby, landscape painter. He reproduced some forty of Reynolds' works, some of these plates ranking among the masterpieces of the art of mezzotint, and was appointed engraver to the prince of Wales. He had an extensive connection as a print-dealer and publisher, and would have been wealthy but for his dissipated habits. He was a boon companion of George Morland, whose figure-pieces he excellently mezzotinted. He died at Doncaster on March 2, 1812. As a mezzotint engraver Smith occupies the very highest rank. His prints are delicate, excellent in drawing and finely expressive of colour.

His small full-lengths in crayons and his portraits of Fox, Horne Tooke, Sir Francis Burdett and the group of the duke of Devonshire and family support his claims as a successful draughtsman and painter. Other paintings are the subject-pictures, the "Unsuspecting Maid," "Inattention," and the "Moralist."

SMITH, JOSEPH (1805–1844), founder of the Mormon religion, was born at Sharon, Vt. (U.S.A.), Dec. 23, 1805. In 1815 his parents moved to Palmyra, N.Y., on a hill near which Smith claimed to have unearthed in 1827, in answer to a vision, the golden plates of the *Book of Mormon.* With the aid of two optical instruments found with the plates Smith translated the characters they contained, which he said were "a revision of Egyptian hieroglyphics," and from behind a curtain dictated the matter to several scribes. In 1830 the first edition of the *Book of Mormon* was printed, and in the same year on April 6, some believers in his doctrines being found, Smith organized the "Church of Jesus Christ of Latter Day Saints." Subsequent revelations continued to be reported by Smith from time to time according to which the details of the church's organization and its laws were shaped. Smith directed the affairs of the church during its many trials and removals until he was killed, June 27, 1844, by a mob which attacked the jail at Carthage, Ill., in which he was confined. (*See* MORMONS.)

SMITH, RICHARD BAIRD (1818–1861), British engineer officer, was born on Dec. 31, 1818, was educated at Lasswade and Addiscombe, and joined the Madras Engineers in 1838. Being transferred to the Bengal Engineers, he served through the second Sikh war. In the Indian Mutiny, when Delhi was invested, he was appointed chief engineer in charge of the siege works, and prevented Wilson from relaxing his hold on Delhi until the arrival of John Nicholson with reinforcements from the Punjab, and of the siege train from Phillour. Nicholson then joined Baird Smith in compelling Wilson to make the assault, which proved successful, on Sept. 14. After the Mutiny he was made A.D.C. to Queen Victoria, and became secretary to the Government of India in the public works department. He died at sea on Dec. 31, 1861. He married a daughter of De Quincey, who long survived him.

See Colonel H. M. Vibart, *Richard Baird Smith* (1897).

SMITH, ROBERT (1689–1768), English mathematician, was born in 1689, probably at Lea near Gainsborough. After attending Leicester grammar school he entered Trinity College, Cambridge, in 1708, and becoming minor fellow in 1714, major fellow in 1715 and senior fellow in 1739, was chosen master in 1742, in succession to Richard Bentley. From 1716 to 1760 he was Plumian professor of astronomy, and he died at Cambridge on Feb. 2, 1768. He published *A Compleat System of Opticks* in 1738, which gained him the sobriquet of "Old Focus," and *Harmonics, or the Philosophy of Musical Sounds* in 1749. He was the founder of the Smith's prizes at Cambridge, leaving £3,500 South Sea stock to the university for the purpose.

See *Alumni Cantabrigenses* (Cambridge, 1927).

SMITH, ROBERT (1757–1842), an American statesman, was U.S. secretary of the navy, 1802–05, and attorney general, 1805–09, under Jefferson; also secretary of state, 1809–11, under Madison. In the last mentioned post he entered into an agreement with David M. Erskine, the British minister at Washington, which was promptly repudiated by George Canning, the British foreign secretary; and, when Canning sent the insolent Francis James Jackson to take Erskine's place at Washington, it became necessary for Secretary Smith to break off all relations with the British minister. Smith was much maligned by his enemies, the chief of whom was Albert Gallatin, who had been kept out of the office of secretary of state; and the reputation of Smith has subsequently suffered at the hands of historians. But a recent writer has pointed out that as a member of the Maryland legislature, and as secretary of the navy under Jefferson, Smith appeared eminently successful; and this writer has also shown that his work as secretary of state was of a high order, that Gallatin's charges against him (the mishandling of government funds) broke down completely, and that Gallatin, by threatening to resign as secretary of the treasury, prompted Madison to call for the resignation of Smith. After his retirement Smith reviewed his career as secretary of state in an *Address to the People of the United States* (June 1811). Thereafter he served in various positions in Maryland, and died on Nov. 26, 1842, the last survivor of the electoral college of 1789, which elected George Washington first president of the United States.

See Charles C. Tansill, "Robert Smith, Secretary of State," in Samuel Flagg Bemis (ed.), *The American Secretaries of State and Their Diplomacy,* iii. 151–200 (1927).

SMITH, SYDNEY (1771–1845), English writer and divine, son of Robert Smith, was born at Woodford, Essex, on June 3, 1771, the son of a wealthy and eccentric landowner. Sydney was the second of a family of four brothers and one sister, all remarkable for their talents. While two of the brothers, Robert Percy, known as "Bobus," afterwards advocate-general of Bengal, and Cecil, were sent to Eton, Sydney was sent with the youngest to Winchester, where he rose to be captain of the school. In 1789 he had become a scholar of New College, Oxford; he received a fellowship after two years' residence, took his degree in 1792 and proceeded M.A. in 1796. He was ordained priest at Oxford in 1796, and became a curate in the small village of Nether Avon, near Amesbury, in the midst of Salisbury Plain. The squire of the parish, Michael Hicks-Beach, engaged him after a time as tutor to his eldest son. It was arranged that they should proceed to the university of Weimar, but, before reaching their destination Germany was disturbed by war, and "in stress of politics," said Smith, "we put into Edinburgh." This was in 1798. While his pupil attended lectures, Smith was not idle. He studied moral philosophy under Dugald Stewart, and devoted much time to medicine and chemistry. He also preached in the Episcopal chapel, where his practical brilliant discourses attracted many hearers.

In 1800 he published his first book, *Six Sermons, preached in Charlotte Street Chapel, Edinburgh,* and in the same year, married, against the wishes of her friends, Catharine Amelia Pybus. They settled at No. 46 George Street, Edinburgh. Towards the end of his five years' residence in Edinburgh, in Jeffrey's flat in Buccleuch Place, Sydney Smith proposed the setting up of a review as an organ for young malcontents. "I was appointed editor," he says in the preface to the collection of his contributions, "and remained long enough in Edinburgh to edit the first number" (October 1802) of the *Edinburgh Review.* He continued to write for the *Review* for the next quarter of a century, and his brilliant articles were a main element in its success.

Life in London.—He left Edinburgh for good in 1803, when the education of his pupils was completed, and settled in London, where he was morning preacher at Berkeley Chapel, Mayfair, and "alternate evening preacher" at the Foundling Hospital. He lectured on moral philosophy at the Royal Institution for three seasons, from 1804 to 1806, when the London world crowded to Albemarle Street to hear him. With the brilliant reputation that Sydney Smith had acquired in the course of a few seasons in London, he would probably have obtained some good preferment had he been on the powerful side in politics. Sydney Smith's elder brother "Bobus" had married Caroline Vernon, aunt of the 3rd Lord Holland, and he was always a welcome visitor at Holland House. His Whig friends came into office for a short time in 1806, and presented him with the living of Foston-le-Clay in Yorkshire. He shrank from this banishment for a time, and discharged his parish duties through a curate; but Spencer Perceval's Residence Act was passed in 1808, and after trying in vain to negotiate an exchange, he moved his household to Yorkshire in 1809.

"Peter Plymley."—The Ministry of "All the Talents" was driven out of office in 1807 in favour of a "no popery" party, and in that year appeared the first instalment of Sydney Smith's most famous production, *Peter Plymley's Letters,* on the subject of Catholic emancipation, ridiculing the opposition of the country clergy. Its full title was *A Letter on the Subject of the Catholics to my brother Abraham who lives in the Country, by Peter Plymley.* Nine other letters followed before the end of 1808, when they appeared in collected form. Rumours of Peter Plymley's identity got abroad. Lord Holland wrote to him expressing his own opinion and Grenville's, that there had been nothing like it since the days of Swift (*Memoir,* i. 151). He also pointed out that Swift had lost a bishopric for his wittiest performance. Smith won the hearts of his Yorkshire parishioners as quickly as he had conquered a wider world. There had been no resident clergyman in his parish for 150 years; he had a farm of 300 acres to keep in order; a rectory had to be built. All these things were attended to beside his contributions to the *Edinburgh Review.* He continued to serve the cause of toleration by ardent speeches in favour of Catholic emancipation. "I defy Dr. Duigenan,"[1] he pleaded, addressing a meeting of clergy in 1823, "in the full vigour of his incapacity, in the strongest access of that Protestant epilepsy with which he was so often convulsed, to have added a single security to the security of that oath." At this time appeared one of his most vigorous and effective polemics, *A Letter to the Electors upon the Catholic Question* (1826).

Later Years.—Sydney Smith, after twenty years' service in Yorkshire, obtained preferment at last from a Tory minister, Lord Lyndhurst, who presented him with a prebend in Bristol cathedral in 1828, and two livings in the neighbourhood. From this time he discontinued writing for the *Edinburgh Review* on the ground that it was more becoming in a dignitary of the church to put his name to what he wrote. It was expected that when the Whigs came into power Sydney Smith would be made a bishop. But though he was not without warm friends at headquarters, the opposition was too strong for them. One of the first things that Lord Grey said on entering Downing Street was, "Now I shall be able to do something for Sydney Smith"; but he was not able to do more than appoint him in 1831 to a residentiary canonry at St. Paul's in exchange for the prebendal stall he held at Bristol. He was as eager a champion of parliamentary reform as he had been of Catholic emancipation, and one of his best fighting speeches was delivered at Taunton in October 1831 when he made his well-known comparison of the House of Lords, who had just thrown out the Reform Bill, with Mrs. Partington of Sidmouth, setting out with mop and pattens to stem the Atlantic in a storm.

On the death of his brother Courtenay he inherited £50,000, which put him out of the reach of poverty. He died at his house in Green Street, London, on Feb. 22, 1845, and was buried at Kensal Green.

[1]Patrick Duigenan, M.P. for the city of Armagh, a Protestant agitator.

Sydney Smith's other publications include: *Sermons* (2 vols., 1809); *The Ballot* (1839); *Works* (3 vols., 1839), including the *Peter Plymley* and the *Singleton Letters* and many articles from the *Edinburgh Review; A Fragment on the Irish Roman Catholic Church* (1845); *Sermons at St. Paul's . . .* (1846) and some other pamphlets and sermons. Lady Holland says (*Memoir,* i. 190) that her father left an unpublished ms., compiled from documentary evidence, to exhibit the history of English misrule in Ireland, but had hesitated to publish it. This was suppressed by his widow in deference to the opinion of Lord Macaulay.

See *A Memoir of the Reverend Sydney Smith by his daughter, Lady Holland, with a Selection from his Letters edited by Mrs.* [*Sarah*] *Austin* (2 vols. 1855); also *A Sketch of the Life and Times of . . . Sydney Smith* (1884) by Stuart J. Reid; a chapter on "Sydney Smith" in Lord Houghton's *Monographs Social and Personal* (1873); A. Chevrillon, *Sydney Smith et la renaissance des idées libérales en Angleterre au XIX^e siècle* (1894); and especially the monograph, with a full description of his writings, by G. W. E. Russell in *Sydney Smith* (English Men of Letters series, 1905). There are numerous references to Smith in contemporary correspondence and journals.

SMITH, THEOBALD (1859–), American pathologist, was born at Albany, N.Y., July 31, 1859. He graduated from Cornell (1881) and from the Albany medical college (1883). In 1884 he was appointed director of the pathological laboratory of the Bureau of Animal Industry, in the Dept. of Agriculture, at Washington, where for 11 years he investigated infectious animal diseases. At the same time he was professor of bacteriology at Columbian, later known as George Washington, university.

From 1895 to 1915 he was director of the pathological laboratory of the Massachusetts State board of health, and after 1896 was professor of comparative pathology at Harvard. In 1915 he was appointed director of the department of animal pathology of the Rockefeller institute of medical research, at Princeton, N.J.

His numerous scientific papers include *Investigations into the Nature, Causation, and Prevention of Texas or Southern Cattle Fever* (1893); *The Relation between Bovine and Human Tuberculosis* (1896–98); *The Immunizing Effect of Neutral Toxin-antitoxin Mixtures in Diphtheria* (1909); *Milk-borne Epidemics of Human Streptococci* (1915); *The Protective Value of Colostrum* (1922); *The Relation of Bovine Infectious Abortion to Malta Fever* (1925).

SMITH, SIR WILLIAM (1813–1893), English lexicographer, was born at Enfield in 1813 of Nonconformist parents. He taught himself classics while articled to a solicitor, entered University college, London, and took a post at University college school. He next turned his attention to lexicography. His first attempt was the *Dictionary of Greek and Roman Antiquities,* which appeared in 1842. The greater part of this was written by himself. In 1849 followed the *Dictionary of Greek and Roman Biography,* and the *Greek and Roman Geography* in 1857. In this work some of the leading scholars of the day were associated with him. In 1850 he published the first of the school dictionaries; and in 1853 he began the *Principia* series, which marked a distinct step in the school teaching of Greek and Latin. The most important, perhaps, of the books edited by William Smith were those that dealt with ecclesiastical subjects. These were the *Dictionary of the Bible* (1860–65); the *Dictionary of Christian Antiquities* (1875–80), undertaken in collaboration with Archdeacon Cheetham; and the *Dictionary of Christian Biography* (1877–87), jointly with Dr. Henry Wace. The *Atlas,* on which Sir George Grove collaborated, appeared in 1875. He edited Gibbon in 1854–55, and was editor of the *Quarterly Review* from 1867 to his death on Oct. 7, 1893. He was knighted in 1892.

SMITH, WILLIAM (*fl.* 1596), English sonneteer. He published in 1596 a sonnet sequence entitled *Chloris, or the Complaint of the passionate despised Shepheard.* He was a disciple of Spenser, to whom the two first sonnets and the last are addressed. He signed his name W. Smith, and has sometimes been confused with the playwright Wentworth Smith, who collaborated with John Day, William Haughton and others (1601–1603).

SMITH, WILLIAM (1769–1839), English geologist, called "the Father of English geology," and known among his acquaintances as "Strata Smith," was born at Churchill in Oxfordshire on March 23, 1769. At 18 he became assistant to Edward Webb, surveyor, of Stow-on-the-Wold, and traversed the Oolitic lands of Oxfordshire and Gloucestershire, the Lias clays and red marls

of Warwickshire and other districts, studying their varieties of strata and soils. In 1791 his observations at Stowey and High Littleton in Somersetshire first impressed him with the regularity of the strata. In 1793 he executed the surveys and levellings for the line of the Somerset coal canal, in the course of which he confirmed his supposition, that the strata above the coal were not horizontal, but inclined in one direction—to the east—so as to terminate successively at the surface.

On being appointed engineer to the canal in 1794 he made a tour with regard to inland navigation. He carefully examined the geological structure of England, and corroborated his generalization of a settled order of succession in the strata. In 1794 he coloured his first geological map—that of the vicinity of Bath—showing the ranges of the different strata across England.

In 1799 Smith dictated his first table of British Strata, now in the possession of the Geological society of London. It was headed *Order of the Strata, and their imbedded Organic Remains, in the neighbourhood of Bath; examined and proved prior to 1799*. In 1813 Joseph Townsend published, with acknowledgment, much information on the English strata communicated by William Smith, in a work entitled *The Character of Moses established for veracity as an historian, recording events from the Creation to the Deluge.* Meanwhile Smith was completing and arranging the data for his large *Geological Map of England and Wales, with part of Scotland* (15 sheets, 1815). The map was reduced to smaller form in 1819; and from this date to 1822 21 separate county geological maps and several sheets of sections were published in successive years, constituting a *Geological Atlas of England and Wales.*

Smith's collection of fossils was purchased in 1816–18 by the British Museum. In 1817 a portion of the descriptive catalogue, *Stratigraphical System of Organized Fossils,* was published. In 1816 he had commenced the publication of *Strata Identified by Organized Fossils,* with figures printed on paper to correspond in some degree with the natural hue of the strata. In this work (of which only four parts were published, 1816–19) is exemplified the principle he established of the identification of strata by their included organic remains. In 1831 the Geological society of London conferred on Smith the first Wollaston medal; and from the government he received a life-pension of £100 per annum. The last years of his life were spent at Hackness (of which he made a good geological map), near Scarborough, and in the latter town. He died at Northampton on Aug. 28, 1839.

His *Memoirs,* edited by his nephew, John Phillips, appeared in 1844.

SMITH, WILLIAM FARRAR (1824–1903), American general, was born at St. Albans, Vt., on Feb. 17, 1824, and graduated from West Point in 1845, being assigned to the engineer branch of the army. In Aug. 1861 he became brigadier-general of volunteers, and in July 1862 he received promotion to the rank of major-general, U.S. Volunteers. Smith led with conspicuous valour at Antietam and later was placed at the head of the VI. Corps of the Army of the Potomac, which he led at the disastrous battle of Fredericksburg (*q.v.*). The recriminations which followed led to a general order in which Smith and several other senior officers of the army were dismissed and suspended by Gen. Burnside. As a brigadier-general Smith commanded troops in Pennsylvania during the critical days of the Gettysburg campaign. Later, in 1863, as chief engineer of the Army of the Cumberland, he conducted the engineer operations which reopened the "cracker-line" from Chattanooga (*q.v.*) to the base of supplies. For the Virginian campaign of 1864 Smith was specially assigned by Grant to command the XVIII. Corps, Army of the James, and he took part in the battle of Cold Harbor and the first operations against Petersburg, after which, while absent on leave, he was suddenly deprived of his command by Grant. He resigned from the Volunteers in 1865 and from the U.S. Army in 1867. After 1881 he was engaged in civil engineering work. He died at Philadelphia on Feb. 28, 1903.

SMITH, WILLIAM HENRY (1825–1891), English man of business and statesman, was born in London on June 24, 1825. His father was the founder of the distributing firm of W. H. Smith & Son, in the Strand, and at an early age he became a partner and devoted himself to the business. In 1865 he contested Westminster in the Conservative interest against John Stuart Mill. He failed, but he won the seat in 1868. He was secretary to the treasury (1874), first lord of the admiralty (1877), secretary for war (1885), chief secretary for Ireland (1885), secretary for war (1886), and in the end of that year first lord of the treasury and leader of the House of Commons. He was no orator, and made no pretence to genius, but his success in these high offices was complete, and was due to the universal respect which was gained by his patience, good temper, zeal for the public service, and thorough kindness of heart. He died at Walmer Castle (which he occupied as Warden of the Cinque Ports) on Oct. 6, 1891. In recognition of his services a peerage in her own right was conferred on his widow, with the title of Viscountess Hambleden.

SMITH, WILLIAM ROBERTSON (1846–1894), Scottish philologist, physicist, archaeologist, Biblical critic, and editor, from 1881, of the 9th edition of this *Encyclopædia,* was born on Nov. 8, 1846, at Keig in Aberdeenshire, where his father was Free Church minister. He was educated at home and at Aberdeen University, where he won, among other honours, the Ferguson mathematical scholarship. In 1866 he entered the Free Church college at Edinburgh as a student of theology. During two summer sessions he studied philosophy and theology at Bonn and Göttingen. From 1868 to 1870 he acted as assistant to the professor of natural philosophy in Edinburgh University. During this period he produced much original work in the experimental and mathematical treatment of electricity. In 1870 he was appointed and ordained to the office of professor of Oriental languages and Old Testament exegesis at the Free Church college, Aberdeen. He was the pupil and personal friend of many leaders of the higher criticism in Germany, and from the first he advocated views which, though now widely accepted, were then regarded with apprehension. The articles on Biblical subjects which he contributed to the 9th edition of the *Encyclopædia Britannica* distressed and alarmed the authorities of the Free Church. In 1876 a committee of the General Assembly of that Church reported on them so adversely that Smith demanded a formal trial, in the course of which he defended himself with consummate ability and eloquence. The indictment dropped, but a vote of want of confidence was passed, and in 1881 Smith was removed from his chair. At the end of the trial he was probably the most popular man in Scotland. Marks of sympathy were showered on him from all sides.

In 1875 he was appointed one of the Old Testament revisers; in 1880–1882 he delivered by invitation, to very large audiences in Edinburgh and Glasgow, two courses of lectures on the criticism of the Old Testament, which he afterwards published (*The Old Testament in the Jewish Church,* first edition 1881, second edition 1892, and *The Prophets of Israel,* 1882, which also passed through two editions); and soon after his dismissal from his chair he joined Professor Baynes in the editorship of the *Encyclopædia Britannica,* and after Professor Baynes's death remained in supreme editorial control till the work was completed. His versatility, firmness combined with tact, width of view, and painstaking struggle for accuracy were largely responsible for the maintenance of its high standard. But he did not let his other duties interfere with his Semitic studies. He visited Arabia, Egypt, Syria, Palestine, Tunis and southern Spain, and had an intimate knowledge of, and personal acquaintance with, not only the literature, but the life of the East. His early friendship with J. F. McLennan, that most original student of primitive marriage, had a great influence on Smith's studies, and his attention was always strongly attracted to the comparative study of primitive customs and their meaning. His chief contributions to this branch of learning were his article SACRIFICE in the *Encyclopædia Britannica,* his *Kinship and Marriage in Early Arabia* (Cambridge, 1885), and above all his *Lectures on the Religion of the Semites* (1st edition 1889, 2nd edition 1894). His originality and grasp of mind enabled him to seize the essential among masses of details, and he had in a marked degree the power of carrying a subject farther than his predecessors.

In 1883 Robertson Smith was appointed Lord Almoner's Pro-

fessor of Arabic at Cambridge, which henceforth became his home. He occupied rooms in Trinity college till 1885, when he was elected to a professorial fellowship at Christ's college. In 1886 he became university librarian, and in 1889 Adams professor of Arabic. In 1888–1891 he delivered, as Burnett lecturer, three courses of lectures at Aberdeen on the primitive religion of the Semites. Early in 1890 grave symptoms of constitutional disease manifested themselves, and the last years of his life were full of suffering, which he bore with the utmost courage and patience. He never ceased to work, and when near his end was actively engaged in planning the *Encyclopaedia Biblica*, which he had hoped to edit. He died at Cambridge on March 31, 1894, and was buried at Keig. Small and slight in person and never robust in health, Robertson Smith was yet a man of ceaseless and fiery energy; of an intellect extraordinarily alert and quick, and as sagacious in practical matters as it was keen and piercing in speculation; of an erudition astonishing both in its range and in its readiness; of a temper susceptible of the highest enthusiasm for worthy ends, and able to inspire others with its own ardour; endowed with the warmest affections, and with the kindest and most generous disposition, but impatient of stupidity and ready to blaze out at whatever savoured of wrong and injustice. The sweetness and purity of his nature combined with his brilliant conversational powers to render him the most delightful of friends.

See the *Life* by J. S. Black and G. W. Chrystal (1912); *see* also James Bryce, *Studies in Contemporary Biography* (1903).

SMITH, SIR WILLIAM SIDNEY (1764–1840), English admiral, was born at Westminster on July 21, 1764, and entered the navy. In Jan. 1780 he was appointed lieutenant of the "Alcide" (74) after serving at Cape St. Vincent under Rodney; and in May 1782 was made commander of the "Fury" sloop, and promoted captain. He was knighted for his services (1790–92) in advising the king of Sweden during the war with Russia. In 1793 he assisted Lord Hood in the attempt to burn the enemy's ships at Toulon. In 1796 he was captured while hunting French privateers in the Channel, and imprisoned in Paris, whence he made his escape in 1798. In 1799 he left Constantinople, where he was plenipotentiary jointly with his brother, and hastened to the relief of St. Jean d'Acre, compelling Napoleon to raise the siege in May. For this exploit he received an annuity of £1,000. Smith co-operated with Abercromby in Egypt, and was wounded at Aboukir. Promoted rear-admiral of the blue in 1805, he was sent in 1806 to Sicily and Naples, and relieved Gaeta and captured Capri. Proceeding to Malta in 1807, he destroyed the Turkish fleet off Abydos, and in the following November blockaded the Tagus and assisted the Portuguese royal family to embark for Rio de Janeiro. Recalled from Rio de Janeiro, where he had been sent as commander-in-chief (1808), owing to his quarrel with the British minister, he was made a vice-admiral of the blue (1810) and in 1812 was sent to the Mediterranean, as second in command under Sir Edward Pellew. Made K.C.B. in 1815, and admiral in 1821, he died on May 26, 1840, at Paris. His self-assertion brought him into conflict with many of his contemporaries, including Nelson and Sir John Moore, but he was a daring and ingenious officer.

See Barrow, *Life of Admiral Sir W. S. Smith* (2 vols., 1848).

SMITH COLLEGE, an institution for the higher education of women, at Northampton, Mass. It was founded by the will of Sophia Smith (1796–1870) of Hatfield, who chose the neighbouring town of Northampton as the site of the college, and selected the first trustees. The college was chartered in 1871 and opened in 1875.

The equipment of the college in 1928 consisted of a campus of 87ac., including the Allen field for athletics; 48 dwelling houses for students, laboratories for zoology, botany, geology, physics, chemistry, psychology and phonetics, the Lyman plant houses and a botanic garden, an astronomical observatory, a library of 154,460 vols., the Hillyer and Tryon art galleries, a swimming pool, an infirmary, a students' building, an auditorium seating 2,400, two gymnasiums, Sage Hall for music, and other buildings.

All students enter by the examinations of the college entrance examination board. The undergraduate courses, which are chiefly elective, lead to the degree of bachelor of arts. Since 1920 an honours system has been in operation, by which selected students in their last two years concentrate on a special field of study under the direction of tutors, and are relieved from the routine of courses and class examinations. Graduate courses lead to the degree of master of arts and, more rarely, to that of doctor of philosophy. The Smith college School of Social Work, with an eight weeks' summer session and supervised field work in various cities in winter, trains social workers with a special equipment in psychiatry and prepares for the degree of master of social science. In 1927–28 the college had 225 teachers, 2,051 undergraduates, 77 graduate students, 89 in the School for Social Work. The fees for tuition are $400 a year for undergraduates, $200 for graduates. Board and room cost $500. About $100,000 is distributed annually in scholarships and fellowships. The invested funds of the college total (1928) $5,000,000 and the land, buildings and equipment have cost $6,500,000. In 1925 a scheme was initiated of sending students specializing in French to spend their junior year in study at the Universities of Grenoble and Paris under the direction of members of the college staff. Between 40 and 50 students now take advantage of this annually. An Institute for the Co-ordination of Women's Interests studies and experiments with methods of enabling women to maintain their intellectual interests, both cultural and professional, after graduation. The department of education conducts a Nursery school (in co-operation with a Parents' Association) and a progressive day school. The William Allan Neilson chair of research is at present devoted to psychology under the direction of Prof. Kurt Koffka. The college publishes the *Smith College Studies* in history, classics and modern languages, a series of volumes issued in celebration of its 50th anniversary and in the field of zoological science an internationally edited *Catalogue of the Hemiptera*.

The college is governed by a board of 15 trustees, four of whom are nominated by the alumnae (now numbering 10,762) and serve for eight years, the others, with the exception of the president, serving for ten years, and retiring in rotation. The first president was Laurenus Clark Seelye (1875–1910), the second, Marion LeRoy Burton (1910–17), and the third William Allan Neilson (1917–). (W. A. N.)

SMITH-DORRIEN, SIR HORACE LOCKWOOD (1858–), British general, was born on May 26, 1858. He joined the army in 1876, took part in the Zulu War and in the Egyptian campaign of 1882 and, attached to the Egyptian army, served at Suakim in 1884 and on the Nile in 1885–86. He took part in the Tirah campaign of 1897–98, in the final advance to Khartum in 1885 and later in South Africa. After being adjutant-general in India, he held the Aldershot command until 1912, when he was transferred to the Southern command.

On the death of Sir James Grierson in Aug. 1914, Sir H. Smith-Dorrien was appointed commander of the II. Army Corps. His troops received the brunt of the enemy's onset at Mons, and, although his action in giving battle at Le Cateau was criticised, it was subsequently recognized that it saved the British Army from disaster. Afterwards he commanded his corps at the battle of the Marne, on the Aisne, and during the severe fighting in Flanders in October and November. On the splitting-up of the Expeditionary Forces into two armies he was appointed to the command of the II. Difficulties with the commander-in-chief led, in April 1915, to his return to England where he was placed in charge of one of the Home Defence armies. In the following November he was chosen to take charge of the operations against German East Africa, but he fell ill on the voyage out, and had to return home. From 1918–23 he was governor and commander-in-chief of Gibraltar. After his retirement in 1923 he published (1925) *Memories of 48 Years' Service*.

SMITH'S FALLS, a town and outport of Lanark county, Ontario, Canada, on the Rideau river and canal, and the Canadian Pacific and Canadian National railways, 28 m. N.W. of Brockville. Pop. (1931) 7,108. It contains saw, shingle, woollen and planing mills, and large agricultural implement works, and has weekly steamer connection with Ottawa by the Rideau river and canal.

SMITHSON, HENRIETTA CONSTANCE (1800–1854), Irish actress, the daughter of a theatrical manager, made her first stage appearance in 1815 at the Crow Street theatre, Dublin, as Albina Mandeville in Reynolds's *Will.* Three years later she appeared at Drury Lane, London, as Letitia Hardy. She had no particular success in England; but in Paris, in 1828 and 1832, whither she first went with Macready, she aroused immense enthusiasm as Desdemona, Virginia, Juliet and Jane Shore. She had a host of admirers, among them Berlioz (*q.v.*), whom she married in 1833. They separated in 1840. She died on March 3, 1854.

SMITHSON, JAMES (1765–1829), British chemist and mineralogist and founder of the Smithsonian Institution at Washington, was born in France and first known as James Lewis Macie, taking the name of Smithson about the year 1800. He was educated at Pembroke college, Oxford. He published analyses of calamines and other papers in the *Annals of Philosophy* and *Phil. Trans.* The mineral name "smithsonite" originally given in his honour by Beudant to zinc carbonate, is now rarely used. In 1784 he accompanied Faujas St. Fond to the Western isles. He was elected F.R.S. in 1787. He died at Genoa on June 27, 1829. He bequeathed upwards of £100,000 to the United States of America to set up the Smithsonian Institution founded by act of Congress on Aug. 10, 1846.

See "James Smithson and his Bequest" (with portraits), by W. J. Rhees, and "The Scientific Writings of James Smithson," ed. W. J. Rhees, *Smithsonian Misc. Coll.*, vol. xxi. (1879–80).

SMITHSONIAN INSTITUTION, an American institution of learning in Washington, D.C., founded by the bequest of James Smithson (*q.v.*). His estate was left to a nephew, Henry James Hungerford, with the stipulation that should Hungerford die without issue the whole estate should go "to the United States of America to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." Hungerford died without issue in 1835. There was much opposition in America to the acceptance of Smithson's bequest, especially by John C. Calhoun and others, who held that Congress had no power under the Constitution to accept such a gift, but it was accepted, largely through the efforts of John Quincy Adams.

Establishment.—In Sept. 1838 £104,960 in gold sovereigns was delivered from the clipper "Mediator" to the Philadelphia mint, where it was recoined into American money, $508,318.46; in 1867, after the death of Hungerford's mother, a residuary legacy of $26,210 was received and the fund then amounted to $650,000. By savings of interest, and by other gifts, notably that of $250,000 from Thomas George Hodgkins (d. 1892) of Setauket, Long Island, N.Y., the fund was increased. In 1928 it amounted to about $1,500,000. After 10 years of debate Congress accepted the trust and created by enactment an "establishment" called the Smithsonian Institution, consisting of the president, the vice-president, the chief justice and the members of the president's cabinet. It has a secretary, the executive officer of the institution, who is also the keeper of the National Museum. Smithson's money, a great fortune in that day, was lent to the U.S. Treasury, the Government agreeing to pay perpetually 6% interest upon it.

In the fundamental act creating the institution, Congress provided that it should be governed by a board of regents, composed in 1928 of the vice president and chief justice, three members of the Senate, three members of the House of Representatives and six private citizens, two of them residents of the District of Columbia. The fundamental act also provided for a library and for a museum, which was to contain "objects of art and of foreign and curious research, and objects of natural history, etc.," belonging to the United States. The museum was later designated the United States National Museum, but remains under the direction of the Smithsonian Institution.

The first meeting of the regents occurred on Sept. 7, 1846, and in the autumn of the same year they elected as secretary Joseph Henry (*q.v.*), then a professor at Princeton, known for his experiments on the electromagnet and other subjects relating to electricity. Under his guidance the institution took shape. Henry seized the unique opportunity offered by the opening up of the great western areas of the United States, to make collections of fauna and flora, and to study the Indian tribes. A principal feature of his administration, also, was the establishment of international exchanges of scientific literature. About 1900 there took shape, with international co-operation, Henry's idea of a catalogue of the scientific literature of the world, and the Smithsonian was made custodian of the United States branch of the organization.

The diffusion of knowledge was promoted by publishing (1) a series of periodical reports on the progress of different branches of knowledge; (2) occasional separate treatises on subjects of general interest; and (3) monographs on subjects investigated by experts both within and outside the institution. Henry opposed the scheme for the gradual formation of a general library under the charge of the institution, and in 1855 committed the board of regents to a repeal of the previous practice of spending one-half of the annual income on the museum and library, and this action was approved by an investigating congressional committee. In 1846 a plan was presented for the unification and systematization of weather observation under the institution. In Dec. 1847 an appropriation was made by the board for such meteorological research; in 1849 telegraphic transmission of meteorological intelligence collected by the institution was begun; in 1850 a standard "Smithsonian barometer" (Arnold Guyot's improvement of Ernst's improved Fortin "cistern barometer"), was first distributed; weather maps were successfully made in 1856. In 1870 the meteorological work of the institution was incorporated with the Signal corps, independent of the institution. Still later the U.S. Weather Bureau was established by act of Congress. After 1854 Henry's annual reports contained a general appendix with reports of lectures, such as were held under the auspices of the institution until 1865, summaries of correspondence, special papers, etc. Before 1870 meteorology bulked largely in these reports; after that year there was more North American archaeology and ethnology.

Development.—Spencer F. Baird (*q.v.*), Henry's successor, incorporated in the general appendix annual reports on the progress of the sciences, and he perfected Henry's system of international exchanges, under which the institution, through agents in the principal cities of the world, exchanges its own publications, those of other departments of the U.S. Government, and those of learned societies, for foreign publications. Baird had been at the head of the U.S. National Museum, a branch of the institution, before he became secretary of the institution, and the museum particularly was developed during his administration. It was built up around the collections of the U.S. Patent Office, which were turned over to it in 1858, and those of the National Institute, transferred to the Smithsonian in 1861, when the institute was dissolved. A part of the collection (including Smithson's collection) was destroyed by fire in 1865. The small art collection which remained was exhibited in the private Corcoran gallery until 1896. A new building for the museum was erected in 1881, and in 1911 the commodious and handsome Natural History building was added.

The museum gained much valuable archaeological and ethnological material from the exploring parties sent out under J. W. Powell; excellent ichthyological specimens through Baird's position as U.S. fish commissioner; and general collections from the exhibits made at the Centennial exhibition of 1876 by the United States and foreign governments. Its great collection of plants is known as the National Herbarium. The Bureau of American Ethnology was established as a branch of the institution in 1879, when the various organizations doing survey work in the West united as the U.S. Geological Survey, and anthropological and ethnological research was transferred to the Smithsonian Institution.

In 1887 Samuel P. Langley (*q.v.*), was appointed as assistant secretary of the institution, and succeeded as secretary upon Baird's death in the same year. In 1890 a small astrophysical observatory was built in the Smithsonian park; in 1891 an appropriation was made for astrophysical work and $5,000 was contributed by the executors of Dr. J. H. Kidder (1842–1889).

Langley's principal researches in the observatory were on the nature of the infra-red portion of the spectrum, and preliminary experiments indicating a possibility that variation of the sun produces important effects on the weather. His name is perhaps best known for his pioneering work in aeronautics resulting in the publication of *Experiments in Aerodynamics* in 1891, and *The Internal Work of the Wind* in 1893.

Under the terms of the Hodgkins bequest prizes were offered in 1893 for research and investigation of atmospheric air in connection with the welfare of mankind; in 1895 an award of $10,000 was made to Lord Rayleigh and Sir William Ramsay for their discovery of argon; and the Hodgkins medal was awarded to Sir James Dewar in 1899 and one to Sir J. J. Thomson in 1901. By acts of Congress of March 2, 1889, and April 30, 1890, the National Zoological Park was established under the institution; and in a park of 175 ac. in the valley of Rock Creek a small collection was installed which has since grown to be one of the foremost collections of animals in America.

Mrs. Harriet Lane Johnston (1833–1903) left her art collection to a national gallery of art, when such a gallery should be established, and in 1906 the supreme court of the District of Columbia decreed that the collection of the Smithsonian Institution was a national gallery, and turned this collection over to the National Museum, whose art collections have been called since that time the National Gallery of Art. They have been enlarged by the gift of a collection representing contemporary French artists, the Ralph Cross Johnson collection of old masters, the William T. Evans collection, the Eddy bequest, the Ranger bequest and others.

On Jan. 23, 1907, Charles Doolittle Walcott (*q.v.*) (1850–1927), eminent geologist and palaeontologist, was elected secretary. During his administration of almost exactly 20 years the outstanding events for the Smithsonian were the gift by Charles L. Freer, of Detroit, of the Freer Gallery of Art, together with a large testamentary endowment, and the establishment of the National Gallery of Art as a distinct branch of the institution separate from the National Museum. The Freer gift comprised more than 9,000 pieces, including works of American artists, especially Whistler, Tryon, Thayer and T. W. Dewing, and of Japanese and Chinese masters, including precious screens, ceramics and bronzes. Near the close of Walcott's incumbency, great need being felt to increase the unrestricted income of the Smithsonian, a strong movement was inaugurated among prominent Americans to promote an increase of several millions in the endowment.

On Jan. 10, 1928, Charles Greeley Abbot (1872–), astrophysicist and assistant secretary from 1918, was elected secretary, and has continued the researches begun by Langley on the variation of the sun's radiation, improving instruments and methods, and establishing three first class solar observatories in widely separated regions of the earth.

The Smithsonian park occupies a square equivalent to nine city blocks, almost exactly the same size as the Capitol grounds. The oldest building, that of the institution proper, was erected in 1847–1855. It is of seneca brown stone in a mingled Gothic and Romanesque style, designed by James Renwick, and is located in the S.W. part of the grounds. S.E. of it is the arts and industries building of the U.S. National Museum (330 ft.sq.), erected in 1881; and on the N. side of the park is the Natural History building of the National Museum (1911). S.W. of the original Smithsonian building is the Freer Gallery of Art. The noteworthy aeroplane exhibit, and the Astrophysical Observatory, occupy temporary structures S. of the original building. On the grounds is a bronze statue of Joseph Henry by W. W. Story.

The institution publishes: *Annual Reports* (1846), in which the *Reports* of the National Museum were included until 1884—since then the Museum *Reports* have appeared as separate volumes; *Smithsonian Contributions to Knowledge* (1848); *Smithsonian Miscellaneous Collections* (1862); *Proceedings of the United States National Museum* (1878); *Bulletins of the United States National Museum* (1875), containing larger monographs than those printed in the *Proceedings;* and occasional *Special Bulletins; Annual Reports of the Bureau of American Ethnology* (1880); *Bulletins of the Bureau of American Ethnology* (1887), including *The Handbook of American Indians North of Mexico* (1907), pt. 1 being Bulletin 30; and *Contributions to North American Ethnology* (1877–1893); *Annals of the Astrophysical Observatory* (1900); and *Catalogues of the National Gallery of Art* (1922).

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SMITHSONITE, a mineral species consisting of zinc carbonate, $ZnCO_3$, and forming an important ore of zinc. It is rhombohedral in crystallization and isomorphous with calcite and chalybite. Distinct crystals are rare; they have the form of the primitive cleavage rhombohedron. Botryoidal and stalactitic masses are more common, or again the mineral may be compact and granular or loose and earthy. The hardness is 4·5; specific gravity, 4·4. The colour of the pure mineral is white; more often it is brownish, sometimes green or blue: a bright-yellow variety containing cadmium has been found in Arkansas, and is known locally as "turkey-fat ore." The pure material contains 52% of zinc, but this is often partly replaced isomorphously by small amounts of iron and manganese, traces of calcium and magnesium, and sometimes by copper or cadmium.

Smithsonite is found in beds and veins in limestone rocks, and is often associated with galena and blende. It is a product of alteration of blende, having been formed from this by the action of carbonated waters; or in many cases the zinc sulphide may have been first oxidized to sulphate, which in solution acted on the surrounding limestone, producing zinc carbonate. The latter mode of origin is suggested by the frequent occurrence of smithsonite pseudomorphous after calcite, that is, having the form of calcite crystals. It occurs in large amount in the province of Santander in Spain, in Missouri, and at several other places where zinc ores are mined. The best crystals are from Chessy near Lyons and Broken Hill in Northern Rhodesia. A translucent botryoidal smithsonite banded with blue and green is found at Laurion in Greece, and has sometimes been cut and polished for small ornaments. In Britain, smithsonite is usually called calamine.

SMOHALLA or **SHMOQULA** (*i.e.*, "preacher"), a religious prophet of the North American Indians and founder of the sect called Dreamers, was born in the Columbia river valley about 1820 and became chief of the Wanapum tribe in Washington State. On one occasion after a tribal fray he was left for dead, but recovered and journeyed through California, Mexico, Arizona and Nevada back to his home on the upper Columbia, where he announced that he had been in the spirit world and had returned with a new revelation. This consisted in a return to primitive Indian customs, and a ritual combining genuine Indian features with what he remembered of Roman Catholic ceremonies. Smohalla had frequent trances and his influence extended over most of the tribes of eastern Washington and Oregon and western Idaho. The sect gave much trouble from 1870 to 1885 by refusing to come under reservation restrictions. A church was established at Priest Rapids on the upper Columbia, and one at Union Gap on the Yakima reservation. Smohalla died about 1908 but his religion continued to be influential.

See J. Mooney, "The Ghost-dance Religion," in *14th Ann. Rep.* Bureau of Ethnology (1896).

SMOKE: IN WARFARE. The first historical reference to the use of smoke in war, was the miracle whereby the Israelites were protected during their march from Egypt to the Promised Land (Exod. xiv. 19). In this old Biblical story of the Israelites lies the whole essence of the use of smoke in war—the blinding of one's enemy. In the civil wars of the Roman empire both Caesar and Pompey used smoke as a weapon of attack, chiefly in landing operations.

Examples from History.—There appears to be little or no mention of the use of smoke for many centuries after this, but we find an instance in the 17th, when in 1632 Gustavus covered his

crossing of the Lech in face of Tilly by a smoke screen created by setting fire to wet straw, and another when on July 2, 1667, the Dutch fleet appeared off Landguard (near Harwich) and its ships took up their position to bombard it from all sides at once. Some of them were placed exactly to windward so that the smoke of their guns swept along the beach, and so covered the landing of their troops from the sight of the mariners in the fort.

In the battle of Seneff in 1674 smoke was used by the French when, as a strategem to cover their retirement, they hung up their lighted "matches" in the hedges. In 1770 Charles XII. of Sweden used smoke in the crossing of the Dvina in his campaign against the Saxons. On this occasion specially constructed barges carrying tar barrels were used.

The Waterloo campaign had a great effect on the use of smoke in war, as it was realized at this time to what an enormous disadvantage the defence were put by the use of the black powder, which wrapt them in clouds of smoke, but it was not till 1885 that the introduction of smokeless powder was brought about by the French. Domokos, in the Turko-Greek war of 1897 was the last battle fought in Europe with smoke powder, and it is a remarkable fact that it was not till 1915—nearly 20 years later—that a means was devised of projecting smoke on an enemy on the battlefield.

An experiment in covering the attacking troops by throwing forward smoke candles, such as were used for testing drains, was tried at Aldershot before the South African war and was rightly condemned, as the whole essence of the success in the use of smoke is the element of surprise and the blinding of the defenders by the attackers which can be done by smoke projection. No mention of the use of smoke is made in the histories of the South African and Russo-Japanese wars, though the Boers on occasions lit veldt fires to cover their withdrawal.

The World War.—The first instance of the use of smoke in the World War was probably the lighting of a haystack north of the La Bassée canal in October 1914, which enabled a company of the Devonshire Regiment to be withdrawn. Shortly after this a battery of artillery, in somewhat like manner, made good its withdrawal. At Loos in September 1915 smoke was wrongly used as a blind by lighting candles in British trenches, and thus brought down heavy shell fire. From this battle may be dated the realization of the necessity of the *projection* of smoke and its use in attack, and danger to any defence.

By November 1916 smoke shells were in use in some divisions in France, but it was not, however, until the battles of Arras, 1917, when they were used by the 9th (British) Division that the art of accurately projecting smoke shells, and their great value, came to be appreciated. Many instances in 1917 and 1918 are on record when numbers of lives were saved by the invention of smoke shell, and when victories were gained with a minimum of casualties by the use of smoke. The Germans quickly copied the British, and used it in their offensive of March 1918, while the Australians used it to cover their withdrawal over the Piave in May 1918. The navy used smoke with conspicuous success at Zeebrugge on St. George's day, 1917, when fast coastal motor-boats greatly assisted the blocking operations by blinding the enemy's observation and shore guns.

Smoke, which may be used in war by artillery, infantry, aircraft and tanks, has certain inherent disadvantages, in particular the blinding of observation, and the variability of wind—the latter is a serious difficulty—but by practice all difficulties can be overcome, and the experience of the World War proved that the advantages created by the use of smoke far outweigh the disadvantages. It may be said of smoke that, if properly used, it will on almost every occasion in the attack, and also in the withdrawal, save many casualties. By its use the utmost is made of "fire power" and man power is concealed until the decisive stages. Infiltration—an art in war—is facilitated and losses are greatly reduced through the use of cover by ground and cover by smoke. The chief object in the use of smoke-tactics, is, as far as possible, to impose on the defenders the conditions of night, while the attackers have the conditions of day, and thereby effect surprise and reduce casualties. To summarize the use of smoke in war it may be said that it is used to obtain concealment of movement which begets surprise. (P. R. W.)

SMOKE AND SMOKE PREVENTION. Smoke and its Production.—Smoke is a general term applied to the visible exhalations from burning materials. The character of smoke varies according to its source, which may be a waste heap, a bonfire or a cigarette; but the smoke which is produced in by far the largest quantities, and which on account of its injurious effects has become a serious economic problem, is that associated with the general use of raw bituminous coal as a fuel.

Nearly all fuels consist essentially of carbon, hydrogen, oxygen and nitrogen, in various proportions and variously combined. In addition they usually contain a little sulphur, while in solid fuels varying amounts of incombustible mineral ash are also incorporated. If complete combustion were always attainable no fuel would emit smoke, the final products in such an ideal case being limited to carbon dioxide, water vapour and free nitrogen, all quite innocuous gases, and invisible unless the water vapour condenses to a cloud of steam. There would, however, if sulphur were present, also be produced small quantities of sulphur dioxide gas, which, although also invisible, has a pungent smell, and in contact with air and moisture tends rapidly to be converted into a corrosive acid; while the mineral constituents would remain unburned in the form of ash.

To achieve such finality it is necessary only that a fuel should be brought into contact with enough air for full oxidation while maintained at a temperature sufficiently high for combustion to take place. These conditions, although apparently simple, are by no means easy to realise, and in practice some proportion of a fuel always eludes complete combustion. The unburned products vary widely both in amount and in composition according to the nature of a fuel and the manner of its use, being in some circumstances inappreciable, in others very large. They are moreover not necessarily in the form of smoke, since with insufficient air carbonaceous materials may emit gaseous intermediate products such as carbon monoxide and unsaturated hydrocarbons; but whether or not smoke is produced, imperfect combustion is always indicative of thermal loss. The heat which a given weight of carbon liberates in oxidising to carbon monoxide, for instance, is less than one-third that generated by its complete combustion to carbon dioxide.

Thorough admixture with air is relatively easy to secure in the case of gaseous fuels, which in properly constructed and properly adjusted burners produce neither smoke nor other unburned products in appreciable quantity. An inadequate air supply, however, or the chilling or smothering of the flames, may result in the evolution of unburned gaseous products, including carbon monoxide and oxides of nitrogen, both highly poisonous; or in extreme cases may even cause the deposition of soot.

Smoke from Solid Fuels.—Owing to the relatively high density of solid fuels, the problem of bringing them into contact with sufficient air for complete oxidation is greatly intensified, and, even with an air supply far in excess of that theoretically required, perfect combustion cannot in practice be counted upon. Certain forms of solid fuel, however, such as anthracite, which is naturally nearly free from volatile matter, or coke, from which the volatile matter of the original coal has been artificially extracted, can be burned, if not completely, at least without smoke emission. With bituminous coals, on the other hand, smoke production to a greater or lesser degree, according to the circumstances, is practically unavoidable; for such coals are subject to decomposition at temperatures below the ignition point, with the evolution of combustible gases and condensable tarry vapours. These are of so complex a character, and under the action of heat are subject to such complicated chemical changes, that although the more readily ignitible constituents may burst into spasmodic flames, others almost inevitably escape unburned. Coal smoke consists of such unconsumed distillation products, in association with carbon and tarry matter condensed by premature chilling of flame, together with dust and ash entrained by the upward rush of hot air and gases from the grate. Some of this settles on the walls of the flue as soot; the remainder is carried

out through the chimney into the atmosphere with the excess air and gaseous products of combustion, both burned and unburned.

Since 1920 the total home consumption of coal in Great Britain has averaged roughly 175 million tons annually, of which about 40 million tons has gone to meet domestic requirements, most of the remainder being burned in industrial furnaces, mainly for the production of steam. Coals of relatively low volatile content are largely absorbed for steam raising purposes and when due attention is paid to furnace design, stoking procedure and draught control, they can be burned without much smoke and with remarkably high efficiencies of steam generation. On the other hand, in certain metallurgical furnaces, etc., it is claimed that a smoky atmosphere is essential.

Most of the British domestic coal supplies are drawn from highly bituminous seams, and since they are burned in a very haphazard and careless manner, with little possibility of proper air regulation, it is not surprising to learn that the domestic chimney is on the whole responsible for far more than its proportionate share of smoke and soot. In London, domestic smoke forms more than two-thirds of the total, but in centres of iron, steel or pottery manufacture, or in the immediate vicinity of large works, industrial smoke may obviously preponderate. Apart from considerations of its quantity, however, domestic smoke is in character dissimilar to, and far more objectionable than, factory smoke, in so far as it contains relatively high proportions of tar, while boiler smoke consists largely of ash and dust. This point is amply illustrated by the following analyses, due to Professor Cohen, of soot from similar coal burned respectively in a sitting-room grate and a boiler furnace.

Analyses of Soot from Domestic and Boiler Fires

	Original coal	Domestic soot	Boiler soot			
			Base	13 ft. up	20 ft. up	110 ft. up (top)
Carbon	69·30	40·50	19·24	16·66	21·80	27·00
Hydrogen	4·89	4·37	2·71	0·86	1·44	1·68
Nitrogen	1·39	4·09	0·23	0·00	1·18	1·09
Ash	8·48	18·16	73·37	75·04	66·04	61·80
Tar	1·64	25·91	0·09	0·28	0·80	1·14
Sulphur	1·74	2·99	2·76	2·07	2·58	2·84
Chlorine	0·27	5·19	0·11	0·75	1·46	1·60
Acidity	0·0	0·39	1·62	1·04	0·58	0·47

Bituminous coal normally contains 1% to 2% of sulphur. Most of this is evolved in the gaseous form; but some is found in the soot, mainly in the combined state as ammonium sulphate; and some is left behind in the residue. The sticky nature of tarry soot causes it to adhere tenaciously to objects with which it comes into contact, and since it usually contains free sulphur acids in addition to ammonium sulphate, it has a destructive action upon stone, fabrics, metals and vegetation, apart from the widespread dirt and discolouration which it causes.

A number of investigators have made direct determinations of the actual amounts of soot emitted from burning coal, usually by aspirating a measured volume of the flue gases through suitable filters. Roberts-Austen, in analyses carried out in connection with the 1884 London Smoke Abatement Exhibition, obtained from domestic grates soot equivalent to 6% by weight of the coal burned, a value in agreement with later measurements by Cohen and Hefford. Sinnatt, however, in experiments undertaken for the Manchester Corporation, found a corresponding soot loss of only 2%, but unburned gaseous products represented thermal losses of as much as 15–20%. Scheiner-Kestner's boiler furnace soot determinations gave values averaging under 1%, but probably in small inefficient plant, and certainly in other types of industrial furnaces, this amount is often exceeded. Further, it is not always feasible, even in efficient boiler practice, to avoid altogether an escape of unburned gaseous products. For while it is desirable in the interests of economy to aim at complete combustion, increase of excess air to this end is justifiable only so long as the additional heat generated is sufficient to offset the increased losses in sensible heat.

Investigation of Atmospheric Pollution.—In 1912, as the outcome of a conference held in London under the auspices of the Coal Smoke Abatement Society, a voluntary committee was appointed for the investigation of atmospheric pollution. Initiated as a private body, this later became an advisory committee of the Meteorological Office, but in 1927 responsibility for the direction of subsequent work was transferred to the Department of Scientific and Industrial Research. Annual reports of the investigations undertaken and the results obtained have been published by H. M. Stationery Office. The chief aim throughout has been the compilation and collation of systematic information respecting the nature and amount of atmospheric pollution in various localities, with a view to obtaining both seasonal variations and variations from place to place; but investigations of a more academic nature have also been undertaken. Standard methods of measurement have been adopted for the statistical work, which has been carried out in co-operation with various local authorities and institutions.

Town air always contains large numbers of suspended solid particles, which of course are not derived exclusively from smoke, but include also dust, vegetable matter, etc. These tend gradually to settle down under the force of gravity. The impurities so deposited can be caught in a suitable receptacle and analysed, and if collected under similar conditions in different places afford material for interesting comparisons. The organisation of an investigation on these lines has formed the chief work of the above-mentioned committee, and in 1927 seventy-nine deposit gauges, maintained by thirty-four authorities, were in operation. These return monthly records not only of the total weight of deposited matter, but also of its insoluble and soluble constituents separately. The insoluble fraction is further divided into combustible and ash, and is analysed for sulphates, chlorine and ammonia. The lowest deposits, measured in the smaller towns or in suburban districts, amount annually to some 75–100 tons per square mile; the highest deposits, measured in the heart of large industrial areas, reach ten times these figures.

One of the most interesting features of these observations is the gradual alteration shown in the composition of the deposit from town to country, particularly in regard to carbonaceous matter and sulphates. In the heaviest deposits the proportion of carbonaceous and tarry matter is relatively high, usually amounting to 20–30% of the total, but in the lightest deposits it may fall as low as 5–10%. On the other hand sulphates, which (as SO_3) in city deposits account for only 5–15% of the total, may rise to 20–30% in country districts. The relation between the different constituents is shown in the following table derived from the Reports of the Atmospheric Pollution Committee for two selected stations, one, Malvern, a remarkably clean one, the other, Newcastle-on-Tyne, representing a heavy deposit.

Constituents of Matter Deposited from the Atmosphere

	Malvern (3 years' average)		Newcastle-on-Tyne (5 years' average)	
	Tons per sq.mile	% of total	Tons per sq.mile	% of total
Total solids	74	100	602	100
Tar	..	..	7·2	1·2
Carbonaceous matter	4·9	6·6	128·2	21·3
Insoluble ash	11·0	14·9	269·7	44·8
Loss on ignition	17·5	23·7	63·8	10·6
Soluble ash	40·6	54·8	133·0	22·1
Sulphates (as SO_3)	17·2	23·2	62·1	10·3
Chlorine	4·3	5·8	21·7	3·6
Ammonia	0·5	0·7	3·6	0·6

Selective effects are to be expected in the deposition of atmospheric impurities, for the larger particles naturally fall most quickly and are therefore deposited in the more immediate neighbourhood of their source; but there are also present in smoke numerous particles so small that they become thoroughly mixed up with the air by eddies and may be carried many miles on the wind before ultimately reaching the ground or coming to rest on buildings or vegetation. Owens has devised an automatic

BY COURTESY OF (1, 4) THE COAL SMOKE ABATEMENT SOCIETY, (2, 3, 5, 6) THE BRITISH COMMERCIAL GAS ASSOCIATION

SMOKE POLLUTION IN ENGLAND

1. Pinnacle of Henry VII.'s chapel, Westminster Abbey, before cleaning, showing accumulation of soot. (*See* fig. 4.)
2. View of Sheffield, England, at noon on a working day, showing soot-laden atmosphere
3. View of Sheffield, England, on a non-working day, taken 24 hours before that of fig. 2
4. Pinnacle of Henry VII.'s chapel, Westminster Abbey, after cleaning. Compare with fig. 1, above
5. Town of Bradford, England, obscured by heavy veil of smoke
6. Same town with the atmosphere clear

instrument for filtering hourly through special discs of paper a measured volume of air, and so obtaining information in regard to the progressive changes in the quality of black suspended matter. In London the suspended impurity is at its minimum between midnight and 6 A.M., subsequently rising rapidly owing to the lighting of fires, to a maximum at 9 or 10 A.M., after which it gradually falls again; the summer charts are naturally less black than the winter ones. Sundays are on the whole the cleanest days, and certain characteristic differences between different week-days, varying from place to place, are exhibited. Owens has also examined microscopically the number and nature of the suspended atmospheric impurities, and has been able in some cases to recognize salt crystals, mould cells, etc., in addition to soot particles and fused ash.

Evil Effects of Smoke.—Smoke not only damages health, property and vegetation, but in addition entails greatly increased expense in general maintenance, washing, cleaning, and artificial lighting. It is also indicative of a loss of fuel which in soot alone probably amounts to at least 2 million tons annually, while unburned gaseous products of combustion are responsible for still more serious thermal losses.

The duration of sunshine in such towns as Leeds, Sheffield and Manchester is in the winter months less than half that in outlying districts. In summer the deficiency is less marked but the intensity is at all times impaired, particularly in respect of the ultraviolet rays, which are now recognized as being so essential to health. A similar state of affairs holds in London but a steady improvement has been in progress for many years, and while in the period 1881–1885 the City of London and Westminster received only 20% of the sunshine registered at Kew, by 1916–1920 the corresponding proportion had risen to 53%.

Were it not for the action of the wind in spreading smoke, and its tendency to rise to the upper layers of the atmosphere, which normally are cooler than those down below, fog would be an everyday occurrence in thickly populated districts. Still weather, indeed, is in winter usually accompanied by more or less dense smoke fog, or haze, especially since on cold, clear nights radiation to space chills the surface layers of air and is liable to produce in the atmosphere a "temperature inversion," or increase of temperature with height, which checks the upward drift of chimney products. Smoke also contains hygroscopic particles which act as nuclei for the condensation of water vapour and tend to produce wet fogs in chilled air. As might be expected, not only the number of carbon particles but also the amounts of carbonic and sulphurous acid rapidly increase during fog.

The depressing effects of dirt and gloom perhaps scarcely need be insisted upon, but the exact relation between smoke and physical welfare is impossible to assess, owing to the large number of other contributory factors. Smoky fog is certainly the signal for an increase in the number of deaths from pulmonary and cardiac diseases, but since such fogs are associated with special types of weather they are not necessarily its sole cause. Cohen and Ruston, however, quote an interesting investigation by Ascher, who by a comparison with industrial and non-industrial areas was led to the conclusion that coal-dust, smoke and soot increase the death rate from acute lung diseases.

The sulphur acids in soot or rain attack and destroy building materials, particularly limestones, slates and zinc. Sulphuric acid reacts with the carbonates of limestone, turning them into much more soluble sulphates, which are dissolved out by rain, often to be precipitated later in disfiguring incrustations. A simultaneous increase of volume tends to cause the stone to flake away, disintegration being especially rapid if the sulphates are formed in cracks or flaws, for instance in stones possessing marked cleavage planes. Sandstones are not so directly affected as limestones, unless they contain a calcite binding material, the destruction of which may result in large masses being dislodged.

The contrast between town and country gardens makes sufficiently apparent the detrimental effects of smoke upon vegetation. A deposit of soot, apart from the corrosive action of its acid constituents, not only impedes the transpiration of plants but also acts as a screen to sunlight. Acid rain is also directly harmful to plant life and affects adversely the soil, although soot is a valuable manure. The vitality of any type of vegetation usually suffers progressively as an industrial centre or large town is neared; crops diminish and reproductive powers are enfeebled. Evergreens become deciduous or may perish altogether, while many hardy perennials have to be replanted yearly. Some plants refuse altogether to grow in urban districts, others appear to be able to survive after a fashion almost anywhere.

Prevention of Smoke.—Broadly speaking, the prevention of smoke is to be sought both in improved methods of burning raw coal and in a wider development of the pre-treatment of coal for the production of potentially smokeless alternative fuels, such as gas and coke.

There are grounds for regarding hopefully the prospects of industrial smoke abatement. The observation of scientific principles in furnace design and air regulation coupled with the adoption of continuous mechanical stoking have made possible the almost smokeless operation of modern large scale steam boilers, even when working on bituminous coals. Smokeless combustion is less easy to achieve in small hand-fired boiler furnaces, particularly in the periods immediately following the opening of the fire-door and the introduction of fresh charges of fuel; for the chilling effect of the cold fuel and the accompanying inrush of cold air, together with the increased resistance of the deeper fire-bed, tend to the escape of unburned distillation products. Careful and systematic stoking at short intervals, however, by maintaining a fire of even depth with uniform air supply, can give surprisingly good results, and it is quite feasible in such a manner to improve greatly smoky plant. Courses of instruction in furnace manipulation have been inaugurated in a number of large industrial towns, and the education of stokers is under consideration by a London Joint Committee on Smoke Abatement appointed in 1927.

Further, there is ample evidence to prove that coke is a convenient and efficient boiler fuel, capable of giving results not inferior to those obtainable with coal. Its bulkiness, however, necessitates the use of relatively large furnaces, and the substitution of coke for coal in plant which is already hard-pressed to meet adequately the demands, would probably result in failure. There is taking place, especially in small-scale furnaces, a gradual development of the use of gas and oil, which not only can be burned without thick smoke, but contain less sulphur than coal. The possibilities of pulverised fuel are also attracting attention; in this form solid fuel can be burned completely, but the sulphur products are of course not reduced, and unless special precautions are taken a large proportion of the ash may be carried into the atmosphere as a gritty dust. The question of the necessity for smoke production in exempted trades and special processes is a controversial one, but there are known methods of removing soot and dust particles from flue gases, for instance by washing out with water, by centrifugal action or by electrical precipitation, though these naturally entail a certain amount of expense. Gas firing is being successfully adopted in certain branches of the pottery industry and both gas and electrical furnaces are making some headway in formerly smoky metallurgical processes; while for power production the use of electricity is steadily developing.

There is little hope of burning bituminous coal smokelessly in domestic appliances and the only satisfactory solution in this field, apart from the wider adoption of central heating for large buildings, lies in its replacement by smokeless fuels. The possibilities of such a course are governed mainly by economic considerations. For certain purposes, such as cooking and intermittent heating gas, or in more limited circumstances, electricity, compares favourably with coal even in running cost; but unfortunately at present prices the complete elimination of solid fuel is not feasible. Gas coke and anthracite suggest themselves as alternatives to coal, but both are somewhat difficult to ignite and, although suitable for use in stoves or independent boilers, they are not always altogether convenient in ordinary grates. Further, anthracite is expensive, even after taking into account its high calorific value. Hence the widespread interest which has been aroused in the possibility of establishing on a commercial scale, low temperature carbonisation processes for the production from

coal, at a competitive price, of ignitible solid smokeless fuels.

Legislation Against Smoke.—As early as 1306 a Royal proclamation was issued, forbidding the use of coal in London, followed by a Commission to punish miscreants "for the first offence with great fines and ransoms, and upon the second offence to destroy their furnaces." A further proclamation issued during Elizabeth's reign made illegal the burning of coal during the periods Parliament was sitting. Nevertheless its use continued, for the great forests were dwindling before the agricultural needs of an increasing population, and wood was becoming both scarce and dear. In 1648 Londoners unsuccessfully petitioned Parliament to prohibit the importation of coal from Newcastle on account of the injury suffered from smoke.

The extraordinary industrial activity of the 19th century gave the coal industry further impetus and by 1819 the smoke nuisance had become so conspicuous that Parliament appointed a Committee to enquire how far persons using steam engines and furnaces could erect them in a manner less prejudicial to public health and comfort; but although it was reported that evidence bore out the practicability of smoke prevention, no active steps were taken. Further Select Committees in 1843 and 1845 achieved some practical result; for sections were inserted in the Railway Clauses Act of 1845 requiring locomotives, and in the Town Improvement Clause Act of 1847 requiring factory furnaces, to consume their own smoke.

Between 1875 and 1926 English law relating to the excessive emission of smoke from industrial chimneys, with the exception of London, was administered under clauses in the Public Health Act 1875, which enacted that "any fireplace or furnace which does not, as far as practicable, consume the smoke from the combustible consumed therein . . . shall be deemed to be a nuisance," provided "that where a person is summoned before any Court in respect of a nuisance from a fireplace or furnace, the Court shall hold that no nuisance is created within the meaning of the Act if it is satisfied that such fireplace or furnace is constructed in such a manner as to consume as far as practicable (having regard to the nature of the manufacture or trade) all smoke arising therefrom; and that such fireplace or furnace has been carefully attended to by the person having the charge thereof." It has not been customary to attempt to convict under this clause, owing to the difficulty of defining the term "practicable," advantage usually being taken of a further and more workable clause that "any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance, shall be deemed to be a nuisance liable to be dealt with summarily in the manner provided by the Act." Neither of these clauses was applicable to mines or to certain specially exempted metallurgical processes such as smelting and the conversion of pig iron into wrought iron. London was covered by very similar but somewhat more severe provisions in its own Public Health (London) Act 1891, while certain modifications of the general clauses of the 1875 Act were introduced in various local Acts. Scotland also had separate legislation.

The Public Health (Smoke Abatement) Act 1926 was largely the outcome of the work of a Departmental Committee on Smoke Abatement charged to examine the existing state of the law and its administration, and to make proposals to Parliament prior to its amendment. This Act modifies previous clauses by the important phrase "notwithstanding that the smoke is not black smoke," although a conviction cannot be secured if the offender is able to prove that he "has used the most practical means for preventing the nuisance." Local authorities are empowered to "make by-laws regulating the emission of smoke of such colour, density or content as may be prescribed by the by-laws," and, further, to combine in carrying out their duties. Advantage of this latter provision was immediately taken in several districts. There should result a greater degree of uniformity in the definition of smoke nuisances. Concessions to metallurgical industries are retained and the Minister of Health is empowered to extend these by Provisional Order to other trades or processes. Domestic grates are also exempted, but power is given to make by-laws requiring the provision in new buildings other than private dwelling-houses of such arrangements for heating and cooking as are calculated to prevent or reduce smoke emission.

Owing to the wider use of central heating, the more recent development of industry, and the greater regard for technical training, the smoke nuisance is less apparent on the Continent of Europe than in Great Britain, and other European countries have not parallel smoke legislation. Certain measures, however, both national and local, are in force. In Germany, for instance, particulars of projected boiler or furnace installations must be subjected to the police authorities for examination by technical experts and advertised in order that complaints of possible damage may be submitted. In Paris the Préfet de Police has instituted a committee to enquire into remedial measures against smoke.

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UNITED STATES

Many efforts have been made by American cities to mitigate the smoke nuisance. In addition to causing great economic losses by injuring merchandise, defacing buildings, ruining contents of homes and by the waste of the fuel value, smoke is probably a predisposing cause of pulmonary diseases and by obscuring the sun's ultra-violet rays is undoubtedly prejudicial to health. Previous to 1917 many American cities had smoke regulations which, however, were not widely observed, and during the World War, regulations were held in abeyance. With the return of normal conditions health organizations met with considerable interested opposition, public apathy and often official indifference. In 1924 more than 50 American cities had smoke regulations. The administration of these was variously under the jurisdiction of health, boiler inspection, building departments or departments of public safety. New York city, Chicago, Baltimore, Philadelphia, Louisville, Denver and Columbus, O., were cities in this class. Milwaukee, Cincinnati, Salt Lake City, St. Louis and Harrisburg, Pa., had independent bureaux or departments for the purpose.

A smoke advisory committee, composed of engineers co-operating with the New York city department of health, reported in Dec. 1927, the results of a survey. The report declared that inasmuch as the supply of Pennsylvania anthracite was rapidly becoming exhausted, smoke-producing coal would necessarily become New York's main future supply. The report affirmed, however, that smoke from soft coal could be reduced at least 50% by suitable coal-burning appliances and careful supervision. The increasing substitution of fuel-oil and gas for coal promised beneficial results. By 1921 fuel-oil had replaced coal in the sugar, glass and certain other industries. This movement went on both in the east where anthracite was used and in the west where bituminous coal is the chief domestic fuel. Many of these were installed in heaters formerly using coal. The railways, long responsible for a great part of the smoke in urban districts, used 70,000,000bbl. of fuel-oil in 1925.

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SMOKE-BOX is the chamber at the front end of a locomotive boiler (or boiler of similar type for steam rollers and portable engines), by which access is given to the fire-tubes for cleaning or repair purposes. The blast-pipe leading the exhaust steam from the cylinders stands up into the smoke-box and increases the draught. Leakage of air into the box is prevented by fitting a very rigid dished door, tightly seated by a clamping arrangement. Extra fittings to the smoke-box in some locomotives include a feed-water heater, or a superheater, while a spark arrester is essential in certain countries.

SMOKELESS DOMESTIC FUEL. Attention has been increasingly drawn to this subject of late years, and many organizations have carried out useful propaganda in relation thereto. By the more scientific consumption of fuel, not only could enormous waste be obviated but the atmosphere of towns would be rendered vastly clearer and the health of the residents enhanced. (*See* article COAL AND COAL MINING, under Origin and Occurrences, Composition and Varieties, Chemical and Physical Characteristics.)

The more bituminous a coal is, that is to say, the higher the volatile hydro-carbon content and consequently the more fuliginous it is the more smoke it makes in burning. But even in the case of such coals, the volume of smoke in burning can be considerably reduced by mixing excess of air with the burning gases, evolved from the coal, before the temperature has fallen below the point necessary for combustion; for smoke is composed of particles of unconsumed carbon. In order to understand the reason for this we have only to realize what smoke is and how it comes to be formed. If the air feeding a fire is too limited, or the temperature too low to effect the combination of the carbon in the coal with the oxygen in the air, the atoms of carbon will combine with each other to form molecules of carbon which will collect in solid particles which it is very difficult to supply with sufficient air of a temperature high enough for combustion, and so the particles pass up the chimney with the gases (chiefly carbon dioxide) into the atmosphere. The admission of too much unheated air also conduces to the formation of smoke by reducing the temperature of the fire.

Electricity for heating and cooking may eventually take the place of coal, but at present is too costly. The use of gas for these purposes has grown considerably of late years, and it certainly produces a smokeless fuel, but the use of gas has its disadvantages. The use of anthracite where burned in stoves in the house, or to afford the heat in a central heating system, has greatly increased in recent years. It can be burned with difficulty in the open grate, but is seldom so used. It burns with little or no flame and gives out great heat, but requires, for its economic application, special air feeding arrangements. "Gas" coke, *i.e.*, coke made at gas works, because it is softer and more open than metallurgical coke, is largely used for central heating and is sometimes burned in the open grate, either alone or mixed with bituminous coal.

Many processes have been evolved and some carried into practice for providing a low temperature coke suitable for the domestic hearth, and it would appear likely that the time is not far distant when this class of fuel will be in extensive demand for heating, whether in the open grate or in stoves, and for cooking.

SMOKELESS POWDER: *see* EXPLOSIVES.

SMOKE-TREE (*Cotinus Coggyria,* formerly *Rhus Cotinus*), a spreading shrub, sometimes 15 ft. high, of the cashew family, the Anacardiaceae, native to southern Europe and eastward to central China, and widely planted for its feathery flower clusters and attractive foliage. The very similar American smoke-tree (*C. americanus*), a tree sometimes 40 ft. high, is found from Kentucky and Missouri southward to Texas. The indigo-bush (*Dalea spinosa,* fam. Leguminosae), sometimes 25 ft. high, native to the deserts of south-eastern California, adjacent Arizona and Mexico, is also called smoke-tree.

SMOLENSK, a province of European Russia, smaller than the pre-1917 province of that name. Area 57,200 sq.kilometres. Pop. (1926) 2,258,064. It is bounded on the west by White Russia, on the north by Pskov and Tver, on the east by Moscow and Kaluga and on the south by Briansk. The Central Russian plateau occupies much of the province.

The Vazuza and Gzhat, tributaries of the Volga, have cut a deep valley opening northwards towards Rhzev, but most of the river valleys open towards the western plain. The Dnieper and its tributaries the Vop, Vyazma, Sozh and Desna, rise in the province but are not navigable here, though timber is floated on them. The Kasplya and Mezha, flowing into the Dvina, and some of their affluents, are navigable for small boats. The Ugra, flowing eastwards into the Oka, also forms a channel for floating timber.

The plateau region is composed of carboniferous limestone, the western plain mainly of tertiary sands, marls and ferruginous clays, covered with boulder clay. Post-tertiary sands cover some areas, and the marshy depressions, which are a marked feature of this morainic region, and which are a source of malaria, are filled with peat-bogs. These are a potential source of wealth in view of the increasing use of peat as fuel in electricity generating stations. There are patches of forest everywhere, most dense in the north-west and north, and thinning out to the south-west. The soil is of a clayey or sandy forest type, not favourable to agriculture.

The climate is somewhat modified by proximity to the western oceanic régime; average January temperature at Smolensk 13·5° F, average July temperature 67·2° F, rainfall about 20 in. per annum.

In spite of the poor soil, agriculture is the main occupation, the chief crops being rye, oats, potatoes and flax, with smaller quantities of buckwheat, barley, hemp and makhorka tobacco. The type of farming is poor, the three field system prevailing, but of late years energetic campaigns have been carried out with a view to the introduction of a better rotation of crops, with a greater sowing of clover, lucerne and root crops. There is much need for better drainage of the marshy soils, and beginnings have been made in some districts. The soils require heavy manuring.

Sheep, cattle, pigs and horses are bred, and the problem of their pasturage has been much eased since the 1917 revolution. Previous to that time the peasants had little access to the meadow and pasture lands, which were chiefly in private ownership. A dairy industry is springing up; poultry is increasingly kept and Yorkshire breeds of pigs are being introduced with a view to developing a bacon industry in conjunction with dairying. The improvement of agricultural implements began before 1917 and is being actively carried on now.

Apart from the town of Smolensk (*q.v.*) there is not much factory industry, the chief occupations of this type being flour-milling, saw-milling, oil-pressing and leather works. Matches are made at Vyazma and there are textile industries at Sychevka and Yartsevo. Apart from Roslavl, which has a population of 25,494, there is no large town other than Smolensk. Every variety of work dependent on the abundant timber supply is carried out amongst the peasants, including the preparation of tar and pitch, the making of wooden instruments, carriages, etc.

The province was important in early times as a link on the commercial route between Constantinople and the north. Later its position on the west made it the arena of struggles between Lithuania, Russia and Poland. The region suffered severely during the French invasion of 1812, and the peasants afterwards remained in dire poverty, partly due to the unequal distribution of pasture. Proximity to the disorders of the western front in 1914–20 added to the distress and the standard of life is poor. Many peasants seek seasonal additions to their income by migrating to other regions as navvies.

SMOLENSK, a town of Russia, the administrative centre of the province of Smolensk, situated on the Dnieper river, in 54° 50′ N., 32° 5′ E., at a point where the plateau is deeply entrenched and approaches the river both on the north and south. The ancient *kreml* or fortress was built on high crags on the left bank during the reign of Boris Godunov (1598–1605), but is now in ruins. The

town has developed owing to its position as a railway junction for five lines. Its industries include copper and iron smelting, the making of machinery for the textile industries, saw-milling, the manufacture of wooden goods, brick and pottery making and brewing. Pop. (1926) 71,177. Since the revolution a university has been created in the town, which had previously several scientific societies and museums and three public libraries. Its cathedral was built in 1676–1772 on the site of a building dating from 1101 and destroyed in 1611 during a siege by the Poles. The town has a monument commemorating the Russian musical composer M. I. Glinka (1885).

Smolensk is one of the oldest towns of Russia, and is mentioned in Nestor's *Chronicle* as the chief town of the Slav tribe of the Krivichis, situated on the great commercial route "from the Varyaghs to the Greeks." It maintained a lively traffic with Constantinople down to the 11th century, when the principality of Smolensk included Vitebsk, Moscow, Kaluga and parts of the present government of Pskov. The princes of Kiev were often recognized as military chiefs by the *vyeche* (council) of Smolensk, who mostly preferred Mstislav and his descendants, and Rostislav, son of Mstislav, became the ancestor of a series of nearly independent princes of Smolensk. From the 14th century these fell under the influence of the Lithuanian rulers, and in 1408 Smolensk was annexed to Lithuania. In 1449 the Moscow princes renounced their claims upon Smolensk; nevertheless this important city, with nearly 100,000 inhabitants, was a constant source of contention between Moscow and Lithuania. In 1514 it fell under Russian dominion; but during the disturbance of 1611 it was taken by Sigismund III. of Poland, and it remained under Polish rule until 1654, when the Russians retook it. In 1686 it was definitely annexed to Russia. In the 18th century it played an important part as a basis for the military operations of Peter the Great during his wars with Sweden. In 1812 it was well fortified; but the French, after a two days' battle, defeated the Russians here and took the city, when it suffered much.

SMOLLET: *see* Salmon.

SMOLLETT, TOBIAS GEORGE (1721–1771), British novelist, was born in Dalquhurn, Dumbartonshire. His father Archibald (youngest son of Sir James, the laird of Bonhill, a zealous Whig judge and promoter of the Union of 1707) died in 1723. Tobias was sent to Dumbarton school, and, after qualifying for a learned profession at Glasgow university, was apprenticed in 1736 to a surgeon in that city. At the age of eighteen he crossed the border to conquer England with a tragedy, *The Regicide,* based on Buchanan's description of the death of James I.

The story of the journey is told in the early chapters of *Roderick Random.* The failure of the play—certainly the worst thing he ever wrote—became the stock grievance of Smollett's life. No one would read it, and he would have starved had he not secured a position as surgeon's mate on H.M.S. "Cumberland," and served during the whole of the siege of Cartagena in 1741. The fleet returned to Jamaica, where Smollett fell in love with the daughter of a planter, Nancy Lascelles, whom he married on returning to England. He set up as a surgeon in Downing street, but with little success, and he soon began to devote his attention to writing fiction. His first novel *Roderick Random* (1748) recounts a life of varied adventure in the company of a servant. The author draws on his adventures on the English highway and in the cockpit of a king's ship, revealing the seaman to such purpose that, as Scott says, every one who has written about the navy since seems to have copied more from Smollett than from nature. There was no author's name on the title of the two small volumes of *Random;* it was actually translated into French as being by Fielding. But Smollett went to Paris to ratify his fame, and published his derelict play as "by the author of *Roderick Random.*"

Smollett still designed to combine medicine with authorship, for in June 1750 he obtained the degree of M.D.; and after a visit to Paris published in 1751 his second novel, *The Adventures of Peregrine Pickle,* which was a resounding success, both in England and France. It is no exaggeration to say that the tideway of subsequent fiction is strewn on every hand with the *dissecta membra* of Smollett's happy phrases and farcical inventions; but this novel is marred to an even greater extent by interpolations and personal attacks than its predecessor. His third novel, *Ferdinand Count Fathom,* appeared in 1753, by which time the author, after a final trial at Bath, had abandoned medicine for letters, and had settled down at Monmouth House, Chelsea. The squalor and irony of the piece repel the reader, but it is Smollett's greatest feat of invention, and was the model of all the mystery and terror school of fiction commencing with Radcliffe and Lewis. It was not particularly remunerative, and his expenses seem always to have been profuse. He was a great frequenter of taverns and entertained largely.

To sustain these expenses Smollett organized big and saleable "standard" works for the booksellers, contracting them out to his "myrmidons." He edited *Don Quixote,* a new literary periodical the *Critical* (Feb. 1756) by way of corrective to Griffith's *Monthly Review,* and organized a standard library *History of England,* and a seven-volume compendium of *Voyages,* for which he wrote a special narrative of the siege of Cartagena. In 1758 he projected and partly wrote a vast *Universal History,* and in January 1760 he brought out the first number of a new sixpenny magazine, the *British,* to which he contributed a serial, the mediocre *Adventures of Sir Launcelot Greaves.* By these Herculean labours as a compiler Smollett must have amassed a considerable sum. For the extravaganza, *The Reprisal, or the Tars of Old England* he received £200. In 1762 Smollett edited the *Briton.* He had already been ridiculed, insulted, fined and imprisoned in the Marshalsea. He was now to support the North British favourite of George III. in the press, not we may reasonably suppose without substantial reward. Yet after incurring all this unpopularity, Smollett was thrown over by his chief, Lord Bute, on the ground that his paper did more to invite attack than to repel it.

The *Briton* expired in February 1763, and again Smollett undertook such tasks as a universal gazetteer and a translation of Voltaire in 38 volumes. In April, however, his only daughter died at the age of fifteen, and, over-wrought from sedentary strain, he followed the advice of his wife and made two years' sojourn abroad, mainly upon the Riviera, which Smollett turned to such excellent purpose in his *Travels* (1766), remarkable alike for their acidity and for their insight. On his arrival from Italy, where he had provided material for Sterne's portrait of the distressful "Smelfungus," Smollett seemed to be getting over his pulmonic complaint. But his health was thoroughly undermined, and a neglected ulcer helped to sap his strength. He resolved on a summer journey to Scotland, and when he proceeded to Bath in 1766 his complaint at last took a turn for the better.

In 1768 he was again in London, and with a return of his vital energy came a recrudescence of the old savagery. *The History and Adventures of an Atom* is a clever, but coarse Rabelaisian satire upon the conduct of public affairs in England from the Seven Years' War to the date of publication. He lashes out on all sides without fear or favour. In 1769 he settled at Pisa and then near Antignano, near Leghorn, where during the autumn of 1770, he wrote *Humphrey Clinker,* in the form of itinerant letters. The character drawing, though still caustic, seems riper and more matured. He died at Leghorn on Sept. 17, 1771, and was buried there in the old English cemetery.

The chief collective editions are as follows: 6 vols., Edinburgh, 1790; 6 vols., London, 1796, with R. Anderson's Memoir; *Works,* ed. J. Moore, 1797 (re-edited J. P. Browne, 8 vols., 1872); *Works,* ed. Henley and Seccombe (12 vols., 1899–1902). To which must be added a one-volume *Miscellaneous Works,* ed. Thomas Roscoe (1841); *Selected Works* (with a life by David Herbert) (Edinburgh, 1870); Ballantyne's edition of the Novels with Scott's memoir (2 vols., 1821); and G. Saintsbury's edition of the Novels (12 vols., 1895). There are Lives by Robert Chambers (1867), David Hannay (1887) and O. Smeaton (1897). Additional information of recent date will be found in the article on Smollett in the *Dict. Nat. Biog.,* Masson's *British Novelists,* H. Graham's *Scottish Men of Letters in the Eighteenth Century, Blackwood's Mag.* for May 1900; and the introduction to Smollett's *Travels through France and Italy* (World's Classics, 1907). *See* also H. S. Buck, *A Study in Smollett, Chiefly Peregrine Pickle* (New Haven, 1925); L. Melville, *Life and Letters of Tobias Smollett, 1721–71* (1926); H. S. Buck, *Smollett as Poet* (1927).

SMOOT, REED (1862–), American senator, was born at Salt Lake City, Utah, on Jan. 10, 1862. He was educated at Deseret university and at the Brigham Young academy, Provo, Utah. He amassed considerable wealth as a banker and woollen manufacturer. In 1895 he was appointed one of the presidents of the Utah Stake of the Church of Jesus Christ of Latter Day Saints (Mormon), and in 1900 was made an apostle. He was elected to the U.S. Senate from Utah in 1902. Attempts were made to prevent his entering the Senate because of his connection with the Mormon Church and on the charge that he personally favoured polygamy and was a polygamist. He was allowed to take his seat; but the matter was referred to the Senate committee on privileges and elections for investigation.

In June 1906 the committee by a vote of seven to five recommended that he be unseated; but, as the personal charges against him had not been proved, the Senate in Feb. 1907, by a vote of 42 to 23, refused to remove him. He was re-elected in 1908, 1914, 1920, and 1926. In 1919 Smoot opposed participation by the United States in the League of Nations. Later he served as chairman of the finance committee of the Senate, was a member of the World War Foreign Debt Commission, a regent of the Smithsonian Institution, an elector of the New York Hall of Fame, and chairman of the public buildings commission, directing the Government building programme at Washington (D.C.), begun in 1927.

SMUGGLING, a breach of the revenue laws either by the importation or the exportation of prohibited goods or by the evasion of customs duties on goods liable to duty. Legislation on the subject in England has been very active from the 14th century downwards. In the reign of Edward III. the illicit introduction of base coin from abroad led to the provision of the Statute of Treasons 1351, making it treason to import counterfeit money as the money called "Lushburgh." Such importation is still an offence, though no longer treason. After the Statute of Treasons a vast number of acts dealing with smuggling were passed, most of which will be found recited in the repealing act of 1825. The smuggler of the 18th century finds an apologist in Adam Smith, who writes of him as "a person who, though no doubt highly blamable for violating the laws of his country, is frequently incapable of violating those of natural justice, and would have been in every respect an excellent citizen had not the laws of his country made that a crime which nature never meant to be so." The gradual reduction of duties (begun by Pitt) brought smuggling in the United Kingdom into insignificance until the revival of import duties after the World War led to frequent offence. In 1926–27 out of 8,246 seizures of smuggled goods, 5,967 related to tobacco and spirits. Most of the existing legislation on the subject of smuggling is contained in the Customs Consolidation Act 1876.

The main provisions are as follows. Vessels engaged in smuggling are liable to forfeiture and their owners and masters to a penalty not exceeding £500. Smuggled and prohibited goods are liable to forfeiture. Officers of customs have a right of search of vessels and persons. Fraudulent evasion or attempted evasion of customs duties renders the offender subject to forfeit either treble the value of the goods or £100 at the election of the commissioners of customs. Heavy penalties are incurred by resistance to officers of customs, rescue of persons or goods, assembling to run goods, signalling smuggling vessels, shooting at vessels, boats or officers of the naval or revenue service, cutting adrift customs vessels, offering goods for sale under pretence of being smuggled, etc. Penalties may be recovered either by action or information in the superior courts or by summary proceedings. In criminal proceedings the defendant is competent and compellable to give evidence. The Merchant Shipping Act 1894 makes any seaman or apprentice, after conviction for smuggling whereby loss or damage is caused to the master or owner of a ship, liable to pay to such master or owner such a sum as is sufficient to reimburse the master or owner for such loss or damage, and the whole or a proportional part of his wages may be retained in satisfaction of this liability. Additional provisions as to smuggling are also contained in the Customs and Inland Revenue Act 1879, and the Customs and Inland Revenue Act 1881. A smuggling contract is generally illegal. But it may be valid, and the vendor may recover the price of goods, even though he knew the buyer intended them to be smuggled, unless he actually aids in the smuggling so as to become *particeps criminis*. Contracts to defraud the revenue of a foreign state are, according to English decisions, not illegal. There is a German decision, more consonant with international morality, to the opposite effect.

The penalities for smuggling in the United States will be found mainly in tit. xxxiv. ch. 10 of the Revised Statutes. The seaman guilty of smuggling is liable to the same penalty as in England, and in addition to imprisonment for twelve months, s. 4596.

See Stephen Dowell's *History of Taxation* (2nd ed., 1888), and Luke Owen Pike's *History of Crime in England* (1873–76); and for general accounts of smuggling *see* W. D. Chester, *Chronicles of the Customs Department* (1885); H. N. Shore, *Smuggling Days and Smuggling Ways* (1892); Atton and Holland, *The King's Customs* (1908); C. G. Harper, *The Smuggler: Picturesque Chapters in the Story of an Ancient Craft* (1909).

SMUT AND BUNT, in botany and agriculture, the names given to species of fungi attacking various flowering plants, especially cereals and other grasses. The name smut refers to the black, dust-like masses of spores which appear in the flowers of the corn and are the only part of the parasite visible externally. Smuts and bunts comprise the group Ustilagineae of the Basidiomycetes. Bunts, often called, especially in America, stinking smuts, on account of their unpleasant fishy smell, are exemplified by the bunts of wheat (*Tilletia foetens; T. tritici*). Smuts, differentiated from stinking smuts as "loose" and "covered" smuts, attack only the inflorescence, which they destroy entirely. The most important genus is *Ustilaga,* species of which attack oats, barley, wheat, maize, etc. The bunts enter the tissues of the host when the latter is a seedling and their mycelia ramify throughout the plant. Spores appear only in the flowers of the cereal, however, and the parasite destroys the centres of the corn-grains.

Smuts of barley (*Ustilaga hordei*) and the bunts of wheat can largely be kept under by soaking the seed before sowing in a solution of copper sulphate (1 lb. to 25 gal. of water) for 12 hours. Soaking in formalin solution (1 lb. to 50 gal. of water) is also effective against these diseases and against smut of oats (*U. avenae*). Neither of these, however, is of any avail against maize smut (*U. maydis*) and no effectual preliminary treatment is as yet known for this parasite. *See* FUNGI. For their grave economic effects, *see,* also, WHEAT, BARLEY, etc.

SMUTS, JAN CHRISTIAAN (1870–), South African statesman and general, was born on May 24, 1870 near Riebeek West, Malmesbury district, Cape Colony, the son of J. A. Smuts and Catharina de Vries. In 1886 he commenced his studies at Stellenbosch, and in 1891 went to Cambridge, where his career was brilliant. In 1895 he was admitted to the Cape Town bar. In Oct. 1895 his first political speech was delivered at Kimberley, where, as a result of the understanding between Jan Hofmeyr and Rhodes, he defended the latter's policy. The Jameson Raid (Jan. 1896), changed the whole complexion of South African politics. Smuts ranged himself on the side of the Transvaal, and shortly afterwards joined the Bar at Johannesburg. In 1898, though two years under the legal age, he was made state attorney by President Kruger, and took part in the negotiations with the British agent at Pretoria on the franchise. He accompanied Kruger to the abortive conference with Milner at Bloemfontein in July 1899.

In the early stages of the Boer War, Smuts was employed in legal and organising work, but on the occupation of Pretoria, in 1900, he joined the Boer field forces. From the Eastern Transvaal, where his Government was hard pushed, he made his way to the West, where he fought under De la Rey. Subsequently he acted as commander-in-chief of the Boer and Cape rebel commandoes in the Cape. He was besieging a mining camp in Namaqualand, when Botha sent for him to take part in the peace negotiations at Vereeniging (1902). He threw in his weight on the side of those who urged a compromise, as against the intransigent commandants.

After peace, Smuts became a strong and active protagonist of

Botha's policy—loyalty to the new order, and racial conciliation. Practising as a barrister at Pretoria, he spent a good deal of time in the reconstruction of the remnants of the Boer nation and together with Botha and other leaders he met Joseph Chamberlain at Pretoria. The Boers, supported by part of the British population, strongly opposed several points in Milner's policy, *e.g.*, the importation of Chinese coolies for the gold mines, and Smuts was among those who refused Milner's offer of seats in the nominated Legislative Council.

Het Volk.—In 1904 Botha and Smuts founded the political organisation open to both races known as "Het Volk." Early in 1906 Smuts visited London, where he worked for fully responsible government in the Transvaal and Orange Free State, which was granted in 1906. Early in 1907 elections for the Assembly were held. Smuts took a prominent part and was returned unopposed for Wonderboom (Pretoria). As colonial secretary, under Botha, he became the driving force of the Cabinet. In May 1908 Smuts openly declared for the union of the South African colonies. In October of that year, the National Convention, which eventually produced the South African Act, began its work. Smuts was one of the makers of the Act. In May 1910 Union was consummated. Smuts was elected member of the legislative assembly for Pretoria West, and became minister of the interior, mines and defence. In 1911 the South African party was founded at Bloemfontein, where Smuts foreshadowed the political difficulties ahead. Early in 1912 he introduced his Defence bill, which powerfully affected the future of South Africa. A little later Smuts took over the treasury, retaining the portfolio of defence. During the Hertzog crisis, at the end of 1912, he did his utmost to prevent a split, but once the fateful step had been taken, he resolutely supported Botha. In July 1913 a revolutionary strike shook the Rand to its foundations. Botha and Smuts, at great personal risk (and unescorted) saved the situation at Johannesburg, after Lord Gladstone had sanctioned the use of Imperial troops to quell disturbances. In Jan. 1914 an attempted general strike was nipped in the bud by Smuts, who in record time rushed up the commandoes but recently organised under his Defence Act. The deportation of nine strike leaders on the S.S. "Umgeni," though authorised by the Cabinet, has been chiefly debited to Smuts by his opponents. A double Indemnity bill, covering the two revolts, led to a violent and protracted parliamentary debate.

The World War.—The outbreak of the World War shifted the South African centre of gravity to Smuts' office. In Sept. 1914, when Beyers resigned as Commandant-General in the midst of the preparations for a campaign against the Germans in South-west Africa, Smuts assumed his functions. The rebellion of De Wet, Maritz, Beyers and others followed. This was suppressed by Botha, acting in the closest collaboration with Smuts at headquarters. In 1915, after a visit to Botha's forces in South-west Africa, Smuts took the leading part in the general election, which was marked by extreme bitterness. He was re-elected for Pretoria West by a narrow majority. Early in 1916 he refused the command offered him in East Africa by the Imperial Government, but shortly afterwards yielded to representations. For the success of his operations against Lettow-Vorbeck *see* EAST AFRICA, OPERATIONS IN.

Work in London.—In March 1917 Smuts arrived in London to represent South Africa at the Imperial War conference, and was sworn as a privy councillor. After the conference, at a dinner given in recognition of his war services, by members of both Houses of Parliament, he made his famous declaration on the British Commonwealth of Nations. He accepted a seat in the War Cabinet, taking a deep interest in the flying services, and his proposals for their unification were accepted by the Cabinet. Incidentally, he supervised London's air defences. He suggested, and became chairman of, the War Priorities Committee, which settled priority of claims among departments concerned in the war, and allocated man-power and other resources. Occasionally he visited the Western front, where he conferred with commanders. In Dec. 1917 Smuts met Count Mensdorff at Geneva, and explored the possibility of a separate peace with Austria; but was finally convinced that it was not possible. The following Feb. he spent with Allenby in Palestine, working out plans for a great advance.

After the Armistice, Smuts wrote his Memorandum on the League of Nations, *The League of Nations: A Practical Suggestion* (1918), which received the support of both President Wilson and Mr. Lloyd George, and in substance became the Covenant of the League. With Botha, he represented South Africa at the Peace Conference, where he was mainly concerned with the Covenant and Dominion status. At this time he undertook a mission to Vienna and to Budapest, where the Communist Government had violated the Armistice.

South African Politics.—After the conference, he returned to South Africa. In Aug. 1919, he became prime minister of the Union (in succession to Botha). During this period he twice attended the Imperial Conference. In 1921 his visit was notable for the part he played in securing peace in Ireland. During the Conference of 1923 (held while the Ruhr crisis was at its worst), he advocated a fresh attempt to settle the European situation. The suggestion was generally approved, and it helped to prepare the way for the Dawes Commission.

In 1920, repeated attempts to reunite the South African party and the Nationalists failed. The Unionists, under Smartt, decided to dissolve their organisation and to join the South African party. The consequences of this fusion lost Smuts a certain amount of support among both English and Dutch. A general election, held on that issue, left him, however, with a working majority, and the combined party did fairly well in Parliament. In 1922, however, another workers' revolt on the Rand (which had to be suppressed by the military and burghers, after the exercise of considerable patience) led to a junction of forces between advanced Nationalists and the Labour element. By-elections went against the Government, and a formal pact was made by the two Opposition parties. In 1924, after a crucial by-election, Gen. Smuts took the country by surprise; he dissolved Parliament, realising that the people were probably dissatisfied with him. The result, nationally considered, thoroughly bore out the wisdom of his decision, for the South African party was heavily defeated. Hertzog did not obtain a clear majority, but was able with the assistance of Labour to form a coalition Cabinet. Although Smuts himself lost Pretoria West, he was elected unopposed for Standerton, Botha's old constituency.

As Opposition leader, he continued to pay close attention to affairs of state, while indulging to some extent his fondness for philosophy and botany. In 1925 he delivered the opening address, as president of the S.A. Association for the Advancement of Science. In 1926 General Smuts published *Holism and Evolution*, a philosophical treatise; and in 1930 *Africa and Some World Problems*. He visited the U. S. and Canada in January 1930. (N. LE.; X.)

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SMYBERT or **SMIBERT, JOHN** (1684–1751), Scottish American painter, was born at Edinburgh in 1684, and died in Boston (Mass.), in 1751. He studied under Sir James Thornhill, and in 1728 accompanied Bishop Berkeley to America with the intention of becoming professor of fine arts in the college which Berkeley was planning to found in Bermuda. The college, however, was never established, and Smybert settled in Boston, where he married in 1730. In 1731 he painted "Bishop Berkeley and His Family," now in the dining-hall, Yale university, a group of eight figures. He painted portraits of Jonathan Edwards and Judge Edmund Quincy (in the Boston art museum), Mrs. Smybert, Peter Faneuil, and Governor John Endecott (in the Massachusetts historical society), John Lovell (memorial hall, Harvard university), and probably one of Sir William Pepperrell; and examples of his work are owned by Harvard and Yale universities, by Bowdoin college, by the Massachusetts historical society, and by the New England historical and genealogical society.

SMYRNA (*Ismir*), in ancient times one of the most important and now by far the greatest of the cities of Asia Minor, has preserved an unbroken continuity of record and identity of name from the dawn of history to the present time.

1. **The Ancient City.**—It is said to have been a Lelegian city before the Greek colonists settled in Asia Minor. The name, which is said to be derived from an Amazon called Smyrna, is indubitably Anatolian, having been applied also to a quarter of Ephesus, and (under the cognate form Myrina) to a city of Aeolis, and to a tumulus in the Troad. The Aeolic settlers of Lesbos and Cyme, pushing eastwards by Larissa and Neonteichos and over the Hermus, seized the valley of Smyrna. It was the frontier city between Aeolis on the north and Ionia on the south, and was more accessible on the south and east than on the north and west. By virtue of its situation it was necessarily a commercial city, like the Ionian colonies. It is therefore not surprising that the Aeolic element grew weaker; strangers or refugees from the Ionian Colophon settled in the city, and finally Smyrna passed into the hands of the Colophonians and became the thirteenth of the Ionian states. The change had taken place before 688, when the Ionian Onomastus of Smyrna won the boxing prize at Olympia, but it was probably then a recent event. The Colophonian conquest is mentioned by Mimnermus (before 600 B.C.), who counts himself equally a Colophonian and a Smyrnaean. The Aeolic form of the name, Σμύρνα, was retained even in the Attic dialect, and the epithet "Aeolian Smyrna" remained long after the conquest. The situation of Smyrna on the path of commerce between Lydia and the west raised it during the 7th century to the height of power and splendour. It lay at the head of an arm of the sea, which reached far inland and admitted the Greek trading ships into the heart of Lydia. One of the great trade routes which cross Anatolia descends the Hermus valley past Sardis, and then diverging from the valley passes south of Mt. Sipylus and crosses a low pass into the little valley, about 7 m. long and 2 broad, where Smyrna lies between the mountains and the sea.

When the Mermnad kings raised the Lydian power and aggressiveness Smyrna was one of the first points of attack. Gyges (*c.* 687–652) was, however, defeated on the banks of the Hermus; the situation of the battlefield shows that the power of Smyrna extended far to the east and probably included the valley of Nymphi (Nif). A strong fortress, the ruins of whose ancient and massive walls are still imposing, on a hill in the pass between Smyrna and Nymphi, was probably built by the Smyrnaean Ionians to command the valley of Nymphi. According to Theognis (about 500 B.C.), "pride destroyed Smyrna." Mimnermus laments the degeneracy of the citizens of his day, who could no longer stem the Lydian advance. Finally, Alyattes III. (609–560) conquered the city, and Smyrna for 300 years lost its place in the list of Greek cities. It did not cease to exist, but the Greek life and political unity were destroyed, and the Smyrnaean state was organized on the village system (ᾤκεῖτο κωμηδόν.) It is mentioned in a fragment of Pindar, about 500 B.C., and in an inscription of 388 B.C. A small fortification of early style, rudely but massively built, on the lowest slope of a hill N. of Burnabat, is perhaps a fortified village of this period. Alexander the Great conceived the idea of restoring the Greek city; the two Nemeses who were worshipped at Smyrna are said to have suggested the idea to him in a dream. The scheme was, according to Strabo, carried out by Antigonus (316–301), and Lysimachus enlarged and fortified the city (301–281). The acropolis of the ancient city had been on a steep peak about 1,250 ft. high, which overhangs the north-east extremity of the gulf; its ruins still exist, probably in much the same condition as they were left by Alyattes. The later city was founded on the modern site partly on the slopes of a rounded hill called Pagus near the south-east end of the gulf, partly on the low ground between the hill and the sea.

The "crown of Smyrna" seems to have been an epithet applied to the acropolis with its circle of buildings. Smyrna is shut in on the west by a hill now called Deirmen Tepe, with the ruins of a temple on the summit. The walls of Lysimachus crossed the summit of this hill, and the acropolis occupied the top of Pagus. Between the two the road from Ephesus entered the city by the "Ephesian gate," near which was a gymnasium. Closer to the acropolis the outline of the stadium is still visible, and the theatre was situated on the north slopes of Pagus. The line of the walls on the east side is unknown; but they certainly embraced a greater area than is included by the Byzantine wall, which ascends the castle hill (Pagus) from the Basmakhanē railway station. Smyrna possessed two harbours—the outer, which was simply the open roadstead of the gulf, and the inner, which was a small basin, with a narrow entrance closed by a rope in case of need, about the place now occupied by bazaars. The inner harbour was partially filled up by Timur in 1402, but it had not entirely disappeared till the beginning of the 19th century. The modern quay has encroached considerably on the sea, and the coast-line of the Greek time was about 90 yd. farther south. The streets were broad, well paved and laid out at right angles; many were named after temples: the main street, called the Golden, ran across the city from west to east, beginning probably from the temple of Zeus Akraios on the west side of Pagus, and running round the lower slopes of Pagus (like a necklace on the statue, to use the favourite terms of Aristides the orator) towards Tepejik outside the city on the east, where probably the temple of Cybele, the Metroön, stood. Cybele, worshipped under the name of Meter Sipylene, from Mt. Sipylus, which bounds the Smyrna valley on the north, was the tutelar goddess of the city. The plain towards the sea was too low to be properly drained and hence in rainy weather the streets were deep with mud and water.

The river Meles, which flowed by Smyrna, is famous in literature and was worshipped in the valley. The most common and consistent tradition connects Homer with the valley of Smyrna and the banks of the Meles; his figure was one of the stock types on Smyrnaean coins, one class of which was called Homerian; the epithet "Melesigenes" was applied to him; the cave where he was wont to compose his poems was shown near the source of the river; his temple, the Homereum, stood on its banks. The steady equable flow of the Meles, alike in summer and winter, and its short course, beginning and ending near the city, are celebrated by Aristides and Himerius. The description applies admirably to the stream which rises from abundant fountains, now known as Diana's bath, east of the city, and flows into the south-east extremity of the gulf. The belief that the torrent, almost dry except after rains, which flows by Caravan bridge, is the ancient Meles, flatly contradicts the ancient descriptions.

In the Roman period Smyrna was the seat of a *conventus* which included south Aeolis and a great part of the Hermus valley. It vied with Ephesus and Pergamum for the title "First (city) of Asia." A Christian church existed here from a very early time, having its origin in the considerable Jewish colony. Polycarp was bishop of Smyrna and was martyred there A.D. 155. The bishops of Smyrna were originally subject to the metropolitan of Ephesus; afterwards they became independent (αὐτοκέφαλοι), and finally were honoured with metropolitan rank.

When Constantinople became the seat of government the trade between Anatolia and the west lost in importance, and Smyrna declined apace. A Turkish freebooter named Tsacha seized Smyrna in 1084, but it was recovered by the generals of Alexius Comnenus. The city was several times ravaged by the Turks, and had become quite ruinous when the emperor John Ducas Vatatzes about 1222 rebuilt it. But Ibn Batuta found it still in great part a ruin when the famous chieftain Aidin had conquered it about 1330 and made his son Amur governor. It became the port of the Aidin amirate. Soon afterwards the Knights of Saint John established themselves in the town, but failed to conquer the citadel. In 1402 Timur stormed the town and massacred almost all the inhabitants. The Mongol conquest was only temporary, but Smyrna was resumed by the Seljuks of Aidin and has remained till the present day in Mohammedan hands. Until the reign of Abdul Mejid it was included for administrative purposes in the *eyalet* of Jezair (the Isles) and not in that of Anatolia. The representative of the Capitan Pasha, who governed that *eyalet*, was, however, less influential in the city than the head of the Kara Osman Oglu's of Manisa. (*See* MANISA.) From the early 17th century till 1825, Smyrna was the chief provincial factory

of the British Turkey Company, as well as of French, Dutch and other trading corporations. (W. M. RA.; D. G. H.)

2. **The Modern City,** capital of the Aidin vilayet, and the most important town of Asia Minor. Pop. (1927), 190,291. It is one of the principal ports of the Turkish republic, and has a large trade, of which the greater part is with Great Britain. The chief items of export are figs, tobacco, valonia, carpets, raisins and silk. Until 1894 the two railways from Smyrna to the interior belonged to British companies; but in 1897 the Smyrna-Alashehr line passed into the hands of a French syndicate, which completed an extension to Afium Kara-hissar and virtually (though not actually) effected a junction with the Anatolian railway system. This line has branches to Burnabat and Soma. The Smyrna-Aidin line has been extended to Egerdir. It has branches to Buja, Seidikeui, Tireh, Odemish, Sokia, Denizli and Ishekli.

See general authorities for *Asia Minor,* especially the travellers, almost all of whom describe Smyrna. Also B. F. Slaars, *Étude sur Smyrne* (1868); and W. M. Ramsay, *Letters to the Seven Churches* (1904) and article in Hastings's *Dict. of the Bible* (1902).

POST-WAR DEVELOPMENTS

At the Peace Conference which was held in 1919 Greece put forward a claim to the Smyrna area, assigned it was understood to Italy by the Agreement of St. Jean de Maurienne (April 17, 1917)—an agreement which remained unratified owing to Russian objections. M. Venizelos argued on the Greek claim before the Council of Ten on Feb. 3–4, 1919. The final decision of the Council of Three, authorising the Greeks to occupy Smyrna, was taken apparently without the knowledge of the Italians, who had withdrawn temporarily from the conference, or of the American expert advisers to President Wilson. The occupation was in theory an Allied occupation, but was generally taken to mean acceptance of the Greek claims. Greek troops occupied Smyrna on May 15, 1919. The first entry of the Greeks was marked by atrocities against the Turkish population.

Under the Treaty of Sèvres, Aug. 10, 1920, it was stipulated that the town of Smyrna and the Ionian hinterland were to be under Greek administration for five years. The Greek claim was based on ethnographical grounds. Reliable racial statistics for the area were not available, but an American computation of 1914 gave the total population as 1,057,000, including 509,000 Turks, 470,000 Greeks and 78,000 others.

Turkish forces under Mustafa Kemal and the Greeks were soon engaged in hostilities, in which at first the Greeks were successful. Mustafa Kemal, however, continued to consolidate his position in Turkey, while the fall of Venizelos (Nov. 1920) and the return of King Constantine to Greece (*see* GREECE) weakened the sympathies which Greece had enjoyed in Great Britain, her chief supporter among the Allied Powers. Negotiations at the London and Paris conferences (1921 and 1922) having failed, the Kemalists drove back the Greek army, which with many thousands of Greek refugees from all parts of Asia Minor embarked hurriedly and left Smyrna, which the Turks entered on Sept. 9, 1922. Under the Treaty of Lausanne (July 24, 1923) Smyrna and the surrounding zone reverted under full Turkish sovereignty.

Meanwhile, the town and district had suffered frightfully under the atrocities of both belligerents, and these sufferings culminated when, a few days after the Turkish entry into the town, fire broke out in the Armenian quarter. Only the wretched Turkish quarter on Mount Pagus was untouched, and more than three-fifths of the city was destroyed, including all the banks, business houses and consulates in the European quarter on the quay. The loss of life was impossible to compute. In April 1928 Smyrna again suffered serious damage by earthquake.

SMYTH, DAME ETHEL MARY (1858–), D.B.E. (1922), British composer, was born in London April 23, 1858, the daughter of Gen. J. H. Smyth. She studied music at Leipzig under Heinrich von Herzogenberg. She produced her first opera *Fantasio* at Weimar in 1898, others being given at Leipzig, Prague and Vienna. Her first opera to be produced in London was *Der Wald,* given at Covent Garden in 1902 which was followed by *The Wreckers* (1909), a vividly romantic work. Her *Mass in D,* first performed in 1893, was revived 30 years later. *The Boatswain's Mate,* a comic opera, was produced in 1916. Dr. Ethel Smyth took a prominent part in the militant suffragist movement, and composed *The March of the Women* (1911) the battle song of the W.S.P.U. Her compositions include *Fête Galante* (1923) and *Entente Cordiale,* 1924, operas; also chamber music, choruses and songs, all characterised by energy of invention, exuberant vitality and clever workmanship. *See* her brilliant memoirs *Impressions that Remained* (1919, new ed. 1923), *Streaks of Life* (1921, new ed. 1924). *A Three-Legged Tour in Greece* (1927) and *A Final Burning of Boats* (1928).

See also R. A. Streatfeild, *Une Musicienne Anglaise: Ethel Smyth* (1912).

SMYTH, HERBERT WEIR (1857–), American classical scholar, was born at Wilmington, Del., on Aug. 8, 1857. He was educated at Swarthmore (A.B., 1876), Harvard (A.B., 1878), and Göttingen (Ph.D., 1884). During 1884–85 he was instructor in Greek and Sanskrit at Williams college, and then for two years was reader in Greek at Johns Hopkins university. From 1888 to 1901 he was professor of Greek at Bryn Mawr. In the latter year he was appointed professor of Greek literature at Harvard, becoming emeritus in 1925. During 1899–1900 he was professor at the American Classical school at Athens. From 1889 to 1904 he was secretary of the American Philological Association and editor of its *Transactions,* and in 1904 was elected president. His works include a treatise on the Ionic dialect (1894); *Greek Melic Poets* (1900); *Greek Grammar for Colleges* (1916); *Aeschylus,* text and translation (1922–26), in the "Loeb Classical Library"; and *Aeschylean Tragedy* (1924).

SMYTH (or SMITH), **JOHN** (*c.* 1570–1612), English nonconformist divine, commonly called the Se-baptist, was born about 1570, and was educated at Christ's college, Cambridge, where he proceeded M.A. in 1593. He was probably vicar of Hutton Cranswicke in the E. Riding of Yorkshire from 1593 to 1600, when he was elected lecturer or preacher of the city of Lincoln, an office of which he was deprived in Oct. 1602. Becoming connected with the Separatist movement he joined the Gainsborough church, and became its pastor[1]. With Thomas Helwys, John Murton (or Morton) and others, he migrated to Amsterdam at the end of 1607 to escape religious persecution, and in that city practised as a physician, and became the leader of "the second English church." (*See* CONGREGATIONALISM.) Under Mennonite influence he became a Baptist (*see* BAPTISTS). But he and his company were then faced by the dilemma that their own infant baptism did not count, and Smyth solved the problem by first baptizing himself (hence the name Se-Baptist), probably by affusion, and then administering the rite to Helwys and the others. Afterwards they decided to join the Mennonites, who were suspicious of a man who had never held one position for long, and demanded a statement of doctrines, which he gave them in twenty articles written in Latin, and in *The Last Book of John Smyth, called the Retractation of his Errors,* together with a confession of faith in 100 Propositions. Smyth himself died of consumption in August 1612. Helwys and Morton returned to England, and established the first English Baptist churches.

See J. H. Shakespeare, *Baptist and Congregational Pioneers* (London, 1906); H. M. Dexter, *The England and Holland of the Pilgrims* (London and Boston, 1906). (A. J. G.; X.)

SMYTH (or SMITH), **WILLIAM** (c. 1460–1514), bishop of Lincoln, was a Lancashire man by birth, and probably passed some of his early days at Knowsley under the roof of Margaret, countess of Richmond and Derby, the mother of Henry VII. He appears to have been a member of Lincoln College, Oxford, and in 1485, just after the battle of Bosworth, he was made keeper of the hanaper of the chancery. Two of Edward IV.'s daughters were entrusted to his keeping; he was a member of the royal council and he obtained many rich preferments. In 1493 he became bishop of Coventry and Lichfield. The bishop was a member of Prince Arthur's council in the marches of Wales, and in 1501, five years after he had been translated to the bishopric of Lincoln, he became lord president of Wales. About 1507 he

[1]He was never vicar of Gainsborough, and must not be confused with the John Smyth who was imprisoned in the Marshalsea in 1592.

and Sir Richard Sutton (d. 1524) set to work to found a new college in Oxford. They rebuilt Brasenose Hall, added other existing halls to it, and having obtained a charter in 1512, called it *The King's haule and college of Brasennose*. Smyth, who was one of the executors of Henry VII.'s will, retired from public life just after this king's death; he was, however, president of Wales until his death at Buckden in Huntingdonshire on Jan. 2, 1514. In addition to his liberal gifts to Brasenose College he gave money or land to Lincoln and to Oriel Colleges; he founded a school at Farnworth, Lancashire, and he refounded the hospital of St. John at Lichfield. From 1500 to 1503 he was chancellor of Oxford University.

SNAIL, the name usually given to land molluscs of the class Gastropoda which have spiral shells, such as the common snail (*Helix aspersa*) and the wood snail (*Cepea nemoralis*). In Scotland both shell-bearing and shell-less land molluscs are known as "snails." Marine Gastropod molluscs are sometimes called "sea snails" and the freshwater gastropods (*Vivipara, Limnaea,* etc.) are known as "pond snails" and "river snails." The shell-bearing Gastropoda ("snails" in the wide sense) are a very large class of animals, embracing some 40,000 living and extinct species, with a world-wide distribution.

Perhaps the most striking feature in the structure of snails is their shell. In the majority this is spiral and consists of several whorls which have a right-handed (dextral) coil. A left-handed (sinistral) coil is found in certain forms, either as an occasional variation of normally dextral forms (*Limnaea pereger* and *Neptunea antiqua*) or as a fixed generic characteristic (*Physa, Clausilia*). Sometimes the shell is cup-shaped (*Patella*, the common limpet), tubular (*Coecum*) or plate-like (*Scutum*). In many land and marine Gastropods it becomes internal and degenerate or is eventually lost entirely, and a slug-like form is attained. The land snails belong, with some exceptions, to the order Pulmonata and a very large proportion of them are placed in the family *Helicidae,* which is one of the largest groups of land invertebrates. They are mainly animals of retiring habits living on green plants or on decaying vegetable debris, though a few (e.g., *Glandina, Streptaxis*) are carnivorous. As a rule, they are more frequently found upon calcareous soils and are certainly rare on "acid" formations. They usually live during the daytime buried out of sight under leaves and, as a certain amount of moisture is necessary for their well-being, they aestivate in hot and sunny weather in crevices or under ground, from which protection they emerge at night or during rain.

Including the "snail-slugs" (*Testacella*), there may be said to be 125 species of land and fresh, or brackish, water snails in the British Isles. The largest family (indeed, the largest in the phylum Mollusca) is the *Helicidae,* of which there are 22 species in Great Britain. Among the commonest forms are *Helix aspersa,* the common or speckled snail, *Cepea nemoralis* and *hortensis,* the wood and garden snails and *Limnaea peregra,* the common pond snail. Certain species (e.g., *Belgrandia marginata*), which are still living in continental Europe, are found in a fossil state in the British Isles. *Paludestrina jenkinsi,* the only mollusc at present known to reproduce itself parthenogenetically (without fertilization), is found very plentifully in Great Britain.

In North America there are very numerous species of freshwater and land snails. Among representatives of the former group are some 65 species of *Limnaea* and 25 species of *Planorbis*. Of the land snails important families are the *Pupillidae,* with 50 species; the *Zonitidae,* with 65 species; and the exceedingly numerous *Helicidae,* of which the exclusively American genus *Polygyra* alone contains 125 species. (Concerning the use of snails by man, *see* GASTROPODA.)

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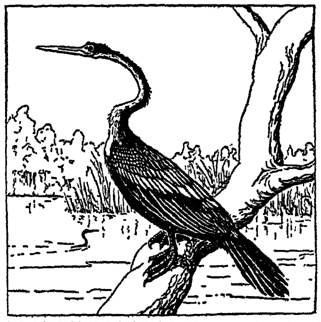
SNAKE-BIRD, or DARTER (*Anhinga anhinga*), a bird belonging to the same order as the cormorants (*q.v.*), to which they bear a resemblance both outwardly and in habits. They are, however, more slender in form and have neck and tail elongated. The pointed bill has its edges beset with backwardly-directed "teeth."

The male of the American species, which is often called the water-turkey, has a black plumage, glossed with green, with a white line on the neck and the bare skin of the head both green and orange, and white patches on the wings and tail. The bird haunts large rivers and lakes, frequently perching on overhanging branches or snags. It feeds on fish, which it chases and spears with its dagger-like bill, its agility under water is amazing. It often swims with only its head above water. The bird has been observed to play at catch with small twigs. The nest is built in a tree close to the water and is a large structure of sticks. The four eggs have white, chalky shells. Other species occur in Africa, Asia and Australia. All are characterised by the structure of the neck; the first seven neck vertebrae form a curve with its concavity forward; but the eighth articulates with the seventh nearly at right angles; the ninth is directed abruptly downwards and the rest form a gentle forward convexity. This mechanism permits great flexibility.



BY COURTESY OF THE ZOOLOGICAL SOCIETY OF LONDON
THE INDIAN SNAKE BIRD (PLOTUS ANHINGA)

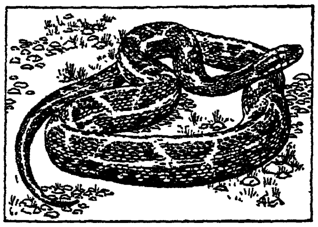
SNAKE-FLY, the name given to neuropterous insects of the genus *Raphidia,* closely allied to the alder-flies, remarkable for the elongation of the head and prothorax to form a neck and for the presence in the female of a long ovipositor. The larva is active, carnivorous, and terrestrial, and lives under loose bark of various trees. These insects are widely distributed, four species occuring in Britain.

SNAKE-ROOT. In most countries where snakes abound some root or herb is used by the natives as an antidote for the bites of venomous species, and many herbs have consequently received the name of snake-root. Botanically speaking, the name properly belongs to *Ophiorrhiza Mungos,* the Mungoose plant, a plant of the family Rubiaceae, used in the E. Indies for the purpose above indicated. In medicine, however, the roots of *Aristolochia Serpentaria, Polygala Senega* and *Cimicifuga racemosa* were understood by this name, being distinguished as the Virginian, seneca and black snake-roots. The root of *Aristolochia reticulata* is known in the United States as Red river or Texan snake-root.

The roots or rhizome of *Liatris spicata, Eryngium aquaticum* and *Eupatorium altissimum* have all been used in N. America for snake-bites, the first two being known as button snake-root and the last as white snake-root. The rhizome of *Asarum canadense* passes under the name of Canadian snake-root. All of these contain acrid or aromatic principles which, when a warm decoction of the drug is taken, exercise a powerfully diaphoretic or, in some cases, diuretic action, to which the benefit, if any, derived from their use must be attributed.

SNAKES, an order (*Ophidia*) in the class of REPTILES (*q.v.*). They are elongate animals without limbs, or with but claw-like rudiments of the hinder pair; without eyelids or external ears, with pointed re-curved teeth fused to the supporting bones, with a forked slender tongue which can be withdrawn into a sheath at its base, and, as a rule, with the two halves of the lower jaw not fused but joined by an elastic ligament. Like the lizards, with which they have many affinities, they are one of the dominant groups of reptiles of the present day and at least 2,000 different species are known. Their distribution is cosmopolitan with the exception of New Zealand, Ireland and some of the more recent, completely isolated, oceanic islands such as the Azores; as in other groups of terrestrial, cold-blooded animals the area of permanently frozen subsoil limits their northern and southern range and the greatest profusion of species and individuals is to be found in the tropics.

In the loss of limbs and the absence of well-differentiated neck, body and tail they may be regarded as degenerate and, by analogy with certain groups of limbless lizards, it seems probable that this type of bodily form arose in correlation with a habitat amongst dense vegetation; under these conditions limbs do not appear to be such efficient organs of locomotion as the lateral undulations which form the basis of serpentiform locomotion. Contrary to the idea expressed in the conventional representations of snakes, the body is not undulated vertically but laterally, and locomotion is effected by the passage of a series of "waves" from before backwards, each wave in its progress pressing against the surrounding medium and forcing the animal forwards. Such a system is efficacious only when the surrounding medium is sufficiently dense to offer an appreciable resistance to the passage of the waves and the majority of terrestrial snakes possess an additional mechanism. The scales of the lower surface are enlarged to form transverse, overlapping plates, whose free edge is directed backwards, and to each of these plates is attached a pair of movable ribs. When the ribs are moved forwards they carry the scute with them, and as this is smooth and has its leading edge protected by the one in front of it, it slips easily over any irregularities of the surface. But, when the scute is moved backwards its free, hinder edge catches on the slightest projection and so enables the snake to push itself forward. As there may be as many as 300 of these ventral shields, each of which can utilise any slight irregularity, progress is possible over almost any surface which is not absolutely smooth.



THE FER-DE-LANCE OF THE WEST INDIES AND SOUTH AMERICA

Probably also correlated with the ancestral habitat is the development of a hard transparent covering over the eye to protect the delicate cornea; in many lizards a transparent covering is developed from the lower eyelid, but in snakes the analogous covering is probably the modified nictitating membrane. In most snakes the outer horny covering of the scales is shed in one piece; sloughing commences at the lips and by vigorous rubbing movements the slough is turned back on itself and the animal works its way out, the old skin being turned inside out in the process. Though the sense of sight is well-developed, hearing must be of a different nature from that of most vertebrates, as there is no external ear or ear-drum; the *columella auris*, which normally transmits vibrations from the ear-drum to the inner ear, in snakes rests with its outer end on the quadrate, the bone which supports the lower jaw; possibly the ear is sensitive, not to air-borne vibrations, but to vibrations transmitted through the substratum on which the animal rests. The sense of smell is well-developed but a snake's most important sensory organ is its tongue; exactly what sense is centred here is not known, but the constant play of this organ makes it evident that the sensations which it registers are of paramount importance in determining the animal's reactions to external conditions.

Practically all snakes are carnivorous and the prey, which under natural conditions must be captured alive, is swallowed whole, the conical re-curved teeth and the divided lower jaw being adaptations to this method of feeding. The prey may be killed by poison or constriction or swallowed alive; it is worked round until the head is in the snake's mouth and then commences the laborious swallowing process. The bones supporting the lower jaw are movable on the skull so that the gape of the mouth is tremendous and this, assisted by the stretching of the elastic ligament between the halves of the lower jaw, permits the swallowing of masses of considerably greater diameter than the snake itself; the teeth of one side of the mouth are hooked into the victim and then, with this as a fulcrum, the other side is pushed forwards a short distance, the teeth engaged and the same action repeated with the opposite side. The hooked shape of the teeth permits of their being pushed forward but not easily drawn back, and in this way the snake literally draws itself over its food. Teeth are frequently broken off by the victim's struggles, but by the side of each functional tooth is a series of new teeth, in different stages of development, lying within a special fold of the lining of the mouth, the *vagina dentis;* as soon as a tooth is lost one of the successional series moves into its place and becomes fused to the jaw-bone. Teeth are also the means by which the venom of poisonous species is injected; these "poison fangs" are always situated in the upper jaw either at the front or the hind end and the channel for the venom is either a simple groove or a groove whose edges have met and so produced a tube with openings at the base and the tip of the fang. The venom itself is the product of a modified salivary gland and is a clear straw-coloured liquid containing certain poisonous proteins, the proportions in which each is present varying according to the type of snake. The two principal constituents are a "haemolytic" agent which breaks up the blood corpuscles and attacks the lining of the blood vessels and a "neurotoxic" agent which attacks the nerve centres, causing paralysis, and having a special affinity for the nerves supplying the respiratory apparatus; the predominance of one or other of these two bodies determines the nature of the symptoms of snake-bite. If neurotoxic agents predominate, paralysis, general prostration and difficulty in breathing are the most dangerous symptoms, but if the patient survives this stage, recovery is rapid and there are few severe local symptoms at the site of the bite; when, on the other hand, "haemolysins" are the principal constituents of the venom there is no paralysis, though there are severe constitutional symptoms and prostration, but even if this is not fatal, local symptoms follow with local extravasation of blood and much swelling of the bitten parts, which may suppurate and become gangrenous. The venom is destroyed by oxidising agents, such as potassium permanganate, silver nitrate and hypochlorites, and this characteristic is the basis on which first-aid treatment should be given. A ligature should be applied above the fang punctures and then a free incision made into the wounds which should, if possible, be washed out with a solution of bleaching powder or potassium permanganate. The ligature must not be kept on for more than half an hour at a time, being released for a few seconds occasionally to allow the circulation to return before it is re-applied. Administration of large quantities of stimulants is useless, but small repeated doses may be given if the patient is on the verge of collapse. Despite a large number of so-called "cures" there is only one reliable treatment for snake-bite, and that is by the use of "anti-venines" which are now manufactured in most countries where snake-bite is at all common. They are prepared by immunising horses against a particular venom by increasing, regulated doses; the blood serum of the horses is then sterilised and made up into doses ready for inoculation. It has not yet been found possible to prepare a serum which is really efficacious against the venoms of more than one or two snakes, so that, to ensure treatment with the correct anti-venine, an attempt should be made to identify the one responsible for the accident. Above all, the earlier an anti-venine is administered the better.

No snakes have a larynx or vocal chords and, in consequence, none have a true voice; they are all, however, capable of hissing and some of the larger, heavy-bodied species, with a large lung capacity, can do so loudly enough to be heard at some little distance; a few forms have a special piece of cartilage in front of the epiglottis and, when a blast of air is emitted, the vibration of this cartilage produces a sound which has been compared with that of a gently struck tuning fork. Rattlesnakes (*q.v.*) have a special sound-producing apparatus and some vipers can make a swishing noise by the movement of the scales one over the other.

The majority of snakes lay eggs; these are elongate with a parchment-like shell, and are usually deposited in a situation exposed to moist heat. In some groups, however, they are retained inside the body of the mother until the young are fully developed.

The various families, based largely on characters of the skull, may best be considered separately.

1. *Typhlopidae.*—Small, harmless, burrowing, worm-like snakes, with the eyes hidden beneath the scales of the head, with a very short, blunt tail, with small, shiny over-lapping scales, no enlarged scutes across the belly and with teeth only in the upper

jaw; inhabitants of almost all tropical countries. These snakes form burrows in loose soil, and to assist in this operation many have a short spine at the tip of the tail which is dug into the ground to obtain a purchase whilst the rounded head is thrust forward, or retracted, by a looping movement of the body; insect pupae and larvae, ants and earth-worms, seem to form the staple diet. The commonest colouring is brownish or flesh colour, but a few, for instance the common *T. punctatus* of tropical Africa, are irregularly marked with black and yellow.

2. *Leptotyphlopidae* (*Glauconiidae*).—Another family of blind, burrowing snakes very similar to the *Typhlopidae* from which they differ in having teeth in the lower, but not in the upper jaw; they are found in Africa, south-western Asia and America. The usual colours are browns or blacks but in *Leptotyphlops albifrons,* the common species of tropical America and the lesser Antilles, the forehead and tip of the tail are white. As the head and tail are also similar in shape, the colouring may be of the "directive mark" type designed, apparently, to enhance the resemblance of the two for the confusion of any would-be attacker.

3. *Ilysidae.*—Harmless burrowing snakes, without any distinct neck but with the cylindrical body tapering slightly at either end, with a pair of claw-like vestiges of hind limbs visible on either side of the vent and with slightly enlarged scales on the belly; teeth are present in both jaws. The few members of this family are larger than most burrowing snakes, attaining a size of 2½ to 3 ft.; they seldom appear above ground but take readily to water, and their food seems to consist principally of other snakes and eels, all, so far as is known, are ovoviviparous. *Ilysia scytale,* of tropical South America, coloured a beautiful coral-red with more or less complete black rings, superficially resembles some true coral snakes (*Micrurus*); as the latter are all venomous this is often regarded as an instance of mimicry. *Cylindrophis rufus* of Burma, the Malayan Region and the East Indies also exhibits what appears to be mimicry, but of a different kind; the upper surfaces are brown or black, with, as a rule, light cross-bars, the belly is white with transverse black bands, and the tail bright red beneath. When the snake is brought above ground the tail is bent sharply upwards exhibiting the brilliant lower surface and if the animal is touched the tail snaps round in the manner of a striking head. Precisely the same tail colour and actions occur also in another burrowing snake of the same regions, *Doliophis intestinalis,* but this animal is not only venomous but possesses the largest poison glands of any Elapine snake.

4. *Uropeltidae.*—Harmless burrowing snakes similar to those of the preceding family, but without any vestiges of hind limbs and with the tail ending in an enlarged scale which is either rugose or produced into two short points. The "earth-snakes" of Ceylon and the hills of southern India are all burrowers in loose earth in damp, forested regions and feed almost exclusively upon earth-worms; those whose breeding habits are known are all ovoviviparous.

5. *Xenopeltidae.*—This family contains but a single species, *Xenopeltis unicolor* of south-eastern Asia, a handsome snake with highly iridescent black or dark brown scales, each of which has a lighter edge; the head is small, not sharply marked off from the rest of the body and covered with enlarged shields; there are no traces of hind limbs, teeth are present in both jaws, the tail is short and the belly is covered with transversely enlarged scutes; total length about 3 feet.

6. *Boidae.*—Non-poisonous, often large, snakes with claw-like rudiments of hind-limbs visible on either side of the vent, enlarged scutes on the belly and teeth in both jaws. This family, which is represented throughout the tropical and sub-tropical regions of the world, is sub-divided into two groups, the Pythons, which are most numerous in the Old World, and the true Boas, whose headquarters are in tropical America with only a few scattered forms in other parts of the globe. These two subdivisions are not recognisable by any external characters, the *Pythoninae* only differing from the *Boinae* by the presence of an extra bone (the supraorbital) in the skull.

(a) *Pythoninae: see* PYTHON.

(b) *Boinae.*—The majority of Boas are arboreal or semi-arboreal, and correlated with this habit the tail is usually more or less prehensile; all kill their prey (chiefly small mammals and birds) by constriction, and all those whose breeding habits are known are ovoviviparous, in contrast with the Pythons which usually lay eggs. Though the name "Boa Constrictor" is frequently used to designate any large snake it is only strictly applicable to a single South American species, *Constrictor constrictor,* which is not particularly large, attaining a total length of only about 11 feet. The genus *Boa* contains a number of species in tropical America, including the West Indies, and two in Madagascar; *Corallus,* another very similar genus, has a similar distribution. The largest species is the Anaconda (*Eunectes murinus*), which inhabits the forests of the Amazon basin and is said to reach a length of 30 ft., though actually, specimens of even 25 ft. seem to be very rare. The animal is largely aquatic and is usually found along the banks of rivers or in swampy regions; it is dark green in colour with numerous, sharply defined, round, black spots and is highly iridescent. In the Old World, *Enygrus* occurs in the islands around New Guinea and on those of Polynesia as far east as Fiji; all the species have prehensile tails. *Eryx,* with about seven species, is an assemblage of small, sand-loving forms in north Africa, south-east Europe and south-west Asia; none of them greatly exceed 3 ft. in length and all have small heads, merging imperceptibly into their bodies, and short, scarcely prehensile tails.

7. *Colubridae.*—This family comprises the great majority of snakes and its members show great diversity of habits and adaptations. In the restricted sense in which the name is here used the family may be defined as follows:—typical snakes, without any rudiments of limbs, with the head usually covered by enlarged scales, with enlarged ventral scutes, with teeth in both jaws and poison fangs, if present, situated on the hinder end of the upper jaw and preceded by smaller, solid teeth; distributed over all the temperate and tropical regions. Every kind of terrain is tenanted, from dense tropical forests to deserts and high mountains, and so uniform are the modifications connected with their different habits that, from its appearance, alone it is possible to draw a fairly safe conclusion as to a snake's mode of life. Burrowing forms are invariably small with relatively short tails, with small heads merging imperceptibly into the body and with greatly reduced eyes; desert dwellers are usually rough-scaled, with pallid or sombre colouring; terrestrial species have cylindrical bodies, a distinct neck and moderately long tails; arboreal snakes are greatly elongate with whip-like tails, long, pointed snouts, very large eyes and a more or less compressed body; thoroughly aquatic forms have the nostrils on the top of the snout and fitted with valves which can be closed while the animal is under water and, as a rule, the enlarged ventral scutes, so necessary for locomotion on land, are reduced. Two groups of Colubrids can be recognised thus:—

Aglypha, without any grooved teeth.

Opisthoglypha, with one or two enlarged, grooved, poison fangs at the rear of the upper jaw.

These two groups, the one harmless, the other venomous, but, on account of the position of the poison fangs, rarely dangerous to man, almost grade into one another, a few species being known in which the posterior teeth are only slightly enlarged and sometimes grooved and sometimes not; they also show a curious parallelism. The *Aglypha* are again sub-divisible into four "sub-families."

(a) *Dipsadinae.*—Arboreal forms with the anterior teeth in both jaws enlarged and without a groove beneath the chin. This groove, present in almost all other colubrids, is part of the mechanism which allows of the two halves of the lower jaw being pushed apart in swallowing bulky objects and its absence in the Dipsads is connected with the feeding habits of the group; they appear to feed exclusively on slugs. *Amblycephalus* and *Haplopeltura* occur in south-east Asia and the Malay Archipelago and *Dipsas* and its allies are confined to Central and tropical South America.

(b) *Acrochordinae.*—Aquatic snakes with valvular nostrils on the upper surface of the snout; they are heavy-bodied animals

frequenting fresh-waters and estuaries in south-east Asia and Central America, and feeding on fish. In a few the enlarged ventral scales are scarcely distinguishable and the common Indo-Malayan *Chersydrus* has the body laterally compressed and equipped with a fold along the lower surface; this fold, simulating a median fin, the compressed body and the absence of ventral shields bespeak an existence spent wholly in water. The less specialised forms with cylindrical bodies and retaining the ventral scutes are still capable of rapid movement on land.

(c) *Dasypeltinae* (*Rhaciodontinae*).—Terrestrial snakes with only a few small teeth but with downwardly directed projections, which penetrate the oesophagus, on some of the vertebrae of the neck; a few species only, in tropical and South Africa. These snakes are highly modified egg-eaters; the mouth is enormously distensible and the egg is swallowed whole; when, however, it comes in contact with the vertebral processes in the throat its progress is arrested, and by compression of the muscles of the neck, and backward and forward sawing motions, the shell is cut through and collapses; the contents of the egg run down into the stomach and the shell is rejected.

(d) *Colubrinae*.—Typical snakes, with well-developed teeth in both jaws, with a dental groove and with, as a rule, lateral nostrils. This sub-family is cosmopolitan and its members may be more or less aquatic, arboreal, terrestrial or cryptozoic; as a rule they are oviparous, but some produce fully developed young. Perhaps the most thoroughly aquatic species is *Glypholycus bicolor* which inhabits Lake Tanganyika and in the general shape and the position of the nostrils superficially resembles the *Acrochordinae*. The common English Grass snake (*Natrix natrix*) is a member of a widely distributed genus whose members, though not strictly aquatic, are water loving and whose food consists principally of frogs and fish; *N. natrix*, widely distributed through northern Europe, is very variable in colour, but is usually a greyish-green with some black markings on the back, traces of an incomplete yellow or orange collar on the neck and chequered black and white beneath; it frequents damp and marshy localities and feeds principally on frogs. Its European relative *N. viperinus*, very common in Spain and Portugal, is more aquatic still and feeds almost exclusively on fish, and the Indian Keel Backs (*N. piscator*) and the North American Moccasins (*N. fasciatus*) have similar habits. Allied to *Natrix* are the N. American Garter snakes (*Thamnophis*), a group of likewise semi-aquatic species. The strictly terrestrial genera, very numerous throughout most of the world except the Australian region, feed chiefly on small mammals, birds, toads and lizards. The Rat snakes or Racers of Europe and N. America (*Coluber*) the Chicken snakes (*Elaphe*) and the Indian Rat snakes (*Ptyas*) are all externally of very similar build and either kill their prey by constriction or eat it alive. *Coronella*, another similar genus, is represented in Britain by the Smooth snake (*C. austriaca*), a species frequently confused with the viper but readily distinguished by its smooth scales and the enlarged plates on the top of the head; the species of this genus feed largely upon lizards, and the distribution of the Smooth snake in England corresponds exactly with that of the Sand lizard. Other terrestrial genera with specialised feeding habits are the King snakes (*Lampropeltis*) of N. America, and the African *Lycophidion*. The species of the first-mentioned genus live almost exclusively on other snakes, poisonous or harmless, the victim being killed by constriction; some "mimic" Coral snakes in their colour pattern which consists of broad reddish bands edged with black and separated by narrower yellowish or buff interspaces. *Lycophidion* is characterised by enlarged teeth on the front of both jaws, the "canine" teeth being also directed outwards, and this is probably an adaptation to enable them to hold the smooth, hard-scaled skinks which form their principal diet. The American Hog-nosed snakes (*Heterodon*) are remarkable for their superficial similarity to vipers, due to the broad, flat head and stout body; if annoyed they puff themselves up and hiss in true viperine manner, but if this fails to intimidate the enemy they roll over on their backs and "sham dead." Tree-snakes are greatly elongate, slender creatures and are represented by such genera as *Dendrophis* of south-east Asia and Australia and *Leptophis* of South America; they feed principally on lizards and young birds.

Opisthoglypha.—The back-fanged snakes are divisible into three sub-families which exactly parallel the last three divisions of the preceding group.

(a) *Homalopsinae Aquatic* snakes with valvular nostrils situated on the top of the snout, and often with the ventral scales much reduced. They are confined to the fresh waters and estuaries of south-east Asia, Papua and North Australia and are all ovoviviparous.

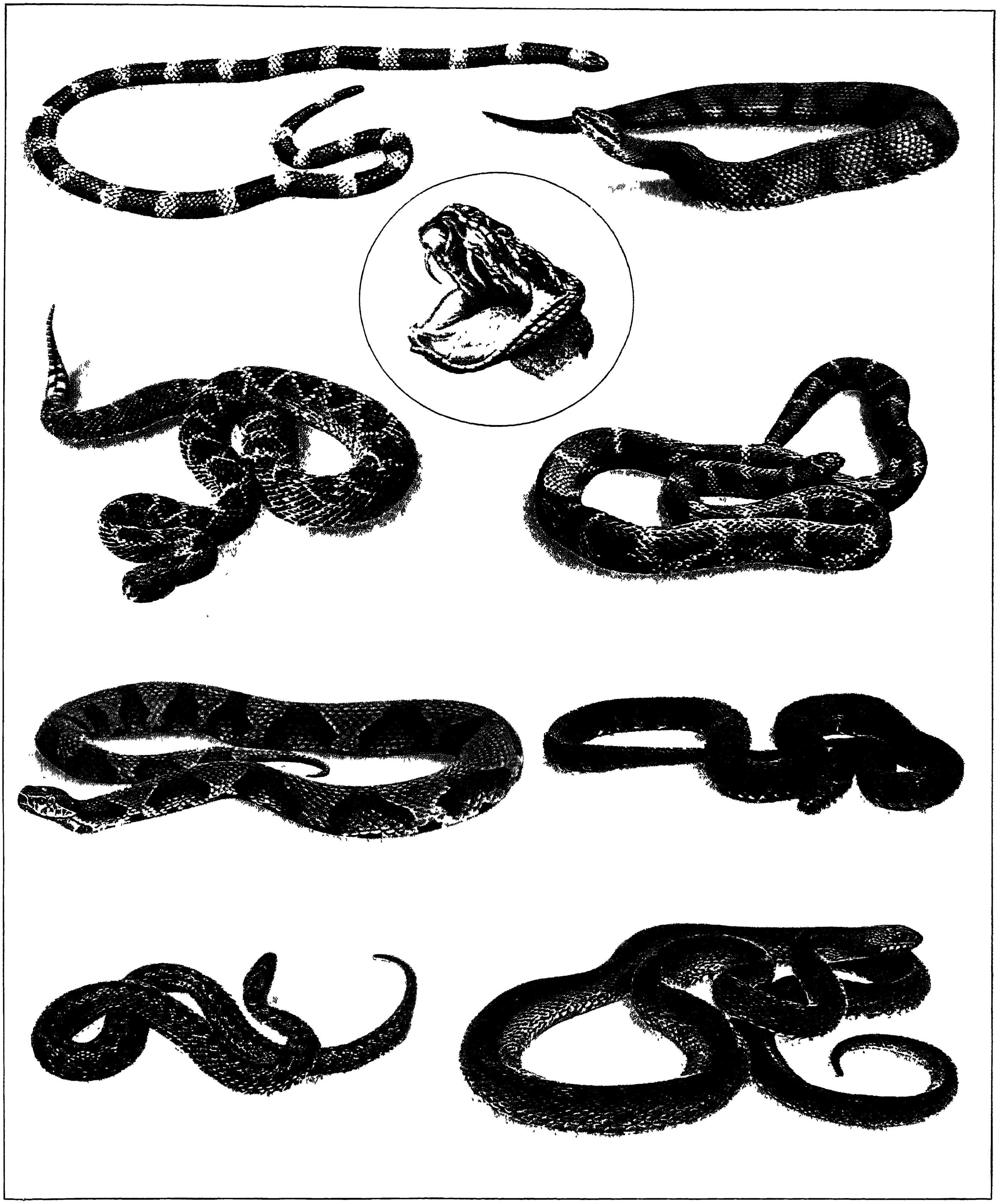
(b) *Elachistodontinae*.—The single snake of this sub-family, known only from a few specimens from Bengal, is the exact Opisthoglyphous analogue of the Aglyphous *Dasypeltis;* it is an egg-eater, with reduced dentition and with vertebral processes penetrating the oesophagus.

(c) *Boiginae* (*Dipsadomorphinae*).—This sub-family parallels the Colubrinae; its members are cosmopolitan and adapted to the same types of habitats, though in this group arboreal forms predominate. Among these may be mentioned a few which are remarkable for their habits or appearance; the slender, bodily form and elongate head is exaggerated in some, such as *Dryophis mycterizans* of the Indian Region or *Langaha* of Madagascar, by the production of the tip of the snout into a pointed or leaf-like dermal appendage. Many of these tree-snakes are brilliantly green to match the foliage, others brown to harmonise with the branches, but some show brilliant colour patterns which, though conspicuous when removed from their natural surroundings, are almost invisible in the dappled light and shade of the bushes which the animals frequent. *Chrysopelea ornata* of India and Malaya is often black with yellow dots on the centre of each scale and a series of red-centred yellow, tetra-petalous flowers along the back. This species is also famous as the Flying snake, a name it has earned by its ability to "glide" to a limited extent; to accomplish this feat the body is held straight and rigid, the ribs pushed outwards to their full extent and the belly drawn in so that a considerable concave surface is produced which checks the fall of the animal and enables it, in an emergency, to descend with safety from a considerable height. Some members of the group, for instance the Boomslang (*Dispholidus typus*) of South Africa, have the peculiar habit of expanding the neck to form a vertical "hood" when annoyed. Unlike the horizontal hood of the cobras, which is produced by an outward pressure of the ribs, this vertical "hood" is brought about by inflation of the wind-pipe. In snakes the cartilaginous rings of the trachea are incomplete along the side nearest the backbone, and a strip of tissue between their free ends is very distensible, so that, when air from the lungs is forced into the wind-pipe, this elastic tissue stretches and the neck is inflated.

Terrestrial genera are represented in Europe by *Coelopeltis*, one of the largest snakes of the continent, in the Mediterranean countries. *Erythrolamprus aesculapii* of Tropical America is a very variable species whose many colour varieties mimic Coral snakes; sometimes the groove, on the fangs may be absent. Africa has many terrestrial forms, of which the commonest are the Sand snakes (*Psammophis*), and also several burrowing genera, e.g., *Miodon* of West Africa and *Aparallactus* from the east and south. Some burrowing forms, notably *Apostolepis* in South America, exhibit "directive mark" coloration; the body is yellow, sometimes with longitudinal black stripes, and the head and stumpy tail are black with a few lighter dots, so that the similarity of the two ends is remarkable.

Only a few Opisthoglyphs can be considered as dangerous to man; the situation of the fangs renders it difficult for any but the very large species to bring them into play except on the smallest objects. Should, however, a wound be inflicted by one of the larger species, such as the Boomslang, the consequences are apt to be dangerous; the venom is largely haemolytic in its action and resembles that of the vipers rather than that of the cobras and their allies.

8. *Micruridae* (*Elapidae*).—Sometimes regarded as Colubrids, these snakes are "proteroglyphous," *i.e.*, have fixed poison fangs in the front of the upper jaw and they always have well-developed ventral shields. Apart from the Cobras (*q.v.*), this family con-



COURTESY, N. Y. ZOOL SOCIETY, FROM PHOTOGRAPHS COLOURED UNDER THE DIRECTION OF R. L. DITMARS

SNAKES

There are more than 2,000 kinds of snakes. Some 600 are more or less venomous, but only a comparatively small number are fatally poisonous to man. The illustration shows the European viper, the only poisonous serpent found in Great Britain, together with five highly venomous snakes, marked *Ven.* and three large but harmless snakes found in North America

Top, left: Coral Snake (*Micrurus fulvius*), *Ven.* Top, right: Water Moccasin (*Agkistrodon piscivorus*), *Ven.* Top, centre: Head of Diamond-back Rattlesnake (*Crotalus adamanteus*), *Ven.* Second row: left, Texas Rattlesnake (*Crotalus atrox*), *Ven.*; right, King Snake (*Lampropeltis getulus*). Third row: left, Copperhead (*Agkistrodon mokasen*), *Ven.*; right, Water Snake (*Natrix sipedon*). Bottom; left, European Viper (*Vipera berus*); right, Bull Snake (*Pituophis sayi*)

tains other genera in the same regions, the true Coral snakes of Central and South America and a number of forms in Australia. Some of the best known of the latter are the Black snake (*Pseudechis*), which reaches a length of 6 ft. and can erect a small cobra-like hood, the Tiger snake (*Notechis*) and the Death Adder (*Acanthophis*); the latter has acquired its appellation of "Adder," which usually means viper, on account of its broad, flat head, which lacks the large shields of the other Micruridae, and its thick-set body. In the Indian region, the larger species are the Kraits (*Bungarus*) whose bite, though not so deadly as that of the Cobras, is responsible for a heavy mortality annually. The dreaded Mamba (*Dendraspis angusticeps*) of tropical and South Africa also belongs to this family, and is one of the few arboreal species in it. Two varieties are commonly recognised, a black, which is really a dark olive, and a green, and as no very small black ones have ever been recorded and the green variety is usually the smaller of the two, it seems probable that the "varieties" are growth stages of the one species; the green phase is almost entirely arboreal but the black is frequently terrestrial. The Coral snakes (*Micrurus* or *Elaps*) are the only representatives of this family in America; they are distributed all over the hotter parts of that continent and are largely burrowing and cryptozoic forms. *Doliophis*, another genus of burrowing animals from the Malayan region, is remarkable for the enormous development of the poison glands, which extend over the anterior third of the body, and for its habit, when annoyed, of raising the tail to show the red colour of its lower surface.

The larger snakes of this family are all highly dangerous to man; the venom is chiefly neurotoxic in its action, as compared with the more haemolytic venom of the back-fanged Colubrids and Vipers.

9. *Hydrophiidae.*—Sea-snakes. Elapids adapted to aquatic life, with valvular nostrils on the top of the snout, vertically flattened tails and the ventral shields greatly reduced or entirely absent; all produce their young fully developed. The snakes of this family, some 55 all told, are divided into two sub-families, the one (*Laticaudinae*) Australian in origin, the other (*Hydrophiidae*) Indo-Malayan; they are found throughout the tropical waters of the Indian and Pacific Oceans, but not in the Atlantic, and, though many are admirably adapted for aquatic life, and indeed are quite helpless on land, they chiefly frequent inshore waters and are most numerous around the coasts of the Indian region and along the chain of islands to north Australia; all are venomous, though the majority are very docile. The majority do not exceed four feet in length but a few reach a length of eight feet or more and many are of great girth, the greatest diameter being in the posterior half of the body, which gradually tapers towards the head; colours, as a rule, are indistinct transverse bands of darker and lighter but the most widely distributed species *Pelamis platurus*, which ranges from the east coast of Africa to the west coast of America, is uniformly black above and yellowish or brown beneath, the two colours being sharply defined in a straight line along the sides but forming vertical bars or spots on the tail.

10. *Viperidae.*—Vipers and rattlesnakes are characterized by the possession of poison fangs situated on the front of an upper jaw which is movable so that the teeth, when not in use, can be folded down parallel with the roof of the mouth; cosmopolitan except the Australian region and Madagascar. As a rule the members of this family are stoutly built, with flattened heads which lack the large plates so characteristic of the majority of the other poisonous snakes. For further details *see* VIPER. (H. W. P.)

SNAPDRAGON or **ANTIRRHINUM,** a plant of the family Scrophulariaceae (*q.v.*), native to central and south Europe, occurring as an alien on old walls in Great Britain and sparingly naturalized in eastern North America. It is an old-fashioned garden perennial of easy cultivation. *Antirrhinum majus*, sown in heat, and forwarded until the general time for planting out, becomes a summer annual, and may be so treated; but under a slower and more hardy régime it may be sown in boxes in August, and pricked off into other boxes and wintered in a frame. So treated, and planted out in well-prepared beds of good garden soil, it is very showy and effective. The genus contains some 40 species, all herbs native to the northern hemisphere, but especially numerous in western North America, 13 species occurring in California, all herbaceous, except *A. speciosum*, an evergreen shrub, 3 to 8 ft. high, with scarlet flowers, found on Santa Catalina and San Clemente islands.

SNEEK, a town in the province of Friesland, Holland, to the west of Sneek lake, 14 m. by rail S.S.W. of Leeuwarden, with which it is also connected by canal. Pop. (1927), 14,527. One of the former city gates (1615) remains, and in one of the churches is the tomb of the naval hero of the 16th century, Lange, or Groote Pier (Long or Great Peter). Sneek is one of the great butter and cheese markets of the province. Its horse-fair is widely attended.

SNEEZING, a violent expiration of air from the nose and mouth; it is an involuntary reflex respiratory act, caused by irritation of the nerve-endings of the mucous membrane of the nose or by stimulation of the optic nerve by a bright light. The irritation may be due to the swelling of the nasal mucous membrane, sneezing often accompanying nasal catarrh, or to foreign bodies in the nose, as by inhalation of snuff. A venerable and widespread belief survives in the custom of saying "God bless you" when a person sneezes. The Hindus say "live," to which the answer "with you" is given (E. B. Tylor, *Primitive Culture*, i. 101). A sneeze was considered a sign or omen from the gods by the Greeks and Romans.

SNELL, HANNAH (1723–1792), the "female soldier," was born at Worcester on April 23, 1723, being the daughter of a hosier. In order to seek her husband, who had ill-treated and abandoned her, in 1745, she donned man's attire and enlisted as a soldier in Guise's regiment of foot, but soon deserted; she then shipped on board the sloop "Swallow" and took part in the siege of Pondicherry and was wounded. She served before the mast on the "Tartar" and the "Eltham," but when paid off she resumed woman's costume. Her adventures were published as *The Female Soldier, or the Surprising Adventures of Hannah Snell* (1750). She died insane in Bethlehem Hospital on Feb. 8, 1792.

SNELL, WILLEBRORD (1591–1626), commonly known as SNELLIUS, Dutch astronomer and mathematician, was born at Leyden in 1591. In 1613 he succeeded his father Rudolph Snell (1546–1613) as professor of mathematics in the university of Leyden. In his *Eratosthenes Batavus* (1617), he describes his method of measuring the earth, and gives as the result of his operations between Alkmaar and Bergen-op-Zoom a degree of the meridian equal to 55,100 toises (=117,449 yd.). Snell is known as the discoverer of the law of refraction (1621). (*See* LIGHT.) He died at Leyden on Oct. 30, 1626.

SNIPE, one of the commonest wading birds, in high repute both with the sportsman and epicure. The common snipe (*Capella gallinago*) breeds in marshes all over Europe and northern Asia, moving south in hard weather. It feeds upon worms, etc. which it obtains by probing the ground with its long bill. In this connection the tip of the latter is flexible and very sensitive. When disturbed, the snipe rises suddenly with a curious twisting flight and a sharp cry, soon settling down, however, to swift straight flying. During the breeding season, the male circles at a considerable height, uttering a sustained cry and plunging down a few feet from time to time, thus producing a bleating sound by the vibration of the outer tail feathers. Snipe have also been known to swoop down from a great height and then skim along horizontally for some distance back downwards. The nest is on the ground, and is a deep hollow lined with dry grass. The striped plumage blends beautifully with the surrounding rushes and grasses. The four eggs are dark olive in colour, while the young are clad in protectively coloured down. Both male and female may sit on the nest together. In North America, Wilson's Snipe, *C. delicata*, differs only from the Old World form in possessing 16 instead of 14 rectrices in the tail.

The Double Snipe (*C. media*) is larger, and much less common. It inhabits northern Europe. The Jack or Half-Snipe (*Lymnocryptes minimus*) is the smallest and most beautiful of the group. It breeds in northern Scandinavia and Russia.

The painted snipes (*Rhynchaea*) of the southern hemisphere

are interesting in that the female is larger and more brightly coloured than the male, who undertakes the incubation.

SNOILSKY, CARL JOHAN GUSTAF, COUNT (1841–1903), Swedish poet, was born at Stockholm on Sept. 8, 1841. He was trained for diplomacy, which he quitted for work at the Swedish Foreign Office. In 1862 he published *Orchideer*. During 1864–65 he was in Madrid and Paris on diplomatic missions. In 1869 he first collected his *Dikter* under his own name. His *Sonneter* in 1871 increased his reputation. Then, for some years, Snoilsky abandoned poetry, and devoted himself to the work of the Foreign Office and to the study of numismatics. In 1876, however, he published a translation of the ballads of Goethe. Snoilsky had in 1876 been appointed keeper of the records, and a member of the Swedish Academy. But in 1879 he resigned, and left for Florence with the Baroness Ruuth-Piper, whom he married in 1880. His later volumes are four other volumes of *Poems* (1881–83–87–97); *Savonarola*, a poem, in 1883, and *Hvita frun* ("The White Lady") in 1885. In 1886 he collected his poems dealing with national subjects as *Svenska bilder* (2nd ed., 1895), In 1891 he returned to Stockholm, and was appointed librarian of the Royal Library. He died at Stockholm on May 19, 1903.

His *Samlade dikter* were collected (Stockholm, 5 vols.) in 1903–1904. *See* C. Warburg, *Carl Snoilsky, Hans lefnad och skaldscap* (1905).

SNORRI, STURLASON (1179–1241), the celebrated Icelandic historian, the youngest son of a chief in the Vestfirðir (western fiords), was brought up by a powerful chief, Jon Loptsson, in Odda, who seems first to have awakened in him an interest for history and poetry. His career begins with his marriage, which made him a wealthy man; in 1206 he settled at Reykjaholt, where he constructed magnificent buildings and a bath of hewn stones, preserved to the present day, to which water was conducted from a neighbouring hot spring. He early made himself known as a poet, especially by glorifying the exploits of the contemporary Norse kings and earls; at the same time he was a learned lawyer, and from 1215 became the *lögsögumaðr*, or president of the legislative assembly and supreme court of Iceland. The prominent features of his character seem to have been cunning, ambition and avarice, combined with want of courage and aversion from effort. By royal invitation he went in 1218 to Norway, where he remained a long time with the young king Haakon and his tutor Earl Skuli. When, owing to disputes between Icelandic and Norwegian merchants, Skuli thought of a military expedition to Iceland, Snorri promised to make the inhabitants submit to Haakon of their own free will. Snorri himself became the *lendrmaðr*, vassal or baron, of the king of Norway, and held his lands as a fief under him. On his return home Snorri sent his son to the king as a hostage, and made peace between Norway and Iceland, but his power and influence were used more for his own enrichment and aggrandizement (he was *lögsögumaðr* again from 1222 to 1232) than for the advantage of the king. Haakon, therefore, stirred up strife between Snorri's kinsman Sturla and Snorri, who had to fly from Reykjaholt in 1236; and in 1237 he left the country and went back to Norway. Here he joined the party of Skuli, who was meditating a revolt. Learning that his cousin Sturla in Iceland had fallen in battle against Gissur, Snorri's son-in-law, Snorri, although expressly forbidden by his liege lord, returned to Iceland in 1239 and once more took possession of his property. Meanwhile, Haakon, who had vanquished Skuli in 1240, sent orders to Gissur to punish Snorri for his disobedience either by capturing him and sending him back to Norway or by putting him to death. Gissur took the latter course, attacked Snorri at his residence, Reykjaholt, and slew him on Sept. 22, 1241.

Snorri is the author of the great prose *Edda* (*see* EDDA), and of the *Heimskringla or Sagas of the Norwegian Kings*, a connected series of biographies of the kings of Norway down to Sverri in 1177. Snorri's sources were partly succinct histories of the realm, such as the chronological sketch of Ari; partly more voluminous early collections of traditions, as the *Noregs Konungatal* (*Fagrskinna*) and the Jarlasaga, partly legendary biographies of the two Olafs; and, in addition to these, studies and collections which he himself made during his journeys in Norway. His critical principles are explained in the preface, where he dwells on the necessity of starting as much as possible from trustworthy contemporary sources, or at least from those nearest to antiquity—the touch-stone by which verbal traditions can be tested being contemporary poems. He inclines to rationalism, rejecting the marvellous and recasting legends containing it in a more historical spirit; but he makes an exception in the accounts of the introduction of Christianity into Norway and of the national saint, St. Olaf. Besides his principal work, he elaborated in a separate form its better and larger part, the *History of St. Olaf* (the great *Olaf's Saga*). In the preface to this he gives a brief extract of the earlier history, and, as an appendix, a short account of St. Olaf's miracles after his death. (*See* further ICELAND: *Literature,* and EDDA.)

SNOUCK HURGRONJE CHRISTIAAN: *See* HURGRONJE, CHRISTIAAN SNOUCK.

SNOW, FRANCIS HUNTINGTON (1840–1908), an American scientist and educator, was born at Fitchburg, Mass., on June 29, 1840. He graduated at Williams college in 1862 (A.M., 1865; Ph.D., 1881) and at Andover Theological seminary in 1866. He was professor of mathematics in 1866–70, professor of natural science in 1870–89, chancellor in 1890–1901, and professor of entomology and meteorology in 1901–08, at the University of Kansas. On his numerous scientific expeditions to the South-west, he made the university's collections of insects, housed in the Snow hall of natural history, one of the largest in the United States. He died at Delafield, Wis., Sept. 21, 1908.

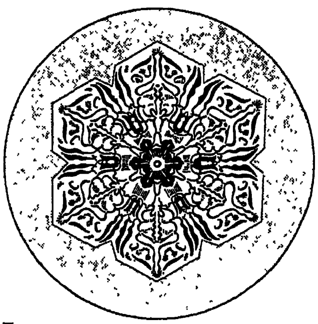


FIG. 1.—SOLID HEXAGONAL FORM OF SNOWFLAKE, HIGH CLOUD TYPE

SNOW, the water vapour in the air crystallized into geometrical forms. Snow forms usually within, below or between cloud strata, and at various heights within the atmosphere, according to the latitude and the temperature prevailing within the clouds. Snow forms in great quantities within lofty clouds in all latitudes. In the tropics, however, it melts into raindrops as it falls, except when it alights upon high mountains. Although most common to the polar region, it doubtless forms in even greater quantity within the north temperate regions, because the air contains much more moisture at lower latitudes than at the poles.

Over the polar regions and upon the tops of lofty mountains perpetual snow covers most of the land to a depth in most cases of many feet. On mountain or plateau regions therein, and on high mountains elsewhere, it accumulates to so great an extent and depth that the pressure of the upper masses converts it into ice, thus forming glaciers, which in the polar regions cover thousands of square miles. In the higher latitudes of the temperate regions it often accumulates to the depth of from one to four or more feet during the winter. It rarely falls in quantity or remains long on the ground on low lands below 30° of latitude. Owing to many causes, both topographical and meteorological, the amount of snowfall varies markedly upon mountain tops and other locations even when situated upon the same parallel degree of latitude. The limit of perpetual snow upon mountains approximates 1,000ft. at 70°; 5,000ft. at 60°; 7,000ft. at 50°; 10,000ft. at 40°; 13,000ft. at 30°; 15,000ft. at 20° and 17,000ft. at the equator.

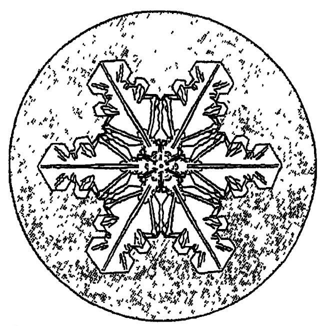


FIG. 2.—TABULAR FORM OF SNOWFLAKE, HIGH CLOUD TYPE

The crystalline varieties of snow are for the most part transparent, and have brilliant facets that reflect light and give them a white appearance in the mass. They vary in size from $\frac{1}{100}$ to

½ of an inch in diameter, and fall to earth either singly or bunched together into flakes. Flake formation occurs most commonly during the mild, moist snowfalls when the temperature at the ground is 32° or above. Their size depends both upon the temperature wherein they form and the depth of the cloud strata through which they fall or float. Intensely cold clouds are always relatively dry, hence tend to produce the smaller, slow growing and solid type of crystal. Conversely, warmer clouds (usually the lower clouds) contain much more moisture and tend to produce the larger, fast growing, branchy type of crystals. Water being a product of the joining of the two gases, hydrogen two parts, oxygen one part, its nuclear atoms have such an arrangement as to favour the formation of triangular or hexagonal forms and to divide into three or six.

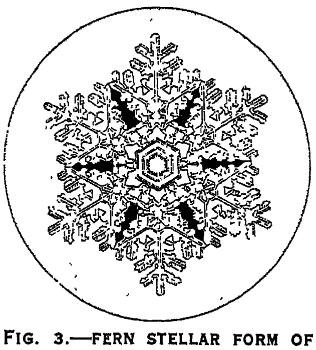


FIG. 3.—FERN STELLAR FORM OF SNOWFLAKE, LOW CLOUD TYPE

The great mass of the crystals of snow have forms whereby they can be roughly grouped into two main classes, columnar and tabular forms. Comprised in the columnar forms are hexagonal columns, both hemihedral and holohedral, and the long, slender, needle-like columns. Grouped in the tabular class are all those, whether solid or branching, that form on a thin, tabular plane. Among the rarer forms are the three or four vaned crystals, twin crystals, four-sided plates and compound forms. The latter consist of a hexagonal column having solid or branching tabular forms attached at one or both ends, and rarely also at the middle of the column. There are in addition many irregular snow forms, among them icy spicules growing outward at many angles from a granular nucleus, frost-like forms and forms due to twinning, etc. During extreme cold or snowfall from very lofty, cold clouds, tiny columns and solid hexagonal or triangular plates usually predominate.

The order of the types in furnishing the bulk of the snowfall is as follows: branching tabular forms, granular forms, plates with branching exteriors, plate forms, columns, needle forms, compound forms. The columnar and needle-like forms are, each in their respective classes, much alike, though they vary in size, length, thickness, etc. Compound crystals show much greater variation one from another, owing to the differences in the size, aspect, interior details, etc., of the end plates. Often the bar connecting the end plates is exceedingly short, resembling a tiny thick hexagonal plate. As a result, the end plates grow outward very close together. When one of the end plates is smaller than the opposite one, it converts the crystals into the semblance of tiny parachutes, and they fall with the smaller plate downward.

By far the most important, varied and beautiful snow crystals are those that comprise the tabular class. Crystals of this class assume delicate, starry, branching forms, solid plate forms and those exhibiting all gradations between the solid and wholly open forms. Rarely is it that any two of them are just alike. The beauty of outline and richness of interior of such crystals are so great as to have attracted the attention and admiration of all students of the snow from the earliest times to the present. They far transcend in beauty, diversity and perfect symmetry the crystals of any mineral species.

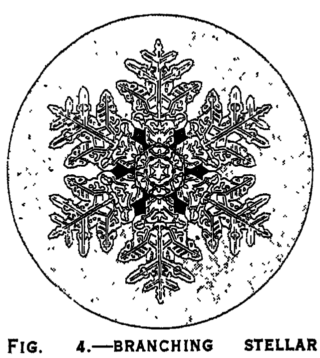


FIG. 4.—BRANCHING STELLAR FORM OF SNOWFLAKE, FROM MEDIUM HEIGHT CLOUDS

The conditions under which the snow crystals form is unique. They crystallize while floating about unsupported in a fluid, the air, of small and varying density. This permits the atoms and molecules of which snow, like all other crystals, is built a much greater freedom of movement while arranging themselves in crystal form than is possible when most crystals are formed. Often the air and clouds wherein they form are in a state of agitation, and vary within their different parts in density, temperature and water content. Sometimes snow crystallizes among a multitude of uncongealed fluid droplets, called cloud. Contrary to popular belief, however, the true crystals are not made of such, though they may collect and freeze upon them in a white opaque manner, or upon themselves to make granular snow, the "graupeln" of the Germans. True snow crystals are formed directly from the invisible and vastly smaller atoms and molecules of water floating between the cloud droplets. Among the many proofs of this, aside from general considerations, is the fact that scanty snowfalls frequently occur from clear skies.

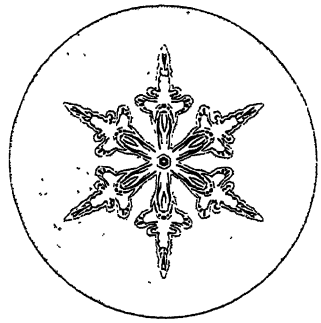


FIG. 5.—STAR FORM OF SNOWFLAKE, LOW CLOUD TYPE

As a result of various unfavourable conditions in cloudland, such as winds, overcrowding, the presence of fluid cloud droplets, etc., the majority of tabular snow crystals fail to attain their natural beauty and symmetry. The most wonderful forms seem to occur within the anterior quadrants of widespread general storms, or during snowfalls that occur between two closely lying storms. The formation of crystals may be determined by some law. It is likely that almost every cyclonic storm produces perfect forms somewhere within its anterior quadrants. There is doubtless a somewhat invariable rule of distribution of the various types of snow within cyclonic storms, columns, or columns and solid plates to one quadrant, granular forms to another, branching crystals to others, etc.

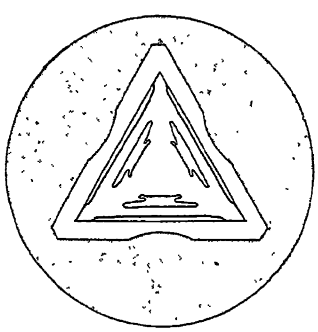


FIG. 6.—TRIANGULAR FORM OF SNOWFLAKE, HIGH CLOUD TYPE, FORMED IN ZERO WEATHER

The feature of chief beauty and interest about the tabular snow crystals, in addition to beauty of outline, is the richness of their interior designs. This richness of interior is due to the presence of minute air tubes and shadings therein, which appear dark when viewed under certain conditions. These interior air tubes and shadings frequently appear in the semblance of tiny rods, dots, lines, etc., often arranged in a marvellously symmetrical manner and outlining geometrical forms. They are caused as a result of the bridging over and inclusion of air as the branches, segments and various adornments grow and unite one to another. Because of this they outline more or less perfectly the various stages of growth and the transitional forms that the crystals assumed in cloudland. Their arrangement doubtless depends largely upon habits of growth. In case of branchy growth they are arranged for the most part at angles of 60° alongside the main and secondary rays. In cases of more solid growth they are often arranged with their greater dimensions in hexagonal order around the nucleus.

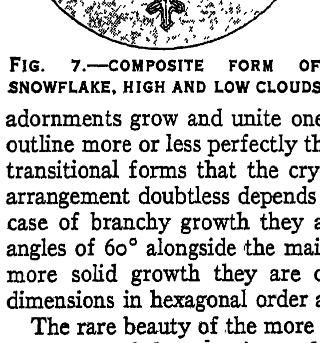


FIG. 7.—COMPOSITE FORM OF SNOWFLAKE, HIGH AND LOW CLOUDS

The rare beauty of the more perfect specimens of snow crystals has attracted the attention and excited the admiration of naturalists from quite early times. We find in the Bible, in the Book of Job, the query, "hast thou entered into the treasures of the snow?"

Many naturalists through the years have made attempts to draw them. During later times many observers, among them Dr. Scoresby and Dr. Glaisher of England, Prof. Squinabol of Italy, Mrs. Chickering of the United States and Dr. Dobrowolski of Poland, made excellent drawings of them. More recently the aid of photography has been employed to portray these evanescent forms. W. A. Bentley of Jericho, Vt., seems to have been the pioneer photomicrographer of snow crystals. Securing the first photomicrographs in 1885, he has continued the work up to the present, making 4,800 photomicrographs, no two alike. In 1903 and soon afterwards Dr. Neuhauss of Berlin, Dr. Nordenskiold of Sweden and Herr Sigson of Russia also made photomicrographs of crystals.

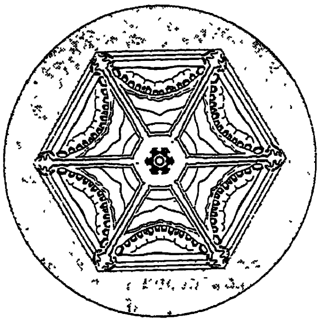


FIG. 8.—SOLID TABULAR FORM OF SNOWFLAKE, HIGH CLOUD TYPE

The formation and deposition of the snow, occurring over so large a portion of the earth's surface and in such enormous quantities as almost to defy computation, constitute a phenomenon of great magnitude and import. The snow forms one of the links in a natural system of continental irrigation, to make possible vegetal and animal life thereon. In winter it conserves the heat of the earth and protects vegetation. It has also served a useful purpose as an aid in transportation, as its icy mantle forms an excellent roadbed over which produce, etc., can be easily drawn in sleds. Snow when compacted and pressed into glacial ice or when melted and converted into streams, rivers, etc., also plays an important part in inland erosion, in the tearing down of mountains and the conversion of rocks into soil.

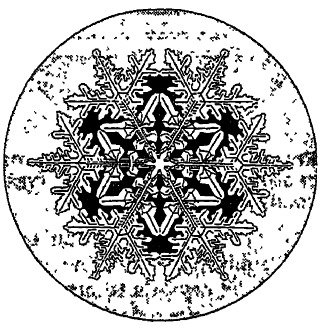


FIG. 9.—BRANCHING FORM OF SNOWFLAKE, MILD WEATHER TYPE

Yet, like the beneficent, life-giving rain, the snow sometimes becomes a destructive agent. The melting of the snows of winter sometimes produces disastrous floods which do great damage. A heavy fall of snow, if accompanied with severe winds, piles the snow into deep drifts along highways and railroads, thus delaying traffic. Not the least of the destructive effects of the snow is the breaking of trees, telephone poles, etc., by the weight of a damp, heavy fall of snow upon them. In mountain regions the snow sometimes accumulates so deeply upon the sides of mountains that great masses break off and descend as destructive avalanches into the valleys, doing great damage and sometimes burying and destroying whole villages. (W. A. BEN.)

SNOWDEN, PHILIP (1864–), British statesman, was born on July 18, 1864, at Cowling, Yorkshire. Educated at an elementary school, he read widely, and became a clerk in the customs and excise department of the Civil Service. Joining the Independent Labour Party in the year after it was founded (1893) he became one of its most effective speakers and, in 1903, and again in 1917 its chairman. He was a member of the I.L.P. for 34 years, but resigned his membership in Dec. 1927, giving as his reason his conviction that the body ought to be merged in the Labour Party and that its continued separate existence was neither desirable nor necessary. His first parliamentary attempts, for Keighley and Blackburn, failed, but, in 1906, he was returned for Blackburn as Labour M.P. In the House he at once made his mark, notably on financial matters. When war broke out in 1914 he was in Australia. On his return he at once ranged himself with J. R. MacDonald and shared much of the latter's unpopularity. Defeated in the 1918 election, he won Colne Valley for Labour in 1922, and held the seat with increased majorities in 1923 and 1924. His appointment as chancellor of the exchequer in MacDonald's cabinet was a matter of course.

In his budget, introduced in April 1924, while limited by the commitments of his predecessor, Snowden endeavoured to relieve the burden of taxation on the poor by his reduction in the food duties, and by making provision, in his contingent Old Age Pensions Act, for the removal of the oppressive features of the thrift disqualification. At the same time, he stood fast by his free trade principles and repealed the McKenna duties on imported motorcars, clocks, musical instruments, etc.; he also terminated the duties imposed under the 1922 Safeguarding of Industries Act. Later in the session he introduced plans of constructive work designed to relieve the prevalent unemployment. At the London conference in July–Aug. 1924, he took charge of the discussions with the bankers which ended in the successful flotation of the German loan in October of that year. Snowden became chancellor of the exchequer for the second time in June 1929.

Snowden's power, both in the Labour movement and outside, was due as much to gifts of character as of brain. As a speaker, he was equally powerful both as a private member in opposition and as a minister. Most of his life was spent in the service of Socialism; he was also a powerful advocate of the emancipation of women and of temperance. In the promotion of these causes, as in his work for peace and in his opposition to Communism, he was notably assisted by his wife, herself a speaker and writer of wide appeal. He was member of the Liquor Control Board during the War, and served on royal commissions on the civil service, canals and venereal disease.

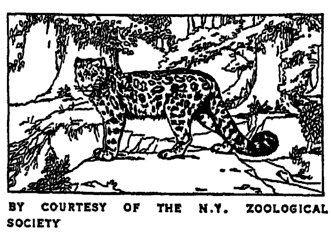
He is the author of various books, among them *A Socialist Budget* (1907); *A Living Wage* (1912); *Socialism and Syndicalism* (1913); *Wages and Prices* (1920); *Labour and National Finance* (1920); *Labour and the New World* (1921).

SNOWDON (*Wyddfa,* view-place; *Eryri,* eagle-place), the highest peak in Wales, formed principally of Ordovician volcanic rocks, slates and grits. (*See* H. Williams, in *Quart. Journ. Geol. Soc.,* 1927, p. 346.) It consists of five "arêtes" converging on the summit, with cirques (*q.v.*), which contain small lakes between them. Surrounding the peak are the Llanberis pass (*q.v.*), Aberglaslyn pass and the Rhyd-ddu pass. Several lakes occur in the valleys rising up to these passes. A rack-and-pinion railway (opened 1897) ascends from Llanberis to the summit ($4\frac{3}{4}$ miles).

See, for full description, *Mountains of Snowdonia* (1925).

SNOWDROP, *Galanthus nivalis,* the best known representative of a small Old World genus of the family Amaryllidaceae, all the species of which have bulbs, linear leaves and erect flower-stalks, destitute of leaves but bearing at the top a solitary pendulous bell-shaped flower. The snowdrop is a doubtful native of Great Britain, but is largely cultivated for market in Lincolnshire. Other distinct species of snowdrop are the Crimean snowdrop, *G. plicatus,* with broad leaves folded like a fan, and *G. Elwesii,* a native of the Levant, with large flowers. All the species thrive in almost any soil or position.

SNOW-LEOPARD or **OUNCE** (*Felis uncia*), a large member of the cat family, from the high mountain regions of Central Asia. It resembles the leopard in general conformation, but has longer fur, grey in colour, marked with large dark rosettes. The head and body are about 4ft. 4in. long, the tail 3ft., and the height 2ft. This animal lives among rocks, and preys upon wild sheep and goats, large rodents, and birds. It even kills ponies.



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY

SNOW LEOPARD OR OUNCE (FELIS UNCIA) A NATIVE OF CENTRAL ASIA

SNOW-LINE, the line above which the snows remain unmelted in the form of a permanent snowfield. Snow-fields occur in any latitude at sufficiently high altitudes, or at any altitude in sufficiently high latitudes. About 78° latitude the snow-line reaches sea-level; in lower latitudes it shows a progressive rise, but many factors in addition to temperature influence its height, *e.g.,* total snowfall, humidity of atmosphere and aspect. In Lapland it is about 4,000 ft. above sea-level; in the Alps about 9,000 ft.; on the south side of the Himalayas about 13,000 ft., but on the

north side over 16,500 ft.; on the east side of the equatorial Andes about 16,000 ft., but 18,500 ft. on the western side.

SNOW-PLANT (*Sarcodes sanguinea*), a North American saprophytic herb of the family Pyrolaceae, so named because it often blooms in moist places in the vicinity of melting snow. It is closely allied to the Indian-pipe (*q.v.*) and, by reason of its bright red or crimson colour throughout, presents a striking appearance. It grows in pine woods on mountain slopes from southern Oregon to Lower California and eastward to Nevada. The single, fleshy, scaly stem, 6 to 15 in. high, rises from a ball of brittle roots and bears at its summit a cylindrical cluster of nodding, bell-shaped crimson flowers.

SNOW PLOUGH. A contrivance for clearing rail tracks of snow. The oldest and most common form is the wedge plough, with a sharp prow. The rotary plough is the most powerful machine. It burrows into the drifts after the manner of an auger, and whirls the snow clear of the track. The rotary element consists of a large fan-like wheel driven by an engine on a truck. As a rule the truck is non-propelling, being pushed by a locomotive. The scoop is about 11 ft. in diameter, and the blades or knives are made of cast-steel; a large wheel may weigh 12 tons.

SNOW-SHOES, a form of footgear devised for travelling over snow. Nearly every American Indian tribe has its own particular shape of shoe, the simplest and most primitive being those of the far north. The Eskimos possess two styles, one being triangular in shape and about 18in. in length, and the other almost circular. Southward the shoe becomes gradually narrower and longer, the largest being the hunting snow-shoe of the Crees, which is nearly 6ft. long and turned up at the toe. Of snow-shoes worn by people of European race that used by lumbermen is about 3½ft. long and broad in proportion, while the tracker's shoe is over 5ft. long and very narrow. This form has been copied by the Canadian snow-shoe clubs, who wear a shoe about 3½ft. long and 15 to 18in. broad, slightly turned up at the toe and terminating in a kind of tail behind.

Snow-shoes are made of a single strip of some tough wood, usually hickory, curved round and fastened together at the ends and supported in the middle by a light cross-bar, the space within the frame thus made being filled with a close webbing of dressed caribou or neat's-hide strips, leaving a small opening just behind the cross-bar for the toe of the moccasined foot. They are fastened to the moccasin by leather thongs, sometimes by buckles. The method of walking is to lift the shoes slightly and slide the overlapping inner edges over each other, thus avoiding the unnatural and fatiguing "straddle-gait" that would otherwise be necessary. Immoderate snow-shoeing leads to serious lameness of the feet and ankles which the Canadian *voyageurs* call *mal de raquette*. Snow-shoe racing is very common in the Canadian snow-shoe clubs, and one of the events is a hurdle-race over hurdles 3ft. 6in. high. Owing to the thick forests of America the snow-shoe has been found more suitable for use than the Norwegian *ski* (*q.v.*) which is much used in less-wooded districts. (X.)

The United States.—While enjoying practically the same snow conditions as Canada, the United States snow belt has never taken up the organization of its interest in snow-shoeing in a great number of specialized snow-shoe clubs. Compared with the snow-shoe clubs of Canada, with their well-known snow-shoe competitions, the United States interest in snow-shoeing is more casual.

Still the snow-shoeing interest in the United States is considerable; it usually ties itself to a general out-of-door winter programme. The men's and women's colleges in the snow belt conduct snow-shoe cross-country races, obstacle races and snow-shoe hikes. Dartmouth college has an annual inter-collegiate snow-shoe contest in which Canadian colleges figure. Lake Placid, N.Y., conducts club and inter-collegiate snow-shoe contests. Practically every winter carnival held in the United States includes snow-shoe obstacle races and cross-country races.

The Appalachian club of the United States promotes mountain climbing on snow-shoes. The Dartmouth Outing club members each year make an ascent of Mt. Washington on snow-shoes. The Intercollegiate Winter Sports Union includes snow-shoe dashes and similar races in its programmes.

See *Lake Placid Club Winter Sports; Appalachia,* organ of the Appalachian Club. (F. K. B.)

SNUFF, the name of a powdered preparation of tobacco used for inhalation (*see* TOBACCO). The practice of inhaling snuff became common in England in the 17th century, and throughout the 18th century it was universal. At first each quantity was fresh grated (Fr. *râper*), whence the coarser kinds were later known as "rappee." This entailed the snuff-taker carrying with him a grater; early 18th-century graters made of ivory and other material are in existence. The art and craft of the miniature painter, the enameller, jeweller and gold- and silver-smith was bestowed upon the box. The humbler snuff-takers were content with boxes of silver, brass or other metal, horn, tortoise-shell or wood. The mull (*q.v.*), a silver-mounted ram's head, is a large table snuff-box.

SNYDERS, FRANS (1579–1657), Flemish painter of animals and still life, was born at Antwerp, where he was baptized on Nov. 11, 1579 and where he died on Aug. 19, 1657. In 1593 he was studying under Pieter Breughel the younger, and afterwards under Hendrick van Balen, the first master of Van Dyck. He visited Italy in 1608. On Oct. 23, 1611 he married Margaretha de Vos, the sister of the painters Cornelis and Paul de Vos. He devoted himself to painting flowers, fruit and subjects of still life, but afterwards turned to animal-painting, and executed with the greatest skill and spirit hunting pieces and combats of wild animals. His composition is rich and varied, his drawing correct and vigorous, his touch bold and thoroughly expressive of the different textures of furs and skins. Rubens frequently employed him to paint animals, fruit and still life in his own pictures, and he assisted Jordaens in a similar manner. In the lion and boar hunts which bear the name of Snyders the hand of Rubens sometimes appears. He was appointed principal painter to the archduke Albert, governor of the Low Countries, for whom he executed some of his finest works. One of these, a "Stag-Hunt," was presented to Philip III., who commissioned the artist to paint several subjects of the chase. The Prado museum, Madrid, is rich in the works of Snyders; others may be seen in the galleries of London, Hampton Court, Paris, Antwerp, Brussels, Dresden, Munich, Leningrad and Vienna.

SOANE, SIR JOHN (1753–1837), English architect and art collector, was born on Sept. 10, 1753 at Whitchurch, near Reading, and died in Lincoln's Inn Fields on Jan. 20, 1837. He came of a family whose name of Swan he altered to Soan or Soane. His talent as a boy attracted the attention of George Dance, junior, the architect, whose pupil he became. He won the Royal Academy's silver (1772) and gold (1776) medals, and a travelling studentship, and went to Italy to study (1777–1780). Returning to England he began to practice as an architect, and in 1784 married a rich wife. He became architect to the Bank of England, which he enlarged and rebuilt in the Roman Corinthian style and did other important public work. He also erected many country houses, the designs for which he published in a book in 1788. He became an A.R.A. (1795), R.A. (1802) and professor of architecture to the Royal Academy (1806). In his house in Lincoln's Inn Fields he brought together a valuable antiquarian museum (now the Soane Museum), which in 1835 he presented to the nation with an endowment.

See A. E. Bullock, *Sir John Soane, His Life, Work and Influence,* Archit. Assoc. Notes xx. (1905); H. J. Birnstingl, *Sir John Soane* (1925); A. T. Bolton, *The Portrait of Sir John Soane* (1927).

SOAP, a chemical compound, or mixture of chemical compounds, resulting from the interaction of fatty oils and fats with alkalis, *i.e.,* the salts of the fatty acids. In a scientific definition, the compounds of fatty acids with basic metallic oxides, lime, magnesia, lead oxide, etc., should also be included under soap; but, as these compounds are insoluble in water, while the very essence of a soap in its industrial relations is solubility, it is customary to use the term "soap" for the compounds of fatty acids with potash, soda and ammonia; the water-insoluble soaps of the other bases may be termed "metallic soaps" or "plasters."

Soap appears to have been first made by boiling goat's tallow

and causticised beech ashes (Pliny); the resulting soft potash soap was converted into hard soda soap by treating the paste repeatedly with salt. Later wood ashes were replaced by soda ashes from sea-plants, kelp, barilla, etc. In the 13th century the industry was introduced from Italy and Germany into France, and the manufacture of olive oil soap established at Marseilles. In England the trade flourished from the 14th century; during the reign of Charles I. a monopoly of soap-making was farmed to a corporation of soap-boilers in London. From 1712 to 1853 an excise duty ranging from 1d. to 3d. per lb. was levied on soap made in the United Kingdom; despite this heavy impost (equal, when 3d., to more than the cost of the soap) the industry expanded with considerable rapidity. In 1793, when the duty was 2¼d. on hard, and 1¾d. on soft soap, the revenue yielded was a little over £400,000; in 1815 it was almost £750,000; in 1835, when the duty was levied at 1½d. and 1d. respectively (and a drawback allowed for soap used in manufactures) the revenue approached £1,000,000. In 1852, the last year in which soap was taxed, it amounted to £1,126,046, with a drawback on exportation of £271,000.

The processes and extent of the manufacture were revolutionized during the first half of the 18th century as a result of Chevreul's classical researches on the constitution of oils and fats, and by the introduction of the Leblanc process (invented 1791) for the manufacture of soda from brine. It was some time, however, before manufacturers could be induced to substitute the new article for natural barilla soda; in fact, Muspratt, the founder of the English alkali industry, had to distribute gratis scores of tons of the manufactured soda in order to popularise the material. The progress of the industry was assisted by further improved processes of caustic alkali manufacture, and by the utilisation of coconut, palm and other oils to supplement the tallow and olive oil exclusively used in older times.

Chemistry of Soap.—Previous to Chevreul's researches on the fats (1811–1823) it was believed that soap consisted of a simple binary compound of fat and alkali. Claude J. Geoffroy in 1741 pointed out that the "fat" (actually fatty acids) recovered from a solution of soap by neutralisation with mineral acid, differed from the original fatty substance by dissolving readily in alcohol, in which ordinary fats were insoluble. The significance of this fact was overlooked, and equally unheeded was a not less important discovery by Scheele in 1783. In preparing lead plaster by boiling olive oil with oxide of lead and a little water—a process palpably analogous to that of the soap-boiler—he obtained a sweet substance which, termed by him "Ölsüss" (*principium dulce oleorum*), is now known as glycerin. These discoveries of Geoffroy and Scheele formed the basis of Chevreul's researches by which he established the constitution of oils and the true nature of soap. In the article OILS it is pointed out that all fatty oils and fats are mixtures of glycerides, *i.e.*, of compounds (esters) of the trihydric alcohol glycerol (glycerin) and some fatty acid such as palmitic acid, etc. Under suitable conditions, the decomposition of a glyceride into acid and glycerin ("hydrolysis" or "saponification") takes place when the glyceride is distilled in superheated steam, or boiled in water with a certain proportion of caustic alkali. In the latter case the alkali combines with the fatty acid to form its potash or soda salt (soap), thus:

$$\underset{\text{Palmitin}}{C_3H_5(O.CO.C_{15}H_{31})_3} + \underset{\text{Caustic Soda}}{3NaOH} = \underset{\substack{\text{Soap}\\ \text{(Sodium Palmitate)}}}{3\,NaO.CO.C_{15}H_{31}} + \underset{\text{Glycerin}}{C_3H_5(OH)_3}$$

(It may be remarked that the term "saponification" is used scientifically to denote the decomposition by water—hydrolysis—of an ester, in this case a glyceride, into its constituent alcohol and acid; it does not necessarily connote the formation of "soap".)

The most important constituent fatty acids of the natural fats are palmitic, stearic and oleic acids, and it is sufficient to regard these as the principal fatty bodies concerned in soap-making. The general characters of a soap are a certain greasiness to the touch, ready solubility in water, with formation of more or less viscid solutions, which on agitation yield a tenacious froth or "lather," and an indisposition to crystallize: hot concentrated solutions are slimy and, on cooling, set to jellies. Soaps give an alkaline reaction in water solution (due to hydrolysis) and have an acrid taste: in the pure condition—a state never reached in commercial practice—they have neither smell nor colour. Almost without exception potash soaps, even if made from the solid fatty acids are "soft" (glutinous jelly) and soda soaps, including those made from the fluid olein are hard; there are, however, considerable variations in consistency according to the prevailing fatty acids. Almost all soda soaps are precipitated from aqueous solution by the addition of sufficient common salt. Potash soap, with the same reagent, undergoes double decomposition—a proportion being converted into the soda soap with the formation of potassium chloride.

Soaps can occur in several physical modifications. In the condition of "neat soap" as found in the pan (containing 30% water) soda soaps display the phenomenon of anisotropy or "liquid crystals." As the neat soap cools the characteristic long thin "curd fibres," which exhibit many of the properties of true crystals, grow from and through the mass of fluid crystals. Transparent solid soaps (*q.v.* below) are supercooled solid solutions in which crystallisation has been retarded; they are optically homogeneous (isotropic) and may be true colloidal gels. In old specimens crystallisation of fibres may occur, and the formation of these can be induced by "seeding" with fibre crystals. The "*figging*" (growth of irregular opaque masses) in potash soft soap is due to the crystallising out of harder constituent soaps of the mixture, the bulk consisting of fluid crystals and isotropic jelly. From alcoholic solutions of pure soaps, such as sodium palmitate, true crystals can be obtained.

In aqueous solution soap was originally regarded as an ordinary colloid; the solution, however, possesses a high electrical conductivity, which is normally associated with electrolytes. These apparently conflicting facts are reconciled by McBain (to whom much of the recent physico-chemical investigation of soap solutions is due) by the theory of "colloidal electrolytes," postulating the occurrence of the "ionic micelle," or multiply-charged and heavily hydrated colloidal aggregate of ionised molecules. In alcoholic solution, soap behaves as a simple unhydrolysed non-electrolyte. When dissolved in water, soap suffers hydrolysis to an extent dependent on the dilution, resulting in the precipitation of acid soaps (*e.g.*, sodium hydrogen palmitate), and the liberation of a small amount of free alkali and infinitesimal quantities of free fatty acid.

Detergent Power.—The detergent power of soaps was originally attributed to the alkali formed by hydrolysis (Berzelius), but recent work has proved (McBain, Hillyer and others) that the amount of such alkali is far too minute to account for the cleansing properties; moreover, hydrolysis is greater in cold dilute solution, whereas the detergent power of hot relatively concentrated solutions is far superior. The detergent action is now considered to be due to the soap itself, and principally a result of its physical characters. Spring considers that soap forms a "colloidal absorption compound" with the dirt, whereby the latter is hindered from re-deposition on the fabric whence its removal was facilitated by the low surface tension between soap solution and grease. In support of the theory, he cites the observation that lamp-black suspended in soap solution is not removed by filtration. It has also been suggested that the soap "lubricates" the dirt particles, rendering them less adherent and more easily removable by rubbing, and that soap may exert a solvent or emulsifying action on oils and grease in the dirty fabric.

The concentration of a soap solution has considerable influence on the cleansing power; as a rule, the best results are obtained with 0·25–0·5% solutions (laundry practice).

Soap Materials.—Almost any fat can be utilised in the manufacture of soap, the choice being determined by the price of the oil or fat and the quality and type of soap required. The most important of the animal oils used are tallow and grease (toilet soap), and of the vegetable oils, cottonseed, coconut (cold-

process, marine soaps) palm, castor (transparent soaps) and olive (textile, toilet soaps) oils. Sulphur extracted olive oil is very suitable for the manufacture of potash soft soaps for the textile industries. Linseed oil is the principal ingredient of soft soaps for other purposes. This is infrequently used in America, soya bean or comoile being more commonly substituted. Rosin (the residue from the distillation of crude oil of turpentine) is an important ingredient of yellow ("primrose") household and washer soaps. Lower grade soaps (brown) are made from bone fat, kitchen grease and low grade tallows. As a result of the increased demand for first quality oils for edible purposes, there has been considerable employment recently of hardened oils *e.g.,* whale, soya-bean, etc. For *alkalis,* caustic soda is usually employed; sodium carbonate may be substituted if the soap is to be made from fatty acids. Caustic potash is used for the production of soft soaps.

Manufacturing Processes.—The processes for the manufacture of soap fall into three classes: formation of soaps by (1) *Neutralization of fatty acids with alkali (caustic or carbonate).* This is not strictly "saponification" but a simple combination similar to the formation of rosin soap. The method enables the manufacturer to employ fats from which the glycerin has been removed by other methods of hydrolysis, and such materials as the "oleine" (liquid fatty acids) which is a by-product of the candle-stearine industry, and "soap-stock fatty acids" recovered from the refining of fatty oils. The soap is made by pouring the melted fatty acids slowly into the preheated alkali solution in the soap-pan, the mass being kept boiling by steam to avoid the formation of lumps ("bunching"). The boiling is continued and the soap "finished" as in the boiling process (*see* below). The production of soft soap by this method has increased latterly, especially on the Continent, as thereby loss of glycerin by inclusion in the soap is avoided. A slight advantage gained by using the cheaper sodium carbonate instead of caustic alkali is counterbalanced by the additional care needed to avoid losses by boiling-over due to the evolution of carbon dioxide. The various methods of saponification or fat-splitting, by which fatty acids may be prepared from oils may be briefly mentioned.

In the Krebitz process lime soaps are formed, washed free from glycerin, and the fatty acids liberated by treatment with mineral acid. The processes of hydrolysis by steam in the presence of catalysts (lime and magnesia in the *autoclave process,* sulphonated fatty acid compounds in the *Twitchell method*) are outlined in the article CANDLE. The only other fat-splitting process of importance (principally used in India) is the *fermentation process,* in which hydrolysis is obtained by the action of the ferment lipase, contained in considerable amounts in castor seeds. The process is a reproduction of the natural hydrolysis of oils by living organisms. The ferment is added, in the form of an emulsion of freshly crushed castor seeds, to the oil to be saponified, and the whole is maintained at a temperature of about 25° C until the reaction ceases. The fatty acids from the various processes are separated by settling, and washed. In most cases the acids are purified by wet distillation with superheated steam. (2) *Saponification of oils and fats by caustic alkalis.*—(A) by processes whereby the glycerin is *not* recovered from the soap: including the production of (i.) *cold process soaps,* (ii.) *hydrated (semi-boiled) soaps* and *soft soaps.* (B) by processes whereby the glycerin is recovered in lyes separated from the soap: exemplified by the *boiling process* for the production of *curd* and *"fitted"* or *"settled"* soaps, which is the method employed at present on the largest scale. (*See* below.) (3) *Formation of soap by double decomposition.*—This method is illustrated by the oldest process of hard soap manufacture, namely, the production of soda soap by double decomposition of potash soap by salt. In another process, the soaps of the alkaline earths are made by saponification of fats with lime, magnesia, etc.; these are decomposed by sodium carbonate forming the soda soap and precipitating the carbonate of the metal. These processes are very little employed in modern practice, and are not used in America.

(2) A (i.) **Soap-making by the Cold Process.**—This depends on the fact that fats of the coconut oil group are very readily saponified by relatively concentrated solutions (about 30%) of caustic alkali (*lyes*) at low temperatures. Further, tallow when admixed with these oils may be saponified under the same conditions. The process is simple and consists in melting the fats at about 60° C (or, in some cases, at a lower temperature) and running exactly sufficient lye with constant stirring; the mixture is thoroughly stirred ("crutched") until it thickens (perfume, colouring matter, etc., may be crutched in as required) and then discharged into the cooling "frames" which may be lagged to prevent over-rapid cooling. The process of saponification completes itself in the frame with the evolution of considerable heat; the soap is ready for distribution in two or three days. The method has the advantage of rapidity, and the extreme simplicity of the plant renders it valuable for districts where it is difficult to obtain or transport machinery. The disadvantages are that the glycerin (unnecessary except in toilet soaps) is retained in the soap and its value lost, and that it is difficult to ensure complete saponification: excess fat renders the soap liable to rancidity, but, with modern methods of scientific control, the presence of excess alkali, which was formerly regarded as the great drawback of cold process soaps, can be avoided. The process finds considerable application in the manufacture of the cheaper toilet soaps and transparent soaps (*q.v.*).

(2) A. (ii.) **Hydrated (Semi-boiled) Hard and Soft Soaps.**—These are made by boiling the fatty material and the caustic lye with open steam until saponification is complete. (In the case of soft soap a little potassium carbonate—"pearl ash"—is added to improve the appearance.) The mixture is boiled down by closed steam to the required concentration and the soap framed or packed into tins (soft soap). The use of soda yields hard soaps while potash produces jelly-like translucent *soft soaps.* No lye is separated and no glycerin recovered. If soft soap is made entirely from linseed oil the transparency is retained at low temperatures; if the stock contains notable proportions of cottonseed or maize oils the soap is liable to become dull ("blind") in winter. The use of a proportion of tallow or of caustic soda gives rise to stellate clusters of crystals of harder soaps (*figging*). Marine soaps and the bulk of soft soaps are manufactured by this process, which is more suitable for fats of high free fatty acid content than the cold process.

Attempts have been made to reduce the time necessary for saponification by hydrolysing the fats under pressure, and a continuous process has been suggested; these methods, however, have not yet attained commercial practice.

To obtain a high-grade product by these methods of manufacture it is essential that all the materials employed shall be of good quality; for, necessarily, all that enters the soap-pan appears in the final product.

(2) B. **Boiled, Settled or Fitted Soaps.**—In this process the stock (fats) is saponified with an indefinite amount of caustic soda; the excess alkali, together with the glycerin of the fats is recovered in the lyes which are separated from the soap by "graining." Soap-pan charges vary from 10–30 tons as a rule, and the process is conducted in the following stages ("changes").

(1) *Pasting or Saponification.*—The melted fats are introduced into the soap-pan, a weak caustic soda lye (about 10%) is added and the whole boiled with open steam from perforated coils. The injected steam suffices to keep the soap masses in a state of vigorous agitation. As saponification proceeds, stronger lye is added with continued boiling until saponification is almost complete, as judged by the taste and texture of the emulsion formed. In order to break this emulsion and to separate the lye, the paste is subjected to (2) *Graining* or salting out. Boiling is continued and salt is sprinkled on the paste, or brine added, until the soap, which is insoluble in salt solution, separates. On allowing the mixture to settle, the soap rises to the surface, floating as a curdy heterogeneous mass of "open grains" enclosing small amounts of lye. The almost neutral brine solution, termed *"spent lye,"* which contains the glycerin derived from the stock, separates below. The spent lye is run off from the bottom of the pan and subsequently treated for glycerin (*q.v.*) recovery. In the case of coconut and palm-kernel oils, whose soaps are soluble in salt

solutions (whence their use at sea as *"marine soaps"*), the graining or "cutting" of the soap is accomplished by the use of strong caustic soda as in the clear boiling change described below. After graining the soap is just "closed" (grainy structure dissolved) by the addition of water, and the next operation (3) of *"making the soap"* or *"boiling on strength"* (*"clear-boiling,"* or *"strength change"*), is performed by boiling up with excess of strong lye which again opens the soap. The mixture is boiled with continued additions of lye until the last traces of fat are saponified, *i.e.,* until permanent "strength" or alkalinity is observed and the soap remains "open." After settling for several hours, the *"half-spent lye"* settles out underneath the soap. This contains considerable quantities of alkali and a small amount of glycerin; it is withdrawn and used for the early stages of the pasting of a fresh batch of material.

Curd Soap.—The soap may be removed and framed at this stage; the product is known as genuine "curd" soap, and usually contains traces of soda and salt.

After clear boiling it is usual practice to give the soap one or two brine washes to remove entangled lye. The soap then undergoes (4) *finishing* or *fitting* (in the U.S.A. called *"settling change"*), which consists in once more closing the soap by the addition of just sufficient steam and water, and boiling until the soap is brought to the right condition of hydration and openness. The workman in charge adjusts the coarseness of the "fit" according to the type of soap handled; the art consists in bringing the soap to such a condition that impurities shall separate in the subsequent "settling" (3–7 days).

The material in the pan settles into four distinct layers: (1) a "fob" or crust of solidified soap foam at the surface, which is skimmed off and added to the next batch fitted: (2) a layer of clean *"neat soap"* ("settled" soap) comprising 75–80% of the contents of the pan, testing 63–64% fatty acids and containing about 30% of water. Such a soap is termed *"genuine* soap," since in practice it is not possible to produce a commercial soap in the pan (without drying) containing less water: (3) a layer (about 15–20% of the total) of darker discoloured soap termed *"nigre,"* containing the separated impurities, chiefly metallic soaps, (of iron, etc.), excess alkali and salt. Nigres from several batches may be united and worked up separately as a lower quality soap, but are usually added to the charge for the next lower grade of soap. Bleaching of the nigres is occasionally practised: (4) a small amount of alkaline liquor containing sodium carbonate, chloride and traces of hydroxide.

In America the practice of skimming off the crust is not common. The "genuine" soap, or settled soap, is pumped off, bringing the crust and the nigre together. Nigres are also generally added to the next charge of the same grade of soap rather than to a lower quality soap. If the kettle to which the nigre is added appears too dark, it is "pitched" or settled so that the nigre from this contains the most of the impurities. This nigre, only obtained once or twice a year, is added to a soap of lower quality.

The pan is "cleansed" by running off the liquid hot neat soap into frames, or into crutching pans for the addition of rosin soap (washer soaps), or medicaments, perfume, colouring matter, etc. (toilet soaps, *q.v.*), or for *"running," "liquoring"* or *"filling"* (household soaps). *Running* or *liquoring* genuine soap consists in the addition of alkaline solutions; soda and sodium silicate are commonly used, and pearl ash is often added to improve the appearance. These materials exert a certain cleansing action and cannot be considered as sheer adulterants such as the "fillers," of which sodium sulphate, talc, chalk, starch, barytes, etc., are typical. In the presence of silicate and salt it is possible to produce a firm soap containing more than the 30% of water characteristic of genuine soap. Rosin may be added to the charge, preferably during the strength boil, but it is more usual to saponify it separately, and to add the resultant rosin soap in the crutching pan; its presence imparts good lathering power to the soap and it possesses a fair detergent action.

After crutching, the soap is run into the frames to cool. Machinery to effect more rapid cooling has been introduced recently and has an increasing vogue, especially on the Continent; the product of rapid chilling is not quite identical with, nor so satisfactory for some uses as, the soap obtained by slow spontaneous cooling.

The cold soap is cut into bars and slabs (by wires stretched on frames). The bars are air-dried for a day, to form a sort of crust, which is sufficiently firm to enable the brand, etc., to be stamped on the tablet. This process completes the manufacture of soap for household and technical use.

Toilet Soaps.—These may be made as already described by the cold-process, or be prepared from a neat settled soap by the simple crutching in of perfume, colouring matter, etc., before framing. Similar soaps are made by *remelting* a genuine or curd soap in special pans for the admixture of perfumes, etc. In this method only cheap perfumes are employed, as considerable quantities are necessary to compensate for the loss by evaporation from the hot mixture.

The bulk of high-grade toilet soap is made from settled soap by the *milling process,* originally introduced from France. The soap from the frames is cut into bars and reduced to fine shavings or chips, which are exposed to warm air in drying chambers until the moisture content (originally 30%) is reduced to about 15%. The chips are mixed with perfume, colouring matters, glycerin, or superfatting material, such as lanolin, etc., as required, and "milled" by passing through a series of smooth granite rollers. On leaving the rolls the soap sheet is again shredded and re-milled, and the process repeated several times until the material is homogeneous. The soap ribbons are then forced through a "plodder," a machine which compresses and extrudes the soap through a heated nozzle in the form of a bar with a glossy surface. The bar is cut into short blocks, which are finished for distribution by moulding in stamping machines to the shape required for the final tablet.

Elaborate blends of essential oils (*q.v.*), both natural and synthetic, are used for the perfuming of soaps. It is necessary to select such perfumes as will not discolour or decompose in the presence of the materials of the soap. Many brands of toilet soap are associated with particular perfumes, *e.g.,* "Brown Windsor" is characterised by the odour of oil of cassia. Vegetable colouring matters, such as chlorophyll, are popular, but the coal-tar dyes have also large application. *Shaving soaps* should be made from a good tallow base; usually a mixture of potash and soda is used for the saponification in order to obtain a suitable consistency. Occasionally gum tragacanth is added to increase the stability of the lather. *Floating soaps* are made by stirring kapok fibre or, more generally, air into the soap, so that on cooling the tablet possesses a density less than that of water. A *solid transparent soap* may be prepared by the cold process by the use of a mixture of coconut and castor oils, with the addition of small amounts of rosin, glycerin, alcohol or sugar (all bodies containing one or more hydroxyl groups in the molecule). Excess of glycerin renders the soap liable to sweating, and it is usual to add rosin and sugar syrup to obtain transparency. Better quality transparent soaps are produced by the older method of dissolving a settled soap, usually a "primrose" or tallow-rosin base in alcohol. The solution is concentrated until the mixture sets to a solid cloudy mass on cooling. This is cut and moulded into tablets, and these are stored in drying chambers for 3–6 months. The bulk of the alcohol evaporates and the soap gradually becomes clear and transparent.

Household and "Washer" Soaps.—The best grade household soaps consist of tallow-rosin, curd and settled soaps (*e.g.,* 20% rosin, 40% tallow, 40% coconut, cottonseed oils, etc.). Lower grades are made from bone-fat, kitchen grease and other low-grade oils and fats. All qualities are made, from a genuine soap (63% fatty acids) through all gradations of carbonated, silicated, "filled" and "run" soaps down to "scouring" soaps, which may contain as little as 10% fatty acids.

Soap powders consist of powdered dried soap admixed with sodium carbonate and silicate, and frequently oxidising agents such as persulphates or perborates.

Mottled Soaps.—If somewhat low-grade fatty material, *e.g.,* kitchen-grease, low quality olive oils, is used in the preparation of curd soaps, it is necessary to finish on a stronger lye, produc-

ing a coarse-grained curd. By careful control of the clear-boiling stage, followed by slow cooling in the frames the soap crystallises fractionally: harder soaps separate first, the more liquid portions solidifying later are segregated into translucent veins in which are trapped any impurities (usually coloured) such as iron soaps, etc. The crude barilla soda used in the earlier days of the soap industry frequently contained impurities of a blue colour, causing a blue "mottle." If excessive water were added to the soap this marbling was not produced; consequently the presence of "mottle" was regarded as a guarantee of a genuine soap. Such a soap is termed *"curd mottled"* or *"genuine mottled."* Now, however, the colour is usually supplied by the deliberate addition to a curd soap of *e.g.*, ultramarine (blue) or manganese dioxide (black mottle). Further, it has been found possible to produce "artificial mottled" soaps from heavily liquored low grade soaps; the presence of mottle, therefore, can no longer be accepted as an indication of genuineness.

Textile Soaps.—Soap is used to a large extent in the manufacture of silk, woollen and cotton goods. In the preparation of woollen goods it is required at three stages: scouring of raw wool to remove the wool-grease, scouring the yarns and cloth after oiling, in fulling and milling. Soap is used for "de-gumming" raw silk, for cleansing silk and cotton before and after dyeing, and in the dye-bath, as well as for calico printing. For all these purposes a potash-olive oil soap is to be preferred; on account of the expense, however, it is frequently replaced for cheaper goods by soda soaps, and by soaps made from kitchen grease, bone-fat, palm and ground-nut oils, etc. The absence of free caustic alkali is imperative for all purposes; for de-gumming silk and for cleaning cotton slight alkalinity (due to free carbonate) is permissible. The soaps should be readily soluble and should not contain rosin, or maize or cottonseed oils, which contain substances that are liable to act as resists to the dyes. Ammonia soaps and soaps made from sulphonated oils have recently been introduced for wool scouring.

Medicated Soaps.—Disinfectant soaps are manufactured by the addition of disinfectants such as coal-tar phenols (*e.g.*, carbolic acid), birch tar, borax, thymol, icthyol, mercury salts, etc., before framing or during the milling process. Lysol preparations consist of soap solutions containing cresol. Soap itself possesses a slight germicidal action and apparently enhances the disinfectant power of certain other substances such as thymol, etc. Heavily medicated soaps are used in the treatment of certain skin diseases, as also the metallic soaps of zinc, copper, mercury and lead. Two preparations of hard soap (sodium oleate) are used in medicine: (1) *Emplastrum saponis,* made with lead plaster; (2) *Pilula saponis composita,* which contains one in five parts of opium. A preparation of the green soft olive oil soap, known as *opodeldoc* (*Linamentum saponis*) is a domestic remedy for stiffness and sprains. The chief use of hard soap is in enemata; it also forms the basis of many pills. Given in warm water it forms a ready emetic in cases of poisoning.

Metallic Soaps.—Besides their use in pharmacy the soaps of the alkaline earths and heavy metals have extensive application in the arts. Lime soaps are the principal constituents of many lubricating greases; aluminium oleate is used as an "oil thickener" for paint and varnish oils and for waterproofing textiles and paper; dissolved in benzene it forms a paper varnish. The oleates and linoleates and rosinates of lead, cobalt and manganese are used extensively as "driers" for paints and oil varnishes.

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SOAP-BARK, the inner bark of *Quillaja Saponaria,* a large tree of the rose family (*Rosaceae*), which grows in Chile. Reduced to powder, it is employed as a substitute for soap, since it forms a lather with water, owing to the presence of a glucoside saponin, which has a marked surface tension action. The same, or a closely similar substance, is found in soapwort (*Saponaria officinalis*), in senega root (*Polygala Senega*) and in sarsaparilla. The saponins are poisonous, having a marked haemolytic (blood-destroying) action. They (with few exceptions) have the general formula $C_nH_{2n-8}O_{10}$, and by the action of dilute acids they are hydrolysed into sugars and sapogenins, which are usually inert pharmacologically.

SOAP PLANTS, the name given to numerous herbs, shrubs and trees which contain the poisonous glucoside saponin. Various parts of such plants form a lather in water and may be used for cleansing purposes, as the soap bark (*q.v.*). Other examples are the soapwort (*q.v.*) or bouncing Bet and the cowherb (*Vaccaria vulgaris*). In the south-western United States various plants called *amole* by the Indians are similarly utilized, especially the small agave (*Agave heteracantha*) and the soap-root (*Chlorogalum pomeridianum*). Other soap plants of the western United States are the zygadene and the sand lily (*qq.v.*).

SOAPWORT (*Saponaria officinalis*), a perennial herb of the pink family, Caryophyllaceae (*q.v.*), called also bouncing Bet, native to Europe and western Asia, common in Great Britain and widely naturalized in North America, often planted in borders and rockeries. It is a stout, smooth, sparingly branched perennial, 2 to 3 ft. high, with lance-shaped leaves and pink or whitish flowers, borne in dense clusters. The leaves and roots contain saponin, which makes a froth with water, and can be used for washing delicate fabrics. (*See* SOAP PLANTS.)

SOBAT, a river of north-east Africa, the most southerly of the great eastern affluents of the Nile. It is formed by the junction of various streams which rise in the south-west of the Abyssinian highlands and north-west of Lake Rudolf. The length of the Sobat, reckoning from the source of the Baro, the chief upper stream, to the confluence with the Nile is about 460 miles. The Baro rises in about 36° 10′ E., 7° 50′ N. at an altitude of some 7,000 ft. The Baro descends the escarpment of the plateau between great walls of rock, dropping 3,000 ft. in 45 miles. It then flows through a narrow gorge at an altitude of about 2,000 ft., the mountains on either side towering 3,000 to 4,000 ft. above the river bed. Just east of 35′ E. the Birbir joins the Baro. Some 40 m. lower down the hills are left behind and the river flows west across a vast plain. From Gambela, a town on its north bank 20 m. below the Birbir junction, the river is navigable by steamers during flood time (June–December) to the point of confluence with the White Nile. In about 33° 20′ E., 8° 30′ N., it is joined by the Pibor. This river issues from the swamp region east of Bor on the Bahr-el-Jebel stretch of the Nile. It is joined from the east and south by various streams from the Kaffa plateau. Of these the chief are the Gelo—which breaks through a gap in the mountains in a series of magnificent cascades—and the Akobo. The Akobo rises in about 6° 30′ N., 35° 30′ E. The whole region of the lower Pibor and Baro is one of swamps, caused by the rivers overflowing their banks in the rainy season. At its junction with the Baro the Pibor is over 100 yd. wide, with a depth of 8 ft. and a speed of 2·3 ft. per second.

Below the confluence of the Pibor and Baro the united stream, now known as the Sobat, takes a decided north-west trend, passing for some distance through a region of swamps. Just beyond the swamps and some 40 m. below the confluence, is the fortified post of Nasser. From Nasser to the junction of the Sobat with the Nile the river has a course of about 180 miles. As it approaches the Nile the Sobat flows in a well-defined channel cut in the alluvial plains through which it passes. The banks become steep, the slope rapid and the current strong. The Sobat enters the Nile almost at right angles in 9° 22′ N., 31° 31′ E. It is 400 ft. wide at its mouth and has a depth of 18 to 20 ft. at low water and of 30 ft. when in flood. The colour of the water when in moderate flood is that of milk, and it is from this circumstance that the Nile gets its name of Bahr-el-Abiad, *i.e.*, White river. In full flood the colour of the Sobat is a pale brick red. The amount of alluvium brought down is considerable. The average volume of water discharged varies from 100 cu.m. per second at low stage in

April to 770 in October and November when it is in full flood. For the part played by the Sobat in the annual rise of the Nile *see* NILE.

The Sobat was ascended for some distance in 1841 by the Egyptian expedition despatched in the previous year to explore the upper Nile. The post of Nasser was founded in 1874 by General C. G. Gordon when governor of the equatorial provinces of Egypt, and it was visited in 1876 by Dr. W. Junker, the German explorer. The exploration of the river system above Nasser was carried out in the last decade of the 19th century by the Italian explorer V. Bottego; by Colonel (then Captain) Marchand, of the French army, who, on his way from Fashoda to France, navigated the Baro up to the foot of the mountains; and by Captain M. S. Wellby, Majors H. H. Austin and R. G. T. Bright, of the British army, and others. By the agreement of May 15, 1902, between Great Britain and Abyssinia the lower courses of the Pibor and Baro rivers to their point of confluence form the frontier between the Anglo-Egyptian Sudan and Abyssinia. (*See* NILE, SUDAN and ABYSSINIA.)

SOBRAON, a decisive battle in the first Sikh War (*see* SIKH WARS). It was fought on Feb. 16, 1846, between the British (15,000) under Sir Hugh Gough and the Sikhs (20,000) under Tej Singh and Lal Singh. The Sikhs had fortified themselves in a bend on the left bank of the Sutlej, with the river in their rear. The battle began with a two hours' artillery duel, in which the Sikh guns were the more powerful, and the British heavy guns expended their ammunition. Then the infantry advanced with the bayonet, and after a fierce struggle took the Sikh entrenchments. The Sikh losses were estimated at from 5,000 to 8,000. This battle ended the first Sikh War.

SOCAGE. A free tenement held in fee simple by services of an economic kind, such as the payment of rent or the performance of some agricultural work, was termed in mediaeval English law a socage tenement. In a borough a similar holding was called a burgage tenement. The term is derived from O. Eng. *soc,* which means primarily suit, but can also signify jurisdiction and a franchise district (*see* SOKE). Historically two principal periods may be distinguished in the evolution of the tenure. At the close of the Anglo-Saxon epoch we find a group of freemen differentiated from the ordinary ceorls because of their greater independence and better personal standing. They are classified as *sokemen* in opposition to the *villani* in Domesday Book, and are chiefly to be found in the Danelaw and in East Anglia. There can hardly be a doubt that previously most of the Saxon ceorls in other parts of England enjoyed a similar condition. In consequence of the Norman Conquest and of the formation of the common law the tenure was developed into the lowest form of freehold. Legal protection in the public courts for the tenure and services deemed certain, appear as its characteristic feature in contrast to villeinage. Certainty and legal protection were so essential that even villein holdings were treated as *villein socage* when legal protection was obtainable for it, as was actually the case with the peasants on ancient demesne who could sue their lords by the little writ of right and the *Monstraverunt.* The Old English origins of the tenure are still apparent even at this time in the shape of some of its incidents, especially in the absence of feudal wardship and marriage. Minors inheriting socage come under the guardianship not of the lord but of the nearest male relative not entitled to succession. An heiress in socage was free to contract marriage without the interference of the lord. Customs of succession were also peculiar in many cases of socage tenure, and the feudal rule of primogeniture was not generally enforced. Commutation, the enfranchisement of copyholds, and the abolition of military tenures in the reign of Charles II. led to a gradual absorption of socage in the general class of freehold tenures.

See Pollock and Maitland, *History of English Law,* i. 271 ff.; F. W. Maitland, *Domesday Book and Beyond,* 66 ff. (1907); P. Vinogradoff, *Villainage in England,* 113 ff., 196 ff. (1892); *English Society in the 11th Century,* 431 ff. (1908). (P. VI.)

SOCCER: *see* FOOTBALL, ASSOCIATION.

SOCIAL ANTHROPOLOGY. Anthropology is the science of man and of his culture at various levels of development. It includes the study of the human frame, of racial distinctions, of civilisation, of social structure and of man's mental reactions to his environment. The problems connected with the human body, such as race, heredity, miscegenation, are the subject matter of *Physical Anthropology. Social,* called also *Cultural Anthropology,* studies questions of the culture and social organisation of primitive tribes and nations. As a rule a somewhat vague line of demarcation is drawn between peoples of simpler culture and those more highly developed, such as the modern inhabitants of Europe and N. America. The study of higher civilisations is then assigned to Sociology. The distinction, however, is unsatisfactory and it would be more correct to say that Social Anthropology is a branch of Sociology, as applied to primitive tribes. Since the study of living peoples uses methods and controls sources of information entirely different from those at the disposal of archaeology and pre-history, Social Anthropology has to restrict its scope to the study of the modern living representatives of primitive mankind.

Social Anthropology begins really with a pre-scientific interest in the strange customs and beliefs of distant and barbarous peoples, and in this form it is as old, at least, as the Father of History. Indeed traces of such pre-scientific interest can be found in the early inscriptions, paintings, reliefs and sacred writings of the Orient and even in the quaint and highly coloured stories which one primitive tribe tells of another. We have not yet succeeded in eliminating this cruder curiosity in "Ye Beastly Devices of Ye Heathen" from modern anthropology, where the thirst for the romantic, the sensational and the thrilling still plays some havoc with the sober scientific attitude.

In the establishment of this latter and of sound methods of research the lead in Great Britain was taken by General Pitt-Rivers E. B. Tylor, J. F. MacLennan and J. Lubbock (Lord Avebury); in Germany by A. Bastian and even earlier by Herder, Grimm and the *Völker-psychologists;* in France by Boucher de Perthes and Perrault.

SOCIAL ANTHROPOLOGY AS A SCIENCE

During the last quarter of the preceding century and at the beginning of this, Social Anthropology gradually crystallised into a scientific study. The specific nature of cultural process was recognised, as well as the complexity of social organisation and of primitive custom and belief. The vastness of the problem, the human interest and the dramatic beauty of anthropological facts were brought home to scholars and laymen alike by the works of W. Robertson Smith, Sir J. Frazer, E. A. Westermarck, E. Crawley and E. Sidney Hartland, to mention a few outstanding names. At the same time, scientific movements of great consequence were developing on the Continent (Durkheim and Wundt). Most important of all, the man of science began to go out into the field himself and to study native races personally by direct observation. The lead to this was given in Great Britain by the Cambridge Expedition organised by A. C. Haddon and in which such eminent anthropologists as W. H. R. Rivers and C. G. Seligman received their training in field-work. Equally fruitful were the pioneering researches of Spencer and Gillen in Australia and the activities of the Polynesian Society in New Zealand and the Pacific.

In America, where the interest in anthropology had a historical basis in both friendly and hostile contacts between settlers and redskins, modern scientific research received perhaps the first official recognition in the foundation of the Bureau of American Ethnology. Early pioneers of anthropology, J. W. Powell, J. Mooney, but above all L. H. Morgan, laid the foundations of scientific field-work and theoretical interest in the North American Indians. Later the work of Franz Boas and his school continued the scientific tradition of American social anthropology. The value of the scientific study of native races was recognised in the official patronage given to colonial research by the Dutch Government and by the German Colonial Office.

The last 20 years have been characterised by a great extension of scientific field work among primitive peoples, by further development of the theoretical work of the opening years of the century

and by important discussions of the methods and aims of anthropology.

MODERN SCHOOLS

In spite of much fuller knowledge of primitive cultures, modern theory presents great diversity.

Two dominant tendencies are recognised in modern anthropology. The one, usually described as the "evolutionary" or "comparative" or "independent origins" school, is based on the assumption that a preponderant part in the formation of human culture has been played by independent evolution taking place on the same lines in various parts of the world. Similarities in custom, institution and belief are in this school explained on the principle that human nature produces at the same level of development identical or similar forms.

The "diffusionist" school on the other hand place all the emphasis on cultural borrowing by one people from another. Similarities in implements and weapons, in beliefs and legends, in social organisation and decorative art are explained by spread from one or several original centres (*see* below).

Only a few extremists, however, belong to either school exclusively or maintain that one factor only accounts for all similarities of culture, either independent evolution or diffusion. The majority of anthropologists recognise—and are unquestionably correct in doing so—that cultural change is always a mixture of both independent development and partial borrowing from other people. In reality the main tendencies of modern Social Anthropology can be stated thus.

Psychological Interpretation of Culture.—Continuing the direct tradition of the German folk-psychologists, as well as of the British classical school, Wundt, Vierkandt, Krueger and their collaborators attempt to explain systematically the phenomena of language, custom, belief and social organisation by references to psychological processes. Quite as exclusively psychological are the contributions of the psycho-analysts, who account for totemism, taboo, initiation ceremonies, in fact for the whole field of primitive cultures, by unconscious mental mechanisms. Psychological interest is also predominant in the works of Frazer, Van Gennep, Sumner, Crawley and Westermarck. All these writers belong on the whole to the evolutionist school.

The extreme representative of the diffusionist school, Graebner, maintains that all the regularities of cultural process are "laws of mental life" and that "their scientific and methodical study is possible only from the psychological point of view" (Graebner, p. 582, 1923), while Pater Schmidt, Wissler, Lowie, Kroeber and Rivers constantly use psychological interpretations. Thus, no anthropologist nowadays wishes completely to eliminate the study of mental processes, but both those who apply psychological explanations from the outset and those who want to use them after culture has been "historically analysed" forget that interpretation of culture in terms of individual psychology is as fruitless as mere historical analysis; and that to dissociate the studies of mind, of society and of culture, is to foredoom the results.

The Distribution, Contact and Diffusion of Culture.—As influential and one-sided as the psychological trend is the interpretation of similarities and analogies of culture by the principle of mechanical transmission. First vigorously propounded by Ratzel as the main problem of ethnology, the study of distribution and diffusion has been followed up by Frobenius, Ankermann, Graebner, Pater W. Schmidt, Pater Koppers and subsequently by the late Dr. Rivers. In England Prof. Elliot Smith and W. J. Perry have carried the diffusionist argument even farther, deriving all culture the world over from Egypt.

The merit of moderate anthropological diffusionism lies in its geographical rather than in its historical contributions. As a survey of facts correlated to their geographical substratum, it is a valuable method of bringing out the influence of physical habitat as well as the possibilities of cultural transmission. The distributions mapped out for America by Boas, Spinden, Lowie, Wissler, Kroeber, Rivet and Nordenskiöld; the survey of Melanesian cultures given by Graebner; of Australian provinces given by W. Schmidt; of Africa prepared by Ankermann and Herskovits, will possess lasting value.

The historical hypotheses of Frobenius, Rivers, Schmidt and Graebner, the sweeping identifications of "culture complexes" all over the globe, will not so easily pass muster. They suffer from a lifeless and inorganic view of culture and treat it as a thing which can be preserved in cold storage for centuries, transported across oceans and continents, mechanically taken to pieces and recompounded. Historical reconstructions within limited areas, such as have been done upon American material for instance, in so far as they are based on definite records or on archaeological evidence, give results which can be empirically verified, and therefore are of scientific value. Dr. B. Laufer's study on the potter's wheel and certain contributions to the history of American culture (T. A. Joyce, A. V. Kiddler, N. C. Nelson, H. J. Spinden, L. Spier) are methodologically acceptable, though they belong to archaeology rather than to the science of living races and cultures. Such sound works must be clearly distinguished from the productions in which a conjectural history is invented *ad hoc* in order to account for actual and observable fact, in which therefore the known and empirical is "explained" by the imaginary and unknowable.

Sociological Theories of Culture.—Robertson Smith is undoubtedly the spiritual father of this movement. He was the first to see that religion must be accounted for quite as much by its social nature, by what it does for tribal cohesion, as by its meaning and value for the individual. The great American Anthropologists, Powell and Morgan, also contributed toward our understanding of clan solidarity in savage societies. Durkheim, inspired by their work as well as by that of Bachofen, Wilken and Sir James Frazer, developed a sociological theory of early culture. Kohler and the school of comparative jurisprudence in Germany, Steinmetz in Holland and later, Rivers in England, also studied primitive society from the sociological point of view, overemphasising perhaps the solidarity of and the lack of differentiation within the early horde and clan. The doctrine of primitive legal cohesion and of social structure by direct solidarity given by Durkheim, Steinmetz and Kohler; the subtle and stimulating interpretation of primitive magic, sacrifice and religion by Durkheim, Hubert and Mauss; the recent analysis of contract and gift by Mauss and Davy, show an enormous advance upon any previous work in the greater precision of concepts, in the consistent application of the sociological interpretation, in the conscious attempt to preserve native classification, nomenclature and perspective. It is impossible to adopt these views unreservedly because they tend to lapse into metaphysical vagueness. In order to avoid the explanation of culture in terms of individual mental processes, yet fully aware that psychology cannot be excluded, these anthropologists compromise by introducing the conception of collective consciousness, which sociologists and anthropologists alike (Ginsberg, MacIver, Radin) have shown to be untenable. The sociological school exaggerates the social nature of primitive man, the importance of the clan and the solidarity of kinship. They neglect the role of individual initiative and variation, the part played by self-interest and the institution of the individual family.

Theories of Specific Difference of Primitive Mentality.—Grown on the soil of the sociological school, but laying more stress on the purely psychological side, other theories seek to account for savage belief and custom by the alleged specific character of mental structure in primitive man. Basing their conclusions on a number of interesting but probably exaggerated and distorted statements by such observers as Cushing and Dennett, and on a mass of obviously immature and superficial accounts by missionaries and other amateurs, the writers of this school aver that the savage is prelogical and mystical, impervious to experience, living in a world of "dim participations" (Crawley, Lévy-Bruhl, Vierkandt, Danzel, H. Werner, Graebner). These views have but limited currency among theoretical anthropologists, whose position has been well expounded by Carveth Read. Modern field-workers, equally competent to speak about the savage from first-hand knowledge and to deal with problems of comparative psychology and epistemology through training, have one and all criticised adversely these points of view (Boas, Rivers, Radin, Kroeber).

None the less, by posing the problem of primitive knowledge and mentality, by stirring up opinion and forcing anthropologists to make up their minds, the writers of this school, above all M. Lévy-Bruhl, have made valuable contribution to Science.

The Functional Analysis of Culture.—This type of theory aims at the explanation of anthropological facts at all levels of development by their function, by the part which they play within the integral system of culture, by the manner in which they are related to each other within the system, and by the way in which this system is related to the physical surroundings. It aims at the understanding of the nature of culture, rather than at conjectural reconstructions of its evolution or of past historical events.

Two factors contribute toward the development of the functional point of view. The modern specialist field-worker soon recognises that in order to *see* the facts of savage life, it is necessary to understand the nature of the cultural process. Description cannot be separated from explanation, since in the words of a great physicist, "explanation is nothing but condensed description." Every observer should ruthlessly banish from his work conjecture, preconceived assumptions and hypothetical schemes, but not theory.

The field-worker who lives among savages soon discards the antiquarian outlook. He sees every implement constantly used; every custom backed up by strong feeling and cogent ideas; every detail of social organisation active and effective. He perceives, above all, that culture, provides primitive man with the means of satisfying his wants, and of mastering his surroundings. The functional view of culture lays down the principle that in every type of civilisation, every custom, material object, idea and belief fulfils some vital function, has some task to accomplish, represents an indispensable part within a working whole.

The better a custom is understood, the clearer it becomes that it does not sit loosely, within its context, that it is not a simply detachable unit like a petrifact in a rock, but that it is organically connected with the rest of the culture. A "superstition" is always a powerful mental force, whether as a restraint, or as an incentive to action. Magic, again, in many of its forms, is an indispensable economic force. Sorcery plays a conspicuous part in the political organisation and the legal arrangements of most tribes. Religion, through the moral integration of the group, invariably provides the basis of a tribal constitution. This mutual relation of customs, aspects and institutions; the work which they do for each other; the function which they fulfil within the whole scheme of culture—this it is that interests the exponent of the functional method.

This method insists, therefore, not only on the dynamic nature of culture, but also upon its organic unity. Culture must not be treated as a loose agglomeration of customs, as a heap of anthropological curiosities, but as a connected living whole. The functional method protests against the tearing away of a custom, institution or aspect from its cultural context. "Magic," "cannibalism," "sociology," "religion," "pottery," "mother-in-law taboos," "marriage," and many other such labels, have given rise to the water-tight compartment method of collecting evidence in the field, of writing it up, and of dealing with anthropological theory.

The functional view of anthropology refuses to regard cultural process as a mere natural growth—through the biological simile of evolution. It refuses also to see in it a simple shifting of disconnected items from place to place—through the mechanical simile of diffusion. The functional method insists on the recognition of the process of culture as a process *sui generis,* which must be studied by special methods, without borrowing from physics, biology or the limbo of untrammelled conjecture; culture is alive, it is dynamic, all its elements are interconnected, and each fulfils a specific function in the integral scheme. The discovery of cultural functions makes it possible for this method to lay down the laws of the functional correlations of anthropology.

Modern field-work thus regards a theory as purely empirical, never to be taken beyond the limits of induction set by the evidence, and as serving only to give a greater insight into the mechanism of culture in its various phases; social organisation, belief and material outfit.

The functional view of culture is implicit in the work of many of the leading writers of the comparative school and in the best achievements of modern field-work. The Comparative school however has allowed the evolutionary view to overshadow the functional method, while most American anthropologists have failed to disentangle the empirical interpretation of culture in terms of function from reconstruction in terms of conjectural history. They have thus lapsed into a type of explanation which at best belongs to archaeology, and so have greatly sterilised their otherwise splendid field-work and stimulating theory.

Recently, however, and among a small number of anthropologists only, the functional method has been applied systematically and exclusively in field-work and theory (R. W. Firth; B. Malinowski; G. Pitt-Rivers; A. Radcliffe-Brown; Richard Thurnwald).

The functional method by showing what culture does for a primitive community, establishes its value and thus utters a warning against too hasty interference with native belief and institutions and too wasteful an exploitation of native labour and resources. By demonstrating how primitive custom and law work, it furnishes the administrator with practical hints of how to frame and administer native regulations. By inquiring into savage economic organisation, the functional method can teach how to manage indigenous labour and how to trade with the natives. By a sympathetic study of early belief and ritual, it can instruct the missionary how to graft a new creed upon the old one without destroying what is good and sound in it.

The functional method, concerned as it is with the actual working and mechanism of primitive culture, supplies the right theoretical foundation for the practical application of anthropology (*see* ANTHROPOLOGY, APPLIED), for which mere antiquarian reconstructions, whether historical or evolutionary, are irrelevant. And indeed recently the future of relations between Europeans and native peoples has come to be recognised as one of the momentous problems of our times. A number of important movements and works indicate the recognition of the necessity for a closer co-operation between the Anthropologist and the man who controls tropical colonies. From the official side there may be quoted Lord Lugard's policy of *indirect* or *dependent* rule, so brilliantly vindicated in his own administration and so well expounded in his book on *The Dual Mandate in British Tropical Africa;* the recent appointment of several Government Anthropologists in British Colonies; and the charter of the Mandated Territories. From the missionary point of view may be mentioned J. H. Oldham's excellent book *Christianity and the Race Problem,* while as a scientific approach to practical Anthropology, *The Clash of Culture and the Contact of Races* by G. Pitt-Rivers is a pioneering piece of work.

The following analysis of some of the main aspects of primitive organisation will best illustrate the subject matter, the aims and the methods of Social Anthropology.

THE CULTURAL FUNCTION OF MARRIAGE AND FAMILY

This is perhaps the most debated and the most instructive of all anthropological problems.

The Institutions of Marriage and Family.—Careful inductive comparison reveals one important fact: marriage and family are almost universal, and can be traced through all types and levels of culture. Their universality can be accounted for by the functional analysis of these institutions. Two functions of paramount importance are fulfilled by any institution which regulates mating and propagation: the maintenance of racial quality and the maintenance of the continuity of culture. Sociological considerations prove that the individual family based on monogamous marriage provides the best opportunities for effective sexual selection. It also supplies the best training for the future cultural work and sociological orientation of the young individual. The importance of the family as the early social and cultural pattern for later life has been independently established

by anthropology and psycho-analysis. The family is the link between instinctive endowment and the acquisition of cultural inheritance, in that it permits the biological bonds between parent and infant gradually to ripen into social ties. It also eliminates a number of dangers due to the disruptive factors of the sexual instinct. (A. L. Kroeber; J. C. Flügel; R. H. Lowie; A. R. Radcliffe-Brown; B. Malinowski.)

Regulated Licence.—The various customs of regulated licence do not allow of a simple and satisfactory solution. As culture advances and larger numbers of men and women come into contact, the experimental component of the sexual instinct drives people towards indiscriminate mating. Freedom in pre-nuptial intercourse, festive licence, religious prostitution, lewd marriage ceremonies are the rule in savage and barbarous communities, with the exception of those of the lowest level (Schmidt and Koppers). Again, in some tribes the institution of marriage suffers temporary obliteration in the form of wife-lending or exchange, *jus primae noctis* sexual over-rights of chiefs and magicians and similar relaxations of the matrimonial bond. These customs have been explained as "survivals of primitive promiscuity." That such an explanation is untenable has been convincingly shown by Westermarck. There are two ways of regulating intercourse between the sexes: either by suppressing all irregular mating, or by allowing a well-defined and limited licence. Biology and psycho-analytic theory teach that stern repression and rigid sex morals are not a complete solution of the problems here involved. Anthropology, moreover, shows that this problem is especially present at low levels of culture. According to some authorities, a regulated and limited licence should be considered as an imperfect but effective way of dealing with the disruptive forces of sex. Such regulation, moreover, is in no savage tribe found to be subversive to the fundamental institutions of marriage and the family which exist in spite of it everywhere.

At the same time, there is not one single tribe where sexual licence is found untrammelled, where anything approaching promiscuity obtains. Two forms of regulation are found everywhere: the strict prohibition of the wife's adultery safeguards the bonds of marriage and is only now and then over-ruled by exceptional customs; the prohibition of incest within the household safeguards the integrity of the family. This is very often extended to exogamy which embraces the whole clan.

The Clan (*q.v.*).—The clan and the classificatory principle of kinship appear on a closer sociological analysis not to be substitutes for the family and household, but the outcome of more extended co-operation in matters other than sexual mating and the rearing of children. (*See* KINSHIP.) The clan functions chiefly in economic, legal and above all in ceremonial matters. It is also closely connected with age-grades, secret societies and men's clubs wherever these exist; with the ceremonial distribution of wealth (the *kula*, the *potlach* or the *hakari*), with magical specialisation and co-operation. Thus, in its functional definition, the clan represents the non-sexual and non-genetic extension of the kinship principle beyond the household and above the natural function of the family. Exogamy again appears as an additional bond of solidarity—a natural extension of the principle of incest running side by side with the extension of the kinship principle. As the link between the individual and the wider groupings of local and political type, the clan is of special importance.

The clan is always due to the over-emphasis of one side of kinship—an over-emphasis necessary to eliminate any ambiguity in the transmission of hereditary rights and obligations. This has been aptly summed up by Dr. Lowie in his terminology of bilateral and unilateral kinship. The clan appears therefore as the natural result of the two influences which come into the foreground as culture advances; the continuity of tradition on the one hand and the extension of co-operation on the other. The clan allows of the establishment of greater cohesion within each generation and across succeeding generations. The explanation here given accounts for the institution, neither by an accident, nor by specific ideas, nor by a hypothetical primitive communism in sexual matters, but by reference to certain deep-seated influences of cultural progress working before our very eyes. With all this, although the clan is of great benefit for society and culture, it never becomes an absolute necessity like the family. It is rather a symptom of advancing social differentiation than its inevitable effect. Thus, although the family and marriage are found to be universal, there exist tribes without any sub-divisions into clans, moieties or matrimonial classes. Further, since the clan is associated with the general scheme of development, it cannot be regarded as a fortuitous index of this or that culture.

Mother-right and Father-right (*q.v.*).—The correlated phenomenon of unilateral kinship also plays a very important part in diffusionist schemes. Mother-right and father-right respectively have been taken by Ankermann, Graebner, Rivers, W. Schmidt and Koppers as principal indices in their classification of cultures. But the question arises, is either mother-right or father-right an independent element, or are they both always linked together? It seems in fact that mother-right and father-right are never found in isolation, but always co-exist—one of them emphasised by the tribal law and the economic arrangements, the other, though subordinate, never completely absent. Until the problem thus raised has been solved, until the proof is given that mother-right and father-right can exist as exclusive, sharply defined stages or sociological principles, their use as indices of culture, and evidence of its spread must remain meaningless. Here again, functional analysis of the methods of reckoning descent leads to a clear definition of such concepts, indispensable for their use in any speculative construction. (*Cf.* B. Malinowski, *Sex and Repression*, Pt. iv.)

Problem of Sex.—Thus the family, the clan, sexual restrictions, as well as sexual liberties, are not the stages of a transformation nor fortuitous indices of cultural type or cultural stratum, but correlated, component parts of one big institution; the institution which controls the mating of sexes, the procreation of offspring and the education of the young, and fulfils the integral function of racial and cultural continuity. The nature of its component elements is explained by the part which they play within this integral scheme. The functional method might also be extended to all the other aspects of organisation—territorial, political, legal and economic. Each is related to an essential need of human society, its distribution over the locality, defence, maintenance of order, and the production of necessaries and values.

ECONOMIC ORGANISATION

Until the recent researches of anthropologists in Melanesia, in New Zealand, in North-West America, in Africa, and in Micronesia revealed a wealth of material, and theoretical students (M. Weber, K. Buecher, R. Thurnwald, R. W. Firth, B. Malinowski) laid stress on the cultural importance of primitive economics, there reigned in anthropology the simple occupational view of primitive husbandry. Schemes of occupational stages or types, the collecting of food, hunting, fishing, the tending of herds, the raising of crops and industrial production were set forward as the only subject matter of descriptive or analytical economics, as it is called.

In all such views, primitive man is regarded as having but simple elementary needs, and proceeding reasonably and naturally to satisfy them. The little spare time he has left over he devotes to the casual production of superfluities, and to the satisfaction of his hobbies, which latter activities, however, are usually placed outside the domain of economics. Thus we read in an authoritative work, *Notes and Queries in Anthropology* (Edn. 1912, p. 260) "The first essential of maintenance is a supply of food; and in many simple communities the actual food quest and operations arising from it . . . occupy by far the greater part of the people's time and energy, leaving little opportunity for the satisfaction of any lesser needs." And again, we are told by another writer (Buxton) that generally the savage "has no means to acquire more wealth than he can carry about on his person or on the persons of his family." The main questions cut short by such *a priori* assumptions are those of the incentives to production, of the organisation of labour and of the primitive forms of the apportionment of wealth.

The Economic Motive.—Is it true then that primitives work only to satisfy their primary needs? In the lowest stages of culture people are ready to endure thirst and hunger, but are bent upon stimulants or narcotics. We know of tribes without clothing, but of none without ornaments. There are natives without fixed habitations yet keen on the display of such wealth as they possess. At higher levels, under more favourable conditions, certain commodities are actually produced far in excess of actual needs. And this, moreover, is not done "in exchange for food or for the means of obtaining it," as current opinion usually runs (*Notes and Queries*).

Nor is it carried out through economic foresight. Large quantities of accumulated food and wealth are employed instead for festive display, for ceremonial yet useless donations, sometimes even for mere destruction, often on a gigantic scale. All such customs serve merely for the manifestation of the wealth of the owner, of his generosity, of his economic power. In the South Seas, the accumulated food is employed for the production of objects of value by the feeding of artisans, who devote themselves to the polishing of axe-blades, to carving, to the making of shell ornaments or of mats (Thurnwald, R. W. Firth). Some of these early forms of valuable tokens of wealth have a distinctly religious character, serve in ritual ceremonies, are associated with belief and possess elaborate mythical pedigrees (Mauss). Finally there is one very important fact which contradicts the merely utilitarian view of primitive economic incentives; the products of savage industries in general, far from being made with the minimum of effort required for their utility, show a lavishness of artistic detail, of decoration and pedantic finish, which would put to shame any civilised artisan. The joy in the work, the satisfaction of perfect craftsmanship, the artistic passion for the general appearance of the finished product dominate savage industry and enterprise (B. Malinowski).

It is clear from this evidence that the "first essentials of maintenance," the primary needs and the requirements of practical utility, do not exclusively control the economic effort of primitive man. Nor is their aim always to achieve the utilitarian maximum of effect by the minimum of effort. To understand the driving forces of early production, it is, therefore, not sufficient to make reference to man's animal needs. It is just as necessary to realise the natives' ideas of value; their pleasure in the integral effect of their work in which artistic, sporting, social and even religious motives are mixed with those of pure utility.

The Character of Early Production.—The well-known scheme of K. Buecher, who would place the whole range of primitive husbandry within the limits of the "Individual search for food" and of "closed household economy" is the clearest expression of the view that primitive man works for himself and his family alone, and that he knows no production on a wider, a communal or tribal scale.

A fuller insight into the nature of primitive labour reveals the existence of organisation. Even in the lowest cultures there are tasks which transcend the forces of one individual or of one family—the felling of trees, drive-hunting, the very collecting of food. At higher stages, such pursuits as communal hunting and fishing, the making of gardens, the construction of houses and canoes require some type of organised labour. This points to a definite specialisation, distribution and synchronisation in time, a division of functions, an integration of the individual contributions to the common end. If we enquire what are the elements of the economic organisation, it soon becomes clear that we must distinguish between moral or persuasive, and social or coercive factors. K. Buecher in a later work (*Arbeit und Rhythmus*) has drawn attention to the great importance of rhythm for successful work. Many other stimulants and incentives could be mentioned, the most efficient of which is unquestionably work in company. Conversation, jokes, mutual assistance and interest relieve the tedium of solitary labour, while emulation, example and the satisfaction of pride are under primitive conditions possible only in communal work. The best worker is always recognised as such among savages, and his leadership is followed. Much more important, however, is the moral prestige enjoyed by supernatural expert knowledge which, in the form of magic, always controls vital and difficult economic pursuits. Marking the dates, inaugurating the successive stages, imposing periods of rest and setting the time limits, it acts as an organising, co-ordinating influence (B. Malinowski in *Argonauts of the Western Pacific*).

Social coercion is the other important force in economic organisation. As soon as distinctions of rank and power arise they are used as means of extorting labour, while, on the other hand, economic inequalities function as indices of social status.

Primitive Ownership.—This economic problem has been discussed in some detail by anthropologists. But while, on the one hand, the writers, who, like Buecher, assume an atomised economic production, admit only of individual or personal ownership, those following Morgan, and influenced by a strong socialistic bent, Engels, Bebel, Cunow, make the savage into a communist. As a matter of fact, property, which is but one form of legal relationship, is neither purely individualistic nor communal, but always mixed (B. Malinowski, *Crime and Custom*).

The misuse of such conceptions as "communism," associated with an incorrect application of the concept of "money" may be exemplified in a scheme recently put forward by the late Dr. Rivers. Dr. Rivers designates certain forms of valuables found in Melanesia, such as mats, arrows, pigs' jawbones and, above all, shell discs, as "money," following the usage of white traders, missionaries and planters. Dr. Rivers to justify the use of this word, insists that these objects "are used for no other purpose" and "have a very definite scale of value," but he gives in other contexts a definite and concrete account of several ways in which these objects are used "for other purposes," and thus stultifies his first criterion. The second criterion is obviously insufficient for identifying a commodity as "money." All objects have in our economy "a very definite scale of value," yet we do not apply the word money to a pair of slippers, a motor-car or a picture by Raphael, still less do we use these things as money.

Now the taking of terminological liberties with well-defined concepts has its dangers. "Money" has no sooner been introduced into the argument than "communism" crops up and the two are related by a remarkable piece of reasoning.

"The subject of communism in property is closely connected with that of money. A thoroughly communistic people can have no use for money among themselves. If they possess anything which can be regarded as currency it can only be used in transactions with other peoples. The use of money should therefore be associated with the disappearance of communism; if it can be shown that Melanesian money is due to immigrant influence, and especially to that of the Kava people, we shall have gone far to establish the conclusions already suggested" (*History of Melanesian Society*, vol. 2, p. 385).

And again:

"A thoroughly communistic people would have no need for money, and any explanation of the communism of Polynesia will therefore furnish also the explanation of the absence of money" (p. 392).

And as an "historical explanation" of these facts:

"The explanation of the absence of money in Polynesia and of the communism of its people is to be found in the special mode of settlement of the Kava people" (p. 393).

What a "thoroughly communistic people" are is difficult to say. The Bolshevik regime aspires to that title, but they have not done away with money, they use it in fact for internal purposes without qualms or difficulties. On the other hand, the Central Australians, the Fuegians and the Melanesians of Eastern New Guinea have a keen sense of individual property, yet they use no money or currency. The fact is that neither in primitive nor in advanced cultures is there any correlation between communism and absence of money. Under a system of rigid individual property, exchange takes place in the form of direct barter; in a highly developed economic organisation with money and banking systems, the community may control almost completely the resources of the individual and establish thorough-going communism.

It can be very seriously doubted whether Dr. Rivers has ever

proved that in some parts of the Western Pacific there exists communism and in others individualism, nor as we have seen is his statement that certain objects are money functionally correct. The absence of money on the other hand which Dr. Rivers explains by the existence of communism can be very simply accounted for by the absence of any need for it under primitive conditions. The moral of this criticism is that we need in Anthropology far greater precision in the use of terms and the definition of concepts and far richer and minuter observations on economic matters. We can dispense on the other hand with daring speculations about absence of property or presence of monetary systems in pre-historic Oceania.

Summary.—To sum up briefly, it is incorrect to assume that man for a long time has lived in a semi-natural primitive stage of individual acquisition of food and primary utilities. Equally untrue is the correlated assumption that he lifted himself out of this condition by the gradual application of the economic principle of maximum of effect for the minimum of effort. Instead, from the outset, artificial, cultural, non-instinctive aims have been indispensable to him and his culture. Early types of value and symbols of wealth have spurred him from the outset to economic effort. This effort is organised and standardised by tradition. The real problem, therefore, consists in gaining insight into the primitive forms of condensed wealth, into the mixture of motives and impulses which drive man and in studying the manner in which these primitive incentives control organised effective effort. All the conclusions arrived at show that for the discussion of economic problems it is necessary to consider the relations of early wealth to religion and to magic as well as its function in primitive social structure.

The borderland questions—the influence of economics on social structure; the problem of wealth as the foundation of rank, power and status; the rule of give-and-take in social obligations; ceremonial distribution of goods, and its economic importance—are gradually coming into the forefront of anthropological interest, and open up entirely new horizons in theory and field-work. They bring it into close contact with the disciplines of economics, history and sociology (Buecher, Schwiedland, M. Weber, K. Lamprecht).

The relation between the various larger aspects of culture opens a new type of problem. Social organisation is largely dependent upon economic foundations, while economics cannot be studied without a knowledge of the various groups within the tribe. Religion and magic are not independent, but are intimately associated with economic pursuits, with power and prestige, with domestic life and everyday necessities.

THE SUPERNATURAL

Here the functional view is put to its acid test. What can be the function of primitive belief and superstition, of animism considered as valueless, crude and mistaken, of magic, regarded as spurious and fallacious pseudo-science, of totemism, of barbarous burial ceremonies and of cruel initiation rites? Yet the method here set forth stands or falls with the possibility of defining the whole of the supernatural. It is bound to show in what way belief and ritual work for social integration, technical and economic efficiency, for culture as a whole—indirectly therefore for the biological and social welfare of each individual member.

The great majority of modern theories in fact come near to the posing of this problem and to its solution. It is implied in the whole structure of Frazer's *Golden Bough*, in the contributions of Westermarck to the moral side of religion, in Durkheim's analysis of the integrative function of public ceremonial, in the additions of Hubert and Mauss to his theories, in Marett's analysis of magic, in Crawley's vitalistic view of religion, above all, in the analysis of Andaman belief and ceremonial by A. Radcliffe-Brown. But too often the functional view is still smothered by evolutionary or historical discussions—as to whether magic preceded religion, as to what was the primitive form of religion, and so on.

Magic (*q.v.*).—The majority of theories dealing with magic range between two views that are apparently opposed, which label magic as primitive science or primitive stupidity (*Urdummheit*) respectively. We must reject the implication of the first theory, that magic preceded science, and that once it fulfilled that function. It must be placed to the credit of this theory, however, that it does full justice to the practical context of magic. The second theory emphasising the central conception of impersonal ubiquitous force—*mana, orenda, wakan*—rightly appreciates the difference between belief and knowledge; and brings out the mystical character of magic (Marett, Hubert and Mauss, Preuss).

The functional theory reconciles the two points of view. Let us start from the close association of magic with practical activities. First, every practical pursuit amongst savages is always primarily based upon knowledge and is never exclusively controlled by magic. There are in all savage cultures certain activities in which technical ability, guided by knowledge, completely suffices. In others, the help of magic is also invoked. What are the respective contributions of knowledge and of magic to such a mixed activity? In its essentials the division of function between the two is very simple; as far as his knowledge goes, as far as he can safely rely on experience, reason and technical ability, the native—whether in his gardening or fishing, the building of craft, in warfare or sailing—does not use magic. No savage has ever been observed to select the tree for his dug-out by divination, to bring forth seedings by formulae without having planted them. Only where, in spite of knowledge and effort, the results still turn unaccountably against him, only when forces completely beyond his mental grasp and practical control baffle him—in dealing with garden pests, with the supply of fish and animals, in securing favourable wind or weather, in preventing disaster at sea or in war, above all in dealing with bodily decay, disease or personal accidents—does the savage resort to supernatural means of filling the lacunae in his practical power.

The type of belief met in magic is always an affirmation of man's power to deal with the situation by a rite or spell. This belief simply repeats in a standardised manner, what hope all the time has whispered within the individual's own mind. Again, the rite repeats in a fixed, definite form what the natural expression of emotions already contains, only, as a rite, it is carried out with a purpose and with the conviction that it is a means to an end.

When we compare the forms of the fixed magical ritual, they are remarkably akin to the response of disturbed equilibrium occurring under similar conditions. Black magic, which corresponds to the sentiment of hate, and which replaces the outbursts of impotent rage, contains in its most typical ritual of stabbing, pointing the bone, mimic destruction, and in the text of its formulae, a reproduction of the various gestures, words and types of behaviour, which we can watch in the natural vent of the emotions. Exorcism of evil powers repeats in word and deed the reactions of fear.

In all practical activities, the goal is brought vividly before the mental vision at moments of uncertainty and suspense—a state of mind which we call "hope." Now magical ritual, which bridges over the fateful moments, invariably expresses the suggestions of hope and baffled desire. Sir J. Frazer's apposite term of "imitative magic" and his exhaustive illustrations of his point of view are another way of stating the present theory. Here it is only suggested that the association of "ideas," designated by Frazer as the cause of "imitative magic," can only be accounted for by our theory of imperfect biological adjustment induced by culture. Baffled instinct arouses emotional tension as well as a conflict of ideas and an impasse in conduct. Through magic, culture prescribes the adequate ideas, standardises the valuable emotional tone and establishes a line of conduct which carries man over the dangerous moment.

This new type of explanation, based on the functional method, shows how cultural behaviour, in the very act of bestowing immense benefits and advantages on man, also opens up new problems and creates new needs. To satisfy these a new type of behaviour, ritual practices, and a new mental adjustment, faith or mystical outlook, come into being, thus providing an answer to the question which is always essential: What actual benefit does magic confer upon man, what is its positive contribution to culture? It is a remedy for specific maladjustments and mental

conflicts, which culture creates in allowing man to transcend his biological equipment.

Social Consequences.—In its traditional aspect, magic leads to important social consequences. It is the essence of magical lore that every word of a formula must be spoken correctly, without omission or alteration, every detail of the rite performed. Since magical knowledge can live only in man's memory, the correct transmission, the legitimate filiation of magic are essential to man's confidence in its efficiency. The inheritance of magic is always one of the most important problems of descent and of the modes of reckoning kinship. As a rule, magic is handed on within the family circle.

In this connection it is important to stress that *all* forms of magic usually perform an important social role. No magic can be regarded as anti-social in the sense in which Durkheim and his school attempt to define it. Even sorcery or black magic functions as a legitimate though dangerous weapon, of which one of the main uses is the enforcing of an established power and the biddings of law. The actual manner in which magic is connected with practical activities makes it, as we have seen, the very skeleton of economic organisation. It supplies most of the co-ordinating and driving forces of labour, it develops the qualities of forethought, of order, of steadiness and punctuality, which are essential to all successful enterprise. Thus magic fulfils an indispensable function within culture. It satisfies a definite need which cannot be satisfied by any other factor of primitive civilisation.

Totemism.—Totemism (*q.v.*) is a belief which affirms an intimate bond between a group of men and an animal or vegetable species, or sometimes a class of objects. It raises therefore two problems, the first as to the nature of the belief, the second as to the social organisation with which it is linked.

Most theories have seen its origin in some small or accidental detail of social organisation or belief, as in nicknames, guardian spirits, transmigration of souls and, recently, in the Freudian theory of parricide. To the functional theory the real problem, however, is: what is the function of a type of belief which affirms the affinity between man and animal, is correlated with clan organisation, and leads to moral and ritual rules associated with the multiplication, killing and eating of animals?

Man's interest in his surroundings is primarily practical. He has to collect food, construct his dwelling and roam about his district to hunt or fish. In the forefront of importance are the animals in his territory—those which feed him, those whose skins clothe him, whose feathers, teeth and claws supply him with ornaments and those which threaten his safety or comfort. Hence all animal life has an intense interest and significance for him.

Now in dealing with the animal kingdom, in obtaining the useful and defending himself against the dangerous or repulsive species, primitive man, where his natural means fail him has recourse to the supernatural. The magical claims over any aspect of nature lead always to an assertion of a sort of affinity or kinship between the magician and the object controlled. Indeed most magic implies mythological descent from animals or affiliation to them. Thus we see that the native's practical interest in the animal or vegetable kingdom leads through magic directly to the assertion of a mutual bond.

Magic has a tendency to become specialised and departmental, exclusive and hereditary in a kinship group or clan. The subdivision of the tribe into totemic clans seems to be best explained therefore, by the hypothesis that such clans were originally magical bodies engaged in controlling, through spell and rite, certain animal or vegetable species for the welfare of the tribe.

Thus is assigned to totemism a definite cultural function. Selective interest in vitally relevant factors of the environment, man's capacity to control it, are embodied in a system of beliefs which standardise, enhance and sacralise these culturally valuable mental states. By endorsing man's confidence and his hopes of effective control, by making these tendencies substantial in an explicit mythological dogma, totemism contributes to individual happiness, to social cohesion and to the general efficiency of culture.

In recent work (Frazer, Crawley, Van Gennep, Miss Jane Harrison) much stress has been laid upon the association of religion with the crises of life. In fact in most religions, savage or civilised, the main phases of human life history—conception and pregnancy, birth and puberty, marriage and death—are associated with belief, ritual and mythological stories. Religion therefore fulfils at vital crises an indispensable function in the scheme of human culture.

Culture entails a transformation of direct instinctive response into a mode of behaviour governed by purposive ends, that is, by cultural values. But here in the very act of bestowing her blessings, culture heaps up burdens and creates difficulties. The fruit of knowledge is a dangerous thing, and in giving man forethought, culture gives him also the terrors and pangs of despondency; it makes him probe into his own destiny, and ponder over the ultimate things of human existence. Belief in immortality, early ideas of spirits, gods and beneficent powers, give man comfort and dispel his early misgivings. The role of religion consists in the establishment of spiritual ends, dogmatic realities and moral rules of conduct. In totemism, which sacralises important factors of the environment; in the belief in immortality and in the associated ideas about communion with spirits and their influence on human fate; in the consecration of food and of indispensable elements of culture, such as fire, standard implements, tokens of wealth; in surrounding tribal tradition and order with the halo of sanctity, religion is the source of social and cultural values. Again since man is to adventure in pursuits for which he is not equipped instinctively—to move through water, jungle and desert, to invade and conquer cold, arid and tropical places—culture has to provide him with a mental force to carry him across the gaps in instinctive endowment. The necessary confidence in his own powers of controlling his environment by spell and rite are given to man in magic.

PRIMITIVE KNOWLEDGE

Reason, the capacity to know, to invent and to evolve theories, has been regarded as the distinctive mark of man, dividing Homo sapiens from other living beings. Perhaps over-confident exaggeration of this has led to the recent reaction which denies to the primitive mind any power of reasoning and of observation.

But had primitive technique been studied not as a self-contained object, but in its functional dependence upon knowledge on the one hand and magic on the other, the theory of a primitive mystical and prelogical mentality could never have been erected. Primitive man shows a rational behaviour, an unimpeachable logic and a definite power of empirical observation, not only in his technology, but also in his major economic pursuits and in his sociological behaviour.

Language.—This subject has been so far but imperfectly studied by anthropologists, and its cultural theory is as yet hardly outlined. The study of dead languages by grammarians and philologists has caused speech to be regarded as a self-contained phenomenon governed by special laws of its own. It was a considerable step forward when, some time ago, the study of language was taken up by psychologists, who began to treat it in correlation with thought and other phenomena (Lazarus, Steinthal, Wundt). The structural features of language were explained as an adequate expression of reasoning, of emotional states, of aesthetic needs and of the characteristics of the human will. Even this, however, is not sufficient.

Recent developments in linguistics, as well as in the philosophy of language, have set forth the view that language cannot at any stage of development be regarded as an adequate expression of logical, metaphysical, aesthetic or scientific categories (J. Dewey, Jespersen, Ogden and Richards). Language, in all societies and at all stages of development, is an essential part of human action (Dewey). Communication by spoken word is indispensable for any concerted activity and enters into all aspects of culture as a working element. (*See* LANGUAGE.)

From the functional point of view, a word which designates an implement is as much an essential manner of using that implement as is any type of bodily skill required to handle it. The master of a craft, however primitive, must be able to give his

orders in case of emergency in a technically adequate and theoretically correct manner, and the bodily reactions of his vocal apparatus are as essential to the practical issue as the manual dexterity of his crew. Language plays a similar part in warfare, in economic pursuits, in ceremonial activities. In religious and magical ritual, the spoken word is conceived and felt by man to be a creative act which produces a definite practical effect.

But if speech, in its primitive forms, is an indispensable instrument of cultural behaviour, its structure must be correlated to pragmatic needs and to the requirements of action rather than to logical, reflective or oratorical necessities. Hence the categories of primitive speech must be a compromise between rational and logical conditions, sociological and practical needs, and certain limitations imposed by material culture.

The problem of meaning cannot be treated by the study of language, torn out of its cultural context. The classical philologist has already summoned the archaeologist to his assistance. The study of living languages of the primitive type, helped out by the study of living cultures, would, no doubt, reveal to us infinitely more than can be reached by the study of dead speech. A word is as sterile without the knowledge of how it is used in live context, as behaviour remains mysterious without its accompanying flow of speech. Life is neither verbiage nor a pantomime. Speech has been given man for action, and as mere loquacity it is a disease of culture. (*See* PHILOLOGY.)

Mythology as Primitive Science. (*See* MYTHOLOGY.)—In order to vindicate the autonomy of knowledge within primitive culture, it is still necessary to deal with the view that, at low levels of culture, myth is a substitute for science. We read in the authoritative handbook already mentioned:—

Myths are stories which, however marvellous and improbable to us, are nevertheless related in all good faith, because they are intended or believed by the teller, to explain by means of something concrete and intelligible, an abstract idea, or such vague and difficult conceptions as creation, death, distinctions of race or animal species, the different occupations of men and women; the origins of rites and customs, or striking natural objects or prehistoric monuments; the meaning of the names of persons and places. Such stories are sometimes described as *aetiological,* because their purpose is to explain why something exists or happens (*Notes and Queries,* pp. 210 and 211).

We are thus told that primitive man evolves stories and believes in them, in order to explain abstract ideas. As a matter of fact myth is not a form of primitive science, but an aspect of religion, magic and morality; its function is not to explain queries nor to illuminate abstract or obscure points, but to strengthen belief, to substantiate morals and to enhance tradition, in short to bring home to primitive man all that has to be believed, obeyed and accepted (B. Malinowski, *Myth*).

To establish our point, we have to place myth within the scheme of primitive culture and to show its pragmatic function. Myth is a part of folklore in the narrower sense of the word, that is of oral tradition. Man in all ages and all climes possesses a body of concrete stories which can be readily divided into several classes.

Of these, the first serves predominantly for amusement and recreation. Stories of this class describe more or less dramatic or funny adventures of men and animals, ogres and hobgoblins, none of which are regarded as real. Such tales, when studied within their cultural context and regarded from the native point of view are found to play an important part in native life, in that they enhance sociability, fill out seasons of enforced idleness or make up the substance of amicable gatherings.

Another class of stories, taken more seriously, refer to important exploits and heroic deeds of past generations and are considered to be true. The sociological function of such stories is that they develop family pride, knit kinship bonds more firmly and serve to increase communal or tribal solidarity.

There are finally stories which are regarded as sacred and connected in a specific manner with magical and religious cult, with social organisation and with the body of tribal custom and moral rules. These and these only could be regarded as "explanatory" stories, in that among other subjects, they account for the origin of the world, give the reasons for death, furnish revelations of future existence, and promise immortality, narrate the beginnings of magic, and so on. The explanatory character, however, is prominent only as long as the story is considered without its cultural context. In all cases where the associated ideas and feelings have been observed; where we know the conditions under which the myth is recited or enacted; above all where the practical influence of the myth has been studied—we are able to assign a definite cultural function to it. Thus, in connection with magic, we find stories which are not intended to *explain* the ritual or the phenomenon governed by magic, but are meant to substantiate the belief in magical efficiency. All such stories give us an account of an extremely successful, miraculous precedent. Around the various religious rites and ceremonies, there cluster stories which vouch for the efficiency of the religious acts in obtaining the desired effect.

Again, we have a class of myths which confirm the existence of privileges, give the antecedents of rank and power, or enforce duties and which, in general, strengthen traditional law and order. Wherever myth, that is a sacred story, has been studied in connection with the sources of its sanctity as well as with its sacralising results, it can be shown that it has served to strengthen faith by reference to an original Golden Age, to miraculous precedents in the dim past. The study of myth in conjunction with ritual and institution has been carried out only in limited areas; *e.g.,* in the Andaman islands (A. Radcliffe-Brown), in Central Australia (Spencer and Gillen), in Melanesia (B. Malinowski), in Northwestern America (Boas and others), in Polynesia (Elsdon Best). All the facts we know, however, prove that myth is in no way comparable to primitive science, but that instead it functions as a religious warrant, vouching for the truth of belief, the efficacy of ritual, and the fitness and justice of moral or social duty.

THE IDENTIFICATION OF CULTURE

The functional method seems at first sight to be of especially easy application to artifacts, to material objects fashioned by man for his cultural uses. Food stuffs ready for consumption, man's equipment in protective shelter and clothing, his tools and weapons, are all obviously means to an end.

The Place of Artifacts in Culture.—But this very facility has its dangers. The purposive character of most artifacts has made the *implement* into the typical representative of material objects; hence, all these have generally been regarded as representing the *technique* of culture. It is deemed sufficient to state how these objects are *made* and how they are *handled.* In *Notes and Queries* one-third is devoted to "technology," the description of manual production and of the handling of artifacts. In the *Handbook of Folklore,* this study is defined as an anthropology with technological considerations cut out. All this is incorrect, since "material culture" is not an autonomous, self-contained province of culture, such as religion, law or economics, each of which fulfils a specific function. Material culture is an indispensable accessory of every single aspect, every pursuit and institution, and thus fulfils a general function.

On the other hand, the bald technological treatment is not sufficient to do justice to any class of artifacts. The objects of immediate consumption or use, as well as tools and implements, are essentially correlated to economics and must be studied within its context. The proper analysis of a weapon immediately leads to the description of the manner in which it is wielded, thus to the methods of warfare and war magic and, finally, to the political organisation of the tribe.

There is no single type of human activity without its material accessories. There is not one artifact, however practical or simple, which could be properly understood without its context of living culture, including belief as well as technique, social organisation as well as traditional knowledge.

Once we begin to define form by function, the two categories of meaningless form and of fortuitous coincidence break down completely. An object can be defined and identified only by its use, the study of use leads us again to connect the object with the pursuit, the institution, the aspect. The real identities of

culture appear to lie in the organic connection of its parts, in the function which a detail fulfils within its scheme, in the relation between the scheme, the environment and the human needs. Meaningless details disappear, shape becomes alive with meaning and with function, and a testimony of irrelevant form falls away as worthless. The method of formal treatment breaks down completely.

Summary.—The outer framework of material culture is correlated in a clear and direct manner to the satisfaction of man's biological needs. It constitutes the *milieu* which man evolves to interpose between himself and the rigours, dangers and insufficiencies of his physical surroundings. But this material apparatus has to be operated by men collectively, organised and controlled by the body of tradition, scientific as well as religious and magical. Thus indirectly most elements of social cohesion as well as certain beliefs and ideas can be correlated with man's primary needs, and explained by the biological function which they fulfil and the survival value which they possess. But this is not sufficient, and here an extremely important addition has to be made: the facts of social organisation impose certain conditions upon human behaviour, imply restrictions and create new wants, which again call forth specific cultural arrangements. Thus, higher forms of organised labour need some compulsion, supplied by political inequalities, and some moral framework, supplied by certain forms of magic.

Mental development running side by side with higher technical ability brings about fear, thought and reflection which make man anticipate his destiny and probe into the past and future of his world. The beliefs of primitive man about future life, the beginnings of the world and spiritual powers have to be correlated with his increasing mental outlook as well as with the widening social horizon and the development of cultural values. Social cohesion requires some means of enforcing the various rules imposed upon the individual for the common good, and this brings about the sanctions and inducements, which constitute the essence of primitive law. In all this the functional view avoids the effort of attributing priority to any one aspect of culture. Material objects, social grouping, traditional and moral values, as well as knowledge, are all welded into a functional system. To explain any item of culture, material or moral, means to indicate its functional place within an institution, which has to be thus explained with reference to its aspect and this again has to be placed within the system of culture.

Finally, anthropology hopes, with the help of her sister sciences, to state the place of culture in the scheme of organic evolution; to show how it is correlated to the instinctive animal equipment of the human species; to demonstrate how it has allowed man to rise above the brute level, to control his surroundings, to develop his knowledge, his faith and his conscience.

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SOCIAL ARCHITECTURE comprises all buildings for human residence, recreation, entertainment or health. In this work, several of these are discussed under their own headings; thus the reader should also consult HOSPITAL PLANNING, HOUSE PLANNING, STADIUM, and THEATRE ARCHITECTURE. This article is concerned with contemporary developments, in the designing of private dwellings, apartment houses (flats), and hotels in Europe and the United States. *See* also ARCHITECTURE and the comprehensive list of related articles under the heading ARCHITECTURAL ARTICLES. (X.)

I. DOMESTIC ARCHITECTURE IN EUROPE

Domestic buildings have always furnished a clue to the manner of life of their inhabitants; first of the individual, then of the community of individuals, and finally of that grouping of com-

munities which forms a nation. They are something almost of the soil, since they are so much something of the race. Domestic architecture has always reacted to outside influences, but fundamentally it has developed in a much more local way. Each section of a country, with its own individual habits and traditions of living, has had its local expression of domestic architecture, and yet all these varied expressions have had something in common, namely a reflection of the mental outlook and the physical customs of each individual race of peoples. Outside influences have tinged development, but no one country has ever completely mislaid the national characteristics of its home building. Very gradually, however, as international relations have increased, the barriers of race have been lowered, and the domestic architecture of one country has reacted increasingly to the influences of another. To-day intellectual movements spread with growing rapidity. Interchange of ideas makes for greater community of outlook; and in architecture there have crept in certain features which are a common expression of requirements shared by people in many countries.

England.—English domestic architecture provides an illustration of this theory, though house building in Great Britain has for so long set a standard to the world that it has itself been a main source of inspiration, and as such has latterly been comparatively immune from foreign influences. Prof. Santayana, in his essay on "English Architecture," mentions that "strictly speaking, there is no English architecture at all, only foreign architecture adapted and domesticated in England. But how thoroughly and admirably domesticated. . . . How gently, for instance, how pleasantly, the wave of Italian architecture broke on these grassy shores!" This appreciation is a very true one. Foreign influences, beginning in Norman times, working through the various phases of Mediaevalism, and the Dutch and Italian importations, to the periods of Classic Revival, have all left their mark on English domestic architecture. But always these influences have been absorbed and transmuted into something so removed from the original prototype that the result has become a national expression.

English domestic architecture stands pre-eminent; and that is largely owing to the presence, from whatever influences derived, of certain precious and peculiar qualities: a natural and unaffected use of beautiful materials; an intimate sense of scale, bringing English homes into a beautiful relationship with the countryside; a simplicity which rejects pretention and pomp. The home is a place designed to live in, and not primarily to receive in. England's Jacobean and Queen Anne houses are at once naïve, friendly and intimate, with touches of quiet fancy in the detail of tall gables, chimneys and carved panelling. In Georgian houses there is a warm friendly brickwork, an air of breeding and gentility in the quiet formality of the charming fronts behind which lie rooms at once so convenient in shape and so affable in decoration. In the 18th century there is just a touch of pedantry, which is less display of learning than intellectual good humour; then comes the period just preceding our own times, which has provided the one real menace to a continuity of fine tradition. This break was due to a variety of causes: to a 19th century "revival" of Greek and Roman architecture, from which resulted the outcrop of pseudo-Italian "villas"; to the teachings of Ruskin as misinterpreted first by an eager band of seekers after architectural truth, and afterwards by speculating builders. Or, which is more likely, to the change in social conditions brought about by the great industrial era of the 19th century, dominated by the advent of machinery and characterized by a degradation of the human ideal. Architecture reflected the human characteristics of the time and these were not of the type which would promote beautiful qualities in architecture.

This period has finally ended through a series of sane reactions, brought about by a change of outlook. Three men took a prominent part in this reaction, and their influence is responsible to a large degree for the present high standard of English work, based once more on the national traditions which respect locality and materials and pleasant manners as attributes of house building. These men were Philip Webb, Eden Nesfield and Norman Shaw, who evolved, severally, a type of architecture which inspired many architects to carry on the work of restoring English domestic building to its former high estate. Webb and Nesfield designed in a personal way, particularly the former. His work had at times a Gothic flavour, yet it reflected the more vital influences of his day, when William Morris was becoming a power in the field of art. Webb collaborated with Morris, and his first important house, the "Red House" at Bexley Heath (1859), was designed for Morris himself. This house reflected a mixture of both Gothic and Renaissance, and in its freedom of treatment marked the beginning of a modern school of design. Nesfield also passed through a Gothic phase, and later worked in a free style which was inspired by the Renaissance and the 18th century. He designed in particular, in 1866, a house in the Queen Anne manner which had a considerable influence in popularizing this dignified and homely style amongst younger architects. Norman Shaw was an architect who designed according to the requirements of character and site, and his work ranges from romantic blendings of brick, stone and half-timber, to the dignified simplicity of such plain London fronts as are found in Lowther Lodge in Kensington and his houses in Queen Anne's Gate. In his small houses in Bedford Park, Shaw set a model for dignified design in estate development.

Greatly influenced by Norman Shaw, the late Ernest Newton maintained a high standard in domestic work which was always simple and generally rather formal. His work was less personal than that of his well-known contemporary, Sir Ernest George, whose houses sometimes reflected foreign influences. Pre-eminent to-day stands Sir Edwin Lutyens, who has designed in nearly every material, and has touched the keynote of nearly every traditional English style. Guy Dawber's interesting houses are designed in the simple picturesque idiom—with stone walls and slate roofs—of the Cotswold district, Gloucestershire. Sir Edwin Lutyens and Guy Dawber typify the best English domestic designers, who prefer to use the materials and idiom of the locality where they build.

There is to-day a movement towards larger windows and a reduction in the actual size of houses, which has led to designs that depend less on wall surface and more on window grouping. Coupled with this external effect is a great improvement in planning, great compactness and arrangements for "labour saving" through the elimination of long passages and badly lit spaces. The design of English homes has become more scientific, and with this is a tendency, somewhat pronounced amongst younger architects, to design in a formal manner, the external treatment tending to a type of Georgian rather than to the picturesque type. This is largely due to the abuse of the latter in the hands of speculating builders. In small and large country houses, and in the homes in the "garden suburbs" and "garden villages," estates which are laid out to provide ideal conditions of domestic life, English architects are without superiors. Town houses are well designed, combining 18th century elegance with modern conveniences. The advanced modern movement, with its cubist tendencies, has made little headway in England. There are, however, a few examples, such as the houses designed on the Silver End Estate, near Braintree, by Thomas Tait. This type of house is not, however, particularly well adapted to the English country-side, and presents few practical advantages over the traditional type of house which has developed so naturally from local materials and requirements.

France.—France is a country which offers widely varying climatic conditions. These directly affect the type of domestic architecture; in the south is a warm climate, and we find a typical southern architecture of flat tile roofs, simple thick walls, shuttered windows and shaded eaves. In the north we find steep roofs and an architectural treatment which by its own richness attempts to impart the warmth and interest which the southern sun supplies. Yet in north and south alike we find common characteristics which are national.

In the France of former days, farms, manors or châteaux formed the bulk of the larger detached country residences, and for the rest domestic life was lived in villages in which the houses often formed a continuous street. Community life flourished in French towns and villages, and it has developed in modern times

into life in the large and small apartment houses which form the bulk of domestic building in larger French cities. To-day the château has given way to something more approaching the large English or American country house; the house of the notary or the doctor still remains to recall the architecture of the châteaux, in whose image it was so often built. The town houses of the aristocracy, which were in reality châteaux in town, separated from the street by a courtyard and stables with their main frontage on the garden beyond, have been replaced by the smaller town house, the *hôtel particulier,* not unlike the London town house in scope of accommodation, but very often an entirely detached and independent unit.

Whatever the category of building, practically every French home reflects a dominant French characteristic, the taste for an architectural arrangement permitting a certain degree of grandeur and display. This may perhaps be traced back to the traditions of French court life, the magnificence of Louis XIV. and Versailles. Certainly the homes of the French nobility reflected it in the formality of their planning. In modern French planning the tradition of splendour still persists. The French house takes definite account of the division of the plan into several units, those of reception, of living, of service. Each unit is treated characteristically and logically. The reception suite is open, with symmetrical rooms, wide doors from room to room, and more openings than wall space. Effect, not comfort, is the first consideration. The living quarters are more modest, and the services still more so. The best rooms are for reception; and inadequacy in this respect is rare.

In recent years, however, the English and American idea of comfort has permeated French ideas, particularly in the planning of apartment houses, in the design of which French architects have reached a high standard of attainment. The plans of the latest apartment buildings are remarkable for the easy and skilful arrangement of their rooms, for the clever utilization of often awkward sites and for the excellence of their services and sanitary conveniences. The entrance vestibule from the street and the main staircase are as a rule handsomely proportioned and excellent in the detail of their stucco and ironwork, and in the apartments themselves halls, corridors and cupboard spaces are usually on a generous scale.

The exterior of the typical modern apartment house shows a development from the 18th century or Louis XIII. type of front, of stone, or brick and stone, simple in general lines, crowned with a cornice and slated mansard roof, and relieved by carving and the excellent ironwork of the balconies. The latest tendency is, however, away from this classic type. Flat bay windows often continue up the whole height of the façade, and the roof line is broken up by receding planes with balconies and elaborate dormer windows. French building stone is soft enough to encourage carving, and the modern French apartment house has generally exhibited an abundance of carved enrichment, though the most recent tendency is toward a return to simplicity of treatment. The best examples occur in Paris, where there are many fine new apartment buildings erected in the quarter of the Etoile, Passy, Champ de Mars and Montparnasse. Some of the most stimulating examples are by the architect Henri Sauvage. German and Austrian influences have had their effect on these designs, which have in turn reflected the Art Nouveau and the sterner modern movement; but a certain lightness of handling in mass and detail has always remained in evidence.

The town house or *hôtel particulier* is tending to-day towards a modern character which rejects traditional forms. Large windows, plain surfaces and a general rigidity of form are in evidence, and a group of young architects, headed by such men as Le Corbusier, Mallet Stevens and André Lurçat, is erecting town houses in Paris and elsewhere which have little affinity with French tradition.

In respect of villas and country houses the same tendency is noticeable. At first inspired by local types, such as the tile roofed and half timbered houses of Normandy, the Provençal farms with their stone walls and flat tiled roofs, or the gabled and turreted buildings of the château country of Touraine, the French villa was a not always agreeable modern replica of a fine prototype. The modern movement has spread to a small extent to the villa and country residence, particularly in the south, where it is exemplified in the cubist houses of such designers as Djo-Bourgeois, which with their white walls, rectangular forms and flat roofs, recall the architecture of Tunis and Algiers.

French domestic architecture has undoubtedly been largely influenced by the academic training of the Ecole des Beaux-Arts: to its tradition in formal planning and design in the grand manner it owes its best feature, spacious and easy planning, and also its worst characteristics, which are an undue emphasis of architectural features, often unwise sacrifices to the principle of formal planning, and the retention in small work of architectural elements and embellishments which are more appropriate to a monumental building than to one of domestic character.

Germany.—The termination of the war of 1870 found German domestic architecture without a general directive tendency. On the one hand were those imbued with the ideals of the classic spirit, influenced by the public buildings of great exponents such as Schinkel, Semper and Von Klenze; on the other a group of romanticists inspired by the mediaeval spirit. The result has been a development along these two lines: buildings either in the style of a classical revival, or in continuance of the 18th century tradition; or in a free picturesque manner which has varied between serious renditions of mediaeval type and architecture of the pseudo-romantic type recalling the castles of the Rhineland. Into this war of ideals in expression has been interjected a third powerful influence, that of English domestic architecture, which was introduced into Germany largely through the efforts of the architect Hermann Muthesius, who was imbued with a strong belief in the creed of William Morris and believed that in the architecture of the traditional English house would be found the most fitting inspiration for modern Germany. At present there tends to be a reaction against the English influence, and two schools of thought predominate. On the one hand are those who look to German 18th century architecture for inspiration, on the other the extreme modernists, who are concerned less with style than with principles.

Amongst the architects who have carried out distinguished work on more or less traditional lines may be cited Ludwig Hoffmann, Alfred Messel, Paul Mebes, Albert Gessner and Bruno Paul. English influences are sometimes apparent in the houses of Hermann Muthesius, as in those of Theodor Merrill, Hans Liepe, Paul Bonatz, Heinz Lassen, Otto Bartning and others of the modern German school. There is no type of domestic architecture which can be classified as typical of Germany; as a rule however German domestic work is characterized by somewhat squat proportions, a certain massive quality of composition, emphatic roofs and heavy eaves. The tendency is towards solidity, and there is a general absence of light or fanciful detail.

Since 1914 there have been some interesting developments. A new school of architectural thought was in being prior to the World War, and manifested itself at the Cologne exhibition of 1914. Its tendencies were towards complete freedom in design, a return to the consideration of form, structure and practical requirements as the most important factors in architectural design. This movement, typifying an intellectual reaction against the often illogical restrictions imposed upon design by adherence to a chosen style, has been fostered by post-War conditions which imposed the strictest economy in building. The new architecture, reverting in its masses to the geometric constituents of architectural form, was well adapted to the demands of economy. As a result, in Germany at the present day there exists a school of architects whose work is completely modern in ideals, and has in consequence many points of similarity with that of modernists in other countries such as France, Holland and Austria.

Amongst architects of this modern school may be cited Arthur Korn, Peter Behrens, Richard Döcker, Walter Gropius, Ludwig Hilbersheimer, Mies van der Rohe, Hans Poelzig, Max Taut, Bruno Taut and Erich Mendelsohn. Their designs differ in character and expression, but in the majority of cases they have in common simple geometric masses, plain wall surfaces, large windows—as a rule in metal—flat roofs and an almost complete

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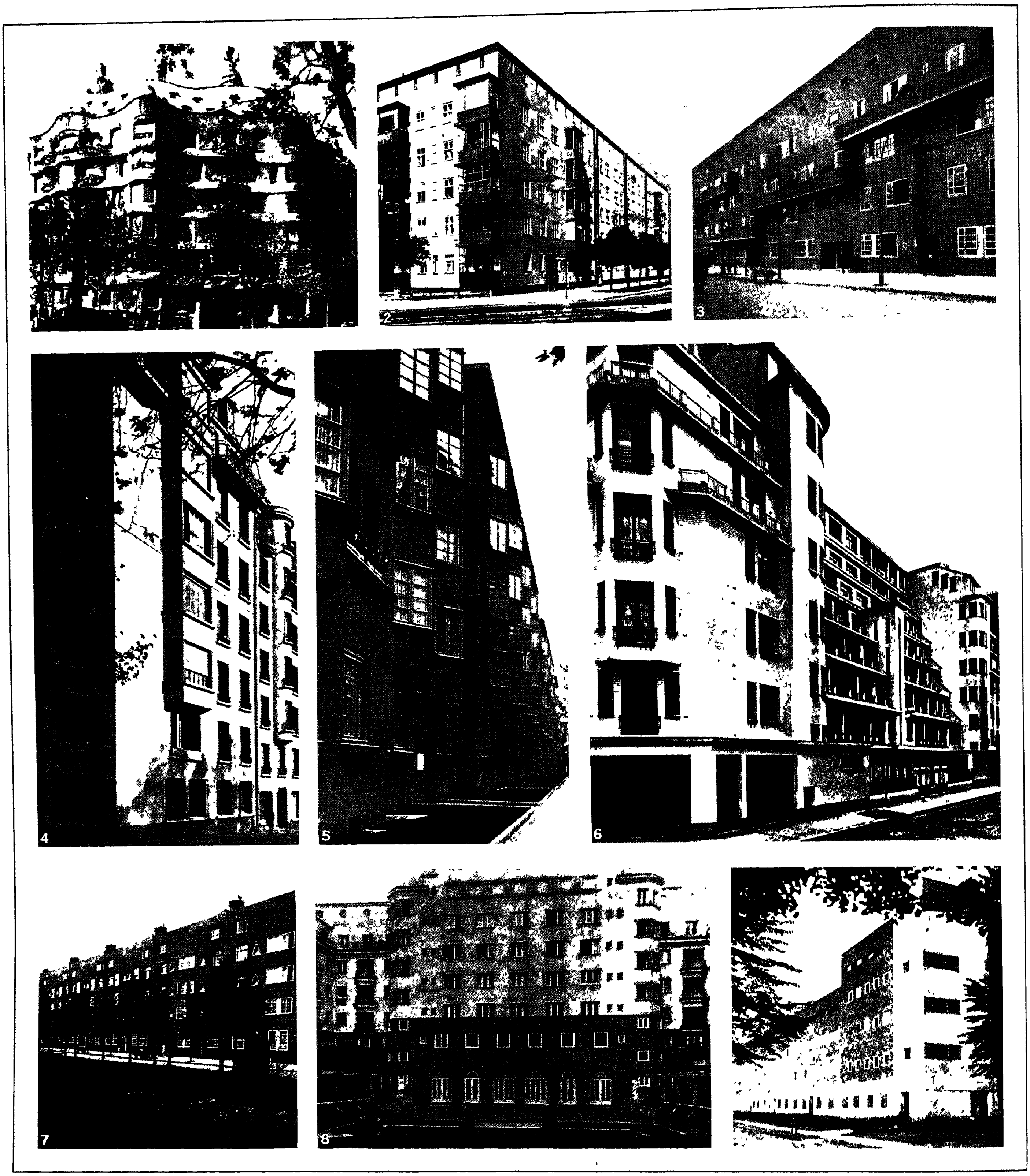
CONTINENTAL AND ENGLISH MODERN SOCIAL ARCHITECTURE

1. Suburbs of Amsterdam showing row of modern apartment houses occupied by labourers' families. Built entirely of brick, a favourite medium of the modernist designer in Holland; each unit uses the tapering silhouette and is separated by new style smoke stacks. M. De Klerk, architect
2. Villa Sonja Knips, Vienna, Austria. Joseph Hoffman, architect
3. Flats in Berlin. Eric Mendelsohn, architect
4. Two family house with garage below. A housing method at Pessac, Gironde, France. Le Corbusier and Jeanneret, architects
5. Concrete houses at Frankfort-on-Main, Hesse-Nassau, Prussia
6. Haus Wenhold, Bremen. View of the garden. E. Fahrenkamp, architect
7. Modern French domestic architecture in concrete, Paris. Robert Mallet Stevens, architect
8. House at Silver End Village, N. Braintree, Essex, England. Thomas S. Tait of Sir John Burnet and Partners, architect
9. Entrance front "Grey Roofs," Epping, Essex, England. Oswald P. Milne, architect
10. Street façade, Maison de rapport Michel. André Lurçat, architect

SOCIAL ARCHITECTURE



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DEVELOPMENT IN EUROPEAN APARTMENT HOUSE BUILDING

1. Barcelona, Spain. Apartment house. Gandi, architect
2. Berlin. Modern apartment houses. Paul Emmerich and Paul Mebes, architects
3. Amsterdam, Holland. Row of houses by M. De Klerk, architect
4. Berlin. An apartment building reflecting the modern tendency towards wider openings and slender supports. F. Vannier, architect
5. Berlin. Companion block to that in fig. 4
6. Paris. Block of labouring class tenement flats. A. Sauvage, architect
7. Amsterdam. Type of modern dwellings for workingmen encouraged by the Dutch government. The conventional type of window is alternated with new pointed arched ones. M. De Klerk, architect
8. Vienna. Municipal flats planned by the city architectural dept.
9. Pankow, suburb of Berlin. A new apartment house by Dr. Erwin Gutkind, architect

absence of ornament. The work of Mendelsohn is in some directions the most original, but he is better known for his commercial than domestic work (*see* INDUSTRIAL ARCHITECTURE).

The new architecture ranges in expression between complete disregard of tradition and a type of design retaining simplicity while accepting certain traditional forms; in this latter category is the work of E. Fahrenkamp, O. Haesler and Thilo Schoder. That of the extremists in modernism was exemplified in an interesting manner at the Stuttgart exhibition of 1927, where houses by modern designers from Germany and other Continental countries were erected as an illustration of the contribution of modern architects towards the solution of the housing problem. The houses erected were in many cases too strange in conception to make a popular appeal, but as a practical experiment they undoubtedly served a useful purpose in providing data for the future. The standard of comfort and equipment in German domestic work generally is second only to that of the United States and—in respect of housing—England.

Holland and Belgium.—The Dutch architecture of tradition, like that of other European countries, is blended of mediaeval and classic or Renaissance influences. In domestic work its best and most characteristic expression is typified by the tall and elegant 18th century houses which line the canals of Amsterdam, and the crowstepped or curly gabled façades which reflect the earlier traditions. In the 19th century, and up to the commencement of the 20th century, these traditions were maintained, but with a gradual debasement as the spirit of individual craftsmanship and fine design became commercialized under the stress of modern conditions. The result of this degeneration was a reaction against tradition, a desire to create afresh in harmony with modern methods of building and commercialized production. An important stage in this phase of reaction was marked by the building in 1898–1903 of the Bourse in Amsterdam by H. P. Berlage, a building marked by simplicity and sincerity, depending for its interest on a straightforward outward expression of its plan and structure. Its material of construction (brick), maintained the Dutch tradition of fine brickwork, but in style it had greater affinities with a simple Romanesque architecture (*q.v.*) than with that of the Dutch Renaissance (*see* RENAISSANCE ARCHITECTURE). This building had great influence on Dutch work generally, and largely to the work of Berlage and his followers can be traced the most characteristic modern Dutch development.

The best contemporary Dutch domestic work varies between a version of traditional design, simplified and modernized, and a very modern architecture which is seen in its most characteristic form in the new housing schemes carried out in Amsterdam, Rotterdam and The Hague since 1918. In each case there is affinity with old work in the use of brick and tiles as materials, and in the painting of doors and shutters in gay colours. The new work depends for its effect on strong modelling of form, on the grouping of windows in long continuous lines, on simplicity in matters of decoration. Flat roofs are almost universal, windows are often placed on the angles of the façades and small details are sometimes given an eccentric turn in design which is not always pleasing. Strength and vigour, however, and a sense of rhythm and breadth, mark the new work and overshadow defects of detail, as in the buildings of such architects as J. J. Oud, P. L. Kramer, M. de Klerk, D. Greiner, J. F. Staal, P. C. de Bazel and W. Dudok.

Belgian architects have turned, like those of Holland, towards the modern movement. There are some interesting examples of private houses in Brussels and elsewhere, tending towards cubism and a general severity of line. Amongst architects who are producing interesting domestic work are Victor Bourgeois, A. Francken, Huib Hoste and Alfred Nyst. Apartment houses reach a good standard in Belgium, and in Brussels are some new buildings which are very up to date in equipment and luxury, in some cases containing baths, dance halls, cinemas, post office and shops, available to the tenants and the outside public.

Scandinavia and Finland.—In Norway, Sweden and Finland, there exists an interesting tradition of an architecture of wood. This has developed to-day into a domestic architecture which ranges from houses which have something in common with Dutch and Swiss architecture of a similar category to a class of substantial and well designed work which reflects the 18th century tradition more than any other.

In Norway are some excellent private houses constructed of wood, with vertical boarding as a covering and roofs of tile, with, in their details, a rococo feeling recalling the English Jacobean (*see* JACOBEAN STYLE); and there is also some good and simple modern work in brick.

Norwegian architects, such as Harold Hals, T. Astrup and A. Arneberg, have not achieved the international reputation of their Swedish confrères, who have carried out domestic and housing work which owes much to the 18th century, and Denmark in particular, but which is nevertheless modern in spirit. Ragnar Ostberg, Arvid Bjerke, Erik Lallerstedt and Ivar Tengbom are designers who have carried out houses of simple outline, fine proportions and charming detail. Swedish work is less heavy than that of Central Europe, and its modern buildings are unmarred by eccentricity.

Finnish domestic work has felt, to its detriment, the influence of the German version of the Art Nouveau movement, which resulted in an outcrop of extravagant shapes and florid decorations. In recent years, however, there has been a reaction towards a sterner architecture, and in Helsingfors and Abo are some good designs in brick and stone which are inspired in form either by classic or Romanesque tradition, but which in detail still reflect traces of 19th century German influences. Eliel Saarinen, Lars Sonck and Armas Lindgren are designers who are helping to create a modern Finnish national style, characterized by strength, but also by a crudeness which may be partially attributed to the extensive use of granite.

The most recent work of the younger school of Danish architects is tending towards a restraint and simplicity which approaches baldness, decoration being eschewed, with effect depending upon the interest of walls, roofs and openings. This work is always distinguished, but at times devoid of vitality. Paul Holsoe, Sven Risom, Paul Baumann, Aage Rafn and Kay Fisker are designers whose domestic work stands comparison with any in Europe.

Other Countries.—In domestic architecture the finest contribution of Austria is towards the solution of the housing problem, for in Vienna have been erected many large blocks of flats for the working classes which are excellent alike in equipment and architectural style. Provision of light and air, numerous balconies, fine courtyards, gardens and children's playgrounds are features of these new dwellings, which externally are simply designed in large blocks, depending on white walls and well grouped windows for their chief effect. In the realm of private houses are some interesting modern versions of the 18th century manner, by such designers as Josef Frank and Josef Hoffmann, as also buildings, which owe much to Tyrolese tradition, by the architect Clemens Holzmeister.

Czechoslovakia is making interesting contributions to the modern movement through such men as Jan Kotera and Josef Gocar, though some of the most recent domestic work is cubist in character and marked by eccentricity.

Switzerland also is feeling the modern movement. Swiss architects as a rule are happier in the 18th century tradition than in their more Germanic vein, though in Geneva, Zurich and Basel are apartment houses in the modern manner which compare favourably with contemporary work elsewhere.

Italy and Spain have contributed little to contemporary domestic work. Modern Italian apartment houses and villas often reflect a debased version of the classic tradition, with a reminiscence tending towards a modern cubism. Much modern Spanish work is extravagant and overornate, influenced by the more florid phases of the modern Continental development from the Renaissance. Barcelona in particular has contributed some remarkable efforts in extravagant modernism; this vogue is however on the wane, and there are evident signs of a return towards greater refinement and simplicity.

Few particulars are available concerning contemporary domestic architecture in Russia. Much fine work of classic and 18th century influence forms a nucleus for a possible line of development,

though it appears probable that the modern cubist school will strongly assert itself when building recommences on any scale.

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II. HOUSING IN THE UNITED STATES

The term "housing" has developed a modern scientific sense that is more limited and specific than its original meaning, which was to provide accommodation for domestic life. In the first place housing implies the idea of furnishing homes to groups of individuals rather than to single individuals or to families alone. In the second place good housing implies that the best use has been made of each dollar of cost. So far as desirability is concerned, the house produced should be the utmost possible within the economic limits set. Housing is that science which devotes itself to the elimination of industrial waste in the production of homes, and attempts to utilize savings in improving the product. Scientific housing necessarily must consider the production of homes of varying size and cost to meet the economic requirements of the various groups within the community.

(A. C. HOL.)

DEVELOPMENT

The first type of habitation of the New England settlers was the crudest sort of dug-out, but it gave way almost immediately to a half-timbered house of traditional mediaeval design, with overhanging second storey, small windows and steep-pitched roofs. By the middle of the 17th century, in adaptation to the severe northern winter this type of house was covered with shingle or clapboard. With improvement in the mechanical facilities for sawing logs, the heavy half-timber construction was supplanted in the 19th century by a lighter form of wooden frame construction, still prevalent wherever wood or stucco is the chief material used. The wood houses of New England, the Dutch stone houses of the Hudson valley, the brick or stone houses near Philadelphia, the colonnaded houses of the South, and the adobe and Spanish houses in New Mexico and California represent the most important regional variations. (*See* MODERN ARCHITECTURE: *18th and 19th Centuries.*)

In the development of the seaboard cities the row house made its appearance early. It was usually two or three storeys high, built of brick and at first only two rooms deep. But as the need for further housing accommodations arose in the 19th century, and as land values increased, the row houses added an extra storey above ground and, to accommodate the furnace and the coal bin, sunk an extra one below. Frequently the plot became narrower, being reduced from 25 to 20 and even 15 ft.; and in the more pretentious quarters the open spaces in the rear were built over to create extra dining-room space, larger bedrooms, and inner rooms used as dressing-rooms, music-rooms and storerooms.

The row house built after the Civil War, with its narrow, dark and ill-ventilated rooms, its lack of sufficient open space in the rear, was without doubt responsible for the disrepute into which row-housing fell. The 19th century witnessed the introduction of three types of housing far lower in quality than was common in colonial times. From the log-cabin and the sod hut built by the prairie settlers no further developments in housing came. The second type was the so-called industrial or company housing, provided by textile manufacturers, mining companies and iron and steel industries in the new communities they created; with certain exceptions this type of housing became another name for monotony, depression and lack of hygienic and sanitary facilities. Finally, a third type was created, the tenant-house, a method of meeting the need for housing in growing cities by turning the single-family houses abandoned by the more prosperous classes into multi-family dwellings, without extra sanitary facilities, without privacy, without safeguard against fire. The tenant-house formed a transitional stage between the old individual house and the new tenement house created by urban land speculation and congestion.

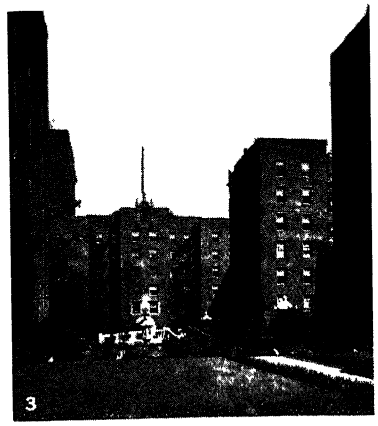
War-housing.—With the sudden expansion of industrial activity in the munitions, ship-building and rubber industries during the World War, the need for adequate housing accommodations became acute. The commercial market could not command the materials or supply the demand. Accordingly, two Government war-housing corporations were formed, one under the Federal Labor Department, the other connected with the Shipping Board, and a fresh attack was made on the problem of supplying an adequate number of houses of good quality for the industrial worker. The war came to an end before many of the promising plans could be completed. But in the Seaside village, a project at Bridgeport, Conn., for which R. Clipston Sturgis and A. H. Hepburn were the architects, and in the Yorkship village near Camden, N.J. (Electus D. Litchfield, architect), definite advances were made in the plan, lay-out and construction of dwellings. Improvements in housing were co-ordinated with improvements in city planning (*see* TOWN PLANNING), in finance, in the establishment of a living wage, and in the provision for community services such as schools (*see* SCHOOL ARCHITECTURE), factors that had hitherto been left out of account or minimized by the conventional housing reformer. These experiments resulted in a more accurate knowledge of the costs that enter into the production of a dwelling house and of the social and technical factors involved in an effort to raise the whole level of housing above the massive depression and jerry-building of the past.

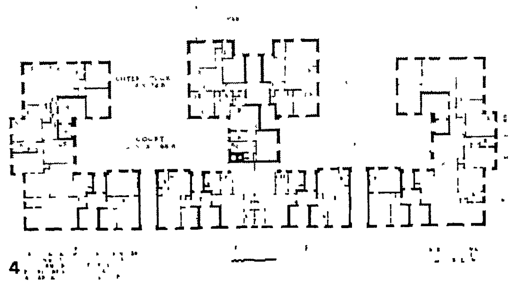
Modern Methods.—On the theory that methods which proved successful in war housing are equally applicable under peacetime conditions to promote better housing for the major part of the population, two separate initiatives in non-speculative group housing must be noted. One is that at Mariemont, a suburb of Cincinnati, O., built through the philanthropy of Mrs. Mary M. Emery, where a large tract of land was subdivided and plotted by John Nolen, and houses and small apartments of various types erected to meet the need of a varied income group. A somewhat different experiment under strictly urban conditions was initiated under Alexander M. Bing at Sunnyside Gardens, Long Island, N.Y., by the City Housing Corporation. In Sunnyside Gardens each block was planned as a unit, with individual houses and individual garden plots, grouped around a central open space to be maintained as common property for 40 years. The necessary garages were grouped at one corner of the tract, and a park of 3 acres was set aside as part of the original cost of housing. By the economies of unified planning, large scale

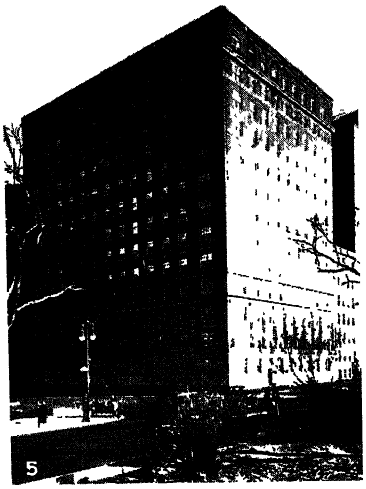
PHOTOGRAPH, (1) JOSEPH SMITH

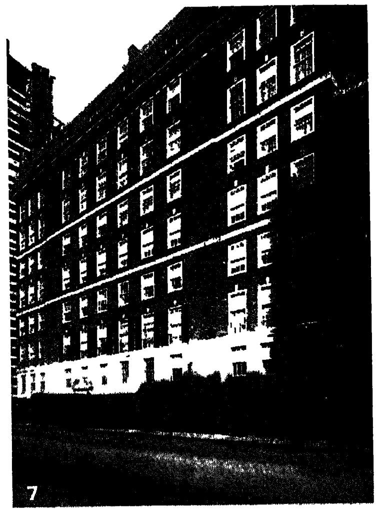
COMMUNITY HOUSING AND COUNTRY HOMES

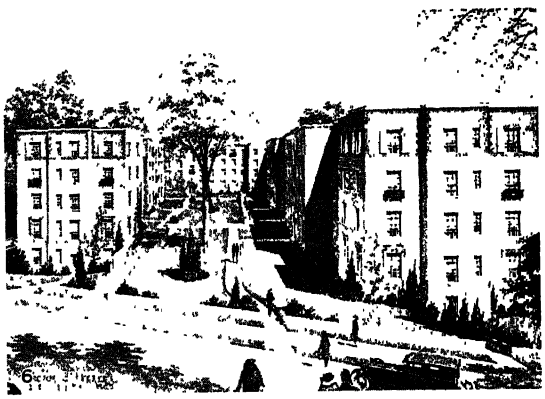
1. A typical American post war suburb, Queens county, N.Y. Narrow, deep lots and uneconomic houses make street improvement costs prohibitive. Result of construction without planning
2. War industrial community near Camden, N.J.; planned as a whole. Electus D. Litchfield, architect
3. Small houses and apartments meet the needs of various income groups in one of the individual units at Mariemont, Ohio, an experimental town planned by John Noelin. Edmund B. Gilchrist, architect
4. Block in Sunnyside Gardens, Long Island, N.Y., planned as a unit with individual houses and individual garden plots grouped around a central open space which will be maintained as common property for 40 years. Clarence S. Stein and Henry Wright, designers; Frederick L. Ackerman, associate architect
5. House of R. T. McCracken, Germantown, Philadelphia, Pa. Mellor, Meigs and Howe, architects. (*See* House Planning.)
6. The Harold E. Chase House, Hope Ranch, Santa Barbara, California. An adaptation of the Spanish style of architecture to large, modern residential requirements. Reginald D. Johnson, architect. (*See* House Planning.)











BY COURTESY OF (2, 4) ANDREW J. THOMAS, ARCHITECT, (8) THE BRYN MAWR BEACH BUILDING CORPORATION; PHOTOGRAPHS, (7, 10) DRIX DURYEA

MODERN APARTMENT HOUSE PLANNING IN URBAN AND SEMI-URBAN DISTRICTS

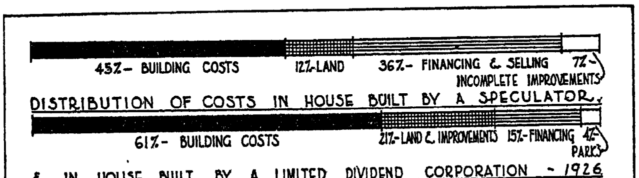
1. View of the garden of the Paul Lawrence Dunbar apartments for negroes, New York city. Andrew J. Thomas, architect
2. Seventh Avenue elevation of the Paul Lawrence Dunbar apartments
3. View of the Thomas garden apartments, a whole block of garden apartments on Mott avenue, New York city. Andrew J. Thomas, architect
4. Plan of the first floor unit of the Paul Lawrence Dunbar apartments
5. Apartment house at 1148 Fifth Avenue, New York city. J. E. R. Carpenter, architect
6. Sagamore apartments. Victor C. Farrar, architect
7. 53 East 66th Street, New York city. M. B. Schmidt, architect
8. Edgewater Beach apartments, Chicago. From a rendering made by designer in office of Charles H. Dornbusch, architect
9. Proposed suburban apartment development in Westchester county, New York. Andrew J. Thomas, architect
10. Colton Hall. Holden & Associates, architects

operations, group housing and more stable finance, it was possible to provide a substantial brick house of semi-fireproof construction, with more adequate open spaces for sunlight and recreation than are usually provided in a much more costly type of suburb. By limiting the profits of the corporation to 6% the houses can be sold and the apartments rented to workers with an income as low as $2,500 per year. The concrete difference between this kind of housing and that usually furnished under speculative enterprise can be put graphically in the following way:

Costs.—Note that in the speculative type of house, financing, selling expenses and profits account for 40% of the cost of the house, while the actual building itself absorbs only 44% of the total cost. The great improvement effected in the Sunnyside Gardens experiment consists in creating a much more durable and adequately equipped building which embodies in tangible utilities 60% of the cost; in reducing financing, sales-cost, profit from 40% to 16%, and in adding a new item, environment, *i.e.*, open spaces and playgrounds, as part of the original cost of the house. A good part of the effort to improve housing conditions has been directed toward economizing on the material, construction and equipment while leaving current methods of finance, sale and profits untouched. The experiment in Sunnyside Gardens demonstrates that much more substantial reductions can be made in the "intangible" costs of housing than in material construction.

Attempts to reduce the cost of housing in America have usually been attempts to reduce cost of the physical shell by lowering the quality of the construction. Where this can go no further, in outlying areas, the speculative builder uses cesspools, instead of municipal sewers, and neglects to lay down permanent roads or other services. These are all deceptive economies. They lower the original apparent cost of the house; but as soon as a neighbourhood grows, and municipal improvements are made, assessments and taxes to meet these necessary expenditures fall back upon the cheap house, and,—together with the high cost of repairs and upkeep, for flimsy construction wastes in annual coal bills more than it economizes on materials and labour,—in the end frequently drive out the original owner who is not prepared to meet them.

Genuine economy lies: (1) In economies in finance and sale. Through the provision of more social methods of finance such as the building loan association, the limited dividend corporation or, as in European examples, through Government loans at low rates of interest to associations that provide low cost housing of a certain minimum standard. The New York State Housing and Regional Planning commission found that in the cheaper types of housing the reduction of 1% in interest meant a reduction of one dollar per month per room in the rent of a dwelling. The reduction of the cost of money from the usual 9% in metropolitan centres to 6% would permit substantial improvements to be made in the ordinary house. A reduction from 7% to 6% in the rate of interest is the equivalent of reducing the cost of construction 10%. (2) Through improved community planning. By decreas-



GRAPH SHOWING HOUSING CONDITIONS IN THE UNITED STATES

ing the amount of money and space wasted through extravagant street planning, through the delayed purchase of park and school sites, through unnecessary public utilities, through the opening up of outlying areas for scattered development long before the necessary improvements can be economically supported, a more economic and efficient community plan that will protect the small house can be created. (3) Through larger initial expense in materials and fixtures; through the use of brass hot-water pipes instead of iron; of brick, hollow tiles and concrete instead of wood; and, in general, of more durable equipment, the ultimate cost of the house may be lessened. Finally, through large-scale operations, using row and group houses instead of free-standing individual units, a more substantial type of construction may be obtained with a smaller outlay. (*See* House Planning.)

One or another of these requirements may be effected in existing centres; to practise these economies on a great scale, however, involves the creation of new towns, such as that begun in 1928 by the City Housing Corporation for Radburn, N. J. Improvement in the quality of modern housing, with such decreases in cost as will make it available for the greater part of the population, requires a co-ordination of all the possible lines of advance. It is only in the newly planned garden city or satellite town that such a condition can be permanently provided. This does not mean that the shell of the house is incapable of improvement. It only means that the shell represents but 44 to 60% of the total cost, and that until attacks are made upon the remaining 56 to 40% as well, no very large improvements can be effected.

With the increase of the number of utilities in the modern house, with the recent introduction of artificial refrigeration and with the probable development in the near future of an artificial cooling system for summer, as well as a heating system for winter, it becomes more and more necessary to use machine work and standard equipment on all parts and connections that have hitherto been done by hand. Already kitchen cabinets are made in the factory. We may look forward to closets, and perhaps even whole bathrooms, being manufactured in the same way and installed as units. Along with this process will go a certain standardization of dimensions, so that linoleums and tiles will be cut at the factory for a standard floor, or stairs put together for a standard rise, precisely as doors and windows are now manufactured. In the mechanical installation of the modern house there will be less room for individual taste and caprice; or, rather, this will be exercised within a definite range of available patterns, subject to the usual changes of taste and style. The other line of development consists in the use of materials that have hitherto been unavailable on account of expense or difficulties of construction.

In the application of all these improvements to the separate units of a house there is the constant danger of bad design and of monotonous application of a single pattern. The remedy for this is not to do away with the improvements but to finance and build houses on such a scale as to provide for the services of the architect and community planner, who will use these separate standardized units as separate blocks in a comprehensive and imaginative design. In short, the depression and monotony of standardized designs is to be overcome, not by anarchic outbreaks of individual taste and "personality" but by the creative incorporation of parks, gardens and open spaces in every normal housing development. (C. S. St.)

MODERN PRACTICE

No house can be produced without the use of the four essential factors; land, credit, labour and materials, but in order that these factors may correctly balance one another there must be a design to govern their use. Altogether too little thought is generally expended on design. When trying to build a small, cheap house many people feel that they can not afford an architect. As a matter of fact, the importance of good design increases as the amount of money available to produce a family unit decreases. (*See* House Planning.) This applies not alone to the house itself but to group arrangement, and above all to the nice balancing of land values, credits and the physical house. The majority of work that in the past has served to provide shelter for the bulk of mankind has been executed with little or no understanding of the importance of design in this larger sense. Almost anybody who felt that he could enclose a house for less money than it could be sold for, has tried to do so. That part of the public with money to spend on essentials but not enough for frills has freely bought the product of the speculative builder and has in the main been dependent upon this unimaginative narrowly conceived type of housing. As to the large class of people who can not even afford to pay for essentials, it has generally been assumed that there were enough cast-off homes available to take care of their needs.

In spite of its failings, however, the average modern American house has mechanical equipment that provides its occupants with more comfort and conveniences than has ever before been available for the working classes.

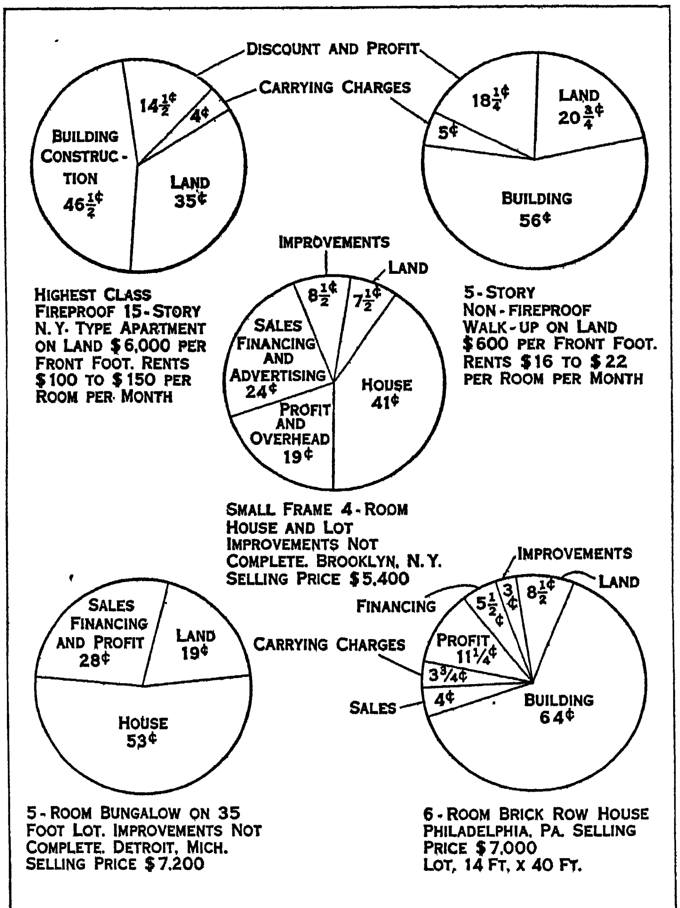
The first step in the direction of bad housing is generally the abandonment of a house by a family which could formerly afford to live in it. The occupancy of the house then changes to a number of families. Each pays a very little, but together they are sometimes able to pay, for the privilege of setting up makeshift homes in the old building, a total greater than the original cost. Since ancient times this has been the first method employed whenever the pressure of population in a rapidly growing city has created a scarcity of homes. The conversion of individual houses to multiple use increases the intensity of the use of land and therefore increases land value. Higher land values in turn provoke the second step in the direction of bad housing. It becomes necessary as well as profitable to erect new multiple dwellings instead of individual houses. Work is plentiful in the great centres of population and people are ready to put up with congestion to be near the source of their livelihood.

The movement into the cities makes city land desirable and tends to increase its value. More intensive use becomes an economic necessity. Fortunately there are natural as well as artificial limits to congestion. Except in times of great crisis or shortage people refuse to rent the most undesirable quarters. Consequently these are usually offered cheap, and some of them are kept filled only because there are always some families who, being able to pay practically nothing, must take what they can get. The average family that moves into undesirable quarters does so with the original idea that it is a temporary expedient until the breadwinner's luck improves. Some of them are never able to pull out. For this reason the State is compelled to step in, and, in order to preserve the standards of public health, to establish minimum standards of decent housing by act of legislature.

Restrictive Legislation.—Wherever there is restrictive legislation, there is a natural tendency to develop types of housing outside of the jurisdiction of the law. New York City has had its full share of this, especially since the World War, because of the great economic changes brought about by the change in the buying power of the dollar. On the more expensive land there has been the irresistible pressure to use the land more intensively. This has resulted in sky-scraper residential types carried, under the pretence of being hotels, to heights greater than those allowed for tenements, and the conversion of single family houses to multiple use without adequate fire protection, on the pretence that these buildings are intended for non-housekeeping use only. Though there are few cities which have developed exactly these methods for evading restrictions, in almost all growing cities where land values are increasing there is the well-marked tendency for the multi-family system to spread beyond the bounds controlled by law and the point of greatest activity will generally be just beyond the limit of restrictive legislation. For example, there has always been a great deal of undesirable wooden three-storey apartment construction going on just outside the fire limits of the greater city of Boston. Fire limits have been continually extended, but the activity in wood construction has always continued just beyond the limits.

Restriction increases the tendency to seek cheap land for development. New land is usually unimproved and frequently appears in the raw state to be cheaper than other available land where improvements such as sewer, water and other service facilities have been completed. For this reason, new land is subject to two faults in development. It is likely either to be developed too intensively or not intensively enough. The apartment is the chief offender in the first instance, for its courts are usually regulated by the legal minimums designed for more expensive land. Cheap land is usually remote land and too intensive buildings placed upon it depend originally upon vacant adjoining land for their desirability. Over-intensive development is likely to disrupt real estate values in the neighbourhood because the income from it is not entirely earned by its own land and buildings. In the outlying sections and in the suburbs this misplaced type of city apartment has become a real problem. This is not to be confused with the really desirable suburban types which are set in the midst of ample land and which are therefore not subject to rapid depreciation after the adjoining land becomes built up. A true suburban type apartment preserves the suburban atmosphere and holds out as the inducement to the longer travel, permanent recreational advantages of the out-of-doors.

As to the problem of new land which has not been developed intensively enough to pay for necessary improvements, the most conspicuous example is in Queens borough, outside the New York city fire limits. An illustration is given which shows the repeated rows of frame houses that have been erected beyond Jamaica. The outer sections of the city of Detroit have been developed in a similar manner. These houses are most of them uneconomic. It is only possible to build them because the financial set-up is misleading. They have been sold under the deceptive slogan, that it is always wise to "own your own home." Many who have bought houses of this type have learned to their regret that there are high discounts for original financing and high expenses for sales and promotion often running up to 43 cents on each dollar of original cost. On the maintenance side, also, there are high charges for rapid amortization and frequently unexpected assessments for improvements besides ordinary interest charges and taxes. Depreciation also is rapid so that the sum total of annual costs for carrying the houses is very great. As a result the inevitable movement to crowd two and three families in houses intended for one has already commenced, although most of the houses are not more than five or six years old. The accompanying diagrams indicate the proportionate shares of the average dollar spent for various representative types of housing, showing distribution to land, construction proper and promotion and finance.



HOUSING IN THE UNITED STATES. DIAGRAMS SHOWING THE PROPORTIONATE PARTS OF THE DOLLAR SPENT FOR "HOUSE," "LAND," "IMPROVEMENTS," "SALES-FINANCING" AND "OTHER EXPENSES" IN THE PURCHASE OF VARIOUS TYPES OF URBAN HOMES

The tendency to think of houses and of real estate as something quickly saleable has made it possible to offer so many

basically uneconomic and ill-considered types of housing to the public. The rise in the value of land has been depended upon to pay for the mistakes that have been made in the design and production of homes.

In recent years there has been a new type of legislation affecting housing. Of course prohibitory and minimum standard codes are still necessary, but enabling legislation has also been put into effect with the purpose of granting aids and encouragement for the production of better type homes. In England a direct cash subsidy has been extended to builders. In Germany the Government has underwritten second mortgages at very low rates of interest. In Austria the Government itself has constructed homes. In America New York State has gone farthest, granting limitation of taxation and establishing a State board of housing with supervisory powers.

Low Rental and Garden Developments.—During the emergency period following the close of the World War, a special act of the New York legislature granted permission to life insurance companies to invest a certain portion of their funds directly in low rental housing. Under this act the Metropolitan Life Insurance Company built multi-family dwellings in Queens borough, N.Y., with accommodations for 2,125 families (A. J. Thomas, architect). The rooms are small but the plan provides for permanent light and air. Since the completion of the buildings there has never been a day's vacancy in any apartment. The project has returned nearly 9% net on the total investment. There is no mortgage, but if first and second mortgages of the usual type were placed, the equity would return about 15% net, which is remarkable considering that rentals are $9 per room per month, from $6 to $4 under the market rate. The Metropolitan project is an example of what large scale planning, construction and management can accomplish. A. J. Thomas was also the architect for the project of the Bayonne Housing Corporation in New Jersey. The lower value of the land made it possible to plan still more openly. The buildings cover only 46% of the lot. At Bayonne the space in the centre of the block is large enough to be a real recreation space. Thomas has been given great opportunities to prove his contention that light and air do pay. He was also architect for a whole block of garden apartments on Mott avenue as well as the great block of Dunbar apartments for negroes built by John D. Rockefeller, Jr. in Harlem, N.Y., not as a charity but as an investment. The great co-operative projects, one by the United Workers Cooperative and the other by the Amalgamated Garment Workers, have been built in the Bronx, N.Y., from plans which follow the principles laid down by Thomas. The architect of the former is Herman Jessor; of the latter Springsteen and Goldhammer.

Along somewhat different lines and strongly influenced by the English garden city has been the work of Clarence Stein and his associate Henry Wright. At Sunnyside Gardens, Long Island, N.Y., which they designed, with Frederick L. Ackerman, associate architect, the detached house, the double house, the row house and the apartment have been combined. The ground is used even less intensively than Thomas advocates, and far more has been done for recreation and for community life. Boyd and Holden have also contributed to the development of housing technique and the latter's associate Leonard Cox has been the leading force in the design of tall garden plan buildings in New York. These latter are noteworthy because they carry the two-room deep type of planning into the high building and demonstrate that it is already possible at current market prices to plan for light and air on land costing up to $30 a square foot.

Housing is, of course, closely related to industry, as has been attested by the genuine concern that industry has shown in some cases for proper housing of its workers. Many companies have made the mistake of being too paternal and that is the reason for the odium which the term "company housing" calls up. Nevertheless, on the physical side some really constructive work has been done. Noteworthy are the experiments of the U.S. Steel Corporation at Gary, Ind., of Cheney Brothers, South Manchester, Conn., and of the Newport News Shipbuilding Co. in Va. So far as the future is concerned probably the most constructive assistance that industry can give toward the proper housing of its workers is in the influence that it can exert through the judicious use of its funds in lowering the rate of financing charges for well-considered and well-designed housing projects. The Bayonne Housing Corporation derives its funds from local industries that have endorsed this policy.

Forecast.—So far as the mass of men are concerned the home of the future depends on the development of the new housing science. If land is to increase indefinitely in value and is to be developed uneconomically and wastefully it is problematical whether the individual house will be able to survive, except as a luxury for the very rich, and in the great cities even the very rich may be driven to seek some desirable type of multiple dwellings as the inevitable solution of their home problem. The factors that will count are land, financing and the proper use of labour, and materials. Land must be properly used; financing costs can be reduced by lessening the speculative risks and doing away with too rapid depreciation. Much is to be hoped for along the lines of a more efficiently organized building industry. Much, too, is to be hoped for from the introduction of new materials and methods of construction. For example, at the present time, experimenters are trying to discover ways of making a practicable steel house and a practicable concrete house. Reinforced concrete which has been so successfully applied to industrial construction has at yet received only scant consideration as a medium for multiple dwellings.

Assuredly in the future large scale operations must come to the front. It must become possible to plan for a whole city block at once. In this way light and air will be permanently guaranteed and proper recreation space provided within the block. Cities of the future will have to depend on large scale operations to get rid of large sections of their areas which have been blighted by undesirable and uneconomic construction. The illustration on p. 880 shows a project worked out by Arthur C. Holden and Associates, architects, in consultation with the committee on the regional plan of New York, for the development of a great area of not less than five blocks which incorporates within the design complete educational, religious, athletic, social and recreational facilities for its residents. Some such attempt at orderliness must of necessity follow from the inconveniences, waste and chaos of present city life.

For the immediate future it must not be concluded that the general trend in housing from the individual to the multi-family house will put an end to the traditional American individual home at once. The American home may survive present tendencies. The point to be made, however, is that many of the individual homes that are produced to-day are a bogus product. The public must familiarize itself with the elements of scientific housing if it is to understand and to discriminate when it buys. If one-half the brains and energy that have been applied to the new automobile industry could be applied to improving the present type of housing, it would not take ten years to double the efficiency and desirability of the home that can be afforded by the average man. (A. C. Hol.)

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III. APARTMENT AND HOTEL ARCHITECTURE

Apartment houses (flats) are buildings of compact and superimposed homes. In Paris in the 18th century, probably due to a need to house more persons in the space available, private

dwellings of several storeys were slightly rearranged so as to accommodate one family per floor. This led to buildings so planned before construction. Later, residential buildings were again altered, this time to provide quarters on each floor for two or more families. The space per family decreased as concentration increased.

The development of apartments has been intimately affected by that of the modern home. One hundred years ago the home was self-sufficient; moreover, it was fairly simple; its appliances and functions could be directed by anyone with common sense and willingness to work. To-day it is quite different. Most of its former functions are performed by specialized agencies, such as hospitals, restaurants, etc. Often it serves only as a place in which to sleep and entertain. Inventions have filled it with convenient, labour-saving devices. Rapid and smooth functioning at all hours is demanded. The apartment house, by bringing people together and pooling their interests, furnishes expert and up-to-the-minute service at relatively small cost per unit apartment. Its popularity has grown steadily; it is now familiar in practically all large cities of the western world; even small communities with ample room for lateral growth demand and build apartments. Paris holds the record for this type of building, its total of concentrated housing space surpassing even that of New York where the skyscraper apartment is common. In the United States, however, there is a marked tendency for apartments with gardens, restaurants, swimming pools, libraries, complete private facilities, to be produced in comprehensive units involving large areas in sections that are within walking distance of important centres but that would be irreclaimable without such planning.

There is no limit to the number of families that can be placed one above the other or on the same floor, but kitchens and toilets have to be provided for each. In many building laws, both in Europe and America, the apartment or tenement classification is based on the existence of these facilities. The kitchen is regarded as the principal fire hazard; therefore, building regulations as to the materials and methods of construction and the requirements for fire stairs, are made with reference to the number of kitchens. The kitchen thereby becomes the indicator of the family unit, except in the apartment-hotel, where it is absent. The only other restriction on the number of families in one building is that on the size of the building itself. (*See* ZONING.) In the United States, tall buildings are now made practically fireproof, but although diminished by the use of gas and electricity, and restaurants instead of kitchens, the fire hazard in an apartment is, of course, still greater than that in an office; consequently, the height of apartment buildings is more stringently restricted. There must always be two independent means of exit.

Apartment buildings are of two distinct types: the walk-up and the elevator or lift. Any building over five or six storeys requires a lift, and to be of practical value the lift must always work. Since no mechanical device is ever perfect, good planning practice requires the installation of a battery of at least two lifts in order to insure constant operation in case of breakdown. It might seem that the lift would change the planning problem only in so far as it makes more storeys possible. When there are only one or two apartments to a floor, either the lift or the stairway occupies a central location, and the apartments are planned around this vertical line of circulation as a starting point. But as the number of apartments per floor in the walk-up type increases, additional, separate lines of stairways must be added where needed. Lifts, however, being perpendicular shafts, are kept together so as to form on each floor a central distributing point to a large number of apartments. This requires special planning.

Planning.—In arrangement the apartment unit is not essentially different from the old-fashioned home, except that its several rooms must be placed with a view to convenient intercommunication, and must be reduced in size to the minimum. The living-room or parlour is the largest room, and opening off this, usually with wide doors which permit the occasional use of the two spaces as one, is the dining-room. Adjacent to the dining-room are the pantry, if one is included in the plan, and the kitchen. Bedrooms and bathrooms are preferably arranged in a wing of the building, so that they may be separated to some extent from the other quarters.

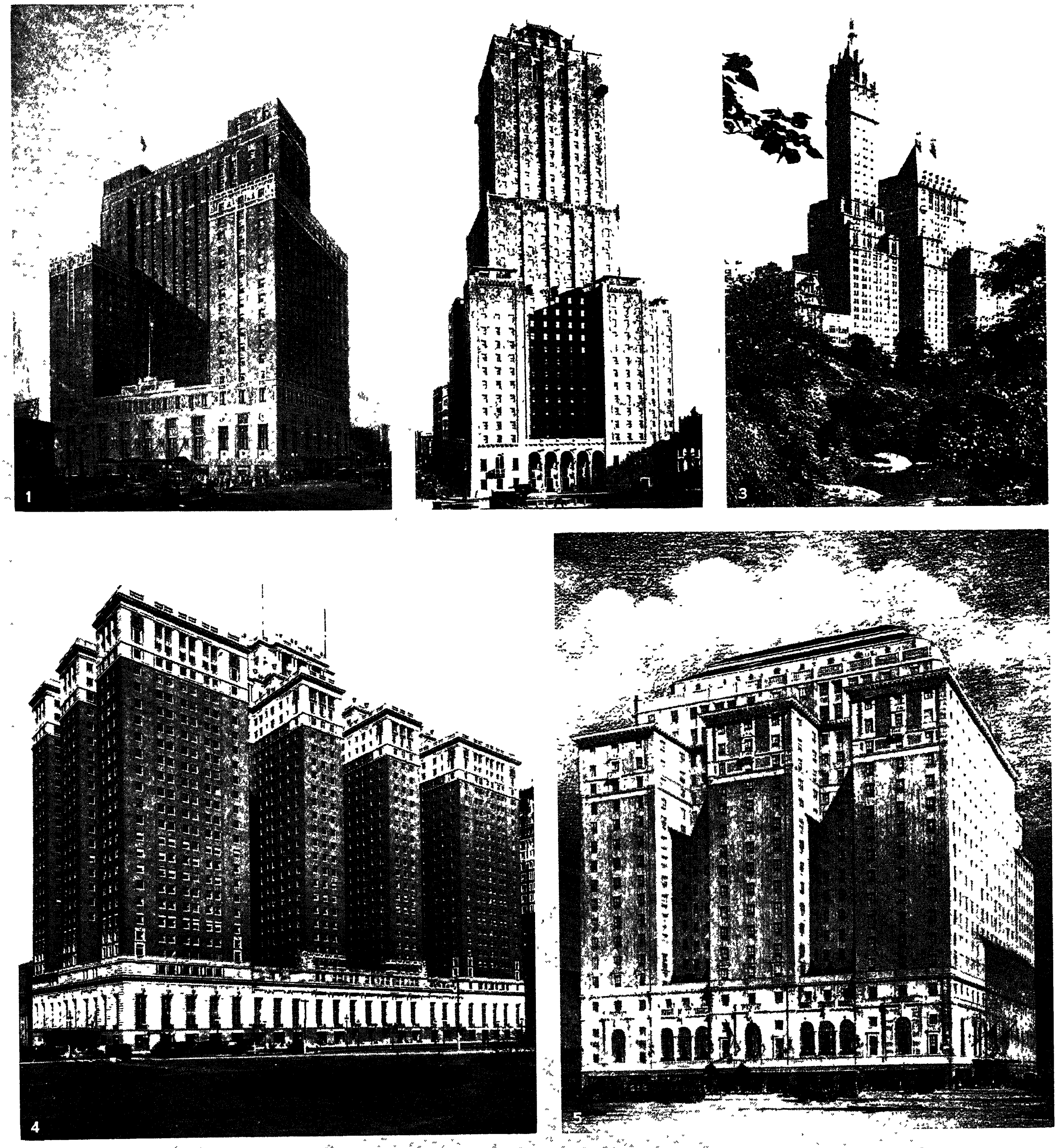
Modern bathrooms are small and very compactly arranged, one to each bedroom when possible. The kitchen has been reduced to a mechanical plant (*see* HOUSE PLANNING), doing more satisfactorily what formerly required a room 17 by 30 ft. in the concentrated space of 7 by 10 ft. When the building does not exceed 9 or 10 floors, a hand-operated dumb-waiter is installed, running from the basement to each kitchen, by means of which the janitor of the building distributes food supplies to the various tenants. Garbage is collected by the same device, although incinerators are also widely employed. The flues of the incinerator open into all the kitchens, and garbage and waste are emptied directly into them and reduced to ashes, which can be removed from time to time at the base. This disposal system keeps the dumb-waiter car and shaft clean. A gas-stove, an all-metal kitchen cabinet, a combination porcelain sink and laundry tub, an ice-box, and in recent years an electric ice-machine are generally installed when the building is erected. In America the use of an ice-box is almost universal, not only for cooling purposes during the summer heat, but because it helps to preserve food in a safe and sanitary condition throughout the year. The dining-room has one or more electric outlets convenient for toasters and electric grills on the dining-room table. The living-room often has a practicable fireplace, not for heating, but as a social amenity.

A single heating plant for each building or group of buildings provides the necessary warmth during the winter months, the system usually employed being steam with exposed radiators in all rooms. When the apartment building exceeds 10 storeys, the hand operated dumb-waiter is hardly practical. Electrically driven "fool-proof" dumb-waiters are sometimes used, but the initial cost is large and the upkeep expensive. In the most modern practice an additional service lift is installed. This is preferably located near the kitchen wing, or at the rear of the apartment house, to bring in food supplies, to remove garbage and waste and for similar services.

Light and an agreeable outlook are important factors in any place in which people are to live. Yet although sunshine is always an asset, large expanses of unbroken window surface are by no means desirable; just as in office buildings (*see* INDUSTRIAL ARCHITECTURE) too much glass surface, particularly in climates like that of the United States with its cold winters, causes economic waste in heating; but too little, of course, is even worse. Two windows to a room not on a corner is considered ample, and in bedrooms and minor rooms often only one is provided. The apartment should be so planned that cross ventilation can be had by opening any door. Because of the development and increasing use of artificial light in modern decoration, particularly in cities, large windows are often heavily draped much of the time; but it is important for each tenant to have at least one attractive outlook.

In the beginning, the particular appeal of the "flat" was the elimination of stairs. In the old-fashioned city house, built like a narrow slab in a block of similar houses, the overburdened housewife found the stairs very tiring, especially when there were six or seven flights from basement to attic. But this advantage in the flat was largely offset by the difficulty of separating living from sleeping quarters. The so-called "duplex" apartment was the first solution of this annoying problem. Here the entire apartment unit occupies two floors, the sleeping quarters above and the living-rooms below, with a small interior stair for communication.

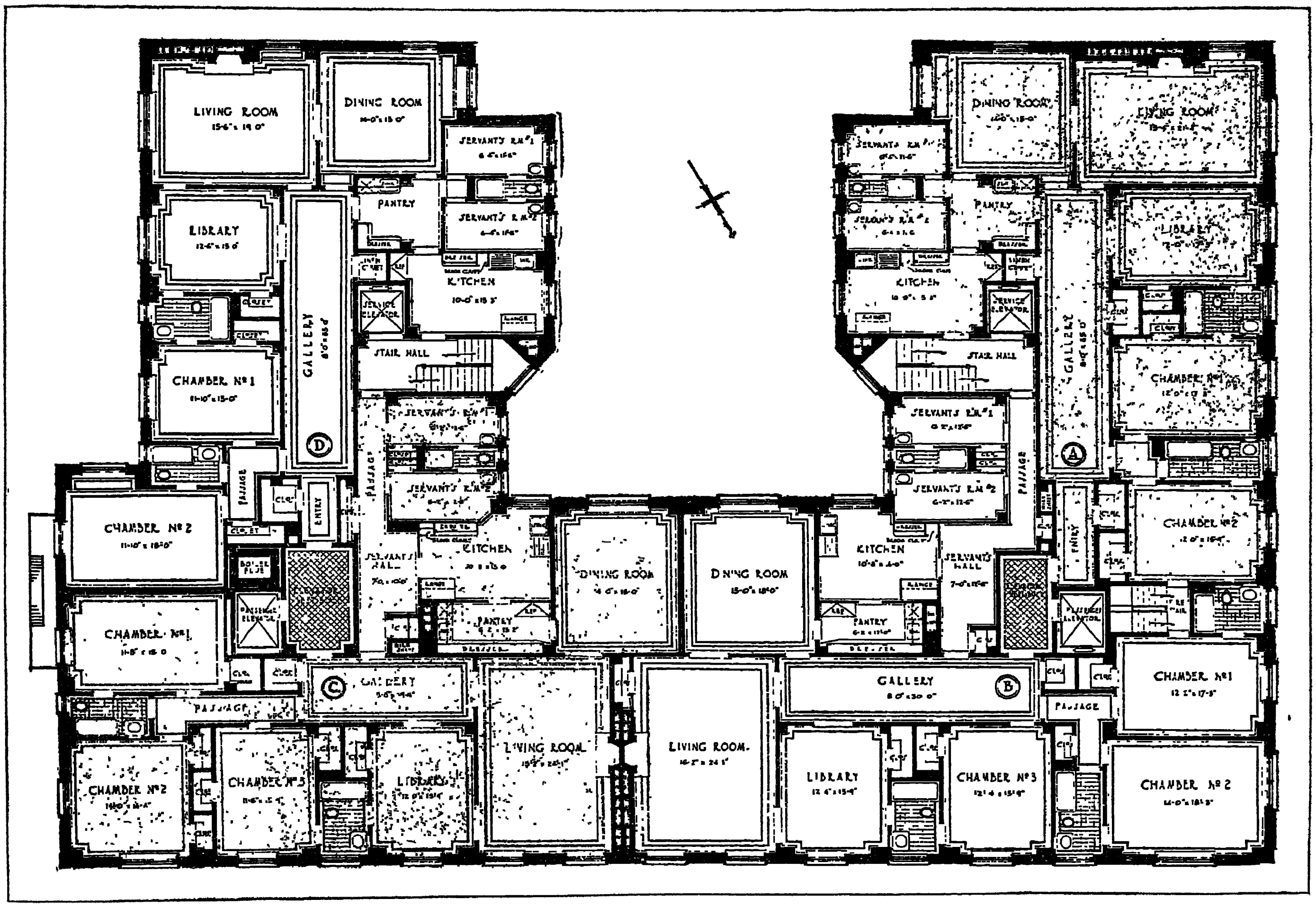
In the effort to reduce space, since part of the care of a home is its size, a low ceiling was adopted. The New York building law at present specifies a clear height of not less than eight feet; formerly it was nine. Consequently builders anxious to get the maximum return from a given piece of property build to this minimum. Even the largest and most expensive apartments seldom exceeded 9½ ft., on account of the great waste of cubic contents in the minor rooms. This has resulted in the evolution of still another type of apartment, in which, by a combination of alternating "duplex" and "simplex" floors, the living-rooms



PHOTOGRAPHS, (2) SIGURD FISCHER, (3) EWING GALLOWAY, (4) KAUFMANN AND FABRY

MODERN TRANSIENT AND RESIDENTIAL HOTELS

1. Schroeder Hotel, Milwaukee, Wisconsin. Holabird and Roche, architects
2. Shelton Hotel, New York city. A. L. Harmon, architect
3. Sherry-Netherlands Hotel, New York, left. Schultz and Weaver, architects. Savoy-Plaza Hotel, right. McKim, Mead and White, architects
4. Stevens Hotel, Chicago, Ill. Holabird and Roche, architects
5. Roosevelt Hotel, New York city. George B. Post and Sons, architects



BY COURTESY OF J. E. R. CARPENDER, ARCHITECT

TYPICAL FLOOR PLAN OF 1148 FIFTH AVENUE, NEW YORK CITY

This plan illustrates the development of the high class apartment showing a completely equipped home in each unit. Note the adequate arrangement for natural light and cross ventilation and also the separation of vertical circulation between passenger and service elevators. Every available foot of space is advantageously used. The room called "Library" located adjacent to the living room and yet provided with closet and access to bath room makes its use possible as an additional bedroom. Most of the service rooms and service stair hall are placed on the interior court giving exterior light to the better spaces

are given an extra ceiling height, bringing them back again to the proportions of the old-fashioned city home, two storeys of living-rooms being placed adjacent to three storeys of minor rooms.

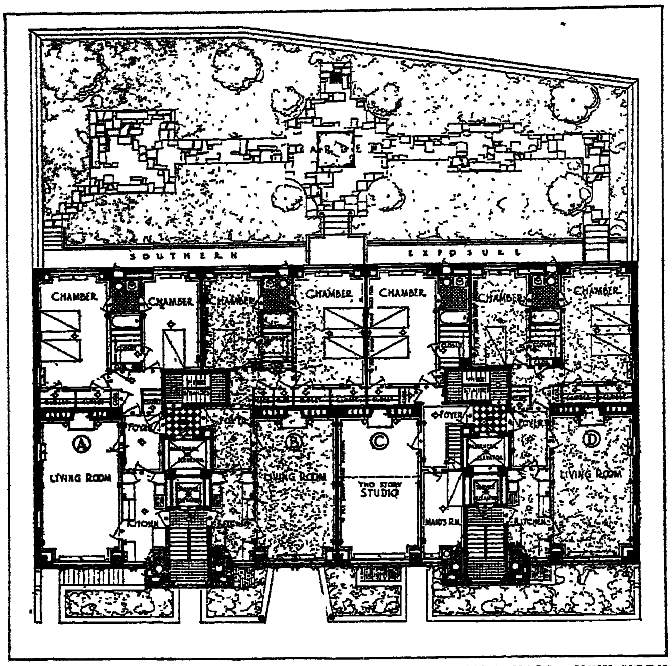
Exterior.—The exteriors of the first buildings erected for apartments were designed to simulate private city residences. This form, especially in districts where such residences exist, is still in vogue when the height does not exceed five or six storeys. It results from the designer's natural inclination to give dwellings, even when piled up, a domestic character. But when the number of storeys exceeds six the design problem becomes one of building masses, for which there is no precedent in domestic architecture and which makes a conventional domestic atmosphere practically impossible. Under the various modern building regulations, the sky-scraper apartment, like any other tall building takes more or less specified forms, and, to the casual observer, differs from the office building only in that it has fewer windows. The set-backs are frequently made into verandas, terraces and gardens on which French windows open. Where the roofs are flat over a sufficient area, penthouses are built and used as independent dwellings or as rooms belonging to the apartment proper immediately below, according as to whether or not the roof of the penthouse comes within the legal height of the building; with potted plants and small statues, the surrounding roof is then treated as a garden. (*See* LANDSCAPE ARCHITECTURE.) Although limited to relatively few tenants, dwellings of this character enjoy the quiet of the old-fashioned separated house.

Interior.—Its domestic character is generally given to a modern city apartment house in the treatment of its interior. In proportion to the mass above it the entrance hall is less spacious than that of an office building; its ceiling height may be kept down to the storey height of the building. It is generally carpeted and furnished as an elaborate lounge with provisions for a controlling office, telephone switchboard, etc. The decoration of the apartments themselves was formerly done in period styles, with elaborate panelling and ceiling effects, depending on the size of the apartment and the wealth of its tenant. The present tendency, however, seems to be away from this and toward the use of both colour and furnishings of a modernistic character. (*See* INTERIOR DECORATION.)

Forecast.—Modern life may be said to be an experiment in concentration, and it is, therefore, worth while to consider the possible results of increasing the concentration of both residence and business—presupposing, of course, that it can be accomplished compatibly with health and comfort. The problem is how to keep the principle of concentration with its economic and cultural advantages while so designing as to get for the individual the minimum travel and hurry, now the most distressing factors in urban life, and the maximum ease. To-day every city is trying to retain as much residence as possible in and near its business zones. Although zoning regulations may restrict business from a residential district, residences, without exception, can be built in business zones. This is done purposely so as not to submit everyone to the loss of time and energy involved in travelling to and from work daily; indeed, the traffic problem gives the strongest impetus to the present tendency to reunite residence and business. Successful attempts to decentralize, in which so-called satellite

towns are developed around the central city, have been made; but such towns, theoretically self-sufficient, seem to decrease as residential and increase as business centres.

Buildings whose bases would cover a large city square could be designed to house commercial enterprises and industries not involving disagreeable smells, noises, etc., in the lower storeys and



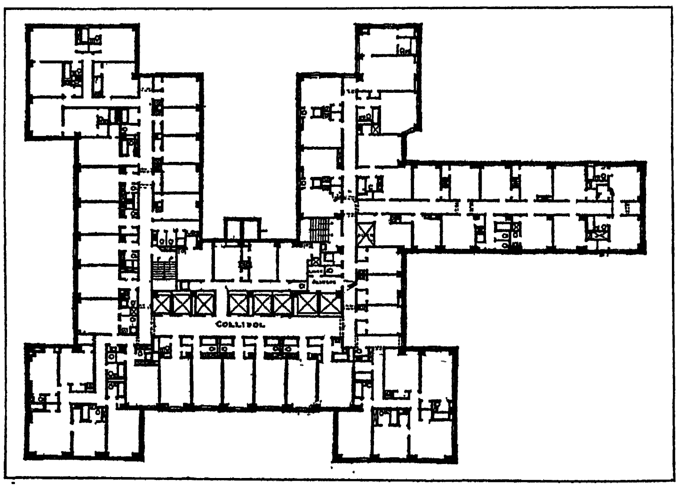
GARDEN PLAN AND TYPICAL FLOOR PLAN OF COLTON HALL, NEW YORK CITY; ARTHUR C. HOLDEN, ARCHITECT

above the first set-back, at the top of the first 10 or 15, the workers associated with them in residences of the apartment or apartment-hotel type, receiving the benefit of broad outlook, sunshine, and natural light and ventilation. A modern office building contains a dark core devoted to service mechanisms and surrounded by office units in horizontal layers. In the largest buildings to-day, most offices while receiving natural light are too deep from the outside wall for it to serve the entire unit; many workers, prevented by the windows from feeling shut in, have artificial light. Moreover, artificial ventilation when properly installed supplies cleaner and healthier air than is possible in the old-fashioned office, even with the windows open. As buildings are increased in size, the increased area of the office unit makes it possible for the workers to be more efficient and under better control per square foot of floor area without suffering inconvenience. Above the first set-back each storey would be recessed behind the one below which then would form, in front of each apartment, a terrace for the use of the residents. These upper storeys, in use and type of management, though not in disposition of spaces, would probably resemble the apartment-hotel more closely than any other present type, for the same economic forces that have driven people from private dwellings to apartments are beginning to turn them from apartments to apartment-hotels in which cooking is a communal service. The stepped and terraced tower would rise from the centre of the block. The interior of the tower, beyond the depth usable for living purposes, would contain communal rooms—dining-rooms, gymnasiums, libraries and radio, lecture, dancing and motion picture halls—all artificially lighted and ventilated. To secure the full benefit of sunshine during at least half the day, the whole building would be oriented north and south, like a ward wing in a hospital. Every room for living or sleeping would face east or west and on a terrace forming the roof of the floor below. At one end of the building block, logically the north, a service tower would rise with elevators or other form of vertical circulation connecting residence with business, pedestrian and traffic levels. Merchandise and people would move up and down through this tower through a series of superimposed landing stages (like floors with no enclosing walls) for aeroplanes, designed to rise and descend vertically, to deposit and receive passengers.

The atmosphere of the present industrial districts is too full of smoke and dust to permit such buildings; however, this condition is slowly being remedied. As cities become organized more communally they become cleaner; more consideration, too, is given to the importance of having plant life near. The well-planned city of the future will have many more parks than any city of to-day. In the giant building, trees, plants and flowers would be installed on the terraces and on a promenade just above the business area and running from block to block by means of bridges at the cross streets. The architect sees the city of 100 years hence as having smokeless skies, dustless air, residence and business reunited—business below in glass-enclosed spaces and apartments with terraced gardens above, all buildings oriented for maximum sunshine, light travel by air with landings on towers, heavy travel at street level, arcaded sidewalks one level up for pedestrians, bridges at this level and again at the living level for the convenient movement of pedestrians, machinery mastered to serve the health, comfort and happiness of man in all walks of life; order, cleanliness, rational disposition of space, sincere expression of structure and materials—the fundamentals of architectural beauty.

HOTELS

Originally, hotels were rambling structures with certain communal rooms—taproom, dining-room, parlour, with small offices on the ground floor and bedrooms scattered round in an irregular and commodious fashion above. Although the large, efficiently planned and highly organized modern hotels lack the domestic charm of their predecessors, the elements involved in hotel planning have changed in size and number only. The single dining-room has multiplied into a great banquet hall, a main dining-room, a breakfast-room, a grillroom, and oyster-bar and various special rooms; the parlour has been extended to accommodate conventions; ballrooms, galleries, swimming pools, gymnasiums and roof gardens have been added. The modern growth of the hotel has taken place mainly in the United States and may be traced to an enormous amount of business being carried on over an area so large that many commercial salesmen have to travel from place to place and conferences at central points have to be held, and to

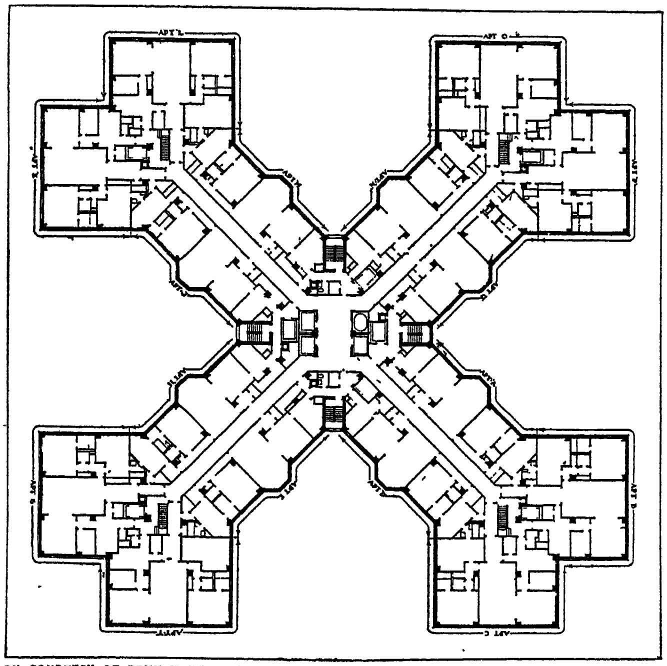


PLAN OF THE SHELTON HOTEL, NEW YORK CITY; ARTHUR LOOMIS HARMON, ARCHITECT

the modern developments in transport facilities which permits widespread travel for pleasure as well as business.

The modern hotel has to be designed to serve the needs peculiar to the modern travelling man of business. Efficient accommodation and time saving arrangements are more important than a domestic atmosphere. On each floor, at the entrance to the elevators, there must be provided space ample not only for circulation of the tenants but also for a control desk complete with key-rack and telephone switch-board. Each room must be equipped with a limited amount of closet space, a toilet, tub and

shower baths, hollow doors in which suits may be placed to prevent the valet's disturbing the tenant, inside and outside telephones, and in the most recent and luxurious even radios. The main lobby, however, is planned, even at the expense of efficiency, to suggest an atmosphere of bustle and a full house; the lanes through which visitors and tenants must pass should not be too wide, and convenient seating arrangements should be made;



BY COURTESY OF BRYN MAWR BUILDING CORP.

PLAN OF AN APARTMENT HOTEL

lobbies so planned have an added interest that may be non-existent if the disposition of space is the result of planning only for the greatest ease and directness of movement.

As in modern office and apartment buildings, a typical upper floor plan providing the greatest possible number of rooms in the space available, is developed first. The necessity of taking advantage of all outside space for rooms produces artificially lighted and ventilated corridors and halls; but wherever possible, especially at the points where tenants await elevators, natural light and ventilation should be brought in, for in enclosed spaces an occasional glint of sunshine and even a small vista relieves the prison-like aspect that many hotels have on bedroom floors. Steel skeleton construction, now the accepted form of building nearly everywhere (*see* ARCHITECTURE), makes possible a more economical bedroom floor arrangement than the older types of wall-bearing construction, with which, of course, there was also a definite limit to the number of storeys possible. The rooms and suites not provided in the upper storeys are much standardized. Since the desirable spaces in a sky-scraper are in the upper storeys, it is not uncommon for the first three or four floors to be occupied by quasi-public rooms, with shops and offices in the lower spaces, although examples exist where some of the public rooms have been put at the top; on the street level, shops open on both the street and the hotel lobby; these elements play an important part in meeting the high cost of operation. The heavy overhead expenses of a modern hotel makes operation with less than 1,000 rooms difficult. In the United States some recent examples exceed 2,000 rooms, 20 storeys are now customary and a 40-storey hotel has been projected.

The opportunities for exterior design presented are similar to those of other types of sky-scrapers. Zoning regulations, however, tending to cut the building back, interfere so materially with the standardized floor plan that the usual practice in the United States is not to carry the building above the permitted height for the straight front wall. This tends to produce a box-like form, and the architect, to soften its hard lines, has to resort to cornices and ornament, or develop roof-garden restaurants with pergolas. The entrance generally has a large marquise running out to the curb. The lower floors, devoted to large public rooms, give the architect an opportunity to express on the exterior, in an interesting treatment of the base, the major elements of the hotel.

From the interior point of view, the main lobby is the most important single feature in the building. It should be very spacious, since both tenants and visitors pass through it or congregate there, but, as has been pointed out, it should be so designed as always to appear busy and full of life. It is generally two storeys high with surrounding galleries. It is sometimes placed below a light well in the centre of the building so as to give some degree of natural light during the day, but in tall buildings skylights have little value and artificial "daylight lamps" are used above them to give daylight effect. Because of their large size the public rooms have to be formally treated, but their architectural formality is often successfully relieved by the use of screens of growing plants and the informal arrangement of the usually luxurious furniture.

The hotel is following in the way of other forms of business and is tending to concentrate in larger and larger units. In Europe, however, the height limit placed on buildings has prevented the adoption of the modern efficiency methods of hotel management with the result that it is impossible for enough typical floors to be superimposed for economic operation.

APARTMENT-HOTELS

Apartment-hotels have developed on a large scale from the modern demand for expert service in living conveniences that has tended to make hotels more and more popular as places of permanent residence. They differ from the apartment house in that the suites have no kitchens and the building generally contains one or more common dining-rooms. They differ from the hotel in that the rooms are not standardized and may or may not be furnished and they are designed without commercial spaces and many of the social rooms found in large hotels. Often tenants contract for their space on long term leases, furnishing and decorating to suit themselves. Sometimes dining-rooms are provided in the apartments, and then meals are served from the hotel kitchen. The management provides service at an hourly rate, thereby eliminating all domestic cares for the tenants. This type of apartment is prevalent in the United States, for there the idea of communal services is becoming increasingly popular.

The best source of information on modern apartment and hotel architecture is the various architectural publications, for which *see* bibliography under ARCHITECTURE. (H. W. C.)

SOCIAL CONTRACT. In political philosophy, a term applied to the theory of the origin of society associated chiefly with the names of Hobbes, Locke and Rousseau, though it can be traced back to the Greek Sophists. According to Hobbes (*Leviathan*), men lived originally in a state of nature in which there were no recognized criteria of right and wrong, no distinction of *meum* and *tuum*. Each person took for himself all that he could; man's life was "solitary, poor, nasty, brutish and short." The state of nature was therefore a state of war, which was ended by men agreeing to give their liberty into the hands of a sovereign, who thenceforward was absolute. Locke (*Treatise on Government*) differed from Hobbes in so far as he described the pre-social state as one of freedom, and held that private property must have been recognized, though there was no security. Rousseau (*Contrat social*) held that in the pre-social state man was unwarlike and even timid. Laws resulted from the combination of men who agreed for mutual protection to surrender individual freedom of action. Government must therefore rest on the consent of the governed, the *volonté générale*. Though it is quite obvious that the theory of a social contract (or compact, as it is also called) contains a considerable element of truth—that loose associations for mutual protection preceded any elaborate idea or structure of law, and that government cannot be based exclusively on force—yet it is open to the equally obvious objection that the very idea of contract belongs to a more advanced stage in human development than the hypothesis itself demands. Thus the doctrine yielding as a definite theory of the origin of

society to the evidence of history and anthropology, becomes interesting primarily as revolt against mediaeval and theocratic theories of the state.

SOCIAL HYGIENE. Although, strictly, social hygiene should deal broadly with all aspects of hygiene in a narrower sense than general hygiene which is the duty of the State and in a broader sense than personal hygiene which is the duty of the individual, the term, at the present time, is usually contracted in its significance to imply hygiene with respect to sex problems alone. Many branches of medicine, economics and government are concerned intimately with sex problems, *e.g.*, mental disease, national insurance, housing, recreation, education, alcoholism, drug addiction; but these, as such, are not included in social hygiene though their importance with reference to the question at issue is manifest. Nor do the different attitudes taken towards sex problems in different parts of the world, east compared with west, north compared with south, enter into the question, though obviously when a population is drawn from many widely differing sources such points must merit grave consideration. To a large extent social hygiene is a product of civilization and tends to be most highly developed in the most highly civilized countries. And yet it is not civilization as such, for in many ancient civilizations of high order social hygiene was but little prosecuted. Rather it is a product of the health and morality which are functions of certain types of civilization. Thus in the Mosaic Code, social hygiene in its modern sense is evident to a far greater extent than it was in Athenian civilization. In the main, problems of social hygiene are dealt with locally rather than nationally or internationally but the establishment of free venereal clinics shows that there is a national side while the concern of the League of Nations over the white slave traffic indicates the international aspect.

The recognized measures employed in the programme of social hygiene are educational, legal and protective and medical. The educational measures aim to promote among the general public an understanding of sex problems and of the best methods and experience in dealing with them, to promote sex education as a normal feature of character education, avoiding undue emphasis upon sex as such, and to promote the training of teachers, leaders of religious and social agencies and parents, for their task in the sex aspect of character education. The legal and protective measures are concerned with the repression of prostitution, the promotion of sound legislation and effective law enforcement in support of social hygiene measures, and of improvements in the organization and administration of police departments and of courts and institutions caring for sex offenders. They seek the prevention of delinquency through the development of desirable and adequate recreational opportunities, the use of women police in the supervision of public recreational facilities and through the extension of the preventive work being carried on by child guidance clinics, vocational adjustment bureaus, visiting teacher associations and voluntary protective agencies. Medical measures aim at the prevention and cure of the venereal diseases. The principal means employed are: instruction of the public in regard to the seriousness and the means of prevention of these diseases, and the necessity for early diagnosis and treatment of infected persons; the provision of facilities which are adequate and available for diagnosis and treatment; follow-up case work to encourage consistent attendance for treatment and to bring contacts of infectious patients under control; research for improvements in diagnostic and therapeutic procedures and materials; more thorough training of practitioners of medicine to deal with these diseases; and continuous study of the prevalence of the venereal diseases and the effectiveness of the various control measures employed.

SOCIAL INSECTS. Although the vast majority of insects are solitary in habit, there are certain groups in which the individuals have developed social behaviour and live together in societies. Each society consists of the two parent insects, or at least the fecundated female, and their offspring, and the members of the two generations live in mutual co-operation in a common abode or nest. Species which exhibit this mode of life are termed social insects.

There is little doubt that the social habit has developed out of the natural propensity of many female insects to lay their eggs in protective structures or burrows with ready access to food when the young hatch out. As a rule the parent then dies, but those species which survive the emergence of their young and, to a greater or lesser degree, also feed and protect them, merit the designation social insects. With solitary insects the usual brevity of adult life, once mating and egg-laying have been accomplished, precludes the development of the social habit. The first indications of the latter will necessarily follow, once the life of the female parent is sufficiently lengthened to allow of its having actual relations, however slight, with its offspring. In order to appreciate the full significance of the behaviour of social insects it is necessary first to consider the subsocial forms, or those in which the social habit is, as it were, in an elementary stage of its evolution.

SUBSOCIAL INSECTS

Insects with incipiently social or subsocial behaviour belong to diverse groups and exhibit parental care for their offspring in various ways. In the common earwig (*q.v.*) the female deposits her eggs in a group in an excavation below the surface of the soil and rests over them until they hatch. The young remain for a few days with the parent who in this respect resembles a hen with her brood of chickens, and her solicitude for her offspring is maintained until they disperse. Among the *Embioptera* (*see* INSECTS) of warm countries Imms has observed similar behaviour with the Himalayan species *Embia major* which lives in dense silken tunnels beneath stones. The young, in this case, keep together in the parental abode and, where necessary, extend it by weaving tunnels for themselves. Among beetles, in the Scarabaeid *Copris lunaris* the male and female associate in pairs and excavate a chamber in the earth which they fill with ellipsoidal balls of dung in each of which an egg is laid. These are guarded while the larvae are feeding and growing within, and when the young beetles emerge the latter are escorted to the surface by both parents and the family then disperses. Other species of *Copris* and also other dung beetles like *Geotrupes*, *Onthophagus* and *Minotaurus* exhibit very similar parental care, higher or lower developed in the several cases. The ambrosia beetles of the family Scolytidae (*see* COLEOPTERA) construct galleries in the wood of trees. Both sexes work together but most of the work devolves upon the female who excavates circular pits along the tunnels laying an egg in each.

Omitting the *Passalidae,* which also exhibit marked social habits, mention must be made of certain beetles of the family *Cucujidae* recently found by Wheeler living along with their brood in the hollow leaf-stalks of young *Tachigalia* trees in British Guiana. The parent beetles live and feed along strands of specially nutritive tissue and while they are thus engaged, numbers of mealy-bugs (*see* SCALE INSECT) wander into the leaf-stalk through the opening made by the beetles, settle in the grooves eaten out by the latter and feed on the nutritive tissue. The beetles lay their eggs and their larvae devour the same food as the parents but, remarkable as it may seem, both the larvae and their parents have learned to stroke the mealy-bugs with their feelers thus stimulating them to exude honey-dew which they eagerly consume. The beetle larvae duly pupate in the leaf-stalks and when the young beetles hatch out they remain with their parents, but soon commence egg-laying with the result that there is eventually a community of beetles, larvae, pupae and mealy-bugs of all ages living together. The subsocial beetles foreshadow the behaviour which obtains in the more highly organized social communities but, unlike the latter, they exhibit no structural or physiological differences between individuals which constitute separate castes.

SOCIAL INSECTS

Social Wasps.—It will be convenient to discuss the social wasps first because they are of special interest in illustrating the evolution of social behaviour. Collectively wasps (*q.v.*) form an extensive group numbering over 10,000 species, the vast majority

being solitary in habit. The social wasps, which alone concern us here, include about 800 species and are all members of the family *Vespidae* of the superfamily Vespoidea. Wasps are primarily predacious and feed upon other insects which they capture as their prey: they are also fond of nectar, over-ripe fruit, honey-dew, etc. Their mouth-parts have not attained the length and perfection found among bees, and hence wasps are unable to exploit the secretions of deeply seated nectaries. They construct paper nests formed of fragments of dry wood chewed and mixed with saliva: such nests consist wholly, or in part, of combs, or regular hexagonal cells, in which the young are reared simultaneously.

In oriental wasps of the genus *Stenogaster* some of the species are solitary, while others betray elementary social habits. According to F. X. Williams the social members of this genus construct small nests of comparatively few cells and the colonies comprise but few individuals. The female parent feeds the larvae from day to day until they are fully grown, when the cells are then sealed over: on emergence from the pupae the daughter wasps share the nest with the parent. In primitive African wasps of the genus *Belonogaster* the colonies are of larger size and in the stronger nests the older females devote themselves to egg-laying and the younger to foraging for food and nest materials. There is thus an indication of division of labour, but without any differentiation in structure among the females. *Belonogaster* is termed a polygynous wasp because each nest contains a number of fecundated females, and when a colony has attained its full development they leave in parties and found new nests elsewhere. Among certain South American wasps of the subfamily Epiponinae there is found the beginnings of caste differentiation: certain of the females are workers, *i.e.*, their ovaries are imperfectly developed and they are either sterile or capable only of laying unfertilized male-producing eggs, while others are true females or queens with fully developed ovaries and capable of fertilization. Since many of these wasps have numerous queens and their colonies are perennial, their nests become extremely populous comprising thousands of individuals. This overcrowding, however, is relieved by their periodically emitting swarms of workers accompanied by a small number of queens. Such swarms are the forerunners of new colonies and are unknown among wasps outside the tropics.

The most familiar social wasps are those of the genus *Vespa* which includes all of the common wasps and hornets of the north temperate zone. Since they are inhabitants of cooler regions, their colonies last for a single season only: swarming is unknown for the reason that this habit is an adaptation to the continuously favourable conditions of food and temperature that prevail only in the tropics. Furthermore, the colonies of *Vespa* are monogynous, each being founded by a single fertilized queen. At the end of the season all members of a nest perish with the exception of an annual brood of queens which, after fertilization, hibernate and each founds a new colony the next spring. A typical wasp's nest is composed of a fertilized female or queen, a large number of workers and a smaller number of males. The three forms of individuals are very alike in coloration, but the queens are considerably the largest: the males have seven evident abdominal segments and 13 joints to the antennae, whereas only six abdominal segments and 12 antennal joints are found in the queens and workers. The latter are a very distinct caste, being much smaller than the queen and incapable of fertilization: such eggs as they occasionally produce give rise to males only.

The hibernating female wasps are roused into activity by the warmth of early spring and commence to seek out likely situations for their nests. *Vespa vulgaris, germanica* and *rufa* make underground nests, other species suspend their nests from bushes, trees, etc., while *Vespa crabro* (the hornet) nests as a rule in hollow trees. In the very common species *V. vulgaris* and *germanica*, the nest is commenced by layers of "paper" being applied to the roof of the cavity in the ground destined to contain it. From the centre of the disk thus formed a stalk is provided and upon its widened free end the first few cells are constructed: they are hexagonal in form, open below and closed above. An umbrella-like covering is formed around the roof of the cavity to protect the comb and an egg fixed at the upper end of each cell by means of a cement, which prevents it from falling out. In a few days, according to temperature, the larvae hatch and are fed with chewed or malaxated portions of caterpillars, flies or other insects until fully grown. Prior to transforming to the pupa the larva spins a cocoon within the cell and closes the mouth of the latter with a tough floor of silk. The wasp grub now evacuates the contents of the gut for the first time and soon changes into a pupa. After four to six weeks from the time of egg-laying the adult wasps bite their way through the floors of the cells and emerge. These early individuals are all workers and they very soon take over the whole business of feeding the brood and extending the nest, so as to leave the queen free to devote herself solely to egg-laying. When the nest is fully formed it is more or less spherical externally and is invested by several protective coats of "paper": once a layer of comb has attained its full dimensions, new layers are built below and interconnected by vertical pillars. This goes on until about seven or more tiers of comb are constructed, and an average sized nest contains about 5,000 wasps towards the end of the season. In addition to the normal occupants a number of other insects inhabit wasps' nests either as inquilines or parasites and in the soil of the earthen chamber beneath the nest fly larvae live on the waste organic residue accumulated there.

Following this brief sketch of the habits of social wasps certain fundamental aspects of their behaviour remain to be mentioned. The feeding of the brood with malaxated portions of insects has already been referred to: the hungry grubs in the comb thrust out their heads, as Wheeler remarks, "like so many nestling birds," eager to attract attention from their nurses. It is now established that the activities of the latter are by no means disinterested and in return for the food supplied to their grubs, the wasps themselves eagerly imbibe the sweet saliva emitted from the mouths of their young. They stimulate the grubs by contact, or even by seizure of their heads between their own jaws, if the desired secretion be not forthcoming. This reciprocal feeding is termed "trophallaxis" which, as will be seen later, is of very general significance in the behaviour of social insects.

Owing to this expenditure of saliva by the larvae and the great number which are reared simultaneously, many are inadequately nourished and pupate as small individuals with poorly developed ovaries. In this manner it is claimed that the workers are produced, while the exigencies of collecting food for the larvae and caring for the nest is exhausting labour, which tends to keep them sterile. It is only later in the season that the abundance of workers and the amount of food brought in, allow of the larvae being more copiously fed, many of which in consequence develop into fertile females.

Social Bees.—Bees, as a group, are to be regarded as specialized wasps which have resorted to feeding upon nectar and pollen. Fully 10,000 species of bees are known, but only about 5% of them are social in habit, the remainder being solitary forms (*see* BEE). The special structural features of bees involve those parts and organs concerned with the gathering of nectar and pollen, and nest-building. The mouth-parts have well-developed mandibles, while the maxillae and labium are especially modified for sucking or lapping up nectar. Among the more primitive bees which visit flowers with exposed nectaries, the maxillae and labium are short as in wasps, but in the social and other specialized forms which visit tubular flowers with deeply seated nectaries, these same organs are greatly elongated, the ligula being drawn out to form the so-called tongue. The under surface of the latter is provided with a groove so overlapped by special hairs as practically to form a tube. Along this channel the nectar is sucked into the pharynx whence it passes into the crop or storage chamber of the gut. Here it becomes mixed with a ferment, presumably derived from the salivary glands, which converts its cane-sugar into invert sugar (dextrose and levulose). In this changed form the nectar is known as honey and it is regurgitated and served as food for the brood. The adaptations for collecting and gathering pollen are pronounced: the whole surface of the body is densely hairy and many of the hairs are branched or plumose so as to retain pollen

grains until the insect combs them off by means of its legs. The pollen is collected in masses and attached to the outer surfaces of the tibiae and first tarsal joint of the hind legs. These parts of the bee are broadened and fringed with long hairs to form a pollen-basket or corbicula. Another important feature is the production of wax, all social bees utilizing this material for comb-building and it is formed as a secretion which is discharged from glands between the abdominal segments where it hardens into lamellae.

The most primitive of the true social bees are the *Bombidae* or bumble bees. About 200 kinds are known and they are characteristic of temperate regions while in the tropics they are generally found in the mountains.

The societies of true bumble bees (*Bombus*) in Europe and North America are in most respects parallel to those of the social wasps of those regions, in that the fertilized females or queens, produced at the end of summer, hibernate and found new colonies in spring. On the advent of mild weather each queen seeks out a spot for her future nest which commonly consists of fine grass or moss formed into a hollow ball and located rather deep in the ground: some kinds, known as "carder bees" form surface nests concealed among herbage. Having formed the nest itself, the queen proceeds to gather a mass of pollen which is mixed with honey into a paste. Upon the top of this mass she constructs a circular wall of wax and in the cell thus formed she lays the first batch of eggs, afterwards capping it over with wax. She also constructs a waxen receptacle or honey pot which is filled with a store of honey for her own consumption, while she is brooding over the eggs to incubate them. The larvae hatch in about four days and feed immersed in their bed of pollen-paste and up to this stage the queen behaves much like a solitary bee. A significant change, however, supervenes and she gnaws a hole in the lid of the cell and regularly supplies her young with regurgitated honey and pollen, thus practising progressive provisioning. About the tenth day after egg-laying the larvae spin tough yellow cocoons and on the twenty-second or twenty-third day the first worker bees appear. New cells become added to the nest, each cell containing about a dozen eggs, and when sufficient workers have emerged the work of provisioning devolves upon them and the queen becomes confined to the nest. The workers construct additional receptacles for honey and pollen or store these substances in the empty cocoons: further new cells are added to the nest and the latter at its period of maximum strength contains from about 100 to 500 bees. Later in the season some of the larvae, enclosed in the larger cells, and derived from fertilized eggs, are abundantly fed and develop into females which subsequently hibernate: males, which develop from unfertilized eggs, appear about the same time. The workers do not differ from the queens except in size, and since they have been more or less inadequately fed during the exigencies of the earlier life of the colony, they are consequently smaller: any eggs laid by them are unfertilized and develop into males.

The nests of *Bombus* are often shared by inquiline bumble bees of the genus *Psithyrus*, each species of the latter adopting a particular species of *Bombus* as its host. Furthermore, the colour and size of a particular inquiline bears a strikingly close resemblance to its host species of *Bombus*. The inquiline species have no worker caste and their queens are devoid of pollen-gathering structures. According to Sladen the *Psithyrus* stings the *Bombus* queen to death and usurps her place in the nest, the *Bombus* workers rearing the inquiline offspring along with the reduced numbers of their brood.

The stingless bees of the genera *Melipona* and *Trigona* number nearly 250 species, which are chiefly found in South America, relatively few occurring in the tropics of the old world. The name stingless bees is a misnomer since a vestigial sting is present while, on account of their small size, they are sometimes called mosquito bees: when disturbed some kinds literally swarm over the face and in the hair of a human intruder to his great annoyance. The castes are well marked in these insects: the workers structurally represent the typical females except that they are sterile, while the queen exhibits degeneration of the typical secondary characters of her sex. The colonies are monogynous but a number of daughter queens are tolerated and these, accompanied by detachments of workers, swarm from time to time and found new nests. The latter are found in tree hollows or on branches; more rarely they occur in the ground or in termites' nests. Most species mix their wax with earth or other material, thus producing a brown or black substance termed cerumen for comb-building.

Social life among bees reaches its highest development in the hive-bees or honey-bees of the genus *Apis*. Only four species are known, viz., *A. mellifica* the common hive-bee, together with the oriental species *A. dorsata, indica* and *florea*. The common hive-bee (*Apis mellifica*) has been introduced into almost all countries of the world and is rarely, if ever, found wild in Britain. The three castes are very easily identified; as the drone (male) is considerably larger and stouter than the worker: it is readily distinguished by its blunter abdomen and the large eyes which occupy the greater part of the top of the head. The queen can be recognized by her much longer abdomen, which extends some distance behind the closed wings. Her reproductive organs are completely developed and attain a large size, whereas in the workers these parts remain rudimentary or occasionally become partially developed in the case of fertile members of their own caste. The colonies are perennial and a flourishing hive will number 50,000 to 80,000 bees, the vast majority of them being workers. The combs are made of wax which is secreted between the ventral abdominal plates of the workers. Each of the combs are composed of a large number of typically hexagonal cells arranged in two series placed back to back: the separate combs hang vertically downwards with just enough space between them to admit of the free movements of the bees. Cells in which workers develop are smaller than those destined to produce drones, while the largest are the royal cells, which are the cradles of the future queens. The royal cells are always very few in number, ovoid and irregular in form and are constructed by the workers as required. Other of the cells are used for storing honey and pollen which are drawn upon during the dormant months of the year. In addition to wax the workers utilize a resinous substance which they collect from the buds of poplar and other trees: this material is termed propollis and is used as a glue to fasten loose portions of the combs or for filling up crevices, etc. The queen lays an egg in each brood cell and the incubation period is about three days: the complete development of a queen occupies about 16 days, a worker three weeks and a drone 24 days. The fertilized eggs develop into workers or queens according to the type of feeding the larvae receive, and the unfertilized eggs produce drones. The young larvae, irrespective of caste, are nourished at first upon a food rich in protein, produced, it is believed, as a secretion of the workers' salivary glands. Queen larvae are fed upon this diet, which is commonly termed "royal jelly," until they pupate, while drone and worker larvae only receive this food up to the fourth day (or third day according to recent American observers), after which they are nourished upon honey and predigested pollen. The queen is able to survive for several seasons, but performs no functions other than egg-laying and is capable of producing up to 1,500,000 eggs during her life: her legs are destitute of the pollen-collecting apparatus so well developed in the workers. New colonies are established by swarming and this event follows the emergence of a daughter queen. The latter remains in the hive and the swarm consists of the old queen accompanied by a host of workers. The new queen takes her marriage flight at the first opportunity and is followed by a number of drones: mating takes place in mid-air and the fertilized queen then returns to the nest. If a second swarm be emitted the same season, it is accompanied not by the reigning queen, but by a new virgin queen. The worker bees when newly emerged are mainly active within the hive attending the brood, nest-building and performing other duties. As they become older they go out into the field in order to collect nectar and pollen: the latter duties are very exacting and summer-hatched workers seldom live longer than about six or seven weeks, while those hatched in autumn live to perform the labours of early spring.

It is important to remember that among bees social life exists

without that peculiar interchange of nutriment between the adults and their brood, which is so characteristic of social wasps. It is possible that the habit of using an abundant and highly nutritious food, and the storage of the same in reserve within the nest, ensures sufficient nourishment at all times for both adults and brood and thus renders exploitation of the latter by their nurses of little advantage.

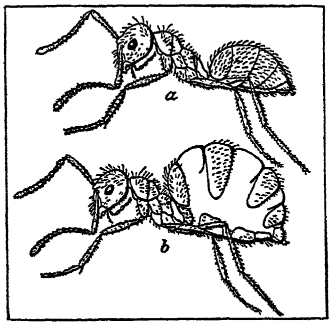
Ants.—It is among ants that social life in insects attains its highest expression and, it may be added, all ants are social in habit. Structurally they are easily recognized by their elbowed antennae and the conspicuous "waist" formed by a pronounced constriction of the abdomen where it joins the thorax. Except in certain individuals to be mentioned later, wings are absent and the mouth-parts are adapted both for biting and for taking liquid food. Ants live in societies which inhabit nests of various kinds: many species construct their abodes in the soil, galleries and chambers being hollowed out underground. Others form mound nests which are composed not only of excavated soil, but also of heaped-up masses of straws, twigs, pine-needles, leaves, etc., so arranged to form an orderly series of galleries and chambers. Perhaps the largest number of nests are simply excavated beneath stones or logs. In the tropics many ants take advantage of cavities found in stems, petioles, thorns, bulbs, etc.: others form suspended nests attached to trees and constructed of earth, carton or silk. The tropical ant *Oecophylla smaragdina* forms leaf nests, the leaves being fastened together by silk. Doflein and others have shown that the silk is provided by the larvae which are held by the jaws of the worker ants and used, as it were, as shuttles in weaving the silken threads, which bind the leaves together.

The larvae of ants are legless creatures with a small head and 13 trunk segments. When they become fully grown some ants construct cocoons which contain the pupae, such cocoons regularly being sold for bird-food under the name of "ants' eggs": other ants pupate without any such protection. No cells are constructed to protect the brood, the latter simply being contained in special chambers of the nest where they are assiduously nursed.

With the exception of the parasitic species, all ants possess a sharply defined worker caste composed of individuals devoid of wings with a relatively simply formed thorax, reduced compound eyes and with the simple eyes minute or wanting. As in other social Hymenoptera these workers are normally sterile females but on occasion their ovaries develop sufficiently to produce parthenogenetic eggs which may give rise to male or, in some cases, worker offspring. In some ants the workers are all alike, but in others they may be differentiated into large-headed or major individuals often termed soldiers, and small-headed individuals or minor workers: in other species there may be grades of individuals between these extremes. The males and normal females are winged insects with well-developed eyes but either sex may develop into abnormal forms of several types.

Under ordinary circumstances the queens cast their wings shortly after mating and the loss of the flight organs results in the degeneration of the voluminous wing-muscles, which finally break down into material which serves to nourish the developing eggs. When the eggs are mature and the first batch is laid, the queen attends the growing larvae, feeding them with her own saliva until they pupate. The workers which emerge then take charge, feeding the queen and themselves besides tending the new brood, thus enabling the parent to devote herself entirely to egg-laying. Winged males and females develop in large numbers in strong colonies and, given favourable weather conditions, they leave the nest and either pair with their brothers or sisters as the case may be or with individuals from other colonies. This flight provides for the dissemination of the species since the fertilized daughter queens usually found their nests some distance from the maternal colony.

The feeding habits of ants are both varied and complicated and it is noteworthy that hunting, pastoral and agricultural modes of life appear to have succeeded one another in these insects, as they are believed to have done in the case of man. As Wheeler points out, the most primitive species are carnivorous or, in other words, hunters of other insects. This habit is well exhibited in the tropical "legionary" or "driver" ants (Dorylinae) which do not construct permanent nests but wander about from place to place. These ants make sorties, often at night, for predatory and migratory purposes attacking insects, spiders and even vertebrate animals—especially if the latter be penned up. There are other groups of ants which represent the pastoral stage, such insects living mainly upon saccharine matter obtained partly from plants, but more especially as honey-dew exuded from Hempiterous insects. Many ants have learned how to induce these insects to void the honey-dew by stroking them with the antennae and even to keep and protect them—Aphides (*q.v.*) are especially sought after for this purpose and Linnaeus was amply justified in calling them the dairy cattle of the ants. This pastoral habit has led to remarkable specialization in species known as "honey-ants" which have discovered the advantage of storing honey-dew when it is available in quantity. Since ants, however, have not the art of making receptacles, they have adopted the curious method of using the crops of certain workers or soldiers for the purpose of food-storage (fig. 1). Individuals thus functioning are termed *repletes,* which become so inflated that they are quite unable to walk, and assume the rôle of animated casks or carboys. When hungry the ants stroke the repletes and receive from them droplets of regurgitated honey-dew collected during times of plenty. The habit above described has been observed in ants living in desert or other arid regions of Africa, Australia and North America, while a more direct vegetarian adaptation is found in certain other ants inhabiting much the same terrain. In such regions insect food is commonly scarce and certain ants resort to collecting and feeding upon plant seeds. These harvesting ants collect, husk and store the seeds in special granaries: in some species the soldiers or major workers appear to function solely as seed-crushers, thus allowing the softer parts to be available for consumption by the smaller individuals. The harvesting ants can hardly, as Wheeler says, be regarded as true agriculturists since they neither sow nor cultivate the plants from which they gather the seeds. There are, however, other ants which form the group of the Attiini, found in America from Long Island, N.Y., to Argentina, which may be looked upon as cultivators. They are fungus-growers and fungus-eaters and the fungi concerned are cultivated in gardens or special chambers of the nest. According to Moeller these gardens are practically pure cultures of the fungi, which are "weeded" and tended by the worker ants.



FROM WHEELER, "ANTS" (COLUMBIA UNIVERSITY PRESS)

FIG. 1.—AN ANT (PRENOLEPIS IMPARIS) MAGNIFIED

A. An ordinary worker; B. a worker greatly distended with a saccharine matter

When discussing social wasps the importance of trophallaxis, or the interchange of food between adult and larva, was stressed. Certain ant larvae supply their nurses with saliva while many exude a fatty secretion through the delicate general integument of the body, and larvae of the group Pseudomyrminae produce similar exudations from special papillae or appendages. These products are eagerly imbibed by the attendant ants, whose maternal care for their brood is, at least in part, initiated and sustained by what they receive in return for their attentions.

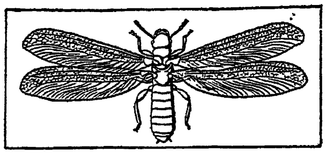
The relations between ant communities of different species represent another aspect of social behaviour. In some cases two species may occupy a compound nest and live amicably together although their broods are kept separate. Relations of this character are of the nature of social symbiosis, but in other cases the behaviour of one species towards another is one of aggression rather than of mutual benefit. The peculiar behaviour that is known as slavery or dulosis is especially well exemplified in the European ant *Formica sanguinea:* its workers raid the nests of *Formica fusca* and other species, carrying off to their own nests pupae from which workers subsequently develop. Such

workers live as slaves in the nests of their captors, but the latter are not wholly dependent upon them since independent slaveless nests also occur. Obligatory slave-makers or "amazons" are represented by another European ant (*Polyergus rufescens*) which is dependent upon its slaves, in whose nests its young queens establish their own brood. *Polyergus* invades a weak nest of *Formica fusca* and, after killing its queen, leaves the workers to feed and tend the amazon's brood. *Polyergus* workers are abundant but their sole part is to raid other *F. fusca* nests and bring back larvae and pupae for purposes of maintaining the slave population to the necessary level. Another European ant *Anergates atratulus* is a highly specialized social parasite with no workers, which lives at the expense of the species *Tetramorium caespitum*. The *Anergates* queen enters a nest of the latter and the host workers rear her offspring which are all males and females.

Passing now from the relations of ants as parasites and hosts of one another, there remain to be considered those cases in which they function as hosts for other creatures that live within their nests. These ant-guests or myrmecophiles include not only members of nearly all orders of insects, but also various mites, spiders, millipedes and land crustaceans which collectively number quite 2,000 different species. The nature of the association between these aliens and their hosts varies immensely. Some, such as certain bristle-tails, mites and rove-beetles are thieves or predators, giving nothing in return and devour dead or diseased ants or prey upon the brood. The bristle-tail *Atelura* is common in the nests of various European ants and according to Janet it obtains most of its food by imbibing it while it is being regurgitated by one ant to another. Other insects such as the curious slug-like larvae of the fly *Microdon* live as scavengers and at least confer some benefit upon their hosts. The true guests, or symphiles, come under a different category to the foregoing and mainly consist of various beetles which all show remarkable adaptations to their mode of life. These insects are tended with the greatest fidelity by the ants who rear their larvae like their own brood, notwithstanding the fact that they devour the eggs and larvae of their host. There are also a large number of Hemiptera and a variety of butterfly caterpillars of the family Lycaenidae which supply either honey-dew or glandular products highly attractive to ants. In many cases these insects are harboured in the nests while in other instances, where the association is less intimate, the ants follow them about on plants solely for the products which they yield them.

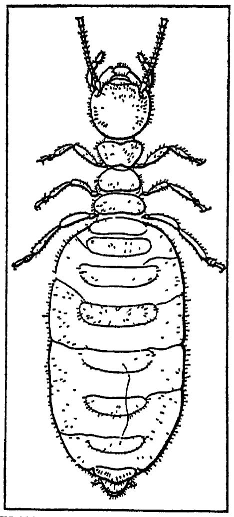
Termites.—The termites or so-called white ants are all, like the true ants, social insects living together in communities. Their social organization is of unusual interest not only because of its complex development, but also from the fact that although these insects are of very primitive structure, being closely allied to the cockroaches, yet their social life parallels in many features that of such highly developed insects as ants. Termites number over 1,200 species and abound throughout the tropics as well as occurring in most warm temperate lands: only two species are common in Europe and nearly 40 kinds occur in the United States. They are usually pale-coloured, soft-bodied insects with a delicate integument and may be readily separated from ants by the absence of any constriction or "waist" where the abdomen joins with the thorax. Their mouth-parts are very like those of the cockroach, the tarsi are almost always four-jointed and a pair of very short cerci are present. Certain members have two pairs of similar elongate membranous wings, which are easily shed by means of fractures at their bases, but the vast majority of the members of a colony are wingless. Metamorphosis is incomplete and often of a very trivial character.

Termites are insects of great economic importance since the chief food of a large proportion of the individuals is cellulose. In order to obtain this material they injure or destroy trees, crops, buildings as well as goods stored in the latter, thereby entailing immense losses to man, especially in tropical countries. Damage to wooden structures of all kinds is so extensive that the more progressive tropical communities are, where possible, replacing wood, especially below ground, by stone, concrete or iron. The nests or termitaria are very varied: the more primitive forms are wood feeders which construct no true nest but merely hollow out galleries in logs, decaying trees or manufactured timber. Other kinds burrow in the ground where they construct a labyrinth of tunnels either with or without mound nests above the surface. Among the higher termites, particularly those of Africa and Australia, the termitaria are often gigantic structures of great durability. They are formed of earth particles cemented together with saliva or with faecal material and, upon drying, the saliva-impregnated earth becomes of a cement-like hardness. Some of the most remarkable of all termitaria are the lofty steeple-like structures constructed by *Eutermes triodiae* in northern Australia, which are known to reach a height of 20ft. with a basal diameter of 12 feet. The interior of such a nest presents a maze of irregular chambers and passages while in its deeper recesses the brood is reared and the royal cell, which will be mentioned later, is located. The compass or "meridional" termite (*Hamitermes meridionalis*) is widely distributed in Australia; its nests attain a height of 8 to 12ft., and are flattened from side to side in such a manner that the broad faces are directed east and west, with the narrow ends north and south. There are other termites which construct carton nests of chewed wood, placing them up trees; such nests are ovoid or rounded, and about the size of a football or larger, and consist of an outer envelope enclosing a comb-like mass of internal passages. Many termites, which have to come above ground in search of food or water, construct earth-like shelter-tubes or passages, which run up buildings or trees often to a great height and are very characteristic features in the tropics. Secure in these covered ways they are able to travel long distances to and from their nests, protected from the daylight and from their enemies, but surrounded at the same time with the requisite humidity.



FROM MARLATT, ENTOMOLOGICAL BULLETIN (U.S. DEPT. OF AGRICULTURE)

FIG. 2.—RETICULOTERMES FLAVIPES, FULLY WINGED MALE



FROM BANKS AND SNYDER, "REVISION OF THE NEARCTIC TERMITES" (SMITHSONIAN INSTITUTE)

FIG. 3.—RETICULOTERMES FLAVIPES, SHORT-WINGED QUEEN MAGNIFIED ABOUT 5 TIMES, WITH ABDOMEN SWOLLEN WITH EGGS WITHIN

Caste development in termites, although strikingly like that of ants, reveals certain important differences. Among termites the sexes are of equal social importance, since each caste comprises individuals of both sexes, whereas in ants the workers and soldiers consist of female individuals only. In most termites there are five castes, three being fertile reproductive castes and two sterile. The reproductive castes consist of the following:

(1). Normal winged males and females or *macropterous forms* (fig. 2) which have a firm dark integument and are usually known as kings and queens: the eyes and brain are large and the reproductive organs well developed. The wings are ultimately discarded and only their persistent bases remain.

(2). Less pigmented *brachypterous forms* (fig. 3) with pad-like or incipient wing rudiments. The brain, eyes and reproductive organs are somewhat smaller than in the first form.

(3). Scarcely pigmented *apterous forms* (fig. 4) with no traces of wings and with the eyes, brain and reproductive organs smaller than in (2).

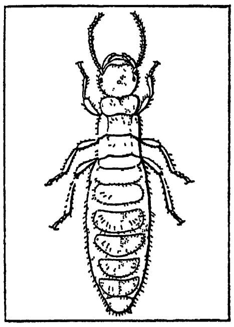
The sterile castes are wingless and in them the reproductive organs are imperfectly developed and non-functional, except possibly at times in the most primitive species only. They consist of:

(4). Unpigmented *workers* with the brain small and the eyes vestigial or absent (fig. 5). The head and mouth-parts are not exceptionally developed.

(5). Large-headed more or less pigmented *soldiers* with the brain small and the eyes vestigial. The mandibles are very large

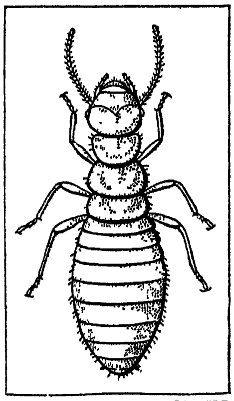
and projecting, varying in form in different species (fig. 6). In a few genera the mandibles are small and the heads retort-shaped, being drawn out into a rostrum bearing the opening of the large frontal gland at its apex: this type of individual is known as the nasute soldier (fig. 7).

Among the most primitive termites like *Archotermopsis, Termopsis* and *Calotermes* there are no workers and their functions are performed by the young soldiers and reproductive forms. In some genera there are major and minor soldiers, and occasionally intermediates also, while there are species with both large and small workers as among ants.



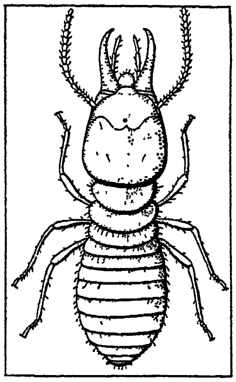
FROM BANKS AND SNYDER, "REVISION OF THE NEARCTIC TERMITES" (SMITHSONIAN INSTITUTE)
FIG. 4.—RETICULOTERMES VIRGINICUS, WINGLESS QUEEN, MAGNIFIED ABOUT 5 TIMES, WITH NO EVIDENT TRACES OF WINGS

The origin of termite castes has given rise to much discussion and Grassi followed by Jucci ascribe the differences between the several types of individuals making up a community to the influence of nutrition. Other authorities, however, have shown that, in some species at least, the young are separable into two types when they emerge from the eggs. Some individuals with small brain and eyes and with the reproductive organs in a very rudimentary condition, develop into sterile workers and soldiers; others with these several organs normally developed grow into fertile reproductive forms. Very early in post-embryonic growth further differentiation proceeds and all the future castes become recognizable by small differences exhibited by the young. In view of these facts it appears probable that among termites caste differences are due to intrinsic causes within the eggs, and are not modifiable by external influences. A remarkable feature in the lives of the more primitive termites which feed upon wood is the presence of enormous numbers of Protozoa in their intestines. Recent discoveries made by Cleveland, following upon the earlier observations of Bugnion and of Imms, indicate that the Protozoa are actually beneficial to the termites, apparently breaking down the wood devoured by those insects and rendering it in a condition capable of being digested. Cleveland has shown that by "sterilizing" termites of all Protozoa these insects are no longer capable of digesting wood and finally die, but if they be reinfected with these organisms their normal life and growth proceeds.



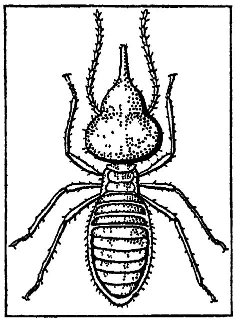
FROM BANKS AND SNYDER, "REVISION OF THE NEARCTIC TERMITES" (SMITHSONIAN INSTITUTE)
FIG. 5.—PRORHINOTERMES SIMPLEX, WORKER, MAGNIFIED ABOUT 10 TIMES

At certain seasons of the year the normal winged (macropterous) males and females issue from well-established colonies in great swarms and after coming to the ground cast off their wings. Enormous numbers are devoured by birds, lizards and other animals, while the few survivors pair and found new colonies. The mated couple—king and queen—excavate a small chamber in wood, in the ground or other situation, and remain together, feeding and caring for the offspring until enough workers or young nymphs have been reared to take over the duties. Mating goes on at irregular intervals, the king cohabiting with the queen for life. Among the more primitive termites large nests contain numerous kings and queens, but in the higher forms only a single royal pair is present. In such cases the queen develops into a huge inert egg-laying machine, incapable of locomotion, and remaining with her relatively tiny mate in a special royal cell where the couple are fed and tended by their numerous progeny. In species of *Termes* the queen may possibly attain a length of four inches and may lay 4,000 or more eggs a day and many millions during a lifetime of perhaps ten years. The brachypterous and apterous reproductive forms are usually regarded as supplementary royalties, which take the place of either of the original royal forms in the event of their death; possibly also they extend the colony or found subsidiary communities, but little is known on this point. These peculiar forms produce no winged adults among their progeny, but only their own types and the sterile forms. The greater part of the duty of feeding the brood and nest-building is performed by the workers, while the soldiers are mainly concerned with defence. The large-jawed type of soldier is apparently less efficient in this respect than the nasute soldier, the pungent secretion of whose frontal gland having a very salutary effect upon ants which, it may be added, are perennial enemies of termites.



FROM BANKS AND SNYDER, "REVISION OF THE NEARCTIC TERMITES" (SMITHSONIAN INSTITUTE)
FIG. 6.—PRORHINOTERMES SIMPLEX, SOLDIER, MAGNIFIED ABOUT 10 TIMES

The feeding habits of termites are both complex and remarkable. Living and dead plant tissues form the staple food but termites have also developed an elaborate system of mutual feeding or trophallaxis. They feed one another, and more especially the brood and royal forms, with regurgitated food, faeces and also saliva and there is also evidence that all castes produce exudations of glandular products from the skin, which are licked by other members of the community: since the queen produces the most copious and palatable exudation she is assiduously tended and licked by her brood. Some termites, like ants, store up food, especially lichens, fragments of grasses, etc., but the analogy between the two groups of insects is exemplified more strikingly in the case of fungus-growing termites. Certain of the higher genera form comb-like fungus gardens and their nymphs graze in these miniature fields like so many tiny sheep; the soldiers and workers do not use this food, but the royal forms are fed upon it like the young.



FROM BANKS AND SNYDER, "REVISION OF THE NEARCTIC TERMITES" (SMITHSONIAN INSTITUTE)
FIG. 7.—NASUTE SOLDIER OF EUTERMES COSTARICENSIS, MAGNIFIED 15 TIMES

The relations of termite communities of different species to one another have been comparatively little studied. Sometimes several species share a compound nest, but their respective galleries are kept separate, while some soldierless species have only been found in the nests of kinds in which that caste is present. A host of other insects or termitophiles live within the termitaria on much the same terms as myrmecophiles exist in ants' nests.

GENERAL REMARKS ON INSECT SOCIETIES

It is a remarkable fact, as Wheeler remarks, that among insects social habits have arisen no less than 24 different times in as many different groups of solitary insects. The various examples of this type of behaviour represent, as has already been pointed out, very different stages in the evolution of their social system. In the simplest cases only mere rudiments of social behaviour are evident, while at the other extreme are highly organized systems involving immensely populous communities, presenting many similarities or analogies to human society. Several writers have compared an insect society to a super-organism and, as Julian Huxley has remarked, the members of the community, although now functioning as parts, were descended from ancestors that functioned as wholes. The castes exhibit a differentiation of structure and function corresponding with the division of labour among the organs of an animal body. A single individual is incapable of prolonged survival apart from other members of an insect community, almost as the separate organs of an animal body are incapable of independent existence. The workers and soldiers may be looked upon as the body of the super-organism, while the fertile members, representing the germ cells, form the organism that ensures the continuance of the species.

One of the most urgent difficulties in communal life is the supply of food. The members of a colony need a regular, abundant and easily available source of nourishment. Certain of the smaller and more primitive insect societies feed upon animal food, but the more highly organized and densely populated colonies of other species as a rule resort to the more certain and abundant supplies afforded by the plant kingdom. The collecting and apportioning of food among adults and young, economy in its use and competition with other organisms in securing supplies, all seem to have contributed to the development of a special worker caste upon whom the onus of provisioning the colony rests. The reproductive instincts likewise present profound difficulties in communal life: unlimited exercise of this faculty would result in a population speedily overreaching its food supply and finally the disintegration of social life. The true social insects have overcome this difficulty because among them the full reproductive powers are confined to few individuals and aborted in the rest. Among the social Hymenoptera the colonies are essentially gynarchic, the female being the dominant sex: under this régime the males, apart from breeding purposes, are little more than social parasites. In the hive bee it is well known that after fertilization of the queen is achieved the luckless males are eventually driven out of the hive. On the other hand, among termites, as we have seen, both sexes participate in the life of the society, and in this respect they more closely resemble the human species.

The onset of social life has led to the development of communal nests wherein security is afforded to the inmates. The helpless, sedentary brood, massed together, is naturally fixed to a particular location and exposed to the attacks of enemies and changes of the elements. The need consequently arose for protective habitations or even fortifications of various types suited for special requirements. Those social Hymenoptera, endowed with wings and adequate stings, chiefly nest above ground while the largely wingless, and on the whole more defenceless, ants and termites have mainly sought protection in a subterranean life. Social insects are highly successful in the struggle for existence, as is exemplified by their abundance in individuals, as well as by the great variety of habitats they occupy and the extent to which such creatures as ants and termites have spread over the world. Tending of the brood by social insects has led to the intimate relationship that exists between the two generations, and consequently to the discovery by the parents of the palatability of the salivary or other secretions of their young. In this way trophallaxis or mutual feeding, previously quoted, has arisen, and the avidity of the parents for what their young have to offer them has developed in so many cases into a bond which has extended and strengthened social behaviour.

Social insects display an elaborate communism where individualism is submerged for the welfare of the community to a degree unattained in human society. Wheeler has stressed how tradition and social inheritance in man have enabled him to preserve and accumulate his capital of culture and advancement, whereas social insects have to begin each new colony anew only with the structural and instinctive equipment provided by true or organic heredity. In this difference he sees the explanation why so little change has taken place in social insects, although they were highly evolved before the origin of man. The distinction, he adds, is nevertheless not absolute, since social insects bequeath their nests, pastures and hunting grounds to successive generations. Insects have not acquired the use of tools, but, on the other hand, they are the only animals besides man that have succeeded in domesticating other animals, and even plants, as well as enslaving their own kind. Means of communication, although not through speech, have undoubtedly been evolved by means of the senses of smell and touch and also through sound production. In the tropics insect societies are of considerable duration and are liable to outstrip means of subsistence: just as the colonizing expeditions of man have gone forth to establish themselves in fresh lands, the swarming propensities of bees, wasps and ants are for a like purpose. Specialization of individuals to specific trades or duties in human society finds its analogy in the castes and differences of behaviour among the individuals of an insect community. Just as in man, the warrior caste has its place in insect society and defensive as well as attacking exploits are prevalent. The nests of social insects, like human habitations and buildings, afford food and shelter for alien creatures and many are more or less tolerated by their insect and human hosts. Insect societies, to quote again from Wheeler, represent final and relatively stable accomplishments which have developed along purely physiological and instinctive lines, and this instinctive basis, with the consequent absence of education and tradition, constitutes a fundamental difference between them and human societies.

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SOCIAL INSURANCE: *see* National Insurance.

SOCIALISM is the name given both to a widespread body of doctrines and to a world-wide movement taking many different forms. It has a long history behind it; and the word has been used in shifting senses as the ideas behind it have developed and the situations facing it changed. A short and comprehensive definition is therefore impossible. We can only say that Socialism is essentially a doctrine and a movement aiming at the collective organization of the community in the interests of the mass of the people by means of the common ownership and collective control of the means of production and exchange.

It is well to begin by ruling altogether out from the scope of this article certain popular uses of the term "Socialism" which were current, especially during the past generation. The well-known phrase "We are all Socialists now," and the constant references to "socialistic legislation," only serve to obscure the real meaning of the word. "We are all Socialists now" only means that everybody in these days, whatever his politics, is ready to agree to a greater amount of Government intervention both in industry and in the affairs of society generally than most people even conceived as possible a generation ago. And "socialistic legislation" is, as a rule, only a phrase indicating disapproval of any measure which increases this collective intervention or seeks in any way to promote a more equal distribution of income among the members of the community.

Again, almost any extension of local government activity, such as the taking over of a tramway system or an electric supply station, or the establishment of a municipal bank, is liable to be referred to as "Municipal Socialism," even if the public body which does it consists mainly of persons who are strongly opposed to Socialism. Socialists certainly urge the extension of municipal trading; but so do many persons who are not in any sense Social-

ists. These and similar uses of the word are accordingly left out of consideration in this article.

We must, however, try to make our initial attempt at a definition somewhat more precise. Socialism, we have said, is the name given at once to a doctrine and to a movement. In its early days, before there existed any widespread or clearly-defined Socialist movement, it was used chiefly as the name of a doctrine, or body of doctrines, and thus tended to be applied very widely to all social theories which stressed the need for collective political or economic action in opposition to the dominant individualist doctrines. The so-called "Socialism of the Chair," which had a vogue in Germany during the second quarter of the 19th century, was called "Socialism" mainly in the broad philosophical sense; and "Christian Socialism," in many of its manifestations, is Socialist only in the sense that it stresses, in opposition to individualism, the corporate nature of society and the need for social solidarity based on the fatherhood of God and the brotherhood of man. In more recent times, as distinctively Socialist ideas have become embodied in a number of organized movements, national and international, the tendency has been to think of Socialism more as a movement than as a doctrine, and to sum it up rather as what the Socialists want than as a definite body of theoretical dogma. For there exists no canon of Socialist doctrines on which all Socialists would agree. Karl Marx came nearest to providing such a canon in his formulation of "Scientific Socialism" as contrasted with the "Utopianism" of his predecessors. But, while most of the Continental Socialist parties profess to base their policy on Marxism, and employ Marxian phrases and ideas for its expression, there are many different interpretations of Marxism, and, in any case, the fundamental doctrines of Marx himself form rather a philosophy of history and a critique of capitalist industrialism and orthodox political economy than a positive policy for Socialism to-day. Moreover, there are many Socialists, including the majority in Great Britain, who do not profess to be Marxists at all.

From the Marxian standpoint, Socialism is the struggle of the working class, or proletariat, to free itself from the domination of capitalism, and establish a new classless society collectively controlled in the interest of the whole people. Marx nowhere formulates clearly either the nature of this new society or the detailed steps by which it is to be approached. He is far more interested in the struggle than in the goal to which it tends; and any attempt to forecast in detail the structure of a Socialist community would have seemed to him mere Utopianism. The parties based on Marxism follow the master's lead, and tend to define their policy in terms rather of the class-struggle between capitalists and labourers than of the positive ends sought in the struggle. The non-Marxist British Socialists, for their part, have usually been more concerned with the early stages in a gradual evolution towards Socialism than with the completed process. Only the Guild Socialists, of modern Socialist groups, have attempted to forecast in detail the structure of the new society they are seeking; and even their attempt is confined, in the main, to an outline of the structure of industry under a system of "workers' control" or "industrial self-government."

We have, then, in attempting to make more precise our definition of Socialism, to avoid relating it in our minds to any Utopian picture of the future. We can say that Socialists seek the common ownership and collective control of the means of production and exchange; but we cannot say that this involves either the "nationalization" of all industries or some particular way of managing them. There are many possible forms of common ownership—nationally by the State, locally by municipalities or similar bodies, and, locally or nationally, by quasi-public trusts, guilds or corporations acting on behalf of the public. There are also many possible forms of administration—directly by State or municipal departments, by specially-constituted boards or commissions of experts, or by representative bodies of producers or consumers, or of both. All these forms of ownership and administration have had advocates among Socialists, and many Socialist plans embody features from several of them, or allow for diversity of experiment in different cases. Nor can it even be assumed that Socialists wish all the means of production to be publicly owned. If the vital and basic industries and services were under public control, many Socialists would be ready to leave smaller enterprises largely in private hands.

It is, however, clear that, whatever might be the precise form of social organization desired, all Socialists would wish the vital aspects of the economic life of society to be brought under collective control. This applies to production and distribution alike. One aspect of Socialism is the collective control of the productive forces; another, certainly no less important, is the collective control of the distribution of the social income. For, fundamentally, the object of the control of production is the abolition of poverty, unemployment and social classes, and the sharing out of all the wealth that the community is able to produce on more equitable lines than capitalism allows.

All Socialists would agree that a more equitable distribution of the social income means a less unequal distribution. But, while some regard absolute equality of income as the only Socialist solution of the problem, others reject this view, and seek only to ensure an adequate minimum for all, and to limit within reasonable bounds the degree of inequality above this minimum. "To each according to his needs" has been a frequent cry among Socialists as well as Anarchists, and many Socialists have regarded complete "Communism," in the sense of unlimited free distribution, as desirable for as many goods as can be produced in the necessary abundance. William Morris's Socialist Utopia, *News from Nowhere,* is purely Communistic in this sense of the term. But the conception of distribution according to need has commonly, as a practical policy, been either re-stated as a conception of complete equality, on the ground that equality is, in face of the limitation of human resources, the nearest workable equivalent, or limited to a demand for an assured minimum standard of living. A desire to lessen inequality of incomes, and to use the State and taxation as the means of achieving this, is all that can be safely assumed as the common doctrine of all schools of Socialists.

The Socialist desire for a nearer approach to equality is not, however, confined to the region of incomes. It implies also the desire both for equality of political rights and for equality of economic and social status. Political democracy, Socialists often contend, can never be made a reality as long as gross inequalities of wealth and status are allowed to persist. Wealth, for example, gives its possessor the means of exerting an exceptional influence on political opinion, and often neutralizes the effects of formally democratic political institutions. Socialists, therefore, stand for political democracy completed and made workable by the abolition of class distinctions and of dangerous inequalities of wealth. This does not imply that they believe the means of transition to Socialism must conform to orthodox democratic ideas; for the Communists, for example, repudiate existing political democracy as a sham, and insist that Socialism can be introduced only by a revolutionary "dictatorship of the proletariat." This view is repudiated by the majority of Socialists outside Russia; and the Socialist parties usually attempt to work towards Socialism by using the methods of parliamentary democracy. This, however, is a matter of expediency rather than of principle; whereas all Socialists, including Communists, believe that Socialism, once securely established, will organize its collective control of society on democratic lines. The "dictatorship" of the Communists is regarded only as a necessary instrument of the transition to a really democratic system.

The differences of view among Socialists, and the difficulty of formulating any precise definition of the policy of Socialism, do not mean that Socialism does not constitute a clearly recognizable movement and body of tendencies in economic and social policy. It is indeed sometimes difficult to say whether a particular organization can properly be described as Socialist or not. The British Labour Party, for example, founded originally in 1900 as the Labour Representation Committee, on the basis of an alliance between the Socialist societies and the trade unions, had at the outset no definite policy, and only adopted Socialist views gradually. There was, in its early years, a dispute at the International Socialist Conference on the question whether its delegates ought to be admitted. Even to-day, though its policy is, in general,

clearly Socialist, it is quite possible for non-Socialists who agree with its immediate programme to be actively associated with it. The Continental parties, having for the most part a definitely Marxian basis, are, in words, far more fully committed to Socialism; but it does not appear that the verbal difference exerts any important influence on their policy. Broadly speaking, the political Labour movement is everywhere Socialist, in that its declared policy conforms with the definition given at the beginning of this article. *Labour and the New Social Order,* the famous manifesto issued by the British Labour Party in 1918, is perhaps the best and clearest short exposition of moderate and evolutionary Socialist policy that has yet been produced.

Origin of the Name.—The words Socialism and Socialist appear to have come into use at nearly the same time in both England and France about 1830. They were employed to describe, in Great Britain, the teachings and the followers of Robert Owen, with his "social system," and, in France, those of Fourier and Saint Simon. Thereafter, the words remained in use, but were often very loosely applied. Survivals of their loose application are to be seen in the names of certain modern political parties, such as the Christian Socialists in Austria and the Socialist-Radicals in France. Neither of these parties is Socialist at all in the modern sense of the word as defined above.

The name acquired a more precise denotation with the growth of Socialist parties in various countries. But the movements out of which these parties grew were more often called "Communist" in their earlier stages. The "Communist Manifesto," drafted by Karl Marx and Friedrich Engels for the Communist League and issued in the "year of revolutions," 1848, is generally regarded as the starting point of modern Socialism. Its second stage is marked by the creation of the International Working Men's Association in 1864, under Marx's leadership (*see* INTERNATIONAL); but the name "Socialism" was not generally applied until Socialist and Social Democratic parties were organized in France, Germany and elsewhere on a permanent basis (German Social Democratic Labour Party 1869—reformed 1875). The International Socialist Bureau, linking up these parties, was not founded until 1900, though a number of international Labour and Socialist Congresses had been held at earlier dates.

The denotation of the Socialist movement thus gradually became plain during the last quarter of the 19th century. The connotation of the word socialism began to be more clearly defined at the same time. Though Marxism never commanded the allegiance of all who called themselves "Socialists," it was above all Marx who first gave Socialism as a body of economic and political doctrine a definite form. This process, begun in the *Communist Manifesto* of 1848, was carried on in Marx's later writings and manifestoes, and above all in the first volume of *Das Kapital* (1867). Marx and his followers distinguished their doctrines, as "Scientific Socialism," from the Utopian Socialism which had gone before. Owen, Fourier, Saint Simon and other Socialist forerunners they regarded as unscientific Utopia-builders, whereas Marxism professed to base itself on a scientific explanation of the movements of history. The materialist conception of history, working itself out in a succession of class struggles, became the scientific basis of the new Socialist movement which arose under Marxian inspiration. The programmes and policies of the new Socialist parties of the '70s and '80s were conceived in Marxist terms; and for a time it seemed as if Marxism and Socialism could be regarded as practically identical. (For an account of Marx's doctrines and activities, *see* the article MARX, KARL.)

Practically, the most important outcome of Marxian Socialism was the close identification of Socialism with the working-class movement. Basing his theory of Socialism upon the class struggle, Marx necessarily regarded the working-class, or proletariat, as the instrument by which Socialism would be created. The task of the Socialists was, therefore, the political and economic organization of the working-class, and its education in class-consciousness and collective action. The close connection between Socialism and such working-class movements as trade unionism, regarded as the instrument of the class struggle in the industrial field, arises naturally out of the Marxist view of Socialism. Modern Socialist propaganda has been, above all, an attempt to bring the organized workers over to a faith in Socialism, to permeate the trade unions and other working-class bodies with Socialist ideas, and to create Labour parties, as in Great Britain, on a Socialist basis and with a Socialist policy. Modern Socialism is more than a working-class movement, and many are Socialists who are not "proletarians," or workers in the ordinary sense of the word. But everywhere the Socialist movement is predominantly working-class, and acts in close conjunction with trade unions and other working-class bodies.

Early History.—Although the words Socialism and Socialist came into use only in the first half of the 19th century, many of the ideas now associated with Socialism have a far longer history, and many earlier writers and reformers are nowadays often called Socialists. Socialist elements, for example, are discerned in the Mosaic law and in the writings of Amos, Hosea and Isaiah, as well as in the so-called "Socialism of the gospels," on which many mediaeval Communist doctrines were explicitly based. The ordered and stratified social system of Plato's *Republic* is often called "Socialist," and clearly is so if Socialism is only the antithesis of individualism and *laissez-faire*. The idea of an ordered society based on community of goods appears again and again in the history of political and religious speculation, from the days of the ancient Greeks through Roman and mediaeval times to the modern world. It is possible to trace many communistic elements in the social institutions of primitive peoples, and there have been theories which represented the rise of individualism and private property as a fall of man from an ideal primitive communism.

As we come nearer modern times, there are clearly large elements of Socialism and Communism in such works as More's *Utopia* and Campanella's *City of the Sun;* and in the 17th and 18th centuries, though Utopia-making went out of fashion, doctrines resembling modern Socialism in one or another respect were abundant. Gerrard Winstanley and the Diggers, Peter Chamberlin, John Bellers and James Harrington, all in their several ways emphasized the vital influence of the economic organization on the political and social condition of the people, and sought to bring economic institutions under some sort of collective control. And, in 18th century France, before the Revolution, while Rousseau attacked the influence of inequality on social institutions and stressed the authority of the State as the embodiment of the general will, writers such as Mably and Morelly worked out social systems based on communism and collective organization of the economic forces of society. On the morrow of the Revolution, the *Conspiration des Egaux* of Gracchus Babeuf and his followers struck the first definitely proletarian note in modern revolutionary history, and influenced not only the French Socialists of the next generation, but also, through James Bronterre O'Brien, the English Chartists.

It is not, however, very profitable, at any rate in this brief treatment, to delve deeply into the history of those doctrines and movements which can be regarded as, in this or that respect, anticipations of modern Socialism. The Socialism with which it is necessary to deal here owes its rise to the growth of large-scale production based on machinery and steam-power. It made its appearance when the changes in methods of production and transport, usually described as the "Industrial Revolution," had created the modern working-class or "proletariat," and had caused that class to organize in some degree for common protection against the evil effects of the new industrial conditions. There was plenty of misery among the workers long before the "Industrial Revolution," and plenty of attempts to make a stand against it were made. But continuous working-class organization, and Socialist doctrines aiming at the collective control of the means of production in the interests of the workers, alike date from the rise of the factory system, which not only subjected them to an unfamiliar and bitterly resented discipline, but also, by massing them together in factories and industrial towns, made agitation among them easier, and combination the natural means of seeking redress.

Socialism of this type naturally arose first in Great Britain, which, in the latter part of the 18th century, took the lead in the transformation of economic processes by the application of

machinery and steam-power. The real foundations of modern Socialism were laid in Great Britain during the first three decades of the 19th century. The Radical and revolutionary writers and leaders of the later 18th century in Great Britain can, for the most part, not be called Socialists. Ogilvie and Tom Paine were Radical land reformers; and Paine put forward advanced Radical views on taxation and the development of social services under the State. But neither was a Socialist in any real sense; and even Thomas Spence, whose followers, the "Spencean Philanthropists," are often regarded as the first English Socialists, was an advocate of land nationalization hardly conscious of the problems presented by the new industrialism. William Godwin, whose *Political Justice* was the bible of intellectual Radicalism at the end of the 18th century, was far more Anarchist than Socialist, and barely discussed the organization of industry.

This was natural; for it was not until the end of the Napoleonic Wars that there was opportunity for an articulate working-class movement to develop in Great Britain, or that the problems of the new industrial system forced themselves on public attention. British Socialism, as a theoretical movement, was born in the decade which followed the battle of Waterloo; and this decade saw also the beginnings of effective political and industrial combination among the workers in the rapidly-growing factory districts.

Owenism.—Robert Owen, the great and successful textile employer of New Lanark, was the first to formulate the doctrine of Socialism in comprehensive form, and to his followers the name "Socialists" was first applied, though he himself commonly spoke of his scheme as "the social system," or "the rational system for the organization of society," or, sometimes, as "the New Moral World." Owen first appeared as a Socialist in the years immediately after 1815. Known earlier as a great educational and factory reformer, he was led by the distress and unemployment which followed the peace to formulate and propose to the Government a scheme for the productive employment of the poor in "villages of co-operation." Rejected by the Government and by the rich, to whom Owen next appealed, this scheme was taken up by the workers, and Owenite societies, with a predominantly working-class membership, were formed all over the country. The growing trade unions were largely captured by the new doctrines, and in 1830 and the following years Owen found himself at the head of a great working-class movement seeking to establish Socialism by means of industrial organization and action. Then, in 1834, the Grand National Consolidated Trades Union, attacked by employers and Government alike, went to pieces, and Owenism shrank up into small propagandist groups, whose greatest achievement was the creation of the Co-operative movement. Socialism, as a doctrine commanding a wide body of adherents, died away in Great Britain, and had to await, for its revival, the coming of Marxism as an international force among the workers.

Robert Owen's Socialism did not begin as, and was never in its creator's mind, a class movement. That was, in large part, why Marx called it "Utopian." Owen became a working-class leader, not because he wished to appeal to one class alone, but because only the workers followed his leadership. He was essentially a philanthropic reformer, acutely conscious of the evils of the industrialism by which he had made his wealth, and confident that these evils could be prevented, and the new productive forces turned to the benefit of mankind, by proper organization and control. He believed the evils of industrialism to be due mainly to two causes—competition and bad education. For competition, which forced down the standard of life and set man against man, he desired to substitute a co-operative control of industry, in order that production might everywhere be maximized in the interests of all, and the product distributed among all according to need. But he believed that men would only give up competition and live co-operatively if, in childhood, they were educated in the right social ideas. His Socialism was, therefore, founded on education, and he was out of his element when he was called upon to lead a great working-class movement which sought to establish Socialism and co-operation by mass action without changing the hearts of men by education. But Owen was also an extraordinary optimist, able to believe that the hearts of men in the mass could be suddenly changed by the proclamation of his new doctrines. In this spirit, he accepted the rôle of working-class leader; but the failure of his great trades union, instead of discouraging him, merely sent him back to spend the rest of his life, undismayed, in educational propaganda on behalf of his ideas.

The two decades which saw the rise and fall of Owenite Socialism as a mass movement were fertile in the growth of Socialist theories. Writers such as Thomas Hodgskin (*Labour Defended*, 1825), attacked the orthodox economists, and drew Socialist deductions from Ricardo's subsistence theory of wages; while William Thompson (*Distribution of Wealth*, 1824), combined constructive Owenite Socialism with destructive criticism of the Ricardians. J. F. Bray, Charles Hall, John Minter Morgan, Piercy Ravenstone, T. R. Edmunds, John Gray and George Mudie are also among the writers who, during these decades, formulated, on broadly Socialist lines, a powerful indictment of capitalist society, reinforced by Thomas Carlyle's denunciation of the Manchester school, and by the Radical political writings of William Cobbett and a host of working-class journalists. Apart from Owen, no writer at this stage designed a constructive Socialist scheme; but the movements of working-class Radicalism, from the Spenceans of 1816 to the Chartists of the '30s and '40s, were strongly imbued with anti-capitalist economic doctrines. Engels, and to a less extent Marx, were in close touch with the Chartists, and there is a direct line of succession from the Chartist and kindred movements of the '40s to the Marxian agitation of 1864 and the following years.

French Socialism.—Meanwhile, in France, Socialism had been pursuing an independent course. Count Henri de Saint-Simon (1760–1825) began to develop his Socialist views about the same time as Owen in Great Britain, while François Marie Charles Fourier (1772–1837), although he outlined his Socialist scheme as early as 1808, had little influence till a good deal later. Both these writers belong, far more than Owen, to the category of Utopian Socialists; for neither had at any stage the same connection as Owen with the organized working-class movement, for which, in France, the time was not yet ripe. Saint-Simon's scheme was, in essence, a plan for the ordered government of society by economic experts. Out of it arose, after his death, a powerful school of thinkers, including Bazard and Enfantin. It greatly influenced Comte, and left its most abiding mark in the development of Positivism, rather than on Socialist thought. Fourier's plan of *phalanstères* was far more like Owen's scheme for Villages of Co-operation; but it, too, was developed rather as an abstract proposal for the perfecting of human institutions than as an attempt to deal with the positive evils of contemporary industrial society. Both the Saint-Simonians and the Fourierists founded societies in Great Britain; and these were found now disputing and now collaborating with the Owenites.

French Socialism entered on a new phase after the Revolution of 1830. Considérant carried on the tradition of Fourier. Louis Auguste Blanqui began his long career of insurrectionary organization. Louis Blanc, in 1840, published his famous tract, *L'Organisation du Travail.* P. J. Proudhon, in the same year, startled Paris with his first important work, *Qu'est ce que la Propriété?* The stage was being set for the French Revolution of 1848, in which, for the first time, the gulf between Socialists and ordinary Republicans was made clearly manifest, and, outside England, a proletarian movement made its distinctive appearance.

Of these leaders, Blanqui, who spent the greater part of his life in prison under successive French Governments, counts, not as a theorist, but as the most persistent revolutionary organizer in Socialist history. His was largely the work that went to the making of the Paris Commune of 1871; and it was the misfortune of the Commune that the Versailles Government had him safe in prison before it was proclaimed. Proudhon counts less as a Socialist than as a theorist of Anarchism and a powerful influence on the development of French trade union and Co-operative thought. Louis Blanc, with his scheme of national workshops (*q.v.*), belongs more properly to the Socialist tradition. Like Owen, he attacked the vices of competition, and urged that the State should eliminate the capitalist by establishing workshops of its own, to be

handed over subsequently to the workers to control. Blanc was a member of the revolutionary Government of 1848, but the workshops started by that Government were a mere travesty of his scheme, and were deliberately crushed by the anti-Socialist majority in the Government. His ideas, and those of Buchez, helped to inspire the Christian Socialists in England, where Charles Kingsley contrasted Blanc's plan for the organization of labour favourably with the purely political demand of the Chartists.

Marxism.—The French Socialism of 1848 was crushed out in the series of events which led up to the *Coup d' état* and the proclamation of the Second Empire. English Owenism had already shrunk up into a tiny sect, after giving birth to the co-operative movement, which speedily lost its original Socialist policy. Chartism was already on the way to dissolution before the failure of the demonstrations and petition of 1848. The Communist League, the international body with which Marx was associated, disappeared in the wave of reaction which spread over Europe as one by one the revolutionary movements of 1848 were liquidated. Socialism remained alive only as the creed of isolated sects, often of exiles. It did not again grow to any considerable stature until the coming, in 1864, of Karl Marx's International Working Men's Association, commonly known as the "First International."

The First International had its headquarters in England throughout its earlier and influential years of life. But this does not mean that Socialism was strong in Great Britain. After the collapse of Chartism, the British working-class movement played for some time little part in politics, but devoted itself to the building up on moderate lines of strong trade unions and co-operative societies. In the early '60s, the leaders of the movement began a vigorous agitation for the extension of the franchise and the fuller legal recognition of trade union rights. The country was very prosperous, and, aided by the prosperity, working-class organizations grew apace. Marx was able to enlist the sympathies of the British leaders for the task of economic and political agitation among the workers abroad; but they were never brought to accept his Socialist ideas, or made really conscious of the revolutionary policy for which the First International stood on the Continent.

Gradually, in the later '60s, Marx and his colleagues built up the International, in one country after another, into a powerful organization of which Governments became deeply afraid. Especially did it take root in Germany, where it gave birth to the Social Democratic Labour Party, headed by Marx's followers, August Bebel and Wilhelm Liebknecht. Here Ferdinand Lassalle (1825–1864) had founded his General Workmen's Union in 1863, and after his death the division between his followers and those of Marx persisted until 1875, when the two parties united on the basis of the famous "Gotha Programme," strongly criticized by Marx himself for its concessions to the Lassallian standpoint. In France, the Marxists contended for influence with the secret societies organized by Blanqui and his colleague, Barbès, and with the followers of Proudhon; but they played, in Blanqui's absence in prison, the leading part in the ill-starred Paris Commune of 1871. The defeat of the Commune, and the savage repression which followed it, wiped out French Socialism, for the time, as an effective force. But there was soon a revival; and the *Parti Ouvrier* founded by Jules Guesde in 1875–76 was a strictly Marxist body. French Socialism, however, long continued to be torn asunder by conflicting tendencies, and especially by the strength of Proudhonist and Anarchist influences, which were dominant in the trade unions and prevented any effective alliance between the political and industrial forces. Not until 1905 was unity achieved even among the rival political groups; and even then the hostility between the Socialists and the trade unions remained unappeased.

In Italy and Russia, Marxism had to contend with the powerful influence of Michael Bakunin, which eventually helped to tear the First International asunder. Bakunin founded, in 1868, an International Social Democratic Alliance, which was rather Anarchist than Socialist in doctrine. Temporary compromises were patched up; but in 1872 at the Hague conference the quarrel again reached breaking point. Bakunin and his followers were expelled by the Marxists from the First International, and, on Marx's motion, the seat of the International was moved from London to New York, where it expired four years later. Its period of influence had virtually ended with the fall of the Paris Commune in 1871, which had scared away most of its more moderate supporters. But it left its permanent mark on Europe, by laying the foundation for the national Socialist parties which sprang up during the following decade in almost every country.

National Movements.—After the fall of the First International, the history of Socialism becomes a history mainly of separate national movements. Germany, where Marx's doctrines had taken the deepest root, supplied the main driving force. From 1878 to Bismarck's fall in 1890, Socialism in Germany was proscribed by special laws, and the agitation had to be carried on mainly from abroad. It grew fast none the less, and, when the German Social Democratic Party was again able to appear in the open, in 1891, the Erfurt Programme of that year was a purely Marxist document. Thereafter the German Social Democrats rapidly increased in parliamentary power. With this growth went a gradual evolution of doctrines within the party, as the revolutionary ideas of Marxism were challenged by "revisionists" desirous of working less for a sudden overthrow than for a gradual transformation of capitalist society. The "revisionists," headed by Eduard Bernstein, who had been greatly influenced by British labour developments, were officially defeated in 1903 at the party congress; but in fact their doctrines permeated the majority of the party, making it less and less revolutionary in its real policy, even while it scrupulously preserved the Marxist phraseology of the preceding generation.

Meanwhile, in Great Britain, the great outburst of labour and trade union activity in the '60s and early '70s had been brought to an end by the serious trade slump of the later '70s. Between 1864 and 1874, it looked as if the British trade union leaders were well on the way to create a separate Labour Party. But after the slump, Labour, seriously weakened, fell back on a dependant alliance with the Liberal Party. Such working-class candidates as entered parliament sat there as Liberals, and Socialism, never strong, was wiped out as an effective influence.

It returned, under Marxist inspiration, in the early '80s. In 1881 Henry Mayers Hyndman, previously a well-known Radical journalist, founded, the Democratic Federation, which speedily accepted Marxian ideas, and, in 1884, adopted the name "Social Democratic Federation" and a complete Socialist programme. In the same year, a split within this body led to the creation of the Socialist League, headed by the famous poet, William Morris, and inspired rather by anarchist-syndicalist ideas in opposition to the purely political Marxism of the S.D.F. These two bodies conducted a widespread agitation during the severe trade slump which culminated in 1886, and were largely responsible for the outburst of aggressive trade unionism among the less skilled workers which found its chief expression in the great dock strike of 1889.

Marxism, however, was not destined at this stage to capture the British Labour movement. Already, in the '80s, Sidney Webb and other leaders of the Fabian Society were developing a moderate and evolutionary Socialism which based its economics rather on Jevons and John Stuart Mill than on Karl Marx, and aimed rather at permeating the existing parties with socialistic ideas than at creating a definitely Socialist party. *Fabian Essays* (1889) gave expression to this new doctrine; and this book was followed up with a wealth of well-written tracts advocating various forms of constructive semi-Socialist legislation.

At the same time, the younger trade unionists, largely stirred into action by the Marxist S.D.F., were beginning to repudiate its doctrine, and to aim at the creation, not of an avowedly Socialist party, but of a more moderate Labour Party, into which there would be more hope of drawing the trade unions and the main body of the workers. James Keir Hardie, a young Scottish miner and a convert from Liberalism, became the leading exponent of this non-dogmatic Socialism, which eschewed theories and based itself and its appeal to the workers on an evolutionary programme of social reform. The result was the creation, in 1893, of the Independent Labour Party, as a rallying point for the "New

Unionists" and other exponents of Labour-Socialism. One of the main objects of the new body was to draw the trade unions as organized bodies, into politics, and so to get behind it the main body of workers. This aim was largely achieved when, in 1899, the Trades Union Congress at last voted in favour of creating an independent working-class party based on a trade-union-Socialist alliance. The Labour Representation Committee, which in 1906 became the Labour Party and entered politics as an effective force, was accordingly created in 1900, with the I.L.P. as its chief driving power, and the Fabians as its counsellors on questions of practical policy. These developments, as we have seen, reacted on German Socialism, and caused Social Democracy in Germany, despite the nominal defeat of Bernstein's "revisionist" party, largely to re-model its tactics on non-revolutionary lines.

Indeed, in the early years of the 20th century, as Socialism became in one country after another a powerful parliamentary force, there was a notable modification of its revolutionary attitude. In practice, Socialist parties which had won a substantial representation in parliament found themselves growingly impelled to work for the improvement of current legislation on social questions, and to appeal to the electorate, not as revolutionaries, but as constitutional reformers seeking a peaceful transformation of the social system. Only where, as in Russia, Socialism was still outlawed, and unveiled autocracy remained in being, did Marxian ideas survive in their original simplicity.

On the eve of the World War, almost every developed country possessed a powerful Socialist or Labour Party, with numerous representatives in parliament; but in no case, except Australia, had the Labour Party achieved a clear majority. In Great Britain, indeed, political development had lagged behind; for the Labour Party had only become properly organized in 1906, and was, in 1914, still but a small group in comparison with the French or German Socialists. It was, moreover, in the years immediately preceding the war, subjected to an increasing amount of criticism for its compromising tactics and its virtual alliance with Liberalism in the House of Commons. These were the years during which a great wave of labour unrest spread over Europe, and new doctrines of Syndicalism and Industrial Unionism, originating in France and America, sought to speed up the pace of economic evolution by resort to industrial action. There were great strikes in England, and new conceptions of Socialism began to make headway. In particular, the idea of the control of industry by the workers through their industrial organizations was widely preached, and traditional conceptions of Socialism were attacked as making for bureaucracy and denying the democratic demand for self-government in the industrial as well as in the political sphere. In Great Britain, Guild Socialism made rapid headway as the expression of this demand for "workers' control."

Both the prevalent industrial unrest and the re-statement of Socialist doctrines were checked for the time by the outbreak of war in 1914. The issues of war sharply divided the Socialist forces. In every belligerent country some Socialists supported and some opposed the participation of their Governments. In the leading countries, except Italy and Russia, the majority supported participation; but in each case a powerful minority took the opposite view, and the Socialist movement ran considerable risk of dissolution in consequence of the cleavage. In Great Britain, for example, while the Labour Party officially supported the war, the Independent Labour Party, which was one of its constituent bodies, opposed it. In Germany, the Social Democratic Party split into two rival bodies, the larger supporting the war and the smaller hostile; and in France an almost similar situation arose, though a positive split was, for the time, averted.

The Russian Revolution.—This was the situation when, in 1917, Russia broke out into open revolution. The Russian Socialist movement, persecuted and proscribed by Czardom, had been, throughout its career, revolutionary by the necessity of its condition. It was, however, sharply divided into rival parties. The largest, the Social Revolutionary Party, was active mainly among the peasants, and was inclined to terrorist tactics and out of touch with West European Socialism. The Social Democratic Party, formed on a Marxian basis towards the end of the 19th century, had divided, in 1904, into two rival groups—the Mensheviks aiming at collaboration with the middle-class parties in the establishment of a constitutional republic as a step to Socialism, and the Bolsheviks, who stood for a complete transformation to Socialism by means of a revolution to be carried through by the "dictatorship of the proletariat." Both parties appealed to Marx as their master, the Mensheviks interpreting Marxism in accordance with the revised practice of the West European Social Democratic Parties, while the Bolsheviks adhered to the revolutionary ideas advocated in the Communist Manifesto of 1848 and the publications of the International Working Men's Association.

The first Russian Revolution of 1917, carried through with the collaboration of Mensheviks, Social Revolutionaries and middle-class Liberals, commanded the universal support of Socialists in all countries. The second, by which the Bolsheviks, aided by a section of the Social Revolutionaries, seized power and proclaimed the "dictatorship of the proletariat," sharply divided European Socialism. The division was accentuated when the Bolsheviks, having established themselves in power, proclaimed themselves the Communist Party, established a new Communist International, and set out to foster a world revolution on principles which they professed to derive directly from Marx's writings, and especially from the Communist manifesto of 1848. The new Communist leaders then denounced the Social Democrats as "social traitors," guilty of the sin of repudiating Marxism and collaborating with the bourgeoisie for the maintenance of capitalism; and the Social Democrats retorted by attacking the Communists as tyrants who had crushed out liberty and democracy in Russia, and imposed their will by force on the mass of the common people.

European Socialism was rent asunder by this conflict, which was far more severe on the Continent than in Great Britain. In Germany, the Social Democrats maintained their position despite the rise of a powerful Communist Party. In France, the majority of the Socialist Party actually went over to Communism, and the Socialist Party was reconstituted as a minority group, which has since electorally regained the upper hand. The sharp division of Italian Socialism into Communist, semi-Communist and anti-Communist factions greatly helped to prepare the way for the triumph of Fascism, which has now driven what remains of Socialism in Italy completely underground. The leaders of the anti-Bolshevik Socialist bodies in Russia, driven from their own country, helped to embitter the conflict elsewhere. European Socialism was divided into two warring camps, organized respectively in the Labour and Socialist International (created to succeed the pre-war International Socialist Bureau as the organ of constitutional Socialist and Labour parties), and the Third, or Communist, International, organized from Russia as the centre for the propaganda of world-revolution.

In Great Britain, Communism has remained too weak to be more than a nuisance to the Labour Party, and a useful bogey to be held up by anti-Socialists in order to scare the electorate. The trade union basis of the British Labour Party makes a split far harder to bring about than it is where Socialist parties are organized apart from the trade unions; and in any case the following of the Communists in Great Britain has remained too small for them to become an effective political force. Nevertheless, here as elsewhere, the Russian Revolution of 1917 has exerted a powerful influence on Socialist opinion, combining with the evolution of economic forces to undermine belief in the stability of the present economic and political order, and giving a stimulus to aggressive trade union action, which found its chief expression in the great strikes of the years following the war, and culminated in the abortive "General Strike" of 1926. On the whole, of late the influence of Communism in the world has declined, as one country after another has to some extent settled down, and the possibility of world-revolution has receded. But it remains a powerful movement, now in most countries sharply distinct from orthodox Socialism, which continues, in despite of it, to move slowly forward towards the constitutional conquest of political power. Already a number of the leading European countries have had, for short periods, Socialist or Labour Governments, which have

held office, by temporary sufferance of other parties or by virtue of their divisions. Great Britain had such a Government in 1924; Sweden has had more than one; Germany has, in 1928, a Socialist chancellor. It is not likely to be long before, in more than one European country, a Socialist Government is able to take office with a clear parliamentary majority behind it.

In this growth of world Socialism, the United States significantly lag behind. The American Socialist Party is still politically an impotent group, and the trade unions still reject all attempts to draw them into organized political activity on party lines. American economic conditions are still markedly individualistic, and American wages and opportunities, for the minority of skilled workers, good enough to hold back any strong development of a Socialist movement. Europe, with its far more homogenous working class and its far more limited ability to give the workman, under capitalism, an opportunity of bettering his position, is in a different situation, and all over Europe, except in the areas temporarily dominated by Fascism and analogous movements, Socialism continues to gain ground.

Socialist Policy.—The distinction between Socialism, as represented by the various Socialist and Labour Parties of Europe and the New World, and Communism, as represented by the Russians and the minority groups in other countries, is one of tactics and strategy rather than of objective. Communism is indeed only Socialism pursued by revolutionary means and making its revolutionary method a canon of faith. Communists, like other Socialists, believe in the collective control and ownership of the vital means of production, and seek to achieve, through State action, the co-ordinated control of the economic forces of society. They differ from other Socialists in believing that this control can be secured, and its use in the interests of the workers ensured, only by revolutionary action leading to the "dictatorship of the proletariat" and the creation of a new proletarian State as the instrument of change. The existing States and parliaments, which the orthodox Socialists seek to capture and use as the agents of social transformation, the Communists denounce as purely capitalist institutions, which must be forcibly overthrown before the constructive work of Socialism can even begin. This doctrine, derived from Marx's Communist manifesto of 1848, is forcibly developed by Lenin in his book, *The State and Revolution* (1917), which gives the clearest account of the underlying political theories of the Communist Party. It follows from this view that the orthodox Socialists, who seek to use the existing institutions of State and parliament as the agents of gradual socialization, are regarded by Communists as the worst enemies of the workers, and denounced with a vigour far exceeding that which is meted out to the defenders of capitalist society.

Apart from this fundamental cleavage, Socialist ideas have undergone considerable transformation in recent years. All schools of Socialists still urge the transference of large-scale industry from private to public ownership; but mere State Socialism, or nationalization of the old type, is no longer a satisfying conception to Socialists of any school. Partly under Guild Socialist influence, and partly as a result of changes in the economic situation, all Socialist programmes now insist that the Socialist State must create special economic organs for the administration of industries under public control, and that the workers must be given some participation in the management of these services. For example, whereas before the war the British miners urged merely the nationalization of the coal industry by its transference to a State department, they now, in conjunction with the Labour Party, propose that it should be administered by a representative commission, and its policy co-ordinated with that of allied services by an expert power and transport board holding a largely independent position. Similarly, the French unions have put forward a new plan of "industrial nationalization," and the problem of "workers' control" has appeared largely in German schemes of socialization since the war. Guild Socialism, influential during and after the war in drawing attention to these problems of the control of industry, appears now to have made its distinctive contribution to Socialist thought and policy, and to have become merged in the general body of revised Socialist doctrine.

The Labour and Socialist International, 1928. Affiliated parties, with membership, voting strength, and representation in legislative bodies. (From the report of the Labour and Socialist International for 1928.)

Country	Name of party	Membership in thousands	Votes at last elec. (thousands)	Percentage of total votes cast	Number of M.P.'s	Percentage of total M.P.'s
Argentina .	S.P.	10	90	.	2	1
Armenia .	R.F.	59		Illegal		
Austria .	S.D.L.P.	669				
Austria, Czechoslovak .	S.D.L.P.	14	1,539	42	71	43
Belgium .	L.P.	597*	820	39	78	41
British Guiana .	L.U.	1*	.	..	..	..
Bulgaria .	S.D.L.P.	30	60	..	10	4
China .	S.S.P.	3	..	..	..	..
Czechoslovakia .	S.D.L.P.	122	..	..	..	..
Czechoslovakia, German .	S.D.L.P.	65				
Czechoslovakia, Polish .	S.L.P.	2	1,042	..	46	15
Czechoslovakia, Ruthenian	S.D.L.P.	5				
Danzig .	S.D.P.	5	61	..	42	35
Denmark	S.D.P.	148	497	37	53	36
Esthonia .	S.L.P.	4	119	23	24	24
Finland .	S.D.P.	37	257	28	60	30
France .	S.P.	99	1,692	..	100	16
Georgia .	S.D.L.P.	18		Illegal		
Germany .	S.D.P.	867	9,146	..	153	31
Great Britain .	L.P.	3,388*	5,487	34	160	26
Greece .	S.L.P.	3	7	..	..	..
Holland .	S.D.L.P.	52	706	23	24	24
Hungary	S.D.P.	138*	126	..	14	6
,,	S. Emigrants	..	..	..	..	.
Iceland	W.A.	5*	6	..	5	12
Italy .	U.S.P.			Illegal		
Latvia .	S.D.L.P.	5	260	33	33	33
Lithuania .	S.D.P.	2	170	..	15	19
Luxembourg .	L.P.	1	.	..	12	23
Norway† .	L.P.	76	367	37	59	39
Palestine .	Jewish L. and S.F.	22	..	..	54	27
Poland .	S.P.	55				
,, .	I.S.P.	..	1,115	..	69	15
,, .	German S.P.	8				
Portugal .	S.P.	2	..	..	..	..
Rumania	S.D.P.	13	40	..	..	..
Russia .	S.D.L.P.			Illegal		
,, .	S.R.P.			Illegal		
Spain	S.L.P.	7	..	..	..	..
Sweden .	S.D.L.P.	202	725	41	105	46
Switzerland	S.D.P.	36	195	25	49	25
Turkey† .	I.S.P.	6	.	.	..	..
,, † .	S.D.P.	..	..	.	..	..
Ukraine .	S.D.L.P.			Illegal		
United States	S.P.	15	1,000	..	1	..
Yugoslavia	S.P.	4	25	..	1	..

*Membership includes affiliated trade unionists.
†Not at present affiliated to the Labour and Socialist International.
List of abbreviations: A.=Association, D.=Democratic, F.=Federation, I.=Independent, L.=Labour, R.=Revolutionary, S.=Social or Socialist, U.=Union or United, W.=Workers'.
Note. In addition, there are in most countries Communist parties affiliated to the Third International, and in some others Socialist or Labour Parties not belonging to either International.

The war and its aftermath have everywhere brought Socialism far nearer to the tests of practical experience and responsibility. Naturally, under these conditions, difficulties are more clearly seen, new problems come to the front, and differences previously latent tend to become more pronounced. It would take a bold

man to prophecy what will be the outcome of the present disputes between Communists and orthodox Socialists. It may be that the need for unity in pursuit of economic ends will, in the long run, reunite the warring factions in the European movement, and compel them to arrive at some basis of political agreement. For the existence of two contending working-class parties, each claiming to stand for Socialism, but seeking its end by distinctive means, has manifest disadvantages for the workers, especially if the quarrel is pushed into the industrial field, and results in a disruption of trade unionism in accordance with the political cleavage. This situation has not arisen in Great Britain in any grave form; but where it has arisen, as in France and Germany, it has weakened trade unionism even more seriously than political Socialism.

The forces making for unity are, first, that the ultimate aims proclaimed by the rival groups are largely the same, and secondly that Socialism is essentially not so much a theoretical plan of social reorganization as a class movement arising directly out of the economic divisions in society. It is an attempt to formulate, primarily for the working class, or proletariat, a policy designed to promote at once a larger and more balanced production and a more equal distribution of wealth, and to abolish class distinction based on inequalities of wealth or social opportunity, or on property laws which encourage the accumulation of the means of production in private hands. Its forms and policies differ from place to place, and vary with the movement of events and economic forces; but through all its changes it retains the fundamental character proclaimed for it in the Communist manifesto of 1848, as a movement based primarily on working-class organization and solidarity. By no means all Socialists, especially in Great Britain, call themselves Marxists; but to this extent, at least, modern Socialism bases itself firmly upon Marx's diagnosis of the social and economic problem.

Socialism has thus necessarily an economic foundation in the working-class movement; but it is important at the same time to realize that much of its driving force comes from its possession of a certain body of principles shared by Socialists of all schools, and scarcely subject to change with changes in the concrete political and economic situation.

Thus, all Socialists agree that the conduct of industry for private profit produces anti-social results, and challenge the view that the pursuit by each citizen of his private economic interests works out for the good of society on a whole. All Socialists, whatever their different views of the best forms of administration for Socialist undertakings, agree in holding that the major industries and services should pass under some form of co-ordinated public control, whether in the hands of the State, of local authorities, of self-governing guilds or co-operative societies, or of new forms of organization specially developed for the purpose. They agree in denouncing private control of the vital means of production, and in holding that both the form and the extent of the national output should be determined by considerations of social need.

Moreover, all Socialists insist that with a change in the control of industry will go a change in the motives which operate in the industrial system, and that the motive of public service, at present thwarted and inhibited by private capitalism, will be brought rapidly into play by the change from private to social ownership and control. Within this common ground there is room for wide differences of opinion and of practical policy; but, through all the changes and chances of the Socialistic movements of the world, these unifying conceptions give a common meaning to the vast variety of organizations and policies to which the term Socialist is habitually applied.

See the articles COMMUNISM, ANARCHISM, NATIONAL WORKSHOPS, and the chief biographies such as MARX, KARL; OWEN, ROBERT; FOURIER, F.M.C.; BLANQUI, L.A., etc.

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(G. D. H. C.)

SOCIALISM: PRINCIPLES AND OUTLOOK. Socialism, reduced to its simplest legal and practical expression, means the complete discarding of the institution of private property by transforming it into public property and the division of the resultant public income equally and indiscriminately among the entire population. Thus it reverses the policy of Capitalism, which means establishing private or "real" property to the utmost physically possible extent, and then leaving distribution of income to take care of itself. The change involves a complete moral *volte-face*. In Socialism, private property is anathema and equal distribution of income the first consideration. In Capitalism, private property is cardinal and distribution left to ensue from the play of free contract and selfish interest on that basis, no matter what anomalies it may present.

I.

Socialism never arises in the earlier phases of Capitalism, as, for instance, among the pioneers of civilization in a country where there is plenty of land available for private appropriation by the last comer. The distribution which results under such circumstances presents no wider departures from a rough equality than those made morally plausible by their association with exceptional energy and ability at the one extreme, and with obvious defects of mind and character or accidental hard luck at the other. This phase, however, does not last long under modern conditions. All the more favourable sites are soon privately appropriated, and the later comers (provided by immigration or the natural growth of the population), finding no eligible land to appropriate, are obliged to live by hiring it at a rent from its owners, transforming the latter into a *rentier* class enjoying unearned incomes, which increase continually with the growth of the population until the landed class becomes a money-lending or capitalist class also, capital being the name given to spare money. The resource of hiring land and spare money is open to those only who are sufficiently educated to keep accounts and manage businesses, most of whom spring from the proprietary class as younger sons. The rest have to live by being hired as labourers and artisans at weekly or daily wages; so that a rough division of society into an upper or proprietary class, a middle or employing and managing class, and a wage proletariat is produced. In this division the proprietary class is purely parasitic, consuming without producing. As the inexorable operation of the economic law of rent makes this class richer and richer as the population increases, its demand for domestic servants and for luxuries of all kinds creates parasitic enterprise and employment for the middle class and the proletariat, not only withdrawing masses of them from productive industry, but also fortifying itself politically by a great body of workers and employers who vote with the owners because they are as dependent on the owners' unearned incomes as the owners themselves.

Meanwhile, the competition of employers for custom, which leads to the production of a dozen articles to satisfy the demand for one, leads to disastrous crises of feverish over-production alternated with periods of bad trade ("booms" and "slumps"), making continuous employment of the proletariat impossible. When wages fall to a point at which saving also is impossible,

the unemployed have no means of subsistence except public relief during the slumps.

It is in this phase of capitalistic development, attained in Great Britain in the 19th century, that Socialism arises as a revolt against a distribution of wealth that has lost all its moral plausibility. Colossal wealth is associated with unproductiveness and sometimes with conspicuous worthlessness of character; and lifetimes of excessive toil beginning in early childhood leave the toiler so miserably poor that the only refuge left for old age is a general workhouse, purposely made repulsive to deter proletarians from resorting to it as long as they have strength enough left for the most poorly paid job in the labour market. The inequalities become monstrous: hard-working men get 4*s.* or 5*s.* a day (post-war rates) in full view of persons who get several thousands a day without any obligation to work at all, and even consider industrial work degrading. Such variations in income defy all attempts to relate them to variations in personal merit. Governments are forced to intervene and readjust distribution to some extent by confiscating larger and larger percentages of incomes derived from property (income tax, super-tax, and estate duties) and applying the proceeds to unemployment insurance and extensions of communal services, besides protecting the proletariat against the worst extremities of oppression by an elaborate factory code which takes the control of workshops and factories largely out of the hands of their proprietors, and makes it impossible for them to exact grossly excessive hours of labour from their employees, or to neglect their health, physical safety, and moral welfare with complete selfishness.

This confiscation of private property incomes for public purposes without any pretence of compensation, which is now proceeding on a scale inconceivable by Victorian ministers, has destroyed the integrity of private property and inheritance; and the success with which the confiscated capital has been applied to communal industries by the municipalities and the central Government, contrasted with the many failures and comparative costliness of capitalist industrial adventure, has shaken the superstition that private commercial management is always more effective and less corrupt than public management. In particular, the British attempt to depend on private industry for munitions during the World War of 1914–18 nearly led to defeat; and the substitution of national factories was so sensationally successful, and the post-war resumption of private enterprise, after a brief burst of illusory prosperity, was followed by so distressing a slump that the reversal of the relative efficiency prestige of Socialism and Capitalism was vigorously accelerated, leaving Capitalism unpopular and on the defensive, whilst confiscation of private capital for communal enterprise and nationalization of the big industries grew steadily in popularity in and out of Parliament.

This change in public opinion had already deeply penetrated the middle class because of the change for the worse in the position of the ordinary employer. He, in the 19th century, was admittedly master of the industrial and, after the reform of 1832, of the political situation. He dealt directly and even domineeringly with the proprietary class, from which he hired his land and capital either directly or through agents who were his servants and not his masters. But the sums required to set on foot and develop modern industrial schemes grew until they were out of reach of ordinary employers. The collection of money to be used as capital became a special business, conducted by professional promoters and financiers. These experts, though they had no direct contact with industry, became so indispensable to it that they are now virtually the masters of the ordinary routine employers. Meanwhile, the growth of joint-stock enterprise was substituting the employee-manager for the employer, and thus converting the old independent middle class into a proletariat and pressing it politically to the left.

With every increase in the magnitude of the capital sums required for starting or extending large industrial concerns comes the need for an increase in the ability demanded by their management; and this the financiers cannot supply: indeed, they bleed industry of middle class ability by attracting it into their own profession. Matters reach a point at which industrial management by the old-fashioned tradesman must be replaced by a professionally trained and educated bureaucracy; and as Capitalism does not provide such a bureaucracy the industries tend to get into difficulties as they grow by combination (amalgamation), and thus outgrow the capacity of the managers who were able to handle them as separate units.

This difficulty is increased by the hereditary element in business. An employer may bequeath the control of an industry involving the subsistence of thousands of workers, and requiring from its chief either great natural ability and energy or considerable scientific and political culture, to his eldest son without being challenged to prove his son's qualifications, though if he proposes to make his second son a doctor or a naval officer he is peremptorily informed by the government that only by undergoing an elaborate and prolonged training, and obtaining official certificates of qualification, can his son be permitted to assume such responsibilities. Under these circumstances, much of the management and control of industry gets divided between routine employers who do not really understand their own businesses, and financiers, who, having never entered a factory nor descended a mine shaft, do not understand any business except the business of collecting money to be used as capital and forcing it into industrial adventures at all hazards, the result being too often reckless and senseless over-capitalization, leading to bankruptcies (disguised as reconstructions) which reveal the most astonishing technical ignorance and economic blindness on the part of men in high repute as directors of huge industrial combinations, who draw large fees as the remuneration of a mystical ability which exists only in the imagination of the share-holders.

II.

All this steadily saps the business prestige of Capitalism. The loss of popular faith in it has gone much farther than the gain of any widespread or intelligent faith in Socialism. Consequently, the end of the first third of the 20th century finds the political situation in Europe confused and threatening: all the political parties diagnosing dangerous social disease, and most of them proposing disastrous remedies. National governments, no matter what ancient party slogans they raise, find themselves controlled by financiers who follow the slot of gigantic international usuries without any public aims and without any technical qualifications except their familiarity with a rule-of-thumb city routine quite inapplicable to public affairs, because it deals exclusively with stock exchange and banking categories of capital and credit. These, though valid in the money market when conducting exchanges of future incomes for spare ready money by the small minority of persons who have these luxuries to deal in, would vanish under pressure of any general political measure like—to take a perilously popular and plausible example—a levy on capital. Such a levy would produce a money market in which there were all sellers and no buyers, sending the Bank Rate up to infinity, breaking the banks, and bringing industry to a standstill by the transfer of all the cash available for wages to the national treasury. Unfortunately, the parliamentary proletarian parties understand this as little as their capitalist opponents. They clamour for taxation of capital; and the capitalists, instead of frankly admitting that capital as they reckon it is a phantom, and that the assumption that a person with an income of £5 a year represents to the State an immediately available asset of £100 ready money, though it may work well enough as between a handful of investors and spendthrifts in a stockbroker's office, is pure fiction when applied to a whole nation, ignorantly defend their imaginary resources as if they really existed, and thus confirm the proletariat in its delusion instead of educating it.

The financiers have their own *ignis fatuus,* which is that they can double the capital of the country, and thus give an immense stimulus to industrial development and production, by inflating the currency until prices rise to a point at which goods formerly marked £50 are marked £100, a measure which does nothing nationally but enable every debtor to cheat his creditor, and every insurance company and pension fund to reduce by half the

provision for which it has been paid. The history of inflation in Europe since the World War of 1914–18, and the resultant impoverishment of pensioners and officials with small fixed incomes, forces the middle classes to realise the appalling consequences of abandoning finance and industry to the direction of unskilled, politically ignorant, unpatriotic "practical business men."

Meanwhile, the mobility of capital leads to struggles for the possession of exploitable foreign territories ("places in the sun"), producing war on a scale which threatens not only civilization but human existence; for the old field combats between bodies of soldiers, from which women were shielded, are now replaced by attacks from the air on the civil population, in which women and men are slaughtered indiscriminately, making replacement of the killed impossible. The emotional reaction after such wars takes the form of acute disillusion, which further accelerates the moral revolt against capitalism without, unfortunately, producing any workable conception of an alternative. The proletarians are cynically sulky, no longer believing in the disinterestedness of those who appeal to them to make additional efforts and sacrifices to repair the waste of war. The moral mainspring of the private property system is broken; and it is the confiscations of unearned income, the extensions of municipal and national communism, above all the new subsidies in aid of wages extorted from governments by threats of nationally disastrous lock-outs and strikes, which induce the proletariat to continue operating the capitalist system now that the old compulsion to work by imposing starvation as the alternative, fundamental in Capitalism, has had to be discarded in its primitive ruthlessness. The worker who refuses to work can now quarter himself on public relief (which means finally on confiscated property income) to an extent formerly impossible.

Democracy, or votes for everybody, does not produce constructive solutions of social problems; nor does compulsory schooling help much. Unbounded hopes were based on each successive extension of the electoral franchise, culminating in the enfranchisement of women. These hopes have been disappointed, because the voters, male and female, being politically untrained and uneducated, have (*a*) no grasp of constructive measures, (*b*) loathe taxation as such, (*c*) dislike being governed at all, and (*d*) dread and resent any extension of official interference as an encroachment on their personal liberty. Compulsory schooling, far from enlightening them, inculcates the sacredness of private property, and stigmatizes a distributive state as criminal and disastrous, thereby continually renewing the old prejudices against Socialism, and making impossible a national education dogmatically inculcating as first principles the iniquity of private property, the paramount social importance of equality of income, and the criminality of idleness.

Consequently, in spite of disillusion with capitalism, and the growing menace of failing trade and falling currencies, our democratic parliamentary oppositions, faced with the fact that the only real remedy involves increased taxation, compulsory reorganization or frank nationalization of the bankrupt industries, and compulsory national service in civil as in military life for all classes, dare not confront their constituents with such proposals, knowing that on increased taxation alone they would lose their seats. To escape responsibility, they look to the suppression of parliamentary institutions by *coups d'état* and dictatorships, as in Italy, Spain, and Russia. This despair of parliamentary institutions is a striking novelty in the present century; but it has failed to awaken the democratic electorates to the fact that, having after a long struggle gained the power to govern, they have neither the knowledge nor the will to exercise it, and are in fact using their votes to keep government parochial when civilization is bursting the dikes of nationality in all directions.

A more effective resistance to property arises from the organization of the proletariat in trade unions to resist the effect of increase of population in cheapening labour and increasing its duration and severity. But Trade Unionism is itself a phase of Capitalism, inasmuch as it applies to labour as a commodity that principle of selling in the dearest market, and giving as little as possible for the price, which was formerly applied only to land, capital, and merchandise. Its method is that of a civil war between labour and capital in which the decisive battles are lock-outs and strikes, with intervals of minor adjustment by industrial diplomacy. Trade Unionism now maintains a Labour party in the British Parliament. The most popular members and leaders are Socialists in theory; so that there is always a paper programme of nationalization of industries and of banking, taxation of unearned incomes to extinction, and other incidentals of a transition to Socialism; but the trade union driving force aims at nothing more than Capitalism with labour taking the lion's share, and energetically repudiates compulsory national service, which would deprive it of its power to strike. In this it is heartily seconded by the proprietary parties, which, though willing enough to make strikes illegal and proletarian labour compulsory, will not pay the price of surrendering its own power to idle. Compulsory national service is essential in Socialism, which is thus deadlocked equally by organised labour and by Capitalism.

It is a historic fact, recurrent enough to be called an economic law, that Capitalism, which builds up great civilizations, also wrecks them if persisted in beyond a certain point. It is easy to demonstrate on paper that civilization can be saved and immensely developed by, at the right moment, discarding Capitalism and changing the private property profiteering state into the common property distributive state. But though the moment for the change has come again and again it has never been effected, because Capitalism has never produced the necessary enlightenment among the masses nor admitted to a controlling share in public affairs the order of intellect and character outside which Socialism, or indeed politics, as distinguished from mere party electioneering, is incomprehensible. Not until the two main tenets of Socialism—abolition of private property (which must not be confused with personal property), and equality of income—have taken hold of the people as religious dogmas, as to which no controversy is regarded as sane, will a stable Socialist state be possible. It should be observed, however, that of the two tenets, the need for equality of income is not the more difficult to demonstrate, because no other method of distribution is or ever has been possible. Omitting the few conspicuous instances in which actual earners of money make extraordinary fortunes by exceptional personal gifts or strokes of luck, the existing differences of income among workers are not individual but corporate differences. Within the corporation no discrimination between individuals is possible: all common labourers, like all upper division civil servants, are equally paid. The argument for equalizing the class incomes is that unequal distribution of purchasing power upsets the proper order of economic production, causing luxuries to be produced on an extravagant scale whilst the primitive vital needs of the people are left unsatisfied; that its effect on marriage, by limiting and corrupting sexual selection, is highly dysgenic; that it reduces religion, legislation, education, and the administration of justice to absurdity as between rich and poor; and that it creates an idolatry of riches and idleness which inverts all sane social morality.

Unfortunately, these are essentially public considerations. The private individual, with the odds overwhelmingly against him as a social climber, dreams even in the deepest poverty of some bequest or freak of fortune by which he may become a capitalist, and dreads that the little he has may be snatched from him by that terrible and unintelligible thing, State policy. Thus the private person's vote is the vote of Ananias and Sapphira; and democracy becomes a more effective bar to Socialism than the pliant and bewildered conservatism of the plutocracy. Under such conditions the future is unpredictable. Empires end in ruins: commonwealths have hitherto been beyond the civic capacity of mankind. But there is always the possibility that mankind will this time weather the cape on which all the old civilizations have been wrecked. It is this possibility that gives intense interest to the present historic moment and keeps the Socialist movement alive and militant. (G. B. S.)

SOCIAL PHILOSOPHY. Social philosophy may be divided into two main parts, critical or epistemological and constructive or synoptic. The object of the first is to disentangle the fundamental

categories and principles employed by the special social sciences and to test their validity. On its more constructive or synthetic side its business is to correct the onesidedness of the specialized social studies and to endeavour to see social life as a whole. In this respect it is greatly helped by the growing science of sociology (the study of human interactions, their conditions and consequences), but it differs from the latter chiefly in its attitude to the problem of value. While sociology cannot exclude from its field of study the psychology and history of ideals in so far as they act as agents influencing human behaviour, it is not as such concerned with the validity of these ideals. Social philosophy on the other hand deals with the validity of the application of ethical categories to the phenomena of social life and development which it studies from the point of view of their contribution to ends or purposes to which we can ascribe intrinsic value.

I. AN EXAMINATION OF SOME OF THE CATEGORIES USED IN THE STUDY OF SOCIETY

It is clearly impossible to attempt here even in outline a discussion of the logical and epistemological aspects of all the social sciences. Attention will be confined to a consideration of the validity of some of the categories that have been applied to the phenomena of social life by those who have approached the subject from the point of view of biology. (*See* SOCIAL PSYCHOLOGY.)

The Theory of a Social Organism.—Societies are frequently said to form organic wholes, and it is implied that there are fundamental laws of development common to organisms and societies (*cf.* especially Dr. Rivers, *Psychology and Politics*, p. 62). There are certainly many respects in which organic wholes and societies do resemble one another in a striking manner. Both may be said to constitute wholes consisting of parts standing to one another in relation of mutual causal dependence of such a nature that the character of the parts depends upon their relation each to the remainder. Both are systems which maintain themselves as wholes by a correlation of functions. Both exhibit a certain adaptability and plasticity of adjustment to a varying environment. Societies like organisms, moreover, vary greatly among themselves, in complexity, differentiation of function, degree of central control and of inner unity or harmony. Accordingly a classification of forms of unity among organisms may prove suggestive in dealing with types of societies. Nevertheless the analogy breaks down in important points. This may be seen best by a comparison between the "higher" organisms and the "higher" societies. In the first place, the latter are much more plastic than the former. In the higher organisms the parts tend to lose their independence, they have no "freedom" in relation to the whole. The more developed a society is, on the other hand, the greater the mobility and freedom and independence of its constituent parts. In the second place, the relations of the parts to the minor or secondary systems within the greater whole differ profoundly in the two cases. The parts of an organism cannot move from one system to another nor interchange functions so readily as can the constituent parts of the higher societies. In short, the individuality of the parts in societies is such that the wholes formed out of their interrelation may well be of a different order than the wholes formed out of the union of cells in the living organism, and the laws of development applying to the former species of wholes may differ radically from the laws applying to the latter.

Biological Change and Social Change.—A study of social change confirms this conclusion. Social change appears to be in the main independent of alteration in racial or inborn characters and proceeds rather by modification of tradition having but little relation to change in biological types. In support of this view several considerations may be offered. To begin with it is generally accepted that in historical times, at any rate, no changes of importance have occurred in either the physical or mental innate equipment of man. Accordingly the vast historical changes that have taken place cannot be attributed to variations in germinal structure. More specifically there is no evidence that any of the striking advances made at various critical periods in human history were due to or accompanied by change in the inherited constitution of man (*cf.* Galton, *Inquiry into Human Faculty*, p. 129). The causes leading to sudden eras of progress are to be found rather in a new orientation given to human faculty, furthered, it would seem usually, by contact with new or strange cultures. Culture contact is more important in this respect than race contact or fusion. Finally forms of culture do not appear to be definitely correlated with forms of race grouping. In other words biological groups do not correspond to culture groups and so far no success has met the efforts made by anthropologists to link up species of civilization with the genetic qualities of race-types (*cf.* T. H. Morgan, *Evolution and Genetics*, 1925, pp. 206–207).

The chief defect of most biological interpretations of society lies in their failure to realize the extreme subtlety and complexity of the relations between human character and the environment. Man's inherited propensities are mere potentialities, part conditions of development whose concrete filling is supplied by the social environment and the individual's own experience. Through this interplay changes in the social environment can bring about changes in human behaviour in a manner independent of alteration in race qualities, and through the agency of forces differing radically from those which are operative in the field of biology.

Thus (1) to the biologist the inheritance of "acquired characters" and its rôle in the evolution of species is a matter of great doubt. In social evolution it is clearly of the greatest importance. What is acquired by one generation is transmitted to the next, either as a totality or, at any rate, as facilitating reacquisition. This makes possible cumulative change inexplicable in biology. (2) In the biological field, the formation of new types by the accumulation of small individual differences is improbable. In social matters vast changes are clearly brought about by the accumulation of small differences. (3) There is no evidence that the occurrence of one mutation in itself favours the occurrence of others in a similar direction. One of the outstanding difficulties of natural selection is to account for the appearance of correlated structural changes. In the human sphere, on the other hand, a new idea is an excellent stimulus to further new ideas. (4) Inventions are far more common than mutations. This obvious fact has important bearings upon the problem of the relation between racial qualities and social change. Enormously significant changes can be brought about in a society without involving any changes in the inherited structure of the race. (5) Social changes, unlike mutations, can often be explained as the result of co-operation, as is best illustrated from the history of science and invention. (6) Whether the chances of the occurrence of mutations increase with changes in the environment is a matter of doubt. In the case of social mutations or inventions, it can be shown that great changes and upheavals act as stimulants, and that social or cultural advance is favoured by variability in the environmental conditions and the clash of ideas resulting from contact with new cultural elements. (7) The problem of orthogenesis or evolution in what appears as a directed line which has so far remained a mystery to the biologist is more readily explained in social evolution. The effects of changes in the environment are here cumulative and each new generation can start on the basis of what has been acquired by past generations, since the method of transmission does not depend on the mechanism of physical heredity. (8) Finally the source of variation in social affairs is not nearly so mysterious as is the cause of mutation in biology. For in human life teleological factors are plainly operative. Changes are brought about by a process of trial and error and by deliberate effort directed to ends more or less clearly apprehended. Whatever be our view of the rôle of mind in organic evolution, there can be no doubt of its importance in social evolution.

At this point the biologist might retort that conation and purpose are activities centred in some mind and mind itself grows up under the conditions determined by survival value, so that in the end we are driven back to biological agencies summed up in the term natural selection. This argument, however, is based upon what appears to be an erroneous view of the rôle of selection. Selection is not an originative agent and mind cannot be said to be its product. Nothing is known of the ultimate source of variations and this applies to forms of mind as to other things.

The mind once arisen is, indeed, limited by biological conditions but it gradually comes to control them by a purposeful handling of the environment and in so doing modifies the conditions of its own survival. Natural selection should accordingly not be spoken of as producing improvements or as the cause of progress. It produces nothing, but at most only acts upon existing variations so as to secure a certain definiteness of type. In social evolution the mind operates by adapting the environment to itself rather than by adapting itself to the environment. Changes are not brought about by waiting for the appearance in the course of hundreds of generations of survivors adapted to the new situation. The efforts of the mind are directed at securing adaptation by an increase in plasticity, more and more independent of changes in specific race qualities.

II. THE ETHICAL BASIS OF SOCIAL RELATIONS

The central problem of social philosophy on its ethical side is the nature of political obligation and authority. In this, two essentially different questions are involved which it is important to distinguish. We have first of all to account for the concentration of coercive power in some determinate person or persons and for the growth of habits of obedience to those persons on the part of the other members of society. We have, secondly, to inquire into the ethical justification of social obedience or, looking at it from the point of view of the persons exercising political power, into the moral basis of their authority. Though the two problems have points of contact they are at bottom quite different in nature, the one being a matter for history and psychology, the other for ethics and political philosophy. Into the historical conditions which have led to the emergence of different forms of political organization, we need not here enquire. It is sufficient to point out that although brute force and military conquest have played an important rôle in their determination, yet, in the long run, political power and habits of obedience and social co-operation rest upon a recognition, however vague or dim on the part of the members of society, that the public authority maintains and furthers common interests and common goods. The psychological factors involved, however, are extremely inchoate and obscure. They cannot be described accurately in terms of a common or corporate will. They constitute rather "an impalpable congeries of hopes and fears" resting upon feelings of discomfort and maladjustment experienced when an accepted rule is broken or a common requirement not fulfilled, a dim recognition, perhaps, that somehow order must be maintained and that somebody must be entrusted with the duty of maintaining the social peace. Consent for the majority of the people hardly rises above passive acquiescence, and in complex societies has not the character of voluntary decision. Power rests upon the will of the people in the sense that if stretched beyond a certain point, their acquiescence will not be secured, and social apathy and even disruption may result. Thus the degree of power exercised by a public authority depends ultimately on the amount of obedience it can command, and therefore varies greatly in duration, scope and intensity. If by the term sovereignty is meant supreme or unlimited coercive power vested in determinate persons, then clearly the notion is no more than a convenient fiction of jurisprudence, since no determinate person ever had such power. The attempt to place sovereignty in the general will in the sense of the congeries of vague psychological elements underlying common or joint action must fail, since in this sense the general will is indeterminate and cannot therefore be vested in a person or persons.

The General Will.—In the discussion of the second problem psychology and history have been confused with ethics. It is true that psychologically obedience on the part of an individual may be influenced by his recognition that the law which he accepts is in the common interest, but this recognition by him does not give the law its authority and it is arguable that the law might still be right even if a given individual did not recognize its rightness. The problem here involved has given rise to the theory of a general will. It was thought that a moral imperative must be self-imposed and that obligation consists in this adoption by the self of its own law. Accordingly the problem of political obligation comes to be put as the question how self-government is possible, and the answer is found in the light of a distinction between our momentary or actual explicit consciousness at its ordinary level and our "real being" in which "we will our own nature as a rational being." This real being, it is then argued, is universal, is expressed in the State, and in obeying its injunctions the individual obeys his own real will and is therefore "self-governed." (*See* Bosanquet, *The Philosophical Theory of the State.*)

Now it must be granted that to have true moral value obedience on the part of an individual must be self-imposed, but the ground of the obligation itself is not found in the acceptance or will of the individual, but in the constraint due to the worth or value of the end or ends to which the act in question is directed, and this value is not dependent upon its recognition or appreciation by a given subject or individual. The problem of obligation is not to be solved by an analysis of volition, but rather of the ends or objects which have value, by an analysis not of willing but of what is willed. But, it will be said, society is a condition of there being any ends or objects of will at all, or perhaps more precisely that just those ends which are of the greatest significance for the growth of individuality are those which society (or man's social nature) lays on him. (Hetherington, *Aristot. Proc.* 1917–18, p. 304.) It would follow that the constraint, control and stability which an individual owes to the ends in which he is interested are socially conditioned, and this, it may be said, is what is meant by the operation of the general will on the individual.

Here again it must be urged in reply that though psychologically the individual would not come to form ends apart from society, and though some ends are as such social in nature in the sense that they relate to other persons or depend upon co-operation for their realization, it is not their social nature that makes them morally binding, but rather their intrinsic value or worth. Common ends may have greater value as being more inclusive but the value itself may consist in something other than being included in a whole (though wholeness or completeness may be *a* value).

We must therefore abandon the attempt to find a repository for obligation in the real will. Nothing is gained by the argument that what *ought* to be willed *really* is willed by some one (God, our best self, etc.). It remains true, however, that as a matter of psychological fact institutions may be said to embody the efforts of social individuals towards mutual adjustment and the attainment of common ends. But this is a mere generality which throws no light upon the nature and value of any particular institution or association, or of the relations between them. The weakest side of the theory of the general will, since its formulation by Rousseau, has always been that it has tended to waver between two different conceptions which it does not succeed in bringing into an intelligible relation to one another. On the one hand the general will is identified with an ideal good, that in which all human purposes would be unified and harmonized. In this sense the general will is not a "*de facto* tendency," but something "essentially logical," that is to say, something logically implied in human endeavour as that which, if fulfilled, would make it complete and systematic. On the other hand, the general will is conceived as something determinate and capable of expression, "a community of view as to the good of social and individual life" (Hetherington, *Arist. Proc.* 1917–18, p. 307), "an effective community of will." If now we follow the first interpretation, it is clear that our ultimate obligation is to the final good which is only inadequately interpreted by any actual institution. If we are told that the State is the "operative criticism of institutions" and our loyalty is to it, it remains to explain the nature of the principles upon which such criticism is based. Moreover, as a matter of fact, effective moral criticism is often rendered by individuals or associations within the State which reach an ethical level higher than that reached by the organized machinery of the State. Again, the principles employed by such criticism are of universal applicability and may go beyond the limits of the State. It is worthy of note in this connection that according to the theory of the real will there is no general will of humanity. If the "real" will is the ideal will can there *really* be no will of humanity? If we elect to

stress the second interpretation of the general will as a determinate community of will, we must challenge its upholders to produce psychological evidence of such a unitary corporate will in the large States of the western world. The relation between "determinate levels" of the real will and the general will remains as obscure as the relation between finite individuals and the absolute spirit in idealist metaphysics.

The Attack on the State.—The issues involved in the above arguments have not been clearly brought out in recent controversy relating to the notion of the sovereign State. Instead of questioning the validity of the theories which seek to find a basis for obligation in will, political theorists have merely sought to replace the unitary will of the State by a plurality of separate wills (Guild Socialism, and kindred movements), amongst which that of the State was *prima inter pares*. Insoluble problems of functional demarcation were thus created and the need of a co-ordinating body had to be admitted, which dangerously resembled the unitary State which these theorists had set out to attack. It has proved difficult to work out the respective spheres of authority of the separate functional wills, and it has had to be admitted that in some sense the State does penetrate into all associations. It is now coming to be recognized that the failure of these efforts was due to the fact that the problem to which they sought to supply an answer was badly formulated. The question is not whether there is one will or many, but whether political obligation is not essentially secondary in character, deriving its authority not from the fiat of any personal will but rather from the moral law, which is above all human organizations whatever. It is true that the moral law has to be interpreted by organs set up by society, but social institutions have authority only to the extent to which they in fact promote the social good, and they must be judged by what they do. It is idle to maintain that the State *qua* State is always good and that the general will cannot err. The content of such will must be scrutinized and evaluated in the course of its actual expression. It follows that ultimately the individual conscience is the final arbiter. The problem before the individual is not, however, that of reconciling clashing wills or of putting his "own good" against that of others. No really satisfactory theory of obligation can be built on the basis that in serving others I am *really* serving my own interest. Such a notion of the common good assumes a harmony between competing interests which in a complex world is not warranted by facts, and cannot in any event account for genuine self-sacrifice. The ultimate principle seems to be that the good is binding and should be promoted wherever and by whomsoever it may be achieved, and that in this respect the individual agent counts for no more and no less than any other similar agent similarly situated. For the ambiguous category of the common good it is better to substitute the notion of just distribution of goods, and the problem is in every case to determine the conditions which would secure the justest distribution of goods among all those affected, or more generally to formulate a system of rights and obligations based upon principles of justice.

Such principles must be based upon the idea of equality. By this is not meant the view, often ascribed to egalitarians by their opponents, that all men either are equal in capacity or endowment, or that all should be treated alike, but rather that all persons have similar claims in so far as they are similar, and that only such differences should be taken into account as are relevant to the values or goods involved. Equality, in short, is a principle of proportion, as Aristotle long ago pointed out. It is not based upon a denial of differences but upon an evaluation of the relevance of such differences as do exist to the system of rights and duties.

We are confronted here with the difficulty that our notion of the good life is still very indeterminate. In mitigation it must, however, be remembered, that social philosophy is concerned not with the detail of the good life but only with those general conditions of such a life as can be promoted by organized society. Rights are claims to such conditions for the realization of the good as can be secured by social organization. The delicacy and subtlety of organized effort varies from association to association and, in the case of the State, it is clear that its action is relatively mechanical and confined to measures which can be carried out in a relatively uniform manner. This limitation, arising from the character of the means or mechanisms at the disposal of the State, and the further difficulty due to the absence of agreed scales of values, rather than any *a priori* theorizing as to the scope of the State, determines the limits of its intervention and control. For practical purposes these considerations lead us to the conception of a minimum. The organized efforts of society should be directed at securing the minimum conditions requisite for the realization of the good. The duty of the social authority is accordingly:

(*a*) To utilize the collective resources for the promotion of the good of the associated members in the sense of securing to each individual the minimum facilities for the fulfilment of his capacities for good.

(*b*) To control such differences in power and possessions as arise in a society with the object of preventing those who have acquired excess of power from abusing it and forcing others into conditions incompatible with the requirements of the good life.

The principle of equality is clearly in harmony with the conception of a minimum here outlined, but may also sanction differential claims above the minimum should their satisfaction be shown to be necessary for the realization of the good on a maximum scale. The free working out of the implications of this principle would require, among other things, a knowledge of the extent to which individuals differ among themselves in respect of capacity for the attainment of objects having intrinsic value.

The State and Other Associations.—It is clear that with regard to objects of the greatest value in life (such as appreciation of beauty, truth, personal affection) large scale organization, and especially the State as an organ of compulsion and coercion, can do very little. When we are told that the State exists for the sake of the good life, it should be pointed out that it can only be effective if it confines itself to laying down general conditions to which individuals and associations of individuals under a common rule must conform if the good is to be realized. It can operate only with general rules and is utterly incompetent to enter into the finer questions that come from the need of balancing or grading values against one another. In a sense the sphere of the State is wider than that of other associations within it, since it must lay down certain general conditions to which they must conform, and has further the duty of adjustment and co-ordination. In this sense the State is an organ for the maintenance of justice or the rule of equality. But the complexities of human life and the nature of the ends to which we ascribe value make it practically impossible for the State to intervene effectively except to secure the barest and crudest conditions of general welfare. To maintain that the State alone "reaches like wisdom from end to end" (J. H. Muirhead, *Mind*, 33, p. 364) is not very convincing. The purposes of the State are more embracive than those of other institutions, but the embrace is not tender nor very moving and may evoke but a half-hearted response. It touches all things it is true, but only superficially. The deeper purposes of life are utterly beyond its grasp and its power of arbitrament and adjustment in matters of external action, though necessary, afford no solution of the deeper conflicts of the mind in its struggles towards comprehensive values. There are also many purposes and interests, religious, artistic and intellectual, which cut across State boundaries and either have, or ought to have, organs of expression, just as entitled to our allegiance and loyalty as political organizations. When it is said that the State is the whole complex or system of institutions it should be remembered that some institutions transcend political boundaries and it is questionable whether the State has, or ought to have, "the last word" in cases of conflict or divergence among themselves, or between them and the State. This applies even with greater force to disputes between States. They cannot *each* have supreme authority. That can only lie in a world organization. In dealing with the problems of conflicting allegiance and loyalties that thus arise the individual must be guided by a devotion to the best, and in this arduous task of interpretation and evaluation he may find that "Sittlichkeit," like patriotism, is not enough.

The State and the Problem of Responsibility.—Within its

own territory the duty of the State is, then, to maintain a system of rights and to use the collective resources of the community for the promotion of the good life of its members in accordance with the principles of justice or the rule of equality. But this rule is of universal applicability, and justice enjoins the promotion of the good wherever possible. In so far as the State is concerned, however, it is seen that it is limited by the nature of the means at its disposal and, obviously, by the amount of obedience and willing support it can get from its members. It is clear that its first duty is to promote the good of its own members, not because no one else has a claim, or that the good of others is less important, but because of the greater probability of its being able to secure the conditions required for this realization of the good of its own members than that of others of whose requirements it can have no intimate knowledge, and over whose resources it has no effective control. ("Egoism is undoubtedly superior to Altruism as a doctrine of means: in the immense majority of cases the best thing we can do is to aim at securing some good in which we are concerned, since for that very reason we are far more likely to secure it." [Moore, *"Principia Ethica,"* p. 167].) One may go further and say that, in general, it is dangerous for States to seek to promote the good of others, though it has not been uncommon for civilized States to justify their claims to govern the "uncivilized," on the ground that their suzerainty is for the good of the latter. It is odd that those who have maintained that "there is no recognized moral order," to guide States in their relations with one another, have not felt the difficulty of the appeal to moral considerations so often made by white peoples in their dealings with other races. If each State is the guardian of a moral world but not a factor within an organized world there could never be any justification for any attempt to impose the criteria of one "moral world" on any other "moral world." In opposition to such views it must be urged with the utmost emphasis that moral principles are universal, though their application to the problem of international regulation may present greater difficulties than that with which an individual is confronted in cases of perplexities of conscience. The greater relative difficulty, however, arises not from the absence of principles but from the complexity and intricacy of the problems to which they have to be applied. The principles themselves, though they may not as yet be recognized by the whole of mankind, are binding in the sense that they ought to guide States in their mutual relations. Much has been made in this connection of the difficulty of deciding where responsibility lies. But this again raises no real problem of principles. Men acting in concert do not *on that account* lose their responsibility, though the precise incidence of responsibility in group action may vary according to the nature of the group, the genuineness of the control shared by its members, the degree to which the authority of the leaders and agents is based upon active consultation with the rest of the members, and so forth. In practice we certainly recognize differences in degree of responsibility among the members of a group. The responsibility of an ordinary citizen who refrains from protesting against, or merely acquiesces in, an unjust war, is real, but not so great as that of those who actively participate in it or of the statesmen directly concerned in bringing it about. The tradition of the English law of corporations has, it seems, always been to endeavour to fix responsibility upon some person who can be held accountable, and through whom the activities of the group can be controlled. Ethically the individual is not absolved from responsibility merely because he is acting on behalf of a group, even though that group be the State. The actions of States in turn must be judged by the same principles as those which bind individuals or groups of individuals. The most urgent task of the social philosopher is to apply the universal principles of ethics to the problem of international morality and law.

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SOCIAL PSYCHOLOGY: *see* PSYCHOLOGY, HISTORY OF.

SOCIAL SERVICE. The term social service has a somewhat different meaning in Great Britain and America.

GREAT BRITAIN

The term social service is a comparatively new one in Great Britain. If it had been used previous to the 20th century it would have meant philanthropy and charity in the ordinary sense. Now it includes not only personal social service but all the principal public social services, especially the voluntary work attached to these. It is distinguished from the older philanthropy by its scientific and systematic character, by its insistence on seeking out the causes of social evils and by its broad study and action.

Personal Social Service.—This need not be charitable. There is much personal service in relation with Boy Scouts and Girl Guides. In the former case Sir Robert Baden-Powell rightly understood juvenile psychology, and the movement has grown with amazing rapidity. The Girl Guides have employed hundreds of well-educated young women who have rendered good service to the community by the training and discipline they impart. The older movements of Boys' and Girls' Brigades do excellent work.

The physical well-being of the young is dependent upon places in which to play, and the National Playing Fields Association, which began in 1925, is trying to open up the country for their recreation. The movement is rapidly spreading. Much time is given also to guilds of play and folk dancing and both men and women who have leisure can serve the rising generation by giving their time to these movements. Another important development is the growth of camps for boys and girls in connection with innumerable clubs and societies. Here the senior boys and girls from public schools have rendered great assistance. For those who are older the Co-operative Holiday Association and the Holiday Fellowship reach a class already interested in open air life. A great deal of personal service is given by such institutions as the Y.M.C.A. and Y.W.C.A. The men's clubs and institutes are well known, but women's institutes are becoming an important feature in British national life not only in the towns, but also in the country. Boys' and girls' clubs with their national organizations and "Toc H" give opportunity for social service. There is a definite tendency to co-ordinate all this recreative work and even the local education authorities are assisting in this, through the juvenile organisations committees set up in 1920. The rural community councils, established in about a dozen counties, represent an important development. They are aided by the Carnegie United Kingdom trust and organized through the National Council of Social Service.

Although established under the aegis of local education authorities, Care Committees are essentially personal. They seek to make friendly contacts within the homes of the people and to link the official with the parents and the children. Voluntary effort has here been most successful, and there are over 1,000 care committees in London. Medical and dental inspection in the schools has enlarged the scope of the care committees and also the choice of employment.

The Charity Organisation Society is the principal society that investigates the condition of the needy and the unfortunate. The committees are composed of voluntary workers although the secretaries are whole time expert agents. In many towns guilds of help and councils of social service embrace the Charity Organisation Society branches and provide opportunities for service.

Settlement and similar institutions have enabled many like Charles Booth, B. S. Rowntree or Prof. Bowley to carry out investigations into poverty and have marked a new stage in social inquiry. There are now comparative studies of a great many places such as Oxford, Cambridge, Ipswich, Hornsey and West Ham. Such social surveys are required for every large town or

city. Personal services rendered by public schools, colleges and other institutions have opened up a large field of social work in the shape of public school and college missions and settlements. The Cavendish club of London is an outcome of this movement.

One form of personal social service inaugurated by the Mansfield House Settlement in Canning Town was the "poor man's lawyer," the idea being to give free legal advice to the very poor. This effort has been widely extended and has now been regularized by the law societies.

Public Social Service.—In the sphere of public health (*q.v.*), voluntary agencies are doing much to assist the local authorities and the Government.

Although most British hospitals are voluntary efforts and utilize the service of unpaid workers, they are gradually taking on the character of public service. Indeed the poor law authorities are responsible for large numbers of hospitals and infirmaries. There is a National League for Health, Maternity and Child Welfare which has done much to create a sound public opinion. These are now supported by local grants and government aid. There are ante-natal clinics, baby and child welfare clinics, clinics for children up to the age of 5, followed by medical inspection and treatment of children in the public schools. In all these cases there is much voluntary assistance and it is a form of social service which will shape the whole future of the country.

Compulsory education has narrowed the field of social service, so far as children are concerned, to the work of management and the after-care committees, although a development of interest on the part of parents in the work of the school is being encouraged and spreading with great rapidity.

Adult education (*q.v.*) offers great opportunities for voluntary effort.

Whatever may be the future of the boards of guardians, the sense of obligation to the poor which was formerly expressed through the monasteries or the overseers of the parish is bound to continue. Harshness of administration has gradually been ameliorated owing to a more humane public opinion. The services both of men and women on boards of guardians are often rendered purely as giving an opportunity for social work. The Brabazon Society in giving concerts and entertainments in workhouses and infirmaries has created an atmosphere of friendliness and especially in relation to the children has opened up a sphere of helpfulness. Many guardians take a special interest in emigration, which though it is not a final solution of economic problems does in many cases offer a way out and a prospect of future usefulness.

There are many men and women to-day who accept the position of magistrate because they feel they can thus serve society most effectively, and by exercising wisdom and patient consideration enable those who have transgressed the law to recover good citizenship. In connection with the criminal system a good deal of social work is carried on in connection with the Borstal institutions, remand homes and prisons, while the work of probation officers, whether paid or voluntary, in connection with children's courts has wrought a veritable revolution in the treatment of young offenders. (P. A.)

THE UNITED STATES

Social service or social work, as understood in the United States, is that form of persistent and deliberate effort that helps the individual (or family group) to make a satisfactory adjustment to his environment. In another aspect it attempts to provide those aids to living which make for a richer and more wholesome existence. In still another aspect social work, through scientific research, is searching out the causes for human distress, measuring the incidence of poverty, ill health and delinquency, etc., or seeking an evaluation of the methods of treating these ills and the character of the results achieved. Finally, social work is engaged in reform. Through legislation, improved administrative procedures and public education, the struggle to improve living conditions and promote social justice is carried on. As the social worker in his daily practice and through research becomes conscious of wrongs and inequalities, he seeks a remedy and becomes an active protagonist of the changes needed to achieve that end.

Groups of Workers.—Social work is carried on by three groups of workers, *i.e.*, the practitioners who serve dependent families, run settlements, playgrounds, boys' and girls' clubs or serve as probation officers in courts, etc.; the research specialists who are technically trained to do the scientific work which must underlie and guide the progress of the practitioner and who point the way toward social reform; the propagandists and reformers who through writing, speaking, public education and varied forms of agitation help to bring about that better day which men are forever seeking and never fully attaining.

For such tasks as these there are needed education and training of a professional character. Whereas, in an earlier day, any person of "good intentions" and with a desire "to do good" was regarded as qualified to engage in philanthropy, it is now generally recognized that special disciplines attained through colleges, universities and schools of social work are essential. There now exists (1929) a professional organization with nearly 5,000 members, known as the American Association of Social Workers, membership of which is based upon a high professional standard.

Classification of Activities.—The breadth and variety of the activities known as social work may be best indicated by reference to a classification adopted by the Welfare Council of New York city—a clearing house and co-ordinating centre for its 1,200 welfare and health organizations.

Family Welfare.—Under this division are found the following groupings: *Family Service,* charity organization societies that serve dependent families; *Relief Societies,* which provide material assistance but do not engage in "social case work"; *Legal Aid,* societies providing legal service for those unable to pay for it; *Immigrants, Foreign-Born and Travellers,* organizations that assist the immigrant in making his adjustment to the new country; *Homeless,* a group that provides care for those adrift from family, relatives and home; *Seamen,* special services for seamen in American ports; *Care of the Aged,* institutions and homes for aged persons and organizations giving help outside the institutions; *Housing,* societies concerned with improved housing conditions and legislation to attain that end; *Protective and Correctional Agencies,* institutions for delinquents and criminals, prisoners' aid societies, probation and parole, etc.

Child Welfare.—Under this division are: *Dependent Children,* institutions and agencies giving care to children without adequate parental and home supervision; *Day Nurseries and Nursery Schools,* where children are cared for while the parents are away from home in employment; *Auxiliary School Services,* which provide clothing, lunches and special types of aid to children in the public schools; *Summer Camps and Vacation Houses,* which are concerned with providing outings and vacations for children during the summer.

Public Health.—This division includes organizations interested in the promotion of public health through proper *Health Administration and Health Education; Public Health Nursing* organizations, which provide nursing service to those unable to supply it for themselves; *Hospitals,* administered under both public and private auspices; *Clinics; Medical Social Service,* the departments of hospitals that provide special help and service to patients in need; *Convalescent Care,* agencies and institutions serving the patient in convalescence; *Mental Hygiene,* clinics, bureaus of child guidance and other organizations dealing with the problem of mental hygiene.

Neighbourhood Work.—Includes organizations grouped under these headings: *Recreation; Neighbourhood Houses and Settlements; Neighbourhood Associations; Boys' Work; Girls' Work; Education of the Foreign Born; Technical and Professional Education; Employment and Vocational Guidance; Education of the Handicapped.* In addition to the foregoing should be mentioned community organizations whose task is not to serve individuals in need but rather to serve as a co-ordinating centre and clearing house for the various service agencies that exist in the community. These are known as "councils of social agencies," and in many cities are found "community chests" which raise money for philanthropic purposes through a central organization.

Administration.—Social work began very largely as an ac-

tivity of the church; it is now carried on under the auspices of many different organizations. Public departments, Federal, State, county and municipal, are engaged in welfare work of varied sorts. Public hospitals, institutions for the insane and feeble-minded, almshouses, orphanages, homes for the aged, etc., are maintained everywhere by local governments. Other relief administered usually by city and county authorities is now supplemented in most States of the Union by so-called mothers' pensions, *i.e.*, subsidies to enable mothers to keep their dependent children with them in their own homes. State and local public welfare departments are charged with the administration and enforcement of welfare laws designed to protect children and others who are underprivileged or maladjusted. Most large communities now have highly socialized courts such as juvenile courts, dealing with neglected dependent and delinquent children, and family courts which have jurisdiction over such matters as divorce, the enforcement of orders for support, abandonment and desertion, etc.

Voluntary Organizations.—In the field of social service carried on by voluntary organizations supported by the contributions of citizens rather than through taxation, there are various types of societies maintained by churches, nationality groups, fraternal organizations, etc. By far the largest amount of work done in the field is carried on under the auspices of these voluntary and privately supported societies. Some of the work done by recreational organizations and settlement houses is paid for in whole or in part by the beneficiaries of these services and a growing portion of the income of many philanthropic organizations is derived from dues paid by members and from payments for service made by the beneficiaries. (W. Ho.)

SOCIAL SETTLEMENTS. In Great Britain this term is applied to settlements of social workers in depressed areas, whose object is the relief of poverty and its consequent effects. After the opening of Toynbee Hall in 1884 a large number of other settlements sprang up in London and the provinces. Some like Oxford house in Bethnal Green and Cambridge house in Camberwell are connected with a particular university; some like Mansfield house in West Ham with a particular college. Some of the settlements are for men and some for women only. Others like the Manchester University Settlement have separate houses for men and for women. Unlike Toynbee Hall, which has always been non-denominational and non-party, certain settlements are connected with a religious body, usually the Church of England, but no settlement imposes any sort of test upon those who desire to benefit by its operations. Generally all settlements share the ideals of Canon Barnett, the founder of the settlement movement thought they may differ from him and from one another as to the emphasis to be placed upon the several aspects of their work. Thus while some of the settlements are intimately connected with the local government of their areas and encourage their residents to serve on the borough council or board of guardians, others through clubs of all kinds and societies and meetings concentrate upon the personal element in the life of the neighbourhood. It may however be said of all the settlements that though, owing mainly to the development of social legislation in Great Britain they are not as much as heretofore absorbed in tasks connected with the poor or destitute in their areas and tend more than in Barnett's day to specialize in some aspect of social work, they are concerned to further social investigation, education for the young and particularly for the adult, the work of such bodies as the care and after care committees and of such representatives of the public as the school attendance officer and the probation officer. Further all the settlements are the centres of voluntary bodies such as the Children's Country Holiday Fund, the Invalid Children's Aid Association and the Skilled Employment Committee and all are actively assisting the work of such agencies as the Boy Scouts and Girl Guides. Most settlements moreover provide a service of "poor men's lawyers" and are generally willing in any sort of emergency to act as poor man's friend.

Since the end of the World War, the settlements in Great Britain have been drawn together by the Federation of Residential Settlements through which the individual settlements exchange ideas and afford one another various kinds of assistance. The Federation is concerned to promote settlements in areas which seem specially to need them. It has recently established a settlement in one of the villages in the new Kent coalfield and other settlements in socially backward areas are in contemplation. About 50 settlements are affiliated to the Federation of Residential Settlements. Educational as distinct from residential settlements are a development of recent years. Such settlements do not depend upon helpers from the universities and under the direction of a Warden seek to organize higher education in the locality and generally to promote its cultural life. This type of settlement because of the relatively small expenditure which it involves and its singleness of object is particularly suitable to areas inhabited by artisans who desire facilities for education and discussion.

There are settlements in several European countries and in Japan and China but these settlements are not numerous and they tend in important respects to differ from the British type of settlement. The widespread character of the settlement movement is to be judged by the fact that at the first international conference of settlements held at Toynbee Hall in 1922, 21 countries were represented by nearly 300 delegates. At this conference a committee was appointed to keep the settlements in the affiliated countries in touch with one another and to arrange from time to time for the holding of other conferences. A second conference was held in Paris in 1926. (J. J. M.)

The United States.—The founders of the first settlements in the United States lived at Toynbee Hall or talked with Samuel A. Barnett. Neighborhood Guild (University Settlement), the first American settlement, was established August 1886 on the lower East Side of New York by Stanton Coit; Hull House, Chicago, and College Settlement, New York, June 1891; Northwestern University Settlement, Chicago, and South End House, Boston, December 1891. The number reached 103 in 1900 and 413 in 1911. The World War halted the establishment of new houses. In 1928 there were between 600 and 700 houses.

Purpose.—Settlements provide opportunities for working people to meet neighbours and friends and to become acquainted with educated men and women; organize classes in any subject-matter for which there is demand; and obtain for their neighbourhoods better organization of professional service, relief in crises, legal protection against exploitation, improved municipal and governmental public services and public and semi-public recreation. Neighbourliness or friendliness as a means of understanding the problems and point of view of individuals and groups is fundamental. Residence in the area served identifies the settlement staff with the community and its problems. Interpreting the significance of the life of working people to themselves and to the community at large is continuous. Jane Addams (Hull House) has told of the needs and aspirations of individuals and groups with such moving insight and sympathy that all classes have come to think of others with more understanding.

Health.—Lillian D. Wald (Henry Street Settlement) organized the district nursing service for New York city, originated school nursing and helped secure the Federal Children's Bureau. Investigations into midwifery (Union Settlement, New York) and into fly borne typhoid (Dr. Alice Hamilton, Hull House) are typical settlement contributions to public health. Fewer clinics are maintained now than formerly, but more examinations and follow-up in connection with gymnasiums, summer camps, classes in homemaking and women's clubs.

Poverty.—Julia Lathrop (Hull House) brought about improvements in public administration of poor relief in Illinois, and Robert A. Woods (South End House) helped obtain a law which reduced vagrancy in Massachusetts. Settlements in several States assisted in obtaining mothers' pension acts. Most houses cooperate with the family welfare societies in cases of acute need, but do not themselves give relief.

Wage Earning.—Mrs. Florence Kelley (Hull House) and Robert Woods were leaders in the movement to raise the compulsory education age from 14 to 16 years. Graham Taylor (Chicago Commons) has interpreted trade unions and working class life to the Protestant Churches. Mary E. McDowell (University of Chicago Settlement) started forces that led to the

Federal investigation of the conditions of women and child wage-earners in the United States, 1910–1913. John L. Elliott (Hudson Guild) founded a school for printers' apprentices managed jointly by representatives of employers, labour unions and the settlement. The steps which led to the organization of industrial guidance in the public schools were taken at Civic Service House, Boston.

Recreation.—Charles B. Stover (University Settlement, New York) has been a national figure in the playground movement. Public playgrounds, baths, gymnasiums and school centres have been obtained by settlements in many cities. The remarkable public recreation centres in Chicago owe much to Hull House, and in Los Angeles to Bessie D. Stoddard (College Settlement). A great deal of effort continues to be given to promoting public and semi-public recreation.

Clubs and Sociability.—Sociability is an important means through which individuals and groups are trained in ways of living together harmoniously and productively. Settlements were the first to point out the theoretic and practical importance of the "gang" or "natural group" as a useful social instrument. Clubs are usually federated into "councils" which provide training in representative action. There are relatively few men's clubs. The settlement women's clubs have brought the tenement wife and mother into the great woman movement. Classes in physical culture, in home-making and in dancing are an important interest with girls, and athletics and wood work with boys. Summer camps have developed into an educational resource of major importance. The first settlement music school was established by Eleanor Smith (Hull House) in 1892, and there are now (1929) 15 schools with advisory boards of artists, highly trained faculties, and well-rounded curricula; and more than 100 music departments. Drama and the dance have had a similar development. The number of "little theatres" and permanent companies of players grows steadily. Classes in drawing and modelling and pottery are increasing, and needlework departments at a score of houses do work of high practical and educational value. Jane Addams and Mary K. Simkhovitch have made Hull House and Greenwich House (New York) outstanding in range and quality of cultural activities.

Federations of Settlements.—City federations of settlements (1896 ff.) are found in 8 cities. Inter-settlement athletics, art exhibits, dramatics, lectures and gatherings are arranged. Committees on public affairs and legislation are usual. The federated settlements have been influential in child labour and housing legislation, and in control of the liquor trade. A national federation of settlements (1911) included 170 houses of first importance. It holds an annual conference, carries on studies (prohibition, 1927; unemployment, 1928), publishes monographs and a quarterly journal, co-operates with other national agencies and takes occasional part in legislation.

Present Tendencies.—New buildings of exceptional quality are becoming common, *i.e.*, Kingsley House, New Orleans. Endowments are increasing. Programmes are being adjusted to the more comfortable working class income. Housing, irregular employment, adjustment of family relationships, the promotion of understanding across racial, national, religious, economic and social borders engage many leaders. Significant experiments in new forms of co-operative and cultural enterprise, *i.e.*, camps and handwork, are going on. The settlements serve as a bulwark against over-centralization of education and philanthropy. They resist the tendency to stereotype culture, seek for evidence of new life in their communities, and promote adjustment of all kinds in advance of social strain.

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SOCIETÀ ANONIMA "ANSALDO," Italian Mechanical and Electrical Engineering Company, Genoa, was founded in 1846, when an Italian engineer, by name G. Ansaldo, set up a small engineering workshop for repairing locomotives and steamers entering the port of Genoa.

The plants which the company owns enable it to undertake any process in mechanical, electrical and naval engineering. It maufactures, not only hulls, boilers, engines, guns, armour-plate and ordnance material generally, but also locomotives (electric and steam), dynamos, transformers, alternators and metallurgical material of every kind.

During the World War the company established new plant and transformed itself into an organization for the production of munitions. At this time, it employed 50,000 people and supplied no fewer than 10,000 guns to the Italian navy and army, in addition to enormous quantities of ammunition and war material of every description. After the World War the company turned to production for peace purposes, developing especially its engineering and electrical works. On the engineering side, special attention has been paid to the construction of steam turbines for marine and land installations, and also to the construction of steam and electric locomotives, and railway carriages and wagons of every type and size.

The present capital of the company is 125,000,000 lire, and its headquarters and main works are situated in the port of Genoa. (E. N.)

SOCIETÀ TRIESTINA DI NAVIGAZIONE COSULICH. Founded in 1903 by the brothers Callisto and Alberto Cosulich, whose activities were for a long time devoted to shipbuilding, the Società Triestina di Navigazione Cosulich rapidly established itself in the maritime world, and in the short period of ten years increased its capital from two to 24 millions of Austrian crowns. In 1913 its fleet consisted of 29 liners, while five more were in course of construction at the naval shipyard at Montefalcone, near Trieste.

The World War checked development, but as soon as business resumed in the port of Trieste, its activities started once more. The capital was increased various times and has reached 500,000,000 lire. A reconstruction of the shipyard at Montefalcone permitted the building of the large motor vessels "Saturnia" and "Vulcania" (24,000 tons each). At present the total tonnage of the fleet is nearly 200,000.

The services performed by the vessels of the Company are:

1) Trieste-Naples-Marseilles-New York Express.
2) Trieste-Buenos Aires Mail Service.
3) Trieste-South America Cargo Line.
4) Trieste-Savannah-Wilmington Cargo Line.
5) Trieste-Mexican Gulf Cargo Line.
6) Trieste-South America Cargo Line.

The Company's association with powerful concerns such as the Steamship Company "Adria" of Fiume, the naval shipyard of Montefalcone, the Società Italiana Servizi Aerei (Italian Air Services) of Portorose, the Hotel Association of Portorose, the Banca Commerciale Triestina, the Cosulich Financial Company, the Insurance Company of Shipowners makes it one of the most conspicuous organizations of Trieste. The Cosulich Line controls the Lloyd Triestino Line and its affiliated companies, *i.e.* the Stabilimento Tecnico Triestino, S. Rocco Shipyard, Officine Navali Triestine, the Marittima Italiana Steamship Company and the Puglia Line of Bari. The principal services from the Adriatic to the Near and the Far East, North Europe and to North and South America are thus under one control, and the Cosulich, with an aggregate tonnage at its disposal of 500,000, is in a position to provide for a perfect organization of all the services. The Banca Commerciale Italiana is associated with this big fusion of interests. (W. STO.)

SOCIÉTÉ INTERNATIONALE D'ÉNERGIE HYDRO-ÉLECTRIQUE (Sidro), a Belgian company, was formed in 1923. Its original capital of 90,000,000 francs was increased, first to 125,000,000 and then to 162,500,000 francs.

Already at the time of its formation, the Sidro had secured large interests in the Barcelona Traction, Light and Power Company and in the Mexico Tramways Company. It was thus able, for instance, to help actively in the financial reorganization of the Barcelona Traction Company, over which it now practically has full control, and it also controls the Mexico Tramways

Company. But it should be observed that the Mexico Tramways and the Sidro together control the Mexican Light and Power Company; the latter also underwent a financial reorganization in 1927.

Finally the Sidro holds an interest in the Société d'Électricité de la Région de Malmédy, which company, amongst other things, has built a hydro-electric station developing the water power of the River Warche (Belgium). (H. Sl.)

SOCIETIES, LEARNED, are societies or institutions whose members are united in some common interest, organized to pursue some definite line of research, and issue periodical publications concerned with the progress of study in such spheres of human knowledge. These societies are so numerous that it would be manifestly impossible to present a complete list of them in any but a publication devoted to that purpose.

It has been found more convenient to group these societies under the headings of the principal subjects of research, and the reader should therefore look up Astronomical Societies, Botanical and Horticultural Societies, Chemical Societies, and so on to Zoological Societies. Kindred subjects are sometimes grouped, as in Literary, Historical and Archaeological Societies. In cases of difficulty, reference to the Index volume will indicate where the desired article is to be found.

SOCIETIES OF ART. According to a pious tradition St. Luke was a painter, and for that reason, one of the earliest art societies, the Guild of St. Luke in Florence, bore his name. Certain it is that, in banding themselves into societies and associations, artists have always been especially remarkable. The fundamental motive of such leaguing together is apparent, for, by the establishment of societies, it becomes possible for the working members of these to hold exhibitions and thereby to obtain some compensation or publicity for their labours.

GREAT BRITAIN

The growth of cults and the specializing of work have given rise to many new associations in Great Britain, besides the Royal Academy. (*See* Academy, Royal.) At the outset, therefore, it will be well to mention the leading art societies. The (now Royal) Society of Painters in Water Colours, founded in 1804, and the (now Royal) Society of British Artists (1823), are typical of those societies which exist merely for purposes of holding exhibitions and conferring diplomas of membership. The British Institution (for the encouragement of British artists) was started in 1806 on a plan formed by Sir Thomas Bernard; and in the gallery pictures were exhibited from time to time till 1867, when the lease of the premises expired. A few years later, scholarships in painting, sculpture, architecture and engraving were instituted, and they are still annually awarded. The Artists' Society was formed in 1830 to enable its members to perfect themselves in their arts. In the furtherance of a cult the Japan Society, devoted to the encouragement of the study of the arts and industries of Japan, is a typical example. Others in this category are the Society for the Promotion of Hellenic Studies, the Society for the Promotion of Roman Studies, the Egypt Exploration Society, the India Society, the Vasari Society, the Walpole Society, the Blake Society and the Wren Society. The Society of Master Glass-Painters, the Church Crafts League, the Society of Parson-Painters, the Society of Wood-Engravers, the Society of Mural Decorators and Painters in Tempera, the Society of Graver-Painters in Colour, the Colour-Woodcut Society, the Senefelder club and the Woodblock Society are representative of bodies formed in the interests of particular groups of workers. One of the remarkable features in the history of art in Great Britain has been the rapid increase of the artistic rank and file. At the end of 1927 it was estimated that there were quite 10,000 practising artists and designers. Portrait painters, pastellists, miniaturists, women artists, etc. have felt the necessity of organization.

Not until 1903, however, did a society exist in England with the determined object to enlist the sympathies and activities of every kind of art lover, either professional or lay, to help the national art institutions to acquire some of the treasures which were rapidly being bought up by millionaire collectors in other countries. This National Art Collections Fund has had some astonishing successes. At the beginning of 1928 the membership of this patriotic association was nearly 7,000. In this connection the Contemporary Art Society, founded in 1910, should also be mentioned. Founded three years earlier, the Scottish Modern Art Association continues to do similar work in Scotland. In 1909 the Imperial Arts League was formed to provide a central organization to which all members can appeal for advice or assistance in matters of professional business.

Another important society, The Faculty of Arts, was founded in 1921 to cover an even wider field, as it embraces the kindred arts of music and the drama. The British Confederation of Arts is the British section of that international *Confédération des Travailleurs Intellectuels* which has its headquarters in Paris, where the fourth international was held in 1927.

Societies created for the specializing of some study or for the display or protection of some particular branch of practice are tinged more with the spirit of the old guilds than with that of modern trade unionism, such as the British Institute of Industrial Art, with which is incorporated the Civic Arts Association, and the Design and Industries Association. The parent body of these is the Arts and Crafts Exhibition Society.

Exhibiting Societies.—(*a*) Old Established.—Those in London are: The Royal Academy, the Royal Water Colour Society, the Royal Institute of Painters in Water Colours, the Royal Institute of Oil Painters and the Royal Society of British Artists. In the provinces, the Birmingham Royal Society of Artists has been in existence since 1825, and has a life academy with professors attached. (*b*) Modern.—In this category are those which reflect the new spirit which came into artistic life in the last quarter of the 19th century. The New English Art Club, founded in 1885 as a protest against academic art, achieves its purpose by exhibition only, yet it is ironical to add that many of its members have been taken into the Royal Academy. The International Society of Painters and Engravers again represents the wider ideas of the 20th century, but, owing to the lack of a fixed home, is compelled to hold its exhibitions infrequently. The Royal Society of Painter-Etchers and Engravers, consisting of fellows and associates, not exceeding 150 in all, conserves the interests of a large body of workers, and, in addition to holding exhibitions, confers diplomas (R.E. and A.R.E.) on the exhibitors of meritorious etchings or engravings. The Society of Women Artists (formerly the Society of Lady Artists) and the Women's International Art club hold annual exhibitions. In 1891 the (now Royal) Society of Portrait Painters was formed to carry out the object conveyed in its title, but this society and the National Portrait Society suffer, similarly to the International Society, from the lack of a gallery. Undeterred by these obstacles the Portrait Society held an inaugural exhibition in 1928. Two associations advance the art of the miniature-painter, and the Pastel Society, formed in 1898, holds displays of members' work at the Royal Institute Galleries. Other London art societies which achieve their purpose by the holding of periodical exhibitions are such as the Society of Graphic Art for the display of every type of monochrome; the New Society of Artists, founded in 1921; the Ridley Art club (1889); the Old Dudley Art Society; the New Forest Group and the London Group of modernist painters. In Scotland there is the Royal Scottish Academy. The Royal Scottish Society of Painters in Water Colours (Glasgow) grants the title R.S.W. to its members, and the Society of Scottish Artists (Edinburgh), founded in 1891, has a membership of nearly 300 young artists; the artist members and lay members of the Paisley Art Institute which has held an annual exhibition since 1876, number 1,000. There is also a flourishing art society in Dundee. Other exhibiting societies which call for mention are: the Society of Yorkshire Artists (Leeds), which consolidates many local societies; the Nottingham Society of Artists, which also encourages drawing from the living model; the Liver Sketching Club, founded in 1872, which holds an annual exhibition; the Oxford Art Society, founded in 1891; the Bath Society of Artists (1904); the Sheffield Society of Artists; the South Wales Art Society at Cardiff and the Royal Institution of South Wales Art Society at Swansea.

The Belfast Art Society has held exhibitions since 1879, and the membership exceeds 300. In the Dominions the Ontario Society of Artists has held displays in Toronto since 1872, and the British Columbia Art League, founded in Vancouver in 1921, is a very enterprising association.

Societies of Instruction and Popular Encouragement.—In this category the most important is the National Art Collections Fund, already mentioned. The Artists' Society, the Art Workers' Guild, and the Junior Art Workers' Guild, provide meetings, from which the public is excluded, where profitable discussions take place on questions of craft and design. The old Langham Sketching Club (1838) and the London Sketch Club may also be cited as furthering an artist's knowledge. The old Society of Arts in the Adelphi, founded in 1754, has in recent years devised a scheme by which travelling scholarships and awards are made to student-workers in industrial art design. The Royal Drawing Society, 1888, has for its object the teaching of drawing as a means of education.

The great wave of enthusiasm aroused by Ruskin's teachings caused Societies of the Rose to be founded in London, Manchester, Sheffield, Birmingham, Aberdeen and Glasgow; but some of these eventually ceased active work, to be revived again, however, by the Ruskin Union, formed in the year of the writer's death (1900). The Home Arts and Industries Association continues a work which was started in 1884, and anticipated much of the present system of technical education.

Societies of Special Study, Practice and Protection.—Under this head should be placed those associations which affect a cult, or are composed of particular workers, or which protect public or private interests. The most important of these is a society which has never yet held an exhibition, the Royal Society of British Sculptors (1904). The Blake Society and the Wren Society throw further light on the work of the great seer and the great architect. The Vasari Society, founded in 1905, carries on the work of reproducing drawings by the old masters. In this category of special study may also be placed the Egypt Exploration Society and the Society for the Promotion of Hellenic Studies. The number of societies devoted to the art of engraving and lithography in their various forms prove unfounded the old fear that photographic processes would cause these graphic arts to become extinct. As an instance of the tendency of art workers to combine, the National Society of Art Masters is a good illustration. This is an association of teachers of art schools, controlled by the art branch of the Board of Education, and has a membership of over 300. Good work of another kind occupies the National Trust for Places of Historic Interest or Natural Beauty. The council of the trust includes 25 representatives of such bodies as the National Gallery, the Royal Academy, the Royal Society of Painters in Water Colours, the Society of Antiquaries, the Royal Institute of British Architects, the Universities, Society for the Protection of Ancient Buildings and the Selborne Society. (X.)

THE UNITED STATES

In the United States there are more than 600 art societies and associations, not counting endowed institutions or art schools, or even art departments of clubs organized for social or general educational purposes. Of this number nearly 200 are professional organizations—painters, sculptors, architects, craftsmen banded together for mutual benefit and the advancement of their art; 40 or more are associations, chiefly of laymen, sponsoring and directing the development of art galleries or museums; the remainder, and the majority, are organizations composed of laymen who have come together to spread knowledge and appreciation of art either locally or throughout the country. Of each kind of organization described in this article there are not one or two but many, yet almost all of the 600 and more will be found to fall naturally into one or another of these types.

The oldest art association in the United States is the Pennsylvania Academy of the Fine Arts, which was established in Philadelphia in 1805 to provide instruction in the fine arts, exhibit works of contemporary artists and maintain a permanent collection and gallery. An Academy of Sciences and Fine Arts had been formed in Richmond, Va., in 1786, but the project had languished and finally been dropped. The New York Academy of the Fine Arts was organized in New York City in 1802; it existed until 1841 and is said to have provided almost the only art influence in New York City for nearly a quarter of a century. In 1825, however, a number of its students formed the New York Drawing Association, an independent society presided over by the painter-inventor Samuel F. B. Morse, which in 1828 was incorporated as the National Academy of Design.

The development of interest in art in the United States has been progressive, for the first 100 years undoubtedly slow, but during the last 50 more rapid, and during the last 20 surprisingly so. It may well be noted that the art movement has been largely fostered by laymen. In 1909 the American Federation of Arts was formed to furnish a channel for the expression of public opinion in matters pertaining to art, to maintain a central clearing house for art organizations throughout the country and to undertake educational work for which only a national organization could qualify; with headquarters at Washington, D.C., it now has more than 400 art associations and museums affiliated with it. To have a central organization, art associations in some states have federated. The Southern States Art League is pledged to the development of art in the South.

Professional Organizations.—Chartered in 1857, the American Institute of Architects, Washington, D. C., has held annual conventions since 1867; its membership of 3,250, included in 58 chapters, is entirely professional. Other architectural organizations include the Society of Beaux-Arts Architects (1874), 272 members; the American Group of the *Société des Architects Diplômés par le Gouvernement Français* (1899), 85 members; and such local societies as the T Square Club of Philadelphia (1888), 400 members. The Archaeological Institute of America (1879), with headquarters in Washington and 46 affiliated societies, is intended to increase knowledge and disseminate information in its field.

The National Academy of Design, already mentioned, elects to membership painters, sculptors and architects who have attained distinction, holds two exhibitions a season and maintains a permanent collection of works by members, of which there are now 293, and a school. The National Sculpture Society, New York, 372 members, was organized in 1893 to advance sculpture and the welfare of American sculptors. In its field, the Mural Painters, New York (1895), is similar. The American Water Color Society, New York (1850), holds annual exhibitions jointly with the New York Water Color Club (1890). Equally important is the Philadelphia Water Color Club (1900), whose annual exhibitions are usually in association with the Pennsylvania Society of Miniature Painters (1901). Boston, Baltimore, Washington and other cities also have well established water-colour clubs. The American Society of Miniature Painters, New York (1899), 31 members, exhibits regularly, and similar societies are active in Chicago and in California. In recent years etching, lithography and wood-block printing have had a renaissance in the United States. The Chicago Society of Etchers (1910), comprising 485 professional and lay members, holds and circulates exhibitions, gives demonstrations and has established a fund for purchase of works exhibited. The Print Makers' Society of California (1914), 310 members, is similar but holds an annual international exhibition of prints. Other societies of a like nature include the Brooklyn Society of Etchers (1915), 489 members; the Print Club of Philadelphia (1914), 678 members, which holds exhibitions of prints every two weeks during the season, has a press and gives lectures and demonstrations open to the public; and the Print Club of Cleveland (1919), 221 members. The Architectural League of New York (1881), 850 members, includes not only architects but painters, sculptors, craftsmen and workers in the allied arts; it holds annual exhibitions and encourages a close alliance of the arts, both fine and industrial.

To further literature and the fine arts, the American Social Science Association organized in 1898 a National Institute of Arts and Letters, New York, which was incorporated by Act of Con-

gress in 1913. It comprises, by election, 250 writers, painters, sculptors, etchers, etc. In 1904 it organized an American Academy of Arts and Letters, New York, limited to 50 members. The American Academy of Arts and Letters, was organized, obviously, along lines similar to the French Academy.

An organization to advance the artist as well as his art is the Guild of Boston Artists (1914), with 77 artist and 600 associate lay members co-operating in sustaining a gallery for exhibition and sale of members' works. Somewhat similar, the Grand Central Art Galleries, New York (1923), with the frank purpose of marketing works of American artists, maintains a continuous exhibition of works of members and also sends out travelling exhibitions. The Société Anonyme, New York City, was founded in 1920 by Marcel Duchamp and Katherine S. Dreier. Its aim is to promote *art progressive* in all its branches. Its first International Exhibition represented 23 countries.

The alumni associations of the leading art schools are closely allied with the professional art organizations. Examples of these are the Fellowship of the Pennsylvania Academy of the Fine Arts, Philadelphia (1897), 800 members; and the Alumni Association of the Art Institute of Chicago (1912), more than 1,000 members; the Art Students' League, New York (1875). (*See* SCHOOLS OF ART.)

Groups Associated with Museums.—Reference has been made to the development of art museums through the instrumentality of art associations. The individual members of the Metropolitan Museum of Art, New York, now number more than 13,250. The Museum of Fine Arts, Boston, formed in the same year (1870) as the Metropolitan Museum, likewise depends to a great extent on its supporting membership, while the Art Institute of Chicago (1879), more than 17,000 members, is essentially a people's institution. The Toledo Museum of Art (1901) was long supported by an associate membership; the Buffalo Fine Arts Academy (1862) is the parent of the Albright Art Gallery; the Cincinnati Museum Association (1881) acquired a gallery through gifts in 1887 and is still supported by private contribution; the Art Association of Indianapolis (1883), 919 members, acquired a gallery, now the John Herron Art Institute, in 1902; and the Minneapolis Society of Fine Arts (1883) erected in 1911 a building, now the Minneapolis Institute of Arts, with which the Friends of the Institute (1922) co-operate in building up its collections and broadening its influence. Various "Friends of Art" groups have been formed in recent years; perhaps the most notable is the Friends of American Art, Chicago (1910); the art department of the Carnegie Institute, Pittsburgh, has an auxiliary circle, Friends of Pittsburgh Art; the Baltimore Museum has the Friends of Art in Baltimore, and the municipally supported Detroit Institute of Art has an Art Founder's Society. The Newark Museum Association (1909) has 1,650 members. The Fine Arts Gallery of San Diego, Calif., is the child of the Fine Arts Society of San Diego (1925), 1,021 members. Art museum directors have organized in two groups: those east of the Rocky mountains in the Association of Art Museum Directors (1916), those on the Pacific coast in the Western Association of Museum Directors (1921). There is also a national organization, the American Association of Museums, Washington, D.C. (1907). (*See* MUSEUMS.)

Art and Industry.—Probably the first organization in the United States to recognize the need of relating art to industry was the Cooper Union, New York (1854). The handicrafts have largely been fostered by societies especially organized for that purpose, such as the Society of Arts and Crafts of Boston (1897), 1,350 members, which has set a high standard of endeavour and has maintained a sales room most successfully for many years in Boston and in recent years in New York. Similar, the Detroit Society of Arts and Crafts (1906), with over 1,000 lay and professional members, has brought to America notable works by foreign craftsmen. More intimately associated with industrial art are such organizations as the Association of Arts and Industries of Chicago, or the Art in Trades Club, New York (1906), made up of 525 men engaged in some form of art in industry. The Art Directors' Club, New York (1920), 200 members, is partly social but is intended to improve art products. The 175 members of the Business Men's Art Club of Chicago (1920) turn to art for recreation rather than as a vocation. The Graphic Sketch Club of Philadelphia is similar in purpose.

Civic Associations.—The American Civic Association (1904), a national organization with headquarters at Washington, D.C., and several hundred affiliated organizations throughout the country, embraces city planning, village improvement, protection of scenic beauty and safeguarding of highways in its objectives. Somewhat akin in purpose is the American Society of Landscape Architects (1899), 215 members, with headquarters in Boston, whose chief aim is the support of professional ideals in the practice of landscape architecture as an art, and whose concern is mostly that of design in city and regional planning and the design of private and institutional parks and grounds. There are also numerous art commissions such as, for example, the National Commission of Fine Arts, Washington, D.C. (1910), appointed by the President with the consent of Congress and comprising an advisory body of experts, serving without pay, to which are referred designs for public buildings, monuments, improvements of public lands, etc.; the Art Commission of the City of New York (1898) and the Art Jury, Philadelphia (1907), intended to safeguard municipal authorities against artistic blunders and secure the maximum beauty for their respective cities; the Municipal Art Society of New York (1892), 1,000 members, a private organization for the development of civic art; and the Community Arts Association of Santa Barbara, Calif. (1920), 1,200 members.

School Organizations.—Public school art teachers have banded together in three organizations: the Eastern Arts Association (1889), 2,000 members; the Western Arts Association (1893), 313 members; and the Art Teachers' Association of Southern California (1917), 150 members. The College Art Association of America (1912), 500 members, is made up of teachers of art in colleges. The purpose of the Federated Council on Art Education (1924) is to study current educational methods and report thereon, with the object of the advancement of art teaching in America. The School Art League of New York City (1911), composed of laymen, art teachers and pupils, fosters art education in the public schools of that city. The Chicago Public School Art Society (1894) is chiefly occupied with placing fine prints and paintings by American artists in Chicago schools but has also been instrumental in securing better design for school buildings and decoration for school rooms.

A complete list of art societies and similar organizations in the United States, together with a report on each, will be found in the American Art Annual, published by the American Federation of Arts. (L. ME.)

THE CONTINENT OF EUROPE

France.—Paris: The *Académie des beaux-arts* dates from 1795, when two academies founded successively by Mazarin and Colbert in 1671 united in a single society. It aims to establish a central meeting place for French and foreign architects, and foster the interests and progress of the profession of architecture. The *Société d'Encouragement à l'Art et à l'Industrie* was founded in 1889 and established as a "public utility" in 1925. The *Société des Architectes Diplômés par le Gouvernement*, founded in 1877 and established as a "public utility" in 1915, has about 1,500 members. The *Association Française des Artistes Graveurs au Burin* is a small but active organization whose object is to propagate the art of engraving. The *Union Centrale des Arts Décoratifs*, founded in 1880 and recognized as a "public utility" in 1882, has for its object the cultivation of those arts which strive to realize beauty in useful things. The *Salon des Tuileries au Palais de Bois* was founded in 1923, and every year invites about 1,000 artists to exhibit. The *Société des Amis du Louvre* endeavours to bring into one association all who are devoted to the Louvre, with a view of enriching its collections.

Germany.—Berlin: The small local societies are affiliated with one large parent body, the *Deutsche Künstlergenossenschaft* in Berlin. The *Deutscher Illustratorenverband* watches over the interests of illustrators and designers. The *Verband Deutscher Architekten- und Ingenieur-Vereine E.V.*, founded in 1871, has

a membership of 8,000 and is very active. The *Deutscher Werkbund,* with a membership of 2,600, has for its aim the ennoblement of craftsmanship in the association of art with industry. The *Reichsverband bildender Künstler Deutschlands* secures representation through one united organization of the artists of Germany in their professional and social interests. It had a membership in 1928 of 8,760, and publishes *Kunst und Wirtschaft.* The *Allgemeine Deutsche Kunstgenossenschaft* has exhibitions at home and abroad. It was founded in 1856 and in 1928 had 500 members. The *Bund Deutscher Architekten,* Frankfort, had 2,764 members in 1928.

Austria.—Vienna: The *Vereinigung bildender Künstler Österreichs* (Society of Austrian Artists) and the *Wiener Künstlergenossenschaft* (Association of Viennese Artists) are prominent.

Belgium:—Brussels: The *Palais des Beaux-Arts de Bruxelles* is the centre of the artistic movement in Belgium and the surrounding countries, Brussels being only a few hours' journey from Paris, London, Amsterdam and Frankfort. During 1928 it held over 50 exhibitions, numerous meetings, concerts, etc. The building was finished in 1926. The *Société des Amis des Musées Royaux de l'État à Bruxelles,* founded in 1907, has about 300 members. Its primary object is to enrich the collections of the museums of the country. The *Société Centrale d'Architecture de Belgique* was organized under the *Union Professionelle* in 1872. It has a membership of about 300.

Scandinavia.—In Stockholm (Sweden) the *Svenska Slöjdföreningen* had 2,800 members in 1928. The *Kungl. Akademien för de fria Konsterna* (The Royal Academy of Fine Arts), founded in 1735, has control of the Royal High School of Art. The *Konstantverkarnas Gille,* founded in 1906, has for its object the promotion of handicraft and the friendly co-existence between handicraftsmen. The *Föreningen för grofisk konst* supports the graphic arts, and the *Föreningen Original-Fräsnitt* interests the public in the art of wood-engraving. Other art societies of Stockholm are the *Svenska Teknologföreningen,* the *Konsthistoriska Sällskapet,* the *Sveriges Allmänna Konstförening,* and the *Svenska Hemslöjdföreningarnas Riksförbund.* In Copenhagen (Denmark) the *Künstnerföreningen* is the outstanding art society.

Italy.—A few of the many organizations interested in the arts are listed. Rome: *Società "In Arte Libertas"; Associazione Internazionale Artistica; Associazione Artistica fra i cultori d'Architectura; Associazione Archeologica Romana; Società degli Amatori e Cultori di Belle Arti; Società degli Acquarellisti; Società Archeologica Anglo-Americana.* Florence: *Associazione Nazionale degli Artisti; Società Artistica; Società Fiorentina per le Sculture artistiche; R. Accademia di Belle Arti.* Bologna: *Comitato per Bologna Storico-Artistica; R. Sopraintendenza alle Belle Arti dell' Emilia: R. Accademia di Belle Arti; Bottega d'arte.* Naples: *Circolo Numismatico Napoletano; R. Accademia di Archeologia Lettere e Belle Arti;* Genoa: *Società di Belle Arti; Società Promotrice di Belle Arti; Società Alere Flamman; Circolo Artistico "Tunnel."* Milan: *Società Italiana di Numismatica; R. Accademia di Belle Arti.*

Other European Countries.—The following societies of art are among the more important: Amsterdam (Holland), *Maatschappij "Arti et Amicitiae";* Budapest (Hungary), the Society of Hungarian Painters and Etchers; Warsaw (Poland), the *Société des Beaux Arts à Varsovie;* Berne (Switzerland), *La Société des Peintres et Sculpteurs Suisses;* Madrid (Spain), *L'Association des Artistes Espagnols;* Lisbon (Portugal), *Sociedade Nacionale de Bellas Artes y Gremio Artistico.*

THE ORIENT

The oldest society dealing with oriental archaeology is claimed to be the *Kon. Bataviaasch Genootschap van Kunsten en Wetenschappen,* Java, founded in 1778, closely followed by the Asiatic Society of Bengal in 1784. In England, the Royal Asiatic Society (1823) has branches in many places in Asia, and also in Canada.

The following societies are the most important in Europe: London: The Royal Asiatic Society (1823) with 950 members and a library of 30,000 volumes, and the India Society (1910), with 350 members; Paris: the *Association Française des Amis de l'Orient* (1920); The Hague: the *Vereenigung van Vrienden der Aziatische Kunst* (1918); Berlin: the *Gesellschaft für Ostasiatische Kunst* (1926); Vienna: the *Verein der Freunde Asiatischer Kunst und Kultur* (1920); Rome: the *Istituto per l'Oriente* (1921); Budapest, Stockholm, Oslo, and Copenhagen have small but active societies.

Other societies interested in the art of the Far East are: the Royal Asiatic Society with the Bombay Branch at Bombay, the Ceylon Branch at Colombo, and the Malayan Branch at Singapore; the Indian Society of Oriental Art (1907), Calcutta; the Mythic Society (1909), Bangalore; the Burma Research Society (1910), Burma; the Punjab Historical Society (1910), Lahore; the Hyderabad Archaeological Society (1915), Hyderabad; and the Bihar and Orissa Research Society, Patna. (*See* INDIAN AND SINHALESE ART AND ARCHAEOLOGY.) (X.)

China.—Temperamentally, the Chinese, especially the highly educated, are not much given to organization (*see* CHINA, *Aesthetic Development*). Consequently in history we hear very little of artistic activity in any organized sense.

The National University of Peking is almost solely responsible for both the moral and intellectual forces now at work in the whole of China. The university faculty is undoubtedly the greatest literary and art society that China has ever known. There are, however, three or four literary and art groups that are perhaps better organized than the faculty group. The Literary Society of China, whose motto is "Art for Life's Sake," has found opposition in another group known as the Creation Society, who started the "art for art" movement in China. A serious effort at regenerating the Chinese culture is represented by another group, The Crescent Moon Society, which was organized in Peking in 1923. Among other things in art, it has produced plays by Ibsen, Shaw, Maeterlinck, Tagore and Eugene O'Neill, as well as the Chinese writers. The *Nan-Kuo* group may be described as representing the Bohemian spirit of young China.

There are innumerable art clubs and societies both in Peking and Shanghai and other cities. The most notable one is the "Pegasus Society" of Shanghai, which has a large membership of artists of the traditional type as well as returned students of art from Western countries. It holds annual exhibitions. The Royal Asiatic Society, North China Branch, Shanghai (1857), has 604 members, possesses a library and museum, publishes a journal and has issued five volumes. (*See* CHINESE ART.)

(T. Hs.; Y. K.)

Korea.—The art of Korea, like that of her great neighbour, China, has always been the product of the leisured class. When Korea's civilization was at its height during the Korai period (10th–14th centuries), literary groups and art societies centered their efforts around Buddhistic culture. The artistic activities of the Buddhists have been carried on in mountain solitudes since the monks were compelled to take refuge there in the 15th century. In 1909, the Chosen Yunkoo Society was established for the purpose of excavating ancient monuments and gathering old prints and fine examples of calligraphy. With the support of the Chosen Government, it has collected about 150,000 prints and specimens. In 1909–15 the members of the Chosen Yunkoo Society made an investigation of the historical monuments. The Korean Art Society was founded in 1922 also under the supervision of the Chosen Government, holding the annual exhibition in Seoul. The Chosen Moondan Society was founded in 1924 in Seoul to spread the doctrine of "Art for Life's Sake," and when it discontinued, the Kaipyuk took its place; it now represents the Bohemian spirit of young Korea. *Kwang Chang Hoi* is a society of artists in Western style, holding annual exhibitions. The *Suwha Yunkoo Hoi,* another society in traditional style, to stimulate calligraphers and painters, develops its work through the Four Sages: the plum, lily, chrysanthemum and bamboo. There are many private societies. (Y. K.)

Japan.—The Japanese are clever in adapting other civilizations to suit their own tastes and needs. This is particularly true in the realm of art, and its various societies. When Buddhism came from Korea in the 6th century, Chinese ideographs and

calligraphy, which included painting, were introduced. Ever since, the Japanese have had art groups, schools or societies—such as the *Yamato* and *Toza* of the 11th century, Kano, founded by Kano Monotobu (1476–1559); *Ukiyoye,* by Iwasa Matahei (1577–1650); *Korin,* following the style of Koyetsu (1552–1637); and *Shijo,* imitating the naturalistic school of Okyo (1733–95). (*See* also JAPANESE PAINTING AND PRINTS.)

The Imperial Art Institute (Teikoku Bijutsu-In), Tokyo, begun under the auspices of the Department of Education in 1907, was modified in 1919, and in 1927 a section of applied arts was added to those of painting and sculpture; exhibitions are held. The National Treasure Preservation Commission (1897) examines treasures in Shinto shrines and Buddhist temples and schedules for State protection paintings, calligraphs, sculpture, buildings, old documents of historical value, armour and weapons, and examples of handicraft. The Fine Arts Association of Japan (*Nihon Bijutsu Kyokai*), Tokyo, was established in 1879 to stimulate art. It arranged a Japanese art exhibition in Paris in 1883. It has over 1,000 members, has always adhered to the old ideals of Japanese art and holds exhibitions. The Japan Art Institute (*Nihon Bijutsu-In*), Tokyo, 1897, conducts a studio, with classes in painting in the traditional style, and in sculpture. *Nika-Kai,* Tokyo, an association of painters in Western style, was organized in 1908 in defiance of the "classical narrowness" of the annual art exhibition then held under the Department of Education. Besides these mentioned above, Tokyo has many other important societies.

Kyoto has a number of societies of art, such as the Fine Arts Association (*Kyoto Bijutsu Kyokai*), Creative National Painting Association (*Kokuga Sosaku Kyokai*), Institute of Painters of the Southern School (*Nihon Nanga-In*).

Osaka has the Art Association of the city of Osaka (*Osakash: Bijutsu Kyokai*) and the Osaka Art Club (*Osaka Bijutsu Kurabu*). (J. HAR.; Y. K.)

SOCIETY ISLANDS: *see* PACIFIC ISLANDS.

SOCIETY OF THE CINCINNATI, an organization formed by the officers of the American Revolutionary Army in May, 1783, a few weeks before the army's disbandment, for the purposes of promoting friendship and union, of cherishing the memory of events through which they had passed, and of aiding members and their families in case of need. Suggestion of such an association is credited to Major General Henry Knox (*q.v.*) and its formation took place at the headquarters of Baron von Steuben near Fishkill Landing, N.Y. George Washington was chosen the first president and remained in that office until his death. State societies, auxiliary to the general society, were formed in the 13 states and a branch was also formed in France. The badge, a golden eagle, suspended by a ribbon, contained in its center a device representing Cincinnatus at his plough receiving the Roman senators who came to offer him a sword. The constitution provided that, in case of death of a member, the eldest male descendant was entitled to wear the badge and enjoy the privileges of the society. In failure of direct male descent the honour passed to male descendants through intervening female descendants, and in case of their failure to collateral descendants judged worthy of becoming members. This hereditary provision aroused opposition for a time from those, especially anti-Federalists, who feared it would result in the creation of an hereditary nobility which would assume to itself political and military offices. The fear, easily understood, did not prove justified by subsequent events, for with the death of the officers themselves the society all but died out, most of the state auxiliaries passing entirely out of existence. Toward the close of the 19th century the society was revived by eligible descendants, and, by 1902, the last of the original 13 state auxiliaries was reconstituted. The state auxiliaries now hold annual meetings and the general society a meeting every three years. The number of members reported at the triennial meeting in 1926 was 1,047.

Proceedings of the state auxiliaries and the general society are issued after each meeting. *See* also A. H. Mattox, *History of the Cincinnati Society* (1880), and F. A. Foster, *The Institution of the Society of the Cincinnati* (1923).

SOCINUS, the latinized form of the Italian Sozini, Sozzini or Soccini, a name borne by two Italian theologians of the sixteenth and seventeenth centuries.

I. LELIO FRANCESCO MARIA SOZINI (1525–1562) was born at Siena on Jan. 29, 1525. His family descended from Sozzo, a banker at Percena, whose second son, Mino Sozzi, settled as a notary at Siena in 1304. Mino Sozzi's grandson, Sozzino (d. 1403), was ancestor of a line of patrician jurists and canonists, Mariano Sozzini senior (1397–1467) being the first and the most famous, and traditionally regarded as the first freethinker in the family. Lelio (who spells his surname Sozini, latinizing it Sozinus) was the sixth son of Mariano Sozzini junior (1482–1556) by his wife Camilla Salvetti, and was educated as a jurist under his father's eye at Bologna. He told Melanchthon that his desire to reach the *fontes iuris* led him to biblical research, and hence to rejection of "the idolatry of Rome." At Chiavenna in 1547 Sozini came under the influence of Camillo of Sicily, a gentle mystic, surnamed Renato, whose teaching at many points resembled that of the early Quakers. He travelled in Switzerland, France, England and Holland. Returning to Switzerland at the close of 1548, with commendatory letters to the Swiss churches from Nicolas Meyer, envoy from Wittenberg to Italy, we find him (1549–50) at Geneva, Basle (with Sebastian Münster) and Zürich (lodging with Pellican). He is next in Wittenberg (July 1550 to June 1551), first as Melanchthon's guest, then with Johann Forster for improvement of his Hebrew. From Wittenberg he returned to Zürich (end of 1551), after visiting Prague, Vienna and Cracow. Political events drew him back to Italy in June 1552; two visits to Siena (where freedom of speech was for the moment possible, owing to the shaking off of the Spanish yoke) brought him into fruitful contact with his young nephew Fausto. He was at Padua (not Geneva, as is often said) at the date of Servetus's execution (Oct. 27, 1553). Thence he made his way to Basle (Jan. 1554), Geneva (April) and Zürich (May), where he, eventually, took up his residence.

Of the Reformers, Bullinger was Sozini's closest intimate, his warmest and wisest friend. Sozini's theological difficulties turned on the resurrection of the body, predestination, the ground of salvation (on these points he corresponded with Calvin), the doctrinal basis of the original gospel (his queries to Bullinger), the nature of repentance (to Rudolph Gualther), the sacraments (to Johann Wolff). The fate of Servetus directed his mind to the problem of the Trinity. At Geneva (April 1554) he made incautious remarks on the common doctrine, emphasized in a subsequent letter to Martinengo, the Italian pastor. Bullinger, at the instance of correspondents (including Calvin), questioned Sozini as to his faith, and received from him an explicitly orthodox confession (reduced to writing on July 15, 1555) with a frank reservation of the right of further enquiry. A month before this Sozini had been sent with Martino Muralto to Basle, to secure Ochino as pastor of the Italian church at Zürich; and it is clear that the minds of Sozini and Ochino acted powerfully on each other.

In 1556, by the death of his father, Sozini was involved in pecuniary anxieties. He visited in 1558 the courts of Vienna and Cracow to obtain support for an appeal to the reigning duke at Florence for the realization of his own and the family estates. Sozini did not proceed beyond Venice. The Inquisition had its eye on the family; his brother Cornelio was imprisoned at Rome; his brothers Celso and Camillo and his nephew Fausto were "reputati Luterani," and Camillo had fled from Siena. In Aug. 1559 Sozini returned to Zürich, where he died on May 14, 1562.

Sozini's extant writings are: (1) *De sacramentis dissertatio* (1560), four parts, and (2) *De resurrectione* (a fragment); these were first printed in *F. et L. Socini, item E. Soneri tractatus* (Amsterdam, 1654). To these may be added his *Confession* (1555), printed in Hottinger, *Hist. eccles. N.T.* ix. 16, 5 (1667); and about 24 letters, not collected, but may be found dispersed, and more or less correctly given in Illgen, in Trechsel, in the *Corpus reformatorum* edition of Calvin's works, and in E. Burnat, *L. Socin* (1894); the handwriting of the originals is exceedingly crabbed. Sand adds a *Rhapsodia in Esaiam prophetam,* of which nothing is known. Beza suspected that Sozini had a hand in the *De haereticis, an sint persequendi* (1553); and to him has also been assigned the *Contra libellum Calvini* (1554); both are the work of Castellio, and there is no ground for attributing any part of them to

Sozini. Beza also assigned to him (in 1567) an anonymous *Explicatio* (1562) of the proem of St. John's Gospel, which was the work of Fausto; this error, adopted by Zanchi, has been a chief source of the misconception which treats Lelio as a heresiarch. In Franc Guinio's *Defensio cath. doct. de S. Trin.* (1590–91) is an anonymous *enumeratio* of motives for professing the doctrine of the Trinity, by some ascribed to Lelio; by others, with somewhat more probability, to Fausto.

For the life of L. Sozini the best guide is Trechsel, *Die prot. antitrin. vor F. Socin*, vol. ii. (1844); but there are valuable materials in Illgen, *Vita L. Socini* (1814), and especially *Symbolae ad vitam et doctrinam L. Soc.*, etc. (1826). R. Wallace, *Antitrin. biog.* (1850), gives the ordinary Unitarian view, relying on Bock, Da Porta and Lubieniecki. *See* also *Theological Review* (July 1879), and Bonet-Maury, *Early Sources of Eng. Unit. Christ.* (trans. E. P. Hall, 1884). Use has been made above of unprinted sources.

II. Fausto Paolo Sozzini (1539–1604) was born at Siena on Dec. 5, 1539, the only son of Alessandro Sozzini, "princeps subtilitatum," by Agnese, daughter of Borghese Petrucci, a descendant of Pandolfo Petrucci, the Cromwell of Siena. Unlike his uncle Lelio, Fausto spells his surname Sozzini, latinizing it Socinus. His father died in 1541. Fausto had no regular education, being brought up at home with his sister Fillide, and spent his youth in desultory reading at Scopeto, the family country-seat. His early intellectual stimulus came from his uncle Celso, a nominal Catholic, but an *esprit fort*, founder of the short-lived *Accademia dei Sizienti* (1554), of which Fausto was a member. In 1561 he went to Lyons, probably engaging in mercantile business; he revisited Italy after his uncle Lelio's death; we find him in 1562 on the roll of the Italian church at Geneva; there is no trace of any relations with Calvin; to Lyons he returned next year. The evangelical position was not radical enough for him. In his *Explicatio* (1562) of the proem to St. John's Gospel he already attributes to Christ an official, not an essential, deity; a letter of 1563 rejects the natural immortality of man (a position subsequently developed in his disputation with Pucci). Towards the end of 1563 he returned to Italy, conforming to the Catholic Church, and for 12 years was in the service of Isabella de Medici, daughter of the grand-duke Cosimo of Tuscany. At the instance of "a great personage" he wrote (1570) his treatise *De auctoritate s. scripturae*. In 1571 he was in Rome, probably with his patroness. He left Italy at the end of 1575, and after the murder of Isabella he declined the invitation of her brother Francesco, now grand-duke, to return. Sozzini now settled at Basle, began translating the Psalms into Italian verse, and became a centre of theological debates. His discussion with Jacques Couet on the doctrine of salvation issued in a treatise *De Jesu Christo servatore* (finished July 12, 1578), which was read in manuscript by Giorgio Blandrata (*q.v.*), court physician in Poland and Transylvania.

Transylvania had for a short time (1559–71) enjoyed full religious liberty under an anti-Trinitarian prince, John Sigismund. The existing ruler, Christopher Báthori, favoured the Jesuits; it was now Blandrata's object to limit the "Judaic" tendencies of the eloquent anti-Trinitarian bishop, Francis Dávid (1510–79), and he called in Sozzini to reason with Dávid, who had renounced the worship of Christ. Sozzini used terms in themselves orthodox in a heretical sense. Thus Christ was God, though in nature purely human, namely as *un Dio subalterno, al quale in un dato tempo il Dio supremo cedette il governo del mondo* (Cantù). In matter of worship Sozzini distinguished between *adoratio Christi*, the homage of the heart, imperative on all Christians, and *invocatio Christi*, the direct address of prayer, which was simply permissive; though in Sozzini's view, prayer, to whomsoever addressed, was received by Christ as mediator, for transmission to the Father.

In Nov. 1578 Sozzini reached Kolozsvár (Klausenburg) from Poland, and, during a visit of four months and a half under Dávid's roof, tried to persuade him to adopt this modified doctrine of invocation. The upshot was that Dávid from the pulpit exerted all his powers in denouncing all cultus of Christ. His civil trial followed, on a charge of innovation. Sozzini hurried back to Poland before it began. He cannot be accused of complicity with what he calls the rage of Blandrata; he was no party to Dávid's incarceration at Déva, where the old man miserably perished in less than three months. But his references to the case show that theological aversions froze up his native kindness and blinded his perceptions of character.

The remainder (1579–1604) of Sozzini's life was spent in Poland. Excluded at first by his views on baptism (which he regarded as applicable only to Gentile converts) from the Minor or anti-Trinitarian Church (largely anabaptist), he acquired by degrees a predominant influence in its synods. He converted the Arians from their avowal of Christ's pre-existence, and from their rejection of the *invocatio Christi;* he repressed the semi-Judaizers whom he failed to convince. Through correspondence with friends he directed also the policy of the anti-Trinitarian Church of Transylvania. Forced to leave Cracow in 1583, he found a home with a Polish noble, Christopher Morsztyn, whose daughter Elizabeth he married (1586). In Oct. 1590 the Holy Office at Siena disinherited him, allowing him a pension, apparently never paid. He now began to publish in his own name, with the result that in 1598 a mob finally expelled him from Cracow. He died at Luslawice on March 4, 1604.

His treatise on the Saviour renders a real service to theology, placing orthodoxy and heresy in new relations of fundamental antagonism, and narrowing the conflict to the main personal benefit of religion. Of the person of Christ in this treatise he says nothing; its one topic is the work of Christ, which in his view operates upon man alone; the theological sagacity of Sozzini may be measured by the persistency with which this idea tends to recur. Though his name has been attached to a school of opinion, he disclaimed the rôle of a heresiarch, and declined to give his unreserved adhesion to any one sect. His confidence in the conclusions of his own mind has earned him the repute of a dogmatist; but it was his constant aim to reduce and simplify the fundamentals of Christianity. Not without some ground does the memorial tablet at Siena (inscription by Brigidi, 1879) characterize him as vindicator of human reason against the supernatural. Of his non-theological doctrines the most important is his assertion of the unlawfulness not only of war, but of the taking of human life in any circumstances. Hence the comparative mildness of his proposals for dealing with religious and anti-religious offenders, though it cannot be said that he had grasped the complete theory of toleration. Hence, too, his contention that magisterial office is unlawful for a Christian.

Sozzini's works, edited by his grandson Andrew Wiszowaty and the learned printer F. Kuyper, are contained in two closely printed folios (Amsterdam, 1668). They rank as the first two volumes of the *Bibliotheca fratrum polonorum*, though the works of Crell and Schlichting were the first of the series to be printed. They include all Sozzini's extant theological writings, except his essay on predestination (in which he denies that God foresees the actions of free agents) prefixed to Castellio's *Dialogi IV*. (1578, reprinted 1613) and his revision of a school manual *Instrumentum doctrinarum aristotelicum* (1586). His pseudonyms, easily interpreted, were Felix Turpio Urbevetanus, Prosper Dysidaeus, Gratianus Prosper and Gratianus Turpio Gerapolensis (=Senensis). Some of his early verse is in Ferentilli's *Scielta di stanze di diversi autori toscani* (1579, 1594); other specimens are given in Cantù and in the *Athenaeum* (Aug. 11, 1877); more are preserved at Siena. Sozzini considered that his ablest work was his *Contra atheos*, which perished in the riot at Cracow (1598). Later he began, but left incomplete, more than one work designed to exhibit his system as a whole. His reputation as a thinker must rest upon (1) his *De auctoritate s. scripturae* (1570) and (2) his *De Jesu Christo servatore* (1578). The former was first published (Seville, 1588) by Lopez, a Jesuit, who claimed it as his own, but prefixed a preface maintaining (contrary to a fundamental position of Sozzini) that man by nature has a knowledge of God. A French version (1592) was approved by the ministers of Basle; the English translation by Edward Coombe (1731) was undertaken in consequence of the commendation in a charge (1728) by Bishop Smalbroke, who observes that Grotius had borrowed from it in his *De veritate Christ. rel.* In small compass his *De auctoritate s. scripturae* anticipates the historical argument of the "credibility" writers; in trying it by modern tests, it should be remembered that Sozzini, regarding it (1581) as not adequately meeting the cardinal difficulties attending the proof of the Christian religion, began to reconstruct its positions in his *Lectiones sacrae* (unfinished).

For the biography of Sozzini the best materials are his letters; a collection is in his works; others are given by Cantù; more are preserved at Siena and Florence; his correspondence is open and frank, never sparing his weak points. The earliest life (prefixed to his works) is by S. Przypkowski (1636); in English, by J. Bidle (1653). This is the foundation of the article by Bayle, the *Memoirs* by J. Toulmin (1777), and the article by R. Wallace (*Antitrin. Biog.*, 1850). Cantù's sketch in *Gli Eretici d'Italia* (1866) gives a genealogy of the Sozzini.

(A. Go.; X.)

SOCIOLOGICAL SOCIETIES. The societies listed below are those of the widest appeal in sociology and allied subjects. Allied subjects (Economic Science, Statistics, Law and Education) are included and the chief institutions for research into these subjects will be found below.

The international societies are the *Association Internationale pour le Progrès des Sciences Sociales* and the *Congrès International de Statistique,* which first met at Brussels in 1853. Both have issued *Comptes rendus.* The *Inst. Internat. de Sociologie* (1893) has its headquarters at Paris. The *National Association for the Promotion of Social Science* (1857) had united with it in 1864 the *Society for Promoting the Amendment of the Law.* It held a yearly migratory meeting, and published *Transactions* (1858, etc.) and *Social Science* (1866, etc.). The *Sociological Soc.,* the *Eugenics Education Soc.* and the *Roy. Economic Soc.* are established in London. The *Royal Statistical Society* (1834), incorporated 1887, publishes a *Journal* (1839, etc.); *Cobden Club* (1866), for the diffusion of the political and economical principles with which Cobden's name is associated, has issued a variety of publications; *Institute of Actuaries* (incorp. 1884); *Institute of Chartered Accountants* (1880); *Institute of Bankers* (1879); the *Society of Incorporated Accountants and Auditors* (1885), and the *Chartered Institute of Secretaries,* also meet in London. There are also the *Manchester Statistical Society* (1833), with *Transactions;* the *Faculty of Actuaries in Scotland* and the *Scottish Society of Economists* (1897), both meeting at Edinburgh; and the *Statistical and Social Inquiry Society of Ireland* (1847), with a *Journal,* at Dublin. After the INNS OF COURT (*q.v.*), the most important of British legal societies is the *Law Society* (1827, incorporated 1832, reincorp. 1845); it began courses of lectures for students in 1833, and was appointed registrar of solicitors ten years later, and obtained supplementary charters in 1845 and 1878. The *Selden Society,* established in 1887 for the promotion of the study of the history of law, prints ancient records. The headquarters of the *Association for the Reform and Codification of the Law of Nations* are in London, but conferences are held in various continental towns. The *Chartered Institute of Patent Agents* (founded 1882, incorporated 1891) issues *Transactions.* The *Juridical Society of Edinburgh* (1773) published five editions of a *Complete System of Conveyancing.* The *Ascham Society* was founded in 1879 for the improvement of educational methods; and the *Society for the Development of the Science of Education* (1875) issued *Transactions.*

UNITED STATES: Baltimore, *Amer. Pol. Sc. Assoc.* (1903), *Proc.* Boston, *Amer. Soc. Sc. Assoc.; Amer. Statist. Assoc.* (1839), *Collections* (1847, etc.). Cambridge, *Amer. Econ. Assoc.* (1886). New York, *Am. Inst. of Social Service, Social Service* (1899, etc.); *Actuarial Soc. of Amer.* (1899). Philadelphia, *Amer. Acad. Pol. and Social Sc.* (1899), *Annals; American Bar Assoc., Reports; Assn. of Amer. Law Schools* (1901). Washington, *Amer. Soc. of Int. Law* (1906), *Journal; Nat. Educ. Assoc.* (1857), *Proc.* FRANCE: Grenoble, *Soc. de Statist.* (1838), *Bull.* (1838, etc.). Marseilles, *Soc. de Statist.* (1827), *Répertoire* (1837, etc.); *Soc. Sc. industr.* (1871), *Bull.* (1872, etc.). Paris, *Soc. Int. des Études Pratiques d'Écon.* (1856, recognized 1869); *Soc. Fran. de Statist. Univ.* (1829), *Journal* issued jointly with *Acad. Nat.* since 1849; *Soc. de Statist. de Paris* (1860, recognized 1869), *Journ.* (1860, etc.); *Soc. de Législation Comparée* (1869, recognized 1873), *Bull., Annuaire de Lég. Franç.,* and *Ann. de Lég. Étran.; Soc. pour l'Instr. Élément* (1815, recognized 1831), *Bull.; Soc. de Linguistique* (1864); *Mém.* (1868, etc.); *Soc. de l'Enseignement Supérieure* (1878), *Rev.* (1881, etc.); *Soc. d'Écon. Sociale* (1856), *Les Ouvriers des deux mondes* (1857, etc.), *La Réforme sociale* (1881, etc.); *Soc. d'Écon. Pol.* (1842), *Annales* (1846–1847), *Bull.* (1888, etc.); *Soc. de l'École des Chartes* (1839), *Mém.* St. Maixent, *Soc. de Statist. des Deux-Sèvres.* Toulouse, *Acad. de Légis.* (1851), *Rec.* (1851, etc.). GERMANY and AUSTRIA-HUNGARY: Debreczen, *Magyar Kir Gazdasági Akad.* (1868). Berlin, *Volkswirths. Ges.* (1860), *Volkswirths. Zeitfragen* (1879, etc.); *Ver. f. deutsche Volkswirths.* (1876), *Ztschr.* (1880, etc.); *Ver. f. Förderung d. Handelsfreiheit* (1878), *Mittheil.* (1879, etc.); *Ver. f. d. Statist.; Jurist. Ges.* (1859), *Jahresber.* (1863, etc.). Dresden, *Statistischer Ver.* (1831), *Mittheil.* Frankfort, *Statistische Ges.; Juristische Ges.* (1866), *Rundschau* (1867, etc.); *Akad. für Sozial- u. Handelswissenschaften* (1901). Freiburg, *Badische Heimat* (1893), *Volkeskunde.* Halle, *Kantgesellschaft* (1904), *Kantstudien.* Laibach, *Jurist. Ges.* Leipzig, *Ver. f. wiss. Pädagogik, Jahrbuch* and *Mittheil.* ITALY: Tortona, *Soc. di Storia Economia, Boll.* BELGIUM: Brussels, *Ligue de l'Enseignement* (1864), *Bull.; Soc. Centr. des Instituteurs Belges* (1860), *Le Progrès; Inst. Solvay de Sociologie* (1901). HOLLAND: Amsterdam, *Ver. voor de Statist. in Nederland, Jaarboekje* (1849, etc.) and *Jaarcijfers* (1882, etc.). SPAIN: Madrid, *Junta Estadist; R. Acad. de Jurisprudencia y Legis.* (1763, 1826); *R. Acad. de Ciencias Mor. y Pol.* (1857). RUSSIA: Moscow, *Juridical Soc.* St. Petersburg, *Pedagogical Soc.* EGYPT: Cairo, *Bureau Central de Statist.* HAVANA (Cuba), *Soc. Econ. de Amigos del Pais* (1792), *Memorias.* JAPAN: Tokio, *Statist. Soc.*

SOCIOLOGY. The word was introduced in 1837 by Auguste Comte in the lectures which resulted in the publication of his "Positive Philosophy." Comte's intention in introducing the word has been widely misunderstood. It has been confused with the suggestions of practical change in polity and in religion, which, in the later part of his life, he advocated.

COMTE, HIS PREDECESSORS AND SUCCESSORS

The circumstances out of which the word and the idea arose are these. Comte considered himself to be in succession with a line of thinkers historically beginning with Thales and Pythagoras, continuing with Bacon and Descartes, and culminating in Hume's "Treatise of Human Nature," which attempted to unify and evaluate the total available knowledge of Man. Between the publication of Hume's "Treatise" in 1739 and Comte's attempt at a fresh synthesis, almost exactly a century intervened. It was a century in which the range of verifiable knowledge was enormously extended in all departments of investigation. It was a period of immense activity, analytic and synthetic, in the mathematical and physical sciences—witness the names of Fourier, Lagrange and Laplace, of Carnot, Coulomb and Volta, of Scheele, Lavoisier, Cavendish, Davy, Berthollet and Dalton. But as affecting the genesis of sociology, the main features of the century were, in the first place, the creation of the Biological Sciences as definite systems of study, and in the second place the growth of the conception of a Science of History. In whole or in part belong to this period the labours of Linnaeus, Haller and Jussieu, of Buffon and Cuvier; and finally, the attempt of Bichat, of Lamarck and of Treviranus to institute a general science of the phenomena of life, for which both the latter used the title Biology. The idea of a science of Human History, if it belongs to any individual, belongs to Vico, who held that he had established it by his "New Science" in 1725. This idea, in the interval between Hume's "Treatise," and Comte's "Positive Philosophy," had been notably developed by Montesquieu, Turgot, Condorcet and Saint-Simon, by Lessing, Herder and Kant, by Adam Smith, Ferguson and Millar.

Comte's Aim.—The immediate task which Comte proposed to himself was to survey with the eye of philosophy the scientific and historical labours of this prolific century intervening between Hume and himself. His attempted unification was propounded under the name of the Positive Philosophy, and, for that portion of the Positive Philosophy which set forth the bearing of the new scientific and historical knowledge on the conceptions of Human Nature and Society, he proposed the name sociology.

Between Vico's "New Science" and Comte's "Sociology," the infiltration of the phrase social science marks a general tendency towards the expansion of science into the field of humanistic studies. Among Comte's contemporaries J. S. Mill (only eight years younger than Comte) declared (in 1836) that the time was ripe for marking off from other studies—both scientific and philosophical—a general social science, and for this he used such phrases as Social Philosophy, Social Science, Natural History of Society, Speculative Politics and Social Economy. After the appearance of the "Positive Philosophy," Mill abandoned both the phrases he had previously recommended as being the most

suitable titles—Social Economy and Speculative Politics. He even denied to the latter any right to exist as a separate department of scientific studies. The word sociology he sanctioned by frequent use in the final book of his "Logic"; that "On the Logic of the Moral Sciences."

Herbert Spencer.—For a long time the word sociology made little headway, and this notwithstanding Mill's sanction and usage of it, and the rapid acquisition and long maintenance by his "Logic," of classic rank throughout the western world; carrying as it did the new term into quarters—notably in Germany and America—where the "Positive Philosophy" did not penetrate. It was not in fact till more than half a century had passed, that the word could be said to be accepted as part of the international vocabulary of the learned world. To this end, Spencer contributed much by his book "The Study of Sociology," which won recognition in almost every civilized country during the two decades between 1870 and 1890. The first volume of Spencer's "Principles of Sociology" appeared in 1876 and the last in 1896. Though comparatively neglected by British universities, Spencer's sociological work has been extensively studied in German and still more in American universities. In France, too, Spencer's influence has tended to the dissemination of the idea and the word sociology; for he is there considered as a continuator of the philosophical and scientific work of Comte.

But the main sociological movement has issued from other origins than those of Comte and Spencer. The master idea, which animated alike the initiator of sociology and his chief continuator, was that of evolution. The evolutionary concept of an orderly development proceeding by discoverable "laws" was applied by Comte to the past, present and future of Western civilization, itself taken as the essential feature of man's activity. Spencer extended this evolutionary concept to other types of society than that of Western civilization; aiming indeed in his "Descriptive Sociology" (of which the volumes continue to be compiled and published under the terms of his testamentary dispositions) at a comprehensive account of every social type to be found on the earth.

Evolution in the Social Sciences.—Independently of the writings of both Comte and Spencer, there proceeded during the 19th century, under the influence of the evolutionary concept, a thoroughgoing transformation of older studies like History, Law and Political Economy; and the creation of new ones like Anthropology, Social Psychology, Comparative Religion, Criminology, Social Geography. It is from these sources that have sprung the main body of writing, investigation, research, that to-day can properly be called sociological. To give content to this statement some illustrative cases may be examined. Take, to begin with, the transformation of Law and History from relatively isolated studies of discursive or narrative type into something ever approximating to social sciences of an evolutionary kind. Discoveries relating to the history of the family contributed largely to the renewal of juristic studies on an evolutionary basis. Disputable as the theories of Bachhofen, Morgan, MacLennan, etc., were in many respects, they proved by evidence the existence of forms of the "family," very different from those known up to that time, and also their *generality*. The remarkable identity of the nomenclature of parentage in Australia, and among the redskins of North America, was significant. The similarities between the Iroquois tribes and the Romance nations, if exaggerated by Morgan, were not purely fictitious. Resemblances of the same kind were proved in the case of criminal law and the law of property, and thus a school of comparative law was founded, whose object was to bring out these agreements, to classify them systematically, and endeavour to explain them as evolutionary phenomena. Of this school of ethnographic jurisprudence Herman Post may be regarded as founder, and other names such as those of Kohler, Bernhoeft, and Steinmetz are to be associated with his.

Simultaneously with the foregoing changes, the concept of Institutions as social phenomena exerted a profound influence upon modes of study in both History and Law. It was observed that Institutions during their evolution preserve their essential characteristics throughout long periods of time, and even on occasion through all the series of a continuous collective existence; for they express the more constitutional elements in every social organization. Stripped of the covering of particular facts which conceals their internal structure and function, institutions, it could be asserted, while varying more or less from one country to another, presented striking similarities in different societies. *Rapprochements* thus became possible, and comparative history came into prominence. The Germanists and the German Romanists, Maurer, Wilda and Ihering, established resemblances between the laws of the various Germanic peoples, and between those of the Germans and Romans. By comparison of the classical texts relating to the organization of Greek and Roman cities, Fustel de Coulanges managed to portray in its essential particulars the abstract type of the city. With Sumner Maine, the field of comparison, still further widened, embracing besides Greece and Italy, India, Ireland, the Slav nations.

Political Economy.—Nothing better testifies to the importance of the scientific transformations in the whole field of social studies than the evolution which political economy underwent during the 19th century. Under the influence of different ideas, otherwise ill-defined, but which it is, however, possible to refer to two principal types, it lost, first in Germany something of that merely dialectical character which made it possible for Comte to contrast it with sociology as the type of the "idealogic" method of construction. To establish the legitimacy of Protection, and more generally of the economic action of the State, List reacted against both the individualism and the cosmopolitanism of the Liberal school. The "National System of Political Economy" maintains the principle that intermediate between humanity and the individual is the nation, with its language, literature, institutions, manners and past. The classical economist fashioned an economic world having no visible existence—the *Güterwelt*—an isolated world uniform throughout—in which the conflict of individual forces acted according to inflexible economic laws. As a matter of fact, it is observable that individuals make their efforts to grow rich in collectivities widely different from one another; and the nature of these efforts changes, and their success varies with the characteristics of the collectivity in which they are displayed. A practical consequence of this principle is that the State acts on the economic conduct of individuals by means of the "reforms" which it introduces, and by its external policy. A theoretical consequence is that economic "laws" are seen to vary from one nation to another, and it becomes increasingly manifest that a "National Economy" based on observation, should take the place of the abstract, *a priori* economics. True, the conception of a "nation" is an obscure idea; and the very definition of national economy would appear to negate the possibility of truly scientific laws, since it conceives its object as unique and excludes comparison. List made, nevertheless, an important step in advance by introducing into economic speculation the idea that a given society has a real existence, and that the economic and other manifestations of its own life are in reciprocal relations.

Under the title of "Socialism of the Chair," studies emerged, which, while attempting also to establish theoretically the political conception of the rule of the State, adapted and developed List's idea. It is not enough to say that economic activity of individuals is dependent on social phenomena; for is it not true that only by abstraction can we speak of individual economic activity? A more concrete reality is the *Volkswirtschaft,* the economic activity of society associated not only with economic, but also with ethical and juridical phenomena. This *Volkswirtschaft* was taken as the immediate object of economic science; it occupied itself essentially with social concerns, and, indirectly only, with individual interests. Here, political economy, though preserving a normative more than speculative character, was at least clearly conceived as a social science with truly social phenomena for its object, of the same nature as other social institutions.

Another phase of progress, akin to the foregoing, was accomplished at the same time. The historical spirit is applicable to all the particular characteristics which distinguish societies and epochs from one another. "National Economy" had therefore to find in

history its argument against the universalist theories of the classical school. List invokes the historical method; and Roscher, the founder of the historical school, does not separate the study of economic facts from that of juridical facts in particular, and from social facts in general. Language, religion, art, science, law, the state, and industry—all are viewed as different aspects of one complete whole, conceived as national life. This school has had a special influence in the development of political economy. Without at any time losing sight of historical research as a means of judging the value of a given political action in given circumstances, it has occupied itself with matters more or less apart from their practical aspect, and has insisted on studying them with a view to their understanding in a detached spirit. It has introduced to some slight extent the comparative method in economic history, and, among its most notable exponents, Schmoller clearly formulated the idea that economic laws are inductive. Another—Bucher—sketched a classification of economic régimes, thus constructing abstract types to which by their economic organisations all nations, whether present or past, might be assumed to belong. Both, and particularly the latter, were no longer content with studying historic societies. In particular they demanded information from ethnography as to the economic condition of lower races.

SPECIALIZED STUDIES

What, however, even more than this reconstruction of law, history and economics on a more or less evolutionary basis, constitutes the main movement towards a system of social sciences, is the appearance of a whole array of new disciplines of an essentially sociological nature. First, may be mentioned the two allied studies—Anthropology, and the Development of Civilization, which the Germans call *Kulturgeschichte;* and amongst the initiators may be mentioned Klemm in Germany, Pritchard in England, and Broca in France. The founding of prehistoric archaeology, by submitting evidence that the human race in very ancient times had everywhere passed through a state similar to that in which savage or barbarian peoples remain who can actually be observed to-day, went yet further in extending the field of these investigations and fortifying their methods. Not only the unity of human minds, but the relative identity of human evolution, was thus affirmed. The impulse once given, anthropologic discoveries rapidly followed one another, calling attention to remarkable similarities between the most different nations. This it was which the partial encyclopaedias of Schoolcraft and Bancroft revealed, but it was most clearly put in evidence by the great work of Waitz Gerland, in which is found synthesized the anthropological work of a whole epoch.

Comparative Religion.—Studies of religions have been submitted to an evolutionary treatment, which, however, has been applied, as yet, almost exclusively to the simple and more primitive forms of cult. With the help of comparative grammar, Max Müller founded comparative mythology; but this comparative study remained for a long while confined to the primitive historical religions of the Aryan nations. Under the influence of anthropology the field of comparison was widened. Numerous scholars, —Mannhardt in Germany, Tylor, Lang, Robertson Smith, Frazer, Sidney Hartland in England, Wilken in Holland,—collected a great number of facts which tended to prove the uniformity of religious beliefs and observances throughout the whole human race. Armed with the "survival" theory, the same authors annexed at one stroke to the comparative science of religions, the whole mass of facts which the Folklore or *Volkskunde* of the Germans—observed, registered and brought together during the 19th century—contained; and they received by that incorporation a new significance. The customs of European peasants, magical practices, ideas concerning death, tales and legends, all appeared now as the debris of ancient civilisation and ancient beliefs.

The Psychological Approach.—And a new science took its birth in Germany, with a view to studying the products of psychological activity in primitive minds or in the underlying mentalities of the more cultured peoples; that is, the *Völkerpsychologie* or folk-psychology, of which Lazarus and Steinthal are the founders. This has been but one of many psychological approaches towards an ever-growing enrichment of the sociological repertoire. The others most notable are: (a) observational and systematic studies of the child-mind in its growth from infancy onwards, culminating in the profound mental and emotional changes of adolescence. This approach has been pioneered mainly by Americans, and notably by Stanley Hall, whose great work *Adolescence* constitutes a landmark in the understanding of those mental changes which transform the "individual" into a social being; (b) the comparative study of animal and human societies, pioneered by Darwin's investigations of emotional expression in animal life; developed by Espinasse in his *Les Sociétés Animales;* and carried fully into the world of man by Trotter in his *Instincts of the Herd in Peace and War;* (c) Durkheim's theory of *Collective Representations,* which goes to show that men united in organised groups think and feel differently from isolated individuals; that societies have *representations* which are peculiar to them, collective representations charged with collective emotions; and that these representations (beliefs, myths, aesthetic images, moral notions, scientific concepts, technical ideas), form the greater part of thought and sensibility strictly human; that it is by its participation in this collective treasure that the thought of individuals surpasses that of animals; and finally above all that these collective representations express not only the exterior world and the individual consciousness, but society itself, a real being and a system of forces, which dominate individuals and act in and through them; (d) the psycho-analytic school founded by Freud and Breuer (but developed by the former and his pupils and continuators, notably Jung and Adler), which shows, with a wealth of detail, how the mind of every individual is built up by a complex interplay between more or less organic impulses (especially those of sex) and social factors such as parental control, the inhibitions and ordinances of custom, the aspirations and repressions of manners, law, religion, politics, etc.

Partial Sociologies.—From the foregoing psychological approaches collectively there is growing up a doctrine of society, its structure, functions, origins and purpose which, in popular estimation, probably outranges any sociological presentation as yet made. Similarly the anthropologists are in course of creating a sociology of their own. Ignoring the vast and profound labours of Comte in establishing and elaborating the concept of Social Inheritance as the differential characteristic of Man in society and therefore the essential subject matter of sociology, those anthropologists who emphasize and work out the idea of Cultural Diffusion are in danger of substituting a biassed particularism for the synthetic generality which a genuine sociology demands. And the same criticism could be levelled against the more generalizing exponents in each one of many specialized subsciences found within the social field. Since these specialisms began, under the influence of the evolutionary spirit, to orient themselves in a sociological direction (as illustrated above), they have collectively accumulated a body of more or less verified knowledge, which to-day must be held to constitute the main corpus of sociology, if that word be taken in a scientific rather than a philosophic sense. But this body of specialized knowledge suffers several grave defects. It is, (a) unsystematized, and therefore, since lacking in real unity, is ill-adapted to the concerted activity on which assured progress in science depends; (b) uninformed by many of the master concepts on which the scientific foundations of sociology were originally laid; (c) inadequately related to biology and the other established sciences which, preliminary to sociology, compose an essential part of the equipment needed for the culminating study of society in evolution. Meantime an expanding flood of literature, in book and periodical form, appearing under the title Sociology gives too much occasion for a widely prevailing belief that sociology is a vague general study of discursive and philosophical rather than scientific character.

LE PLAY AND HIS CONTINUATORS

Two of the grand sources of current sociology have been indicated, viz., on the one hand, the initiative work of Comte and his continuator Spencer, and on the other, the multifarious and unco-ordinated researches of numerous specialized studies which

are, or should be, subsciences of one comprehensive master science. There is a third grand source. It is the writings, impulse and tradition of Frédéric Le Play (1806–1882). He is to be regarded as the creator of an observational method, applicable to concrete outdoor studies in the social sciences, which holds promise of freeing sociology from its dialectical and discursive bias, bringing it into line with biology, and so imparting to it a definite and recognized place in the hierarchy of the sciences. Le Play is best known in England and America for his monumental work *Les Oeuvriers Européens.* In preparation for this, Le Play spent in foreign travel and observation, during more than a score of years, the annual holiday of five to six months which his official duties (as Inspector of Mines) allowed. He visited nearly every country in Europe (England seven times), and extended his travels into Asia. He thus studied and monographed over three hundred working-class families representative of characteristic industries and localities throughout Europe. From all these "Monographies Sociales," thirty-six of the most complete were selected for publication in the *Oeuvriers Européens,* the first edition of which appeared in 1855. Le Play's system of monographs inspired the classic work of Charles Booth in his *Life and Labour of the People in London* (10 vols. 1889–1903, now under systematic revision by the London School of Economics). From the same source came the model and inspiration of much investigation and research in Britain and America on Family Budgets. In these ways Le Play's influence has been conspicuous in helping to transform the older type of discursive political economy into an observational and concrete study growing increasingly fit to take its place as a specialized subscience of a renovated sociology.

The Elemental Occupations.—The social monographs of Le Play which have exerted a marked influence in re-orienting Political Economy in a sociological direction, were themselves antecedent to his later and more mature work upon the primary occupations. In the elemental activities of Hunting, Herding, Mining, Woodcraft, Agriculture and Fishing, which primitively and perennially link Man with Nature, Le Play and his continuators (notably De Tourville and Demolins in France, and Patrick Geddes in Britain), discovered material for the renovating of sociology (though Le Play himself never used that word) extending far beyond the purview of anthropology, economics and social geography. Le Play's original formula of Lieu, Travail, Famille, used in the study of these nature occupations, has grown into the Place, Work, Folk, of a school at once observational and interpretative, which pushes on from "field" studies of the simpler peoples into the most elaborate urban and rural phenomena of civilization.

But, to study these nature-occupations on the spot, most students will not need to go further afield than to the more mountainous regions of their own country, such as the moorlands, glens, forests and estuaries of the Welsh, Scottish and Irish Highlands, or even to the English Pennines. In the course of a walking tour down a typical valley of these regions one can usually see something both of the nature-occupations and of their mode of family and folk life, and how these are conditioned by environment. Picture for instance the appearance of a typical valley as seen, for example, from an aeroplane. On the broad hill-tops, bare rock or moss-grown surface alternating with scrub, heath and bracken, the whole affording scanty food and cover for game, of which the grand source is in the deciduous forest below, sheltering a rich variety of animal life; next is the belt of upland pasture with its wandering flocks; below this the agricultural belt ranging from the poor hill-side croft onwards through the rich farms of the plains, to the market gardens on the outskirts of the great city at the river mouth. Finally, at the estuary is the region of the seafaring folk. Here are four characteristic areas, and the addition of the coniferous forest and mining belts on the western slope altogether make up, as it were, a six-square chequer board. On their respective squares stand the sextet of occupational types, Miner, Woodman, Hunter, Shepherd, Peasant, Fisherman, each ready for his part in the interplay of the rural drama, which constitutes the subject matter of the rural survey.

Pursued systematically, such an investigation is a Rural Survey of genuinely scientific type. If the student pauses to specialize on its environmental aspects, the study becomes social geography; if on aspects of work, it becomes economics; if on folk life and custom, anthropology. Thus these three large sub-sciences of the social group fall into orderly relation to each other and to the facts under investigation. Attempts to co-ordinate these more determinist or objective sciences (social geography, economics and anthropology) give rise to sociology in its more determinist and objective sense.

The Civic Survey.—Now the typical river valley that constitutes the unit of open-air survey, pursued in the Le Play tradition, has, of course, its towns or cities at "nodal" points, and often its great city at the river mouth. In the survey of these towns and cities, the central interest is not nature-occupations, but culture occupations, commonly called vocations. On the more social side, it is not family and folk custom that we emphasize, but the group of people associated for some immaterial purpose (as of religion, political progress, science, literature, art, etc.). Such a group becomes an institution, when lastingly organized. And the word "Polity" may conveniently denote all such groups alike the more and the less permanently organized. In the higher forms of city life, polities largely determine vocation; young men (and, increasingly, young women) choosing careers in relation to the polities with which they are associated. Vocation freely chosen usually results in a development of personality which produces some form of art, and thereby transforms "place" (environment) in terms of purpose. Thus the Civic Survey supplements the Rural Survey and in the former the terms and sequence of the formula used for observation and for interpretation are—Polity →Culture→Art. And this, manifestly, is the formula of the rustic survey reversed, and read as Folk→Work→Place, but with more appropriate civic terms replacing those of the rustic formula. Pausing in the civic survey to specialize on polities, we are from one point of view studying Ethics, and from another (speculative) Polities; specializing on cultures (as embodied in militant types of personality), we study from one point of view History (as Biography) from another, Social Psychology (the "Ethology" of J. S. Mill); specializing on studies of environment transformed to art, our sub-science is Aesthetics. Thus do the more subjective or "idealistic" social sciences take orderly rank in the scheme.

Sociology in its more subjective aspect emerges as the endeavour to co-ordinate these. Rustic surveys combine with civic surveys to make the Regional Survey (*i.e.,* systematic study of the various human societies inhabiting a given region). And as such surveys proceed city by city, region by region, their comparison and generalization should yield a unified social science with adequate and orderly basis of fact. Amongst the advantages claimed for this method are: (1) it supersedes the old-standing dispute between the "sciences" and the "humanities" by bringing them together as the more objective and subjective approaches to the one single study of social life in evolution; (2) it continues the concrete open air method of Nature Study into the human field, thus finding its material in the objects of everyday observation, and putting the student face to face with these, and only falling back on books and classroom work as a secondary aid; (3) it parallelizes the social with the biological sciences, not through the old vague "organic analogy," but by precise correspondence of the elemental concepts in each order of science. Place, work, folk, are manifestly the social equivalents of the biologist's elemental triad, environment, function, organism. The biologist, as his observations ascend the scale of life, sees organisms decreasingly hammered into shape by environment, and increasingly modifying environment in terms of their own vital activities. So also the social student reverses his determinist formula in passing from rustic to civic surveys, and adapts its terms to the observation and interpretation of life, individual and social, increasingly impelled towards the expression and realization of ideals.

THE FUTURE OF SOCIOLOGY

Unfortunately, there does not, as yet, exist any monographic study of the typical Region—a river valley, which, from source

to sea, can be taken as representative of a given civilization. Indeed an organization adapted to a working correlation of all the relevant specialisms, both social and naturalist, has still to be created for this purpose. But there are small tentative beginnings such as the Outlook Tower in Edinburgh, and Le Play House in London. To be sure, many "surveys" of particular cities, towns, villages and other areas, have been, and continue to be, made and published, especially in America. But these are social rather than sociological. In other words such usage, systematization and even synthesis of specialisms, as they make and apply to observation and interpretation of their region, are either personal or appertain to some sectional tradition rather than to the main line of sociological advance. It may well be that effective progress towards the establishment and maintenance of sociology as the culminating synthetic member in the hierarchy of the sciences awaits the coming of a generation of students and investigators, observers and interpreters all of whom shall have been specially trained in definite ways.

These, without doubt, must include: (a) a working knowledge of Comte's master-generalization still awaiting thoroughgoing application to recent history and contemporary social evolution as well as to past history, *i.e.*, of congruent temporal and spiritual powers, operating through characteristic social types for which he used as technical terms, "chiefs" and "people" for the respective arms of the temporal power; and similarly "intellectuals" and "emotionals" for those of the spiritual power; (b) a similar habit of using for everyday observation and interpretation, both versions of Le Play's reversible formula (Place, Work, Folk); (c) a working knowledge of Geddes' development and elaboration of the Le Play formula; (d) a preliminary training in biology and in field-naturalist modes of observation and study; (e) some mastery of contemporary resources in (social) geography, economics and anthropology as the three chief subsciences of sociology on its objective side, and similarly for ethics, psychology and aesthetics as the three chief subsciences of sociology on its subjective side; (f) recurrent travel on foot particularly for observation of the elemental occupations with their rural varieties and their transformations in urban life; (g) similar open-air studies of historic formations and their survivals and renewals in town and country; (h) habitual watching (and interpreting) everywhere and at all times of the interplay between past, present and future; (i) unflagging endeavours to discern the "individuality" of every village, town and city, as a unique factor in the "culture" which every region receives and reflects from the larger civilization; (j) a clear distinction between organic heredity and social inheritance; and persistent effort to see and evaluate the social heritage not only in language and literature, art and religion, occupations, manners, customs, business and politics, but also and more concretely in the edifices, streets and quarters of towns and cities; and above all in the complex life of a whole region fully representative of a given civilization.

Equipped with these (and no doubt other) essentials of his science, the coming sociologist will work towards the long-delayed synthesis of the newer specialisms and of these specialisms with the older studies and knowledges.

BIBLIOGRAPHY.—The great bulk of sociological literature is either specialized on some one or more of the many approaches (economic, anthropologic, psychological, juristic, etc.), or proceeds by a method more dialectical and discursive than observational and hence belongs rather to social philosophy than to science. The best of both kinds will be found either in the specialized journals or in the general reviews. Of the latter the chief are *The Sociological Review* (the organ of the British Sociological Society); *The American Journal of Sociology; Social Forces; The Journal of Applied Sociology* (both the latter, American); the *Année Sociologique* (which summarizes the chief books of the year); the *Revue Internationale de Sociologie;* the *Archiv für Sozialwissenschaft und Sozial politik; Kölner Vierteljahrschrift für Soziologie; Jahrbuch für Soziologie; Ethos: Vierteljahrschrift für Soziologie, Geschichte und Kultur-philosophie; Zeitschrift für Völkerpsychologie und Soziologie;* and the *Rivista di Sociologia.* For the titles of specialized periodicals *see* the relevant articles (Economics, Anthropology, etc.). Of general works may be mentioned: J. J. Findlay, *An Introduction to Sociology* (1920); R. M. MacIver, *Elements of Social Science* (1926); and four books by L. T. Hobhouse, together constituting his principles of sociology, viz., *The Metaphysical Theory of the State* (1926), *The Rational Good* (1921), *The Elements of Social Justice* (1922), *Social Development* (1924); Ellwood's *Cultural Evolution* (1927); Park and Burgess, *Introduction to the Science of Sociology* (1921); Graham Wallas, *The Great Society* (1919); E. R. Groves, *An Introduction to Sociology* (1928), and *Sociological Papers* (British Sociological Society, 1904–06) attempted a comprehensive systematization. On the general history of sociology, *see* E. Bogardus, *History of Social Thought* (Los Angeles, 1922); S. O. Hertzler, *History of Utopian Thought* (1923); J. P. Lichtenberg, *Development of Social Theory* (1924); Albion W. Small, *Origins of Sociology* (1924). For social psychology, *see* L. L. Bernard, *An Introduction to Social Psychology* (1927); C. A. Ellwood, *Psychology of Human Society* (1925); M. Ginsberg, *The Psychology of Society* (1924); W. McDougall, *The Group Mind* (2nd ed., 1927). For the development of the regional survey and its applications, *see* various papers by P. Geddes contributed to the (British) Sociological Society from 1904 onwards, and in two books written jointly with V. Branford, *The Coming Polity* (2nd ed., 1919) and *Our Social Inheritance* (1919); and in *Whitherwards,* by V. Branford. A small *Introduction to Regional Surveys* by S. Branford and A. Farquharson is useful for field work. For an account of the recent and current state of sociological studies in France, Germany and America, *see* three papers respectively by P. Fauconnet, L. von Wiese, and C. A. Ellwood, in the *Sociological Review* for January 1927. As regards social service, *see* "A Select Bibliography," in W. J. Roland's *Social Service,* and *see* also the article SOCIAL SERVICE. (V. BR.)

SOCRATES (*c.* 470 B.C.–399 B.C.), the great Athenian philosopher, was put to death in 399 B.C. at the age of 70. His birth thus falls in or about 470, ten years after Salamis. His father, Sophroniscus, was a friend of the family of the "Just" Aristeides; the tale that he was a sculptor first appears in the 3rd century in Timon of Phlius and seems to be only a misinterpretation of a playful remark in Plato. His mother, Phaenarete, acted as a "midwife," but no inference as to social status can be founded on this. The memoir writer, Ion of Chios, mentioned meeting him at Samos in the company of Archelaus, the Athenian successor of Anaxagoras, presumably during the military operations of 441–440. The connection between the two men is also asserted by Aristoxenus the Peripatetic and the doxographical tradition based on Theophrastus calls Socrates the "disciple" of Archelaus. Plato, Xenophon, Aeschines of Sphettus agree in depicting him as intimate with the leading figures of the Periclean circle (Aspasia, Alcibiades, Axiochus, Callias). Xenophon (*Mem.* iv. 7) concurs with Plato in saying that he was well versed in geometry and astronomy, and this representation agrees with the narrative of Plato's *Phaedo* and the Aristophanic burlesque of the *Clouds.* Socrates must already have been a conspicuous figure at Athens when Aristophanes and Ameipsias both made him the subject of their comedies in 423, and since the comedians made a special point of his neediness he had probably suffered recent losses. (The marked poverty of his old age is said in Plato's *Apology* to have been caused by his preoccupation with his mission to mankind.) Socrates was married, apparently late in life, to Xanthippe, by whom he left three sons, one an infant. Xenophon speaks of her high temper; there is no evidence that she was a "shrew"; the sons, according to Aristotle, proved insignificant (*Rhetoric B.,* 1390, b. 31).

Socrates' record for prowess and endurance was distinguished. He served as a hoplite, perhaps at Samos (441–440), at Potidaea, where he saved the life of Alcibiades (432–430), Delium (424) and Amphipolis (?422 or ?437–436). In politics he took no part, knowing, as he told his judges, that office would mean compromise with his principles. Once at least,[1] in 406–5 he was a member of the council of 500, and at the trial of the victors of Arginusae, being one of the *prutaneis,* resisted, at first with the support of his colleagues, afterwards alone, the unconstitutional condemnation of the generals by a collective verdict. He showed the same courage two years later in the "Terror" of 404. The "thirty" wishing to implicate honourable men in their proceedings, instructed Socrates with four others to arrest Leon, one of their victims. Socrates disobeyed, and says, in Plato's *Apology,* that this might have cost him his life but for the counter-revolution of the next year.

In 399, four years after the amnesty, he was indicted for "impiety." The author of the proceeding was the influential Anytus, one of the two chiefs of the restored democrats, but the

[1]This was not, of course, a "magistracy." Plato, *Gorgias* 474*a,* seems to refer to another earlier occasion.

nominal prosecutor was the obscure and insignificant Meletus. There were two counts in the accusation, "corruption of the young" and "neglect of the gods when the city worships and the practice of religious novelties."[1] Socrates, who treated the charge with contempt and made a "defence" which amounts to avowal and justification, was convicted, probably by 280 votes against 220. The prosecutors had asked for the penalty of death; it now rested with the accused to make a counter-proposition. A smaller, but substantial, penalty would have been accepted, but Socrates took the high line that he really merited the treatment of an eminent benefactor, maintenance at the public table. He only consented for form's sake to suggest the small fine of one *mina*, raised at the entreaty of his friends to 30.

This incensed the court and "death" was voted by an increased majority,[2] a result with which Socrates declared himself well content. As a rule at Athens the condemned man "drank the hemlock" within 24 hours, but in the case of Socrates the fact that no execution could take place during the absence of the sacred ship sent yearly to Delos caused an unexpected delay of a month, during which Socrates remained in prison, receiving his friends and conversing with them in his usual manner daily. An escape was planned by his friend Crito, but Socrates refused to hear of it, on the ground that the verdict, though contrary to fact, was that of a legitimate court, and must therefore be obeyed. The story of his last day has been perfectly told in the *Phaedo* of Plato, who, though not himself an eye-witness, was in close touch with many of those who were present.

Socrates wrote nothing; therefore our information about his personality and doctrine has to be sought chiefly in the dialogues of Plato and the *Memorabilia* of Xenophon. Both men were nearly 45 years younger than Socrates, and can therefore only speak from first-hand knowledge about the last ten or twelve years of his life. Xenophon's relations with him seem not to have been close, and he has even been suspected of deriving much of his material from Plato's dialogues. His admitted deficiencies in imagination and capacity for thinking do not make him the more faithful exponent of a philosophical genius.

To call him a "Boswell" does poor justice to the intellect of Boswell. (It must also be remembered that Boswell collected his material largely during Johnson's life, and with his knowledge and help.) We need also to discount Xenophon's apologetic purpose. His most valuable statements are those which appear most at variance with his main thesis that the prosecutors of Socrates were mistaken from their own point of view. Plato's more vivid picture has been suspected on the ground that Plato used Socrates as a "mouthpiece" for speculations of his own. What this really means is that the so-called "Ideal Theory" expounded in the *Phaedo* is held to have been originated by Plato after the death of Socrates. There are serious reasons for denying this assumption though they have not yet convinced all scholars; in any case it is a *petitio principii* to employ it, without investigation, as an argument to discredit Plato's testimony. Xenophon's silence at most only proves that Socrates did not converse on such matters with him. In some important respects Plato's testimony is confirmed by the remains of Aeschines of Sphettus. The *Clouds* of Aristophanes yields valuable information about Socrates in his middle "forties," when allowance is made for its character as a burlesque. It should be compared carefully with the autobiographical statements put into the mouth of Socrates in the *Phaedo* (96*a*–100*a*). These are not "contemporary evidence," but they are clearly meant to express Plato's *bona fide* belief about his master's intellectual history.

Personal Characteristics.—Though Socrates was a good fighting man, his outward appearance was grotesque. Stout and not tall, with prominent eyes, snub nose, broad nostrils and wide mouth, he seemed a very Silenus. But, as his friends knew, he was "all glorious within," "the most righteous man of the whole age" (Plato, *Ep.* vii. 326 *e*). His self-control and powers of endurance were exemplary; "he had so schooled himself to moderation that his scanty means satisfied all his wants."

But he was no self-tormenting ascetic; he "knew both how to want and how to abound," and could be the soul of the merriment at a gay party. He had no sympathy—this was a main point in the *Telauges* of Aeschines—with the slatternliness of his friend Antisthenes or the godly dirtiness affected by "Pythagorists." There was nothing of the complacent self-righteousness of the Pharisee, nor of the angry bitterness of the satirist, in his attitude towards the follies or even the crimes of his fellow men. It was his deep and life-long conviction that the improvement not only of himself, but of those with whom he might have to do, was a task laid upon him "by God," but the task was not to be executed with a scowling face and an upbraiding voice. Like St. Francis Xavier, he thoroughly understood how important it is to one who would win men's souls to be "good company." Conscious of his own infirmities, he felt a real and profound sympathy for those who had not learned to master their frailties and passions.

He was a true patriot, and his devotion to the city in which he had been born and bred was only made the more evident by his conviction that he could best prove it by setting his face resolutely against the attractions of specious and popular, but deadly, false theories of public and private morality. When the city brought him to trial and threatened him with death his sense of civic duty forbade him to withdraw into exile before the trial, or to accept the opportunity of escape during his unforeseen imprisonment. It was his very patriotism which made him an unsparing critic of the "democracy," which means, in Nietzsche's phrase, "one flock and no shepherd," and so led directly to the accusation which proved fatal to him.

Nothing was more marked in his character than an unusually keen sense of humour, an appreciation of the comic in human nature and conduct which protected him at once against sentimentality and against cynicism. This is what his opponents in Plato call his "irony," and treat as an irritating affectation. "Intellectually the acutest man of his age, he represents himself in all companies as the dullest person present. Morally the purest, he affects to be the slave of passion" (W. H. Thompson). No doubt, in part this irony was "calculated"; it "disarmed ridicule by anticipating it." But its true source is the spontaneous sense of "fun" which makes its possessor the enemy of all pretentiousness, moral or intellectual, in himself and in others. And it is certain that, though the purity of Socrates is beyond question, he really had an ardent and amorous temperament.[3]

Religion.—Socrates was clearly a man of deep piety with the temperament of a "mystic." Like other educated men of his age, he regarded mythology, with its foolish or immoral tales about gods, as a mere invention of the poets. But he found it easy to combine his own strong belief in God, the all-wise and all-good ruler of the world, with the view that in practice we could worship God in the way prescribed by "the usage of the city." God's existence is shown, he held, not only by the providential order of nature and the universality of the belief in Him, but by warnings and revelations given in dreams, signs, oracles. The soul of man partakes of the Divine; the concluding pages of Plato's *Apology* prove that Socrates had a strong belief in its immortality. (Xenophon for apologetic reasons is silent on the point, but has reproduced the argument in the dying speech of his Cyrus in the *Cyropaedia*. Aristophanes, too, makes Socrates combine the parts of "infidel" physicist and hierophant of a mysterious private faith, and in the *Birds* [1553, *seq.*] represents him as presiding at a fraudulent *séance*.) He was regular, says Xenophon, in prayer and sacrifice, though he held that since only the gods know what is good for us, our prayer should simply be "give me what is good"; we must not dictate the form the blessing should take. It is clear from Plato that Socrates was deeply influenced by Pythagorean and Orphic religious ideas, though he regarded the ordinary Orphic mystery-monger with healthy contempt.

[1] *καινὰ δαιμόνια* in the edictment means literally "novel practices in religion," not "novel deities," (though the second is insinuated).

[2] What offended the court was not the smallness of this sum—30 *minae* was not a small sum in the economic circumstances of the time—but Socrates' description of himself as a distinguished public benefactor.

[3] *Cf.* Aeschines, *Alcibiades* Fr. 4 (Krauss), which confirms the representation of Plato on this point.

The evidence that Socrates had a markedly "mystical" temperament is abundant. Plato tells of his curious "rapts," in one of which he stood spellbound for 24 hours in the trenches before Potidaea, and there seems to be an allusion to this singularity in the *Clouds* (171 *seq.*).

The familiar "Divine sign" tells the same story. This, according to Plato, was a "voice" often heard by Socrates from childhood. It forbade him to do things; but never gave positive encouragement. (Xenophon, who makes more of the matter, says, less probably, that it did give positive directions.) Plato treats the "voice" very lightly; by his account, it merely gave prognostications of good or ill luck, and the occasions of its occurrence were often "very trivial." Thus it was neither an "intuitive conscience," nor a symptom of mental disorder, but an "interior audition," a "psychic phenomenon" of a kind now known to be not specially uncommon.

Mode of Life.—Socrates' whole time seemed to be spent "out of doors," in the streets, the market-place, and more particularly, the *gymnasia.* He cared little for the country and rarely passed the gates. Though he frequented by choice the society of lads of promise, he also talked freely to politicians, poets, artisans about their various callings, their notions of right and wrong, the familiar matters in which they might be expected to take an interest. The object of all this, he says in the *Apology,* was to test the famous Delphic oracle which had pronounced him the wisest of men. It is clear from the *Apology* that the oracle had made this declaration, no doubt because the Delphic authorities knew from the form of the question what answer was desired. The presupposition of the *Apology* is that this happened before Socrates had become conscious of his mission to his fellow men; even at that early date, it is implied, he had the highest of reputations in circles interested in wisdom.[1] Acutely sensible of his own ignorance, Socrates set himself to convict "the god" of falsehood.

But when experience showed that those who thought themselves wise were unable to give any coherent account of their wisdom, he had to admit that he was wiser than others, just because he alone was aware of his own ignorance. This account is plainly tinged with the usual "irony." Socrates did not take Apollo and his oracle very seriously. But that he was quite serious in believing himself charged with a mission, not from "Apollo," but from God, to preach to his fellow men the supreme importance of knowledge of what is for the soul's good is proved by his declaration that he is more than ready to face instant death rather than to neglect his commission. The poverty in which this mission had involved him, and the austerity of the rule of life it entailed were notorious.

Summer and winter, his coat was the same; he had neither shoes nor shirt. "A slave who was made to live so," the sophist Antiphon said, "would run away." This self-imposed life of hardships was the price of his spiritual independence. His message was variously received. Some of those whose false pretentions were exposed by his trenchant criticizing regarded him with ill-will; many thought him an officious busybody. Among the younger men, many merely thought it good sport to see their elders silenced. Others (Xenophon says that this was the case with Alcibiades and Critias), deliberately attached themselves to him for a time "for private ends," believing that to learn the secret of so acute a reasoner would be the best preparation for success in the law courts, the council and the assembly. Others sincerely hoped by associating with him to become good men and true, capable of doing their duty by house and household, by relations and friends, by city and fellow-citizens.

Finally, there was an inner circle who entered more deeply into his principles and transmitted them to the next generation. But these were not "disciples" united by a common doctrine. Socrates finally repudiated all claim to have "disciples." The bond of union was a common reverence for a great man's intellect and character. It was, in the main, this group who were collected round Socrates in the day of his death; many of them, *e.g.,* Eucleides from Megara, and the young Theban Pythagoreans, Cebes and Simmias, were foreigners from States which had been enemies of Athens in the Peloponnesian War.

[1]This is also proved by the attachment to him shown by Eleatics from Megara and young pupils of the Pythagoreans from Thebes and Philius. These connections must have been founded before the Peloponnesian War

The Accusation and Its Causes.—The explanation of the attack made on Socrates is simple. He had been on terms of close friendship with the two men whose memories were most obnoxious to the democrats, Critias, the fiercest spirit among the extremists of the "Terror" of 404, and Alcibiades, whose self-will had done so much to bring about the downfall of the Athenian empire. The charge of "educating Alcibiades" was made prominent in the pamphlet written a few years after the trial by the "sophist," Polycrates, in justification of the verdict. More than half a century later, the orator Aeschines reminds his audience that Socrates had been put to death because he was believed to have educated Critias. In point of fact, it was absurd to make Socrates responsible for the ambitions of Alcibiades, and, as he reminded his judges, he had disobeyed an illegal order from Critias and his colleagues at the risk of his life. But it is natural that he should have had to suffer for the crimes of both men, the more that he was known to have been an unsparing critic of democracy, and of the famous democratic leaders. These suspicions would be made the more acute by the remembrance that Socrates had not, like the advanced democrats, withdrawn from Athens during the "Terror."

He was, in fact, suspected of using great abilities and gifts to pervert his younger associates from loyalty to the principles of democracy, and the convinced democrats who had recovered the city in 403 were unwilling, as Burnet has said, "to leave their work at the mercy of reaction." That they took no steps for four years is probably explained by the state of complete confusion and congestion into which the disorders of 404 had thrown the law courts. The motives of Anytus, an upright, unintelligent democrat, are thus quite explicable. From his point of view, Socrates would be at the best a "whig," and democrats who remembered the career of Theramenes could not be expected to make a fine distinction between the "whig" and the traitor.

The real grounds for the attack could not be disclosed in the indictment, since the amnesty which terminated the struggle of 404–403, and of which Anytus himself had been a main promoter, covered all offences committed before the archonship of Eucleides (403). Hence the charge had to be couched in the form of a vague accusation of "corruption of the young." Probably for the same reasons Anytus was ashamed to appear as the principal in the matter and put forward the obscure Meletus, who might venture on "indiscretions" more openly. If Meletus was the same person who also prosecuted Andocides in the same year on the same charge of "impiety," and if, as is not unlikely, he is the real author of the speech *Against Andocides* ascribed to Lysias, he must have been a half-witted fanatic, and this may explain why the charge of irreligion was added. The real nature of this "irreligion" appears never to have been explained. Xenophon suggests that the allusion was to the "Divine sign" but this cannot be correct. It is clear from Plato's *Apology* that Meletus said nothing about the "sign" at the prosecution, and that Socrates is speaking with his "usual irony" when he pretends to guess that the mention of "religious novelties" in the indictment referred to it. In the *Apology,* Socrates says that the prosecution is, no doubt, relying on memories of Aristophanes' *Clouds,* where he had been made to talk "atheism" as part of the burlesque on men of science.

But there must have been more behind the charge, and it seems likely that Burnet is right in reminding us that the prosecution of Andocides revived the old scandal of the "profanation of the mysteries," which had thrown Athens into a ferment on the eve of the Sicilian expedition in 416–415. The two chief victims, Alcibiades and his uncle Axiochus, were both among the intimates of Socrates, and there is reason to think that others of his friends were affected. If this is what lay behind the charge, we can understand why its real meaning seems never to have been explained. Owing to the terms of the amnesty, the matters in question were not really within the competency of the court. Socrates himself, in the account of Plato, who was present at the trial, treats the whole matter with contempt. His defence consists in narrating the facts

of his past life, which proved that he was equally ready to defy the populace and the "thirty" in the cause of right and law, and in insisting on the reality of his mission from God and his determination to discharge it, even at the cost of life. The prosecutors had no desire for blood. They counted on a voluntary withdrawal of the accused from the jurisdiction before trial; the death penalty was proposed to make such a withdrawal certain. Socrates himself forced the issue by refusing at any stage to do anything involving the least shade of compromise. The prosecution had raised the question whether he was a traitor or, as he held himself to be, an envoy from God; Socrates was determined that the judges should give a direct verdict on the issue without evasion. This is what makes him a martyr, but also what forbids us to call Anytus a murderer.

Doctrine and Method.—Socrates was a man of the Periclean age, and the Periclean age witnessed one of the periodical "bankruptcies of science." Cosmological speculation, which had been boldly pursued from the beginning of the 6th century seemed by the middle of the 5th to have led to a chaos of conflicting systems, each of which could establish only one point, that all its rivals were wrong. Parmenides of Elea had apparently cut away the ground from science by showing that the real world must be quite unlike anything which our senses reveal to us, and that, consequently, the method of cosmology, interpretation of the world by analogies from familiar sensible experiences, is inherently fallacious. His pupil Zeno seemed to have shown that even the postulates of mathematics are mutually contradictory.

Science, then, seems impossible, and this is why the ablest men of the generation before Socrates, such as Protagoras and Gorgias, turned away from the pursuit of it and tried to find a use for the intellect in professions which concern themselves, not with the discovery of truth, but with making a success of human life. "Probability is the very guide of life," and in practical matters "useful" points of view may be attainable, even if scientific certainty is beyond our reach. According to the narrative of the *Phaedo*, Socrates, as a young man, began with an experience typical of his age. He was enthusiastically interested in "natural science," and familiarized himself with the various current systems, being specially interested in the contrast between the old Milesian type of cosmology with its flat earth and the Italian type with its spherical earth. He was also interested in the mathematical puzzles raised by Zeno about "the unit" (*i.e.*, the problem of continuity). He discovered, to his distress, that though each authority was quite sure that the views of the others were wrong, none of them could give any proof that his own were right.

There was a complete lack of critical method. For a moment he hoped to find salvation in the doctrine of Anaxagoras that "mind" is the source of all cosmic order, since this seemed to mean that "everything is ordered as it is best that it should be," that the universe is a rational teleological system. But on reading the book of Anaxagoras, he found that the philosopher made no effective use of his principle; the details of his scheme were as arbitrary as those of any other. After this disappointment, Socrates decided that he had "no head for physics" and must fall back on his own mother-wit. Accordingly he resolved henceforth to consider primarily not "facts" but λόγοι the "statements" or "propositions" we make about them. His method should be to start with whatever seemed the most satisfactory "hypothesis," or postulate, about a given subject, and to consider the consequences which follow from it. So far as these consequences prove to be true and consistent, the "hypothesis" may be regarded as provisionally confirmed; if they are false or mutually inconsistent it is discredited. But it must be a strict rule of method not to confuse enquiry into the consequences of the "hypothesis" with proof of its truth. If the question of its truth is raised, the issue can only be settled by deducing the initial "hypothesis" as a consequence from some more ultimate "hypothesis" which both parties to the dispute are content to accept. The method, still familiar to us as that of true science, is manifestly suggested by reflection on the "antinomies" of Zeno, whom Aristotle called the creator of "dialectic," and whom Plato, in the *Parmenides*, afterwards described as meeting Socrates in the youth of the latter. So far, Plato's story has every appearance of being historical. But it is still the fashion to hesitate to follow it any further. According to him, Socrates next proceeded to take it as his own fundamental "hypothesis" that every term (such as "good," "beautiful," "man") which has a single unequivocal denotation directly names a single self-same object of a kind inaccessible to sense-perception and apprehensible only by thought. Such an object Socrates calls an ἰδέα or εἶδος, Form. (The transliteration "Idea" is misleading, owing to the psychologizing of the sense of the word by Locke and his followers.) The sensible things of which we predicate beauty, goodness, humanity, have only a secondary and derivative reality. Strictly speaking, we must not say that they *are* this or that, but only that they *become* this or that for a time, in virtue of the temporary "presence" (παρουσία) to them of the corresponding Form, or, as it is also expressed, in virtue of their "participation" (μέθεξις) in the Form. A sensible thing, in fact, is simply a temporary complex of Forms.

In the *Parmenides* of Plato Socrates is made to expound this doctrine to the great philosophers Parmenides and Zeno as his solution of the standing puzzle of the one and the many. This is the doctrine of Forms (the "Ideal Theory") as it is stated in the *Phaedo* and *Republic*. Though it is quite different from the version of the doctrine ascribed by Aristotle to Plato, it has been usual in the 19th century to assume that it is an earlier form of that doctrine consciously devised by Plato after the death of Socrates. The chief argument for this view is based upon the observation of Aristotle that Socrates rightly "did not separate" the universal from the particular (*Met. M.*, 1078 *b*30) as, it is apparently implied, Plato did. It is, however, not clear that Aristotle means by this, what he never says expressly, that Socrates did not teach the doctrine ascribed to him in the *Phaedo*. He might equally mean that the doctrine of the *Phaedo* does not itself involve the kind of "separation" of the universal from the particular to which he objects in what he describes as the Platonic theory, and, since the *Phaedo* is one of the Platonic dialogues to which he most frequently alludes, it is strange that he should never have said that it misrepresents the historical Socrates on a capital point, if he really thought so.

On the other side, the doctrine is expressly said in the *Phaedo* to be a familiar one which Socrates "was always" repeating, and it is hard to believe that Plato could have made such a statement about a speculation of his own, especially as most of the personages of the *Phaedo* were certainly still alive long after the dialogue was written. It is hard to see what could be the point of such a mystification, and harder to understand how its author could have expected it to be successful. Of course, demonstration is out of the question in such a matter; we can only be guided by considerations of probability. If we think the probabilities against the view which credits Plato with deliberate mystification, we must be prepared to admit the possibility that he is also reproducing the thought of Socrates in the further development of the *Symposium* and *Republic*, where we hear of a supreme Form, that of Beauty, or Good, the vision of which is the far-off goal of all intellectual contemplation. We may fairly suspect that the thought of Socrates is undergoing development in the mind of Plato, but it will be natural to regard the development as, in the main, unconscious, and to recognize that no complete separation of the Socratic and the Platonic in the result is possible.

It is certain that on the logical side the thought of Socrates proceeded "as if" the doctrine of Forms expounded in the *Phaedo* were its point of departure. Both Plato and Xenophon bear out the remark of Aristotle that Socrates may fairly be credited with two things, "inductive arguments" and "universal definitions" (*Met. M.*, 1078 *b*27). The "universal definition" is an attempt to formulate precisely the meaning of a universal significant predicate, *i.e.*, to apprehend what the *Phaedo* calls a Form, and it is from the practice of Socrates, who aimed at the clarification of thought about the meaning of moral predicates as the first indispensable step to the improvement of practice, that the theory of logical division and definition, as worked out in Plato's later dialogues and the logical treatises of Aristotle, has arisen.

The "inductive arguments" mean the characteristic attempts

to arrive at such formulations by the consideration of simple and striking concrete illustrations familiar to us from both Xenophon and Plato, the perpetual arguments about "shoemakers and carpenters and fullers," which the fashionable speakers in Plato profess to think vulgar. Induction, on this view of it, is not regarded as a method of proof. Its function is that of suggestion; it puts the meaning of a proposed "definition" forcibly and clearly before the mind. The justification of the definition, then, has to be sought in a consideration of the satisfactoriness of the "consequences," which would follow from its adoption. Socrates himself sought for his "definitions" principally in the sphere in which he was most interested, that of conduct, private and public. As Aristotle says, he concerned himself with the "ethical," character and conduct, not with "nature" at large. This is what Cicero means by saying that he "brought down philosophy from heaven to earth."

Before him cosmology had been the chief topic of interest, after him, the central problem of philosophy was to formulate a rule of life. With him the "practical use of reason" comes by its rights. In this respect Socrates stamped on philosophy a character which it has never lost. The main outlines of his philosophy of conduct are fortunately quite certain, and could be discovered if we had no more material than the Platonic *Apology* and the *Memorabilia* of Xenophon. As the *Apology* tells us, the specific message from God which Socrates brought to his fellow men was that it is the great business of life to practice the "care" or "tendance" (ἐπιμέλεια, θεραπεία), of one's *soul,* to "make one's soul as good as possible," and not to ruin one's life, as most men do, by putting care for the body or for "possessions" before care for the "soul."

The thought which is here fundamental is that of the "soul" (ψυχή) as that which is most truly a man's self. In Greek literature, down to the end of the 5th century, we can trace two main senses of the word ψυχή. (1) It means "the breath of life" which a man parts with in dying. It is this which, in popular superstition, is left as a mere "ghost," or "shade," when the man "himself," his body, has perished. In earlier Ionian science this is identified with the "air" which a man inhales so long as he is alive. (2) In circles influenced by the Orphic religion the soul is thought of as something which has a destiny beyond the grave, but this, too, is something different from the self. It is a sort of stranger inhabiting the body, but having little to do with the conduct of normal life. It "sleeps while the body is active, but wakes when the body sleeps," and reveals itself chiefly in dream and trance. From the beginning of the 4th century we find ψυχή coming at last to mean what "soul" means to us, the normal waking personality, the seat of character and intelligence, "that," as Socrates says in Plato, "in virtue of which we are called wise or foolish, good or bad," and as this usage of the word first appears in writers whom we know to have been influenced by Socrates (Isocrates, Plato and Xenophon), we may fairly ascribe it to his influence. The thought now works out thus. The soul *is* the man (in the later Academic formulation a man *is* "a soul using a body").

Our happiness or well-being, then, depends directly on the goodness or badness of the soul. It is no happiness to possess health, or strength, or wealth, unless we know how to *use* these advantages rightly. If we use them wrongly, they will only be so many means to misery. The reason why hardly any one achieves happiness is not that men do not wish to be happy. No one ever wishes for anything but true good, that is, true happiness, but men miss their happiness, in spite of the universal wish for it, because they do not *know* what it is. They mistake for real good things which are not really good (*e.g.,* unlimited wealth or power). In this sense, "all wrong-doing is involuntary." The first and fundamental requisite for happiness, then, is that men should *know* true good and not confuse it with anything else. The good state of the soul is precisely that state in which it never makes the mistake of taking anything to be good when it is not really good. To "make one's soul as good as possible" thus means to attain the knowledge of good which will prevent us from *using* strength, health, wealth, opportunity, wrongly. If a man has this knowledge, he will always act on it, since to do otherwise would be to prefer known misery to known happiness, and this is impossible. *"All* the virtues are one thing," *knowledge* of good, and all "vice" is one thing, ignorance of true good.

"Popular" goodness—what passes current as virtue—is mostly illusory, because it is mainly a matter of habit, not of assured conviction about good. It breaks down under temptation; but if a man really knew that, *e.g.,* to commit a crime is worse than to suffer loss or pain, or death, no fear of these things would lead him to commit the crime. The professional "sophist," again, claims to be able to teach "goodness," but the claim is shown to be unfounded by the very fact that the sophist treats "goodness" as though it were a neutral "accomplishment" which can be conveyed by mere instructions. Now an accomplishment, or "art," can always be put to either of two uses, a good or a bad, as the physician, for instance, can use his professional knowledge to cure or to kill.

Knowledge of good is the one knowledge of which it is impossible to make an ill use; the possession of it is a guarantee that it will always be used aright. Thus Socrates becomes, as against the relativism of Protagoras, the founder of the doctrine of an absolute morality based on the conception of a felicity which is the good, not of Athenians or Spartans, or even of Greeks, but of man as man. It is not in virtue of our allegiance to a particular city, nor even of our place in a particular historical civilization, but in virtue of our universal humanity, that we have the task of "making the soul as good as possible," or, as Socrates also said, in language influenced by Pythagoreanism, "making it like God."

Politics, from this point of view, does not differ in principle from ethics. The business of the statesman also is the "tendance" of souls, though his task is to aim at making, not only his own soul, but the souls of all his fellow-citizens "as good as possible." The knowledge of good is also the "royal" science or science of governing, the foundation of all statesmanship. The radical vice of ancient democracy, according to Socrates, is that of not demanding evidence of any special knowledge in its leaders; it suffers the destinies of society to be in the hands of men without true insight. Partly this means that by not demanding intellectual qualifications for office, democracy surrenders the control of affairs into the hands of men with no adequate expert knowledge. But this is only a minor part of Socrates' indictment. His main criticism is that though in some departments, at least, the democracy refuses to take the advice of any one but a qualified expert, on the question of the morality and justice of a proposed policy it treats any one citizen's opinion as of equal value with another's.

Even a Themistocles or a Pericles plainly had no knowledge of true statesmanship, as we see from the fact that they neither taught the principles of it to their sons, nor had them taught these principles by others, and if we look at the actual achievements of these men we can see that they were, so to say, good "body-servants" of the *Demos,* they gave it the things which tickled its taste, such as a navy and a commerce; they were no "physicians of the body politic," for they did not promote "righteousness and temperance," the spiritual health of the community. That is, they measured national greatness by wealth and empire, not by character. According to Plato, Socrates maintained that he himself, who abstained all through from active politics, was the one Athenian of the time who deserved the name of statesman. He deserved it because he understood, as the men of action did not, that national, like individual felicity, depends on the knowledge of good which inevitably leads, where it is possessed, to the action which makes the soul "as good as possible."

The well-known Platonic *Republic* may fairly be said to be, on its political side, a picture of the life of a society in which the whole system of social and economic life is based on this Socratic conviction that "politics" is the application to the community at large of the principle that knowledge of the absolutely good is the necessary and sufficient condition of well-being. How far any of the special regulations of Plato's *Utopia* embody actual convictions of Socrates is more than we can say, though it is significant that the *Aspasia* of Aeschines represented Socrates as maintaining

one of Plato's "paradoxes," the capacity of women for war and politics.

The Socratics.—The thought of Socrates has, in the main, been made fruitful for subsequent ages by being taken up and continued in the life-work of Plato. A more temporary influence was exercised by certain other members of the group of Socratic men whom it has become customary to speak of as the "minor" Socratics. The most important of them are Antisthenes of Athens and Eucleides of Megara, with whom the Cynics and Megarians of the 4th and early 3rd centuries are historically connected. With them it is usual also to mention Aristippus of Cyrene, often still spoken of as somehow connected with the Cyrenaic school of the early 3rd century.

It is probable, however, that the current accounts exaggerate the closeness of the connection between these men and the later schools. Aristippus of Cyrene figures in Xenophon's *Memorabilia* simply as a luxurious and refined man of the world who makes it his rule of life to extract personal enjoyment from existence, sitting loose to all attachments which might interfere with his ease and not allowing himself to take root anywhere. The later anecdotes about him bear out this representation. There is no good evidence that he had a philosophy or originated a school. Aristotle ascribes no doctrine to him and never mentions a "Cyrenaic" school of Hedonists, though he could hardly have avoided doing so in his discussions of Hedonism in the *Nicomachean Ethics* if he had known of one. Plutarch expressly describes the Cyrenaics as contemporaries of Epicurus, and all the names of members of the school known to us belong to the time of the successors of Alexander the Great. The one point of doctrine common to them appears to have been that they rejected the notion of a good more permanent than the pleasure of the moment. The supposed connection of Aristippus with them seems to be based on a confusion with his grandson of the same name, who, according to Eusebius, reduced his grandfather's practice to theory.

Eucleides of Megara was a friend both of Socrates and of Plato, who temporarily took refuge with him after the death of Socrates, and, at a later date, dedicated the *Theaetetus* to him. All we know of his teaching is that he held to the Monism of Parmenides, maintaining that nothing is real except "the One," which is also called "wisdom" φρόνησις, "intellect" (νοῦς) and "God" (*D.L.*, ii. 106). The mention of "wisdom" as a synonym for "the One" seems to reveal the influence of Socrates. Most of our notices of Megarians deal with men of a later time, Eubulides, a contemporary of Aristotle, Diodorus Cronus and Stilpo. These men were pugnacious formal logicians famous for their rejection of the notion of "possibility" which is so fundamental in the Aristotelian philosophy. According to them, nothing is possible except the actual. Aristotle resented the criticism so keenly that "sophist" in his terminology appears to be regularly equivalent to "Megarian logician." It is not clear how these ἐριστικοί are connected with the Monism of Eucleides. There are reasons for supposing the puzzling antinomies of Plato's *Parmenides* to be a parody of Megarian logic, and it is a view which has been widely accepted in recent times that they are also meant in Plato's *Sophistes* by the "friends of Forms" who are there contrasted with the materialists and said to maintain that reality consists of a multitude of "incorporal Forms" which can only be apprehended by thought. This identification is, however, uncertain (and, in the present writer's opinion, mistaken).

Antisthenes was a friend of Socrates of long standing, with a marked individuality of his own, and a voluminous writer much admired for his style. He does not appear to have been a "disciple," though he was personally attached to Socrates, and particularly admired his strength of will and mastery of his passions. In philosophy he is chiefly known for two things, his denial of the possibility of making judgments in which the predicate and subject terms are non-identical, and his insistence in ethics on the simplification of life by the reduction of our wants to an indispensable minimum. In virtue of the latter he was commonly regarded as the founder of Cynicism and it is certain that he personally influenced the famous Diogenes and that the later Cynics were in the habit of regarding him as a model man. But it is not clear either that the Cynics of the 4th century were a "sect" or "school" in any real sense of the words, or that the nickname "dog" was ever given to anyone before Diogenes. It was believed in later antiquity that there was a personal feud between Antisthenes and Plato, and it seems certain that one of the works of Antisthenes, called *Sathon*, was a virulent personal attack on Plato. But the ingenuity spent in the 19th century on discovering polemical allusions to Antisthenes in Plato's dialogues seems to have been mostly wasted. According to Plato, the logical paradox that "contradiction is impossible" was maintained by numerous persons in the days of Socrates. Hence it seems unreasonable to detect special allusions to Antisthenes in the frequent references to this paradox in the dialogues.

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See also SOPHISTS, PLATO, ETHICS. (A. E. TA.)

SOCRATES, the name of a famous 5th-century church historian. The Ἐκκλησιαστικὴ ἱστορία of Socrates, still extant in seven books, embracing the period from 306 to 439, was written in 439, or within a few years thereafter. He was born about 380 and brought up at Constantinople. He was a "scholasticus" or advocate. His work is dedicated to one Theodorus, who had urged him to write such a history. He had no thorough preparation for the task, and for the period down to the death of Constantius (361) was practically dependent on Rufinus. After his work was finished he became a student of Athanasius's writings and came to see how untrustworthy his guide had been. He accordingly rewrote his first two books (see *H.E.* ii. 1) certainly before 450 and probably before 444 (*see* Geppert, p. 8), and it is only this revision that has reached us. The chief sources from which he drew were: (1) the *Church History*, the *Life of Constantine* and certain theological works of Eusebius; (2) the *Church History* of Rufinus; (3) certain works of Athanasius; (4) the no longer extant Συναγωγὴ τῶν συνοδικῶν of the Macedonian and semi-Arian Sabinus—a collection of acts of councils with commentaries, brought down to the reign of Theodosius I. (this was a main source); (5) the *Constantinopolitan Chronicle*; (6) possibly a collection of imperial biographies; (7) lists of bishops; (8) collections of letters by members of the Arian and orthodox parties.

The theological position of Socrates, so far as he can be said to have had one, is at once disclosed in his unlimited admiration for Origen. All the enemies of the great Alexandrian he regards merely as empty and vain obscurantists; for the orthodoxy of his hero he appeals to Athanasius. Closely connected with his high regard for Origen are his appreciation of science generally and the moderation of his judgment on all dogmatic questions. According to him, Ἑλληνικὴ παιδεία is quite indispensable within the Church; many Greek philosophers were not far from the knowledge of God, as is proved by their triumphant arguments against atheists and gainsayers of divine providence. The apostles did not set themselves against the study of Greek literature and science; Paul had even made a thorough study of them himself. The Scriptures, it is true, contain all that appertains to faith and life, but give no clue to the art of confuting gainsayers. Greek science, therefore, must not be banished from the Church, and the tendency within the Church so to deal with it is wrong. This

point of view was the common one of the majority of educated Christians at that period, and is not to be regarded as exceptionally liberal. The same holds true of the position of Socrates in regard to dogmatic questions.

EDITIONS AND LITERATURE.—Socrates' *History* has been edited by Stephanus (Paris, 1544; Geneva, 1612), Valesius (Paris, 1659 *sqq.*), Reading (Cambridge, 1720), Hussey (Oxford, 1853, reissued by Bright, 1878). It is also to be found in volume lxvii. of Migne's *Patrologia,* and there is an Oxford school edition (1844) after Reading. An English translation, revised by Zenos, is published in the Nicene and post Nicene Fathers, 2nd series, vol. ii.

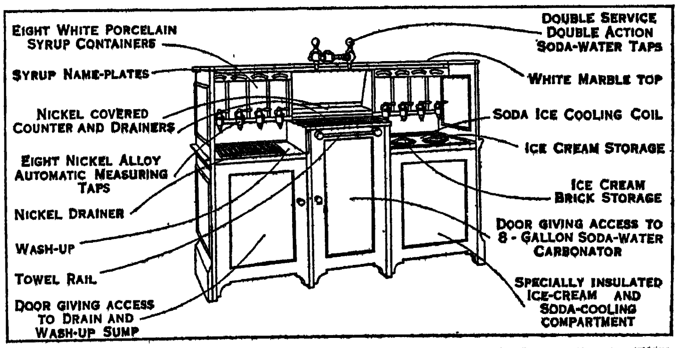
See Harnack, *"Socrates u. Sozomen"* in Herzog-Hauck's *Realencykl.,* 2nd ed., where bibliographical references will be found.

SODA. Under this somewhat loose title are included a number of substances of great industrial importance; viz., sodium carbonate, sodium bicarbonate, sodium hydrate or caustic soda, sodium sesquicarbonate or trona, and soda crystals or washing soda. The bulk of soda compounds is manufactured, but there exist in various parts of the world, notably in Canada, the United States, and East Africa, natural deposits of trona in the form of salt lakes. Washing soda, which is sodium carbonate combined with a proportion of water to form crystals, is a familiar substance; as also is sodium bicarbonate in medical preparations. The remainder of the group provide raw material for other industries and are not commonly met elsewhere. (*See* ALKALI.)

(A. E. H.)

SODA FOUNTAIN. This term was used to designate the equipment from which carbonated water, flavored and sweetened, is drawn and dispensed. An apparatus to serve soda water in a glass or tumbler instead of from a bottle came with the development of carbonating machinery. English and French manufacturers in the period from 1800 to 1825 devised improved equipment for making what was called "soda water." One improvement was a strongly built metal tank, cylindrical in form and holding several gallons of water, in which carbonic gas entered. This "cylinder," as it was called in England, and a "fountain" in the United States, was mounted on a frame and was rocked back and forth so as to increase the saturation of the water by the gas. The cylinder, being portable, was placed under the counter in the shop, and the soda water was drawn through a pipe which had a draft arm above the counter.

The important changes and improvements in the fountain have been made by American manufacturers. About 1855 the marble soda fountain was introduced, the apparatus being a marble box with an ice-chest to cool the coil of pipe and a metal container for the syrups which were drawn from a row of faucets. The early soda fountain changed from time to time as improvements were



REAR OR WORKING SIDE OF A WILSON SODA FOUNTAIN USED IN THE PREPARATION OF SOFT DRINKS

made. At first carbon dioxide was obtained by the interaction of an acid and a carbonate, then the gas was prepared from various sources—from natural gas, collected from brewers' fermenting vats, and from burning coke. The last-named source now supplies most of the carbonic gas, which comes in liquid form in steel tubes for carbonating beverages. Other improvements made in recent years are mainly in perfecting the carbonating machinery, in mechanical or electric refrigeration, in extending the service of the soda fountain, and in simplifying the working of the equipment so that the process or system is more or less automatic.

The present-day standardized soda fountain is built on a steel or iron frame. It resembles a long, narrow metal box, thoroughly insulated and sealed to keep out air and heat, and is divided into many sections and compartments. A 10 ft. fountain unit is commonly equipped with a cooling chamber for soda and ice water, two or three compartments for chipped ice, four cabinets for holding 5 gal. of bulk ice cream in cans and two cabinets for 5 gal. of brick ice cream, six syrup jars with pumps, four crushed fruit jars, one or two dry cold storage compartments for fresh fruits, milk or bottled goods, and two open sections (one at each end of the counter) with drainboard, sink, tumbler rinsers, a dish and spoon vat.

Soda fountains are made in two styles, the counter fountain and the back bar fountain. The latter has a so-called bar back of the counter, a structure 3 or 4 ft. high with a polished wood, tile or marble cornice supported on the two sides by columns of similar materials to match, with shelves for a display of glassware or candy, and with a large mirror in the centre.

At the present time the soda fountain is to be found everywhere in America: in most drug and candy stores, in department stores, in motion picture houses and at the road-side stands and inns for the patronage of tourists and the travelling public. The "soda parlor," as it was originally called, has developed into the soda fountain luncheonette—a place where not only an infinite variety of drinks, but foods such as soup, bouillon, sandwiches, salads, pastry and cake, are served. It is estimated there are from 90,000 to 100,000 fountains in the United States. The number of fountains in the European countries is rather small, probably not more than 1,000, and the demand has increased slowly. The soda fountain is becoming popular in Canada and in South American countries, and in the Australian Commonwealth where some 2,500 are now in use. (L. J. V.)

SODALITE, a member of the group of rock-forming minerals comprising the following isomorphous species:—

Sodalite	$Na_4(AlCl)Al_2(SiO_4)_3$
Haüynite	$(Na_2Ca)_2(NaSO_4{\cdot}Al)Al_2(SiO_4)_3$
Noselite	$Na_4(NaSO_4{\cdot}Al)Al_2(SiO_4)_3$
Lazurite	$Na_4(NaS_3{\cdot}Al)Al_2(SiO_4)_3$

These are sodium (or calcium) aluminium silicates, with chloride, sulphate, or sulphide. In their orthosilicate formulae, as above written, and in their cubic crystalline form they present a certain resemblance to the members of the garnet group. Crystals usually have the form of the rhombic dodecahedron, and are often twinned with interpenetration on an octahedral plane. They are white, or often blue in colour, and have a vitreous lustre. The hardness is $5\frac{1}{2}$, the specific gravity 2·2–2·4. These minerals are characteristic constituents of igneous rocks rich in soda, and they also occur in metamorphic limestones.

The species sodalite (so named because it contains soda) occurs as well-formed, colourless crystals in the ejected limestone blocks of Monte Somma, Vesuvius. In the elaeolite-syenite of Dungannon in Ontario bright sky-blue material has been quarried for use as an ornamental stone. Haüynite, or haüyne (named after R. J. Haüy), occurs as bright blue crystals and grains in the lavas of Vesuvius, Rome, the Eifel, etc. Noselite, or nosean, is found as greyish crystals in the sanidine bombs of the Eifel. Lazurite is an important constituent, together with some haüynite and sodalite, of lapis-lazuli (*q.v.*). (L. J. S.)

SODA WATER: *see* AERATED WATERS.

SODDY, FREDERICK (1877–), British scientist, was born at Eastbourne, Sussex, on Sept. 2, 1877, and was educated at Eastbourne college, the University college of Wales, Aberystwyth and Merton college, Oxford. From 1900–2 he held the post of demonstrator of chemistry at the McGill university, Montreal, where he carried out research work on radioactivity with Sir E. Rutherford, and for the next two years he worked under Ramsay at University college, London, becoming in 1904 lecturer in physical chemistry and radioactivity at the University of Glasgow. Ten years later he went to Aberdeen university as professor of chemistry, but he left there in 1919 to become Lee's professor of inorganic and physical chemistry in the university of Oxford. He made many valuable contributions to the science

of radioactivity, and with Sir E. Rutherford he developed the disintegration theory of the radioactive elements. As a result of his study of the disintegration series of the radio-elements Soddy concluded that certain elements should exist in two or more forms which may have different atomic weights, but are indistinguishable and inseparable chemically; these forms he called "isotopes." This theory, which probably constitutes Soddy's main contribution to scientific knowledge, was first published in 1912 and has since been brilliantly confirmed in many directions. He was awarded the Nobel Prize for chemistry in 1921. He was elected F.R.S. in 1910 and was a member of many British and foreign scientific societies, being president of the Röntgen Society 1905–6. (*See* X-RAYS.)

His numerous scientific publications, chiefly on radioactivity, include *Radioactivity* (1904); *The Interpretation of Radium* (1909) revised and enlarged by a section on the "Structure of the Atom" (1920); *Chemistry of the Radioactive Elements* (Part I., 1920; Part II., 1914); *Matter and Energy* (1912); *Science and Life* (1920); *Cartesian Economics* (1922); *Inversion of Science* (1924).

SÖDERBLOM, NATHAN (1866–), Swedish ecclesiastic, was born in Trönö on Jan. 15, 1866, and educated at the University of Uppsala. After the Lambeth Conference in 1908, Söderblom worked with success to secure an approach to "evangelical catholicity" among various Christian societies, and played an important part in the preparations for the universal Christian Conference on Life and Work held at Stockholm in Aug. 1925, in which he was one of the leaders. He had been appointed archbishop of Uppsala in 1914.

SÖDERHAMN, a seaport of Sweden, in the district (*län*) of Gefleborg, on an inlet of the Gulf of Bothnia, near the mouth of the Ljasne River, 183 m. N. by W. of Stockholm by rail. Pop. (1928), 11,680. Vessels drawing 15 ft. have access to Branthäll. The harbour is usually ice-bound for some four months in winter.

SÖDERTÄLJE, a town of Sweden, in the district (*län*) of Stockholm, 23 m. W.S.W. of Stockholm by rail. Pop. (1928), 14,811. It is on a bay of Lake Mälar, here connected with the Baltic by the Södertälge canal, $1\frac{1}{4}$ m. in length, with a minimum depth of 10 ft. This is on the route followed by the Göta Canal steamers between Stockholm and Gothenburg; it was opened in 1819, though a canal was begun here in the 15th century at the instigation of Engelbrecht. The town contains a church, believed to date from *c.* 1100.

SODIUM [symbol Na; atomic number 11; atomic weight 23·00 (O=16)], a chemical element belonging to the group of alkali metals. It is abundantly and widely diffused in nature, but always in combination. Sodium chloride, or common salt (*q.v.*), is exceedingly common, being the chief salt present in sea-water, besides occurring in extensive stratified deposits. Sodium carbonates are also widely dispersed in nature, forming constituents of many mineral waters, and occurring as principal saline components in natron or trona lakes, as efflorescences in Lower Egypt, Persia and China, and as urao in Mexico, Colombia and Venezuela. The solid crusts found at the bottom of the salt lakes of the Araxes plain in Armenia contain about 16% of carbonate and 80% of sulphate. In Colombia there occurs a double salt, $Na_2CO_3 \cdot CaCO_3 \cdot 5H_2O$, known as gay-lussite. In Wyoming, California and Nevada enormous deposits of carbonates, mixed in some cases with sulphate and with chloride, occur. Vast areas of the steppes in Hungary contain sodium carbonate in the soil. Natural sulphate occurs in an anhydrous condition as thenardite, Na_2SO_4, at Tarapaca, Chile, and in the rock-salt deposits at Espartinas near Aranjuez, Spain. Hydrated sulphates occur at several localities in certain provinces of Spain, and at Mühlingen in Aargau, and copious deposits of glauberite, the double sulphate of sodium and calcium, are met with in the salt-mines of Villarrubia in Spain, at Stassfurt, and in the province of Tarapaca, Chile, etc. A native nitrate of soda is obtained in great abundance in the district of Atacama and in Tarapaca, and was formerly imported into Europe in enormous quantities as cubic nitre for the preparation of saltpetre. Cryolite, a fluoride of aluminium and sodium, is extensively mined in Greenland and elsewhere for industrial purposes. These form the principal natural sources of sodium compounds—the chloride as rock salt and in sea-water being of such predominating importance as quite to outweigh all the others. But it is questionable whether, taken altogether, the mass of sodium they represent is as much as that disseminated throughout the rocky crust in the form of soda felspar (*i.e.,* as silicate of soda) and in other soda-containing rocks. From this source all soils derive small proportions of sodium in soluble forms, hence the ashes of plants, although they preferably imbibe potassium salts, contain traces and sometimes notable quantities of sodium salts, which also form essential ingredients in all animal juices.

Although many sodium compounds have been known from very remote times, the element was not isolated until 1807, when Sir H. Davy obtained it by electrolysing caustic soda. This method was followed by that proposed by Gay-Lussac and Thénard, who decomposed molten caustic soda with red-hot iron; and this in turn was succeeded by Brunner's process of igniting sodium carbonate with charcoal. In spite of many attempts, however, the metal could not be cheaply produced until electrolytic methods were perfected, and that patented by Castner in 1890 formed the basis of subsequent successful methods. If sodium chloride is used, there are several disadvantages: the fused salt and both the products of its electrolysis exert a destructive action upon containing vessels, and, further, the boiling point of the metal (877°) is inconveniently near the melting point (775°) of the salt. Borchers endeavoured to contend against the first difficulty by employing an iron cathode vessel and a chamotte (fireclay) anode chamber united by a specially constructed water-cooled joint. The other difficulty is to some extent met by using a mixture of sodium, strontium and potassium chlorides, which melts at a lower temperature than the pure chloride. In Castner's process (as employed at Oldbury and Niagara Falls and in Germany) fused caustic soda is electrolysed. The apparatus consists of an iron cylinder heated by gas rings below, with a narrower cylinder beneath, through which passes upwards a stout iron cathode rod cemented in place by caustic soda solidified in the narrower vessel. Iron anodes are suspended around the cathode, and between the two is a cylinder of iron gauze at the bottom with a sheet-iron continuation above, the latter being provided with a movable cover. During electrolysis, oxygen is evolved at the anode and escapes from the outer vessel, while the sodium deposited in globules on the cathode floats upwards into the iron cylinder, within which it accumulates, and from which it may be removed at intervals by means of a perforated iron ladle, the fused salt, but not the metal, being able to pass freely through the perforations. The sodium is then cast into moulds. Sodium hydroxide has certain advantages compared with chloride, although it is more costly; its fusing-point is only 320° C, and no anode chlorine is produced, so that both containing vessel and anode may be of iron, and no porous partition is necessary.

Properties.—Metallic sodium possesses a silvery lustre, but on exposure to moist air the surface is rapidly dulled by a layer of the hydroxide. It may be obtained crystalline by melting it in a sealed tube containing hydrogen, allowing it to cool partially, and then pouring off the liquid portion. The specific gravity is 0·971 at 20° C. At ordinary temperatures the metal has the consistency of wax and can be readily cut; on cooling it hardens. On heating it melts at 97° to a liquid resembling mercury, and boils at about 880° C, yielding a vapour, colourless in thin layers but a peculiar purple, with a greenish fluorescence, when viewed through thick layers. (For the optics of sodium vapour *see* R. W. Wood, *Physical Optics.*) Sodium ranks fourth to silver, copper and gold as a conductor of electricity and heat, and is the most electropositive metal with the exception of caesium, rubidium and potassium.

The metal is very reactive chemically. Exposed to moist air it rapidly oxidizes to the hydroxide; and it burns on heating in air with a yellow flame, yielding the monoxide and dioxide; in extremely dry air it is inert. (*See* DRYNESS, CHEMICAL.) A fragment thrown on the surface of water rapidly disengages hy-

drogen, which gas, however, does not inflame, as happens with potassium; but inflammation occurs if hot water be used, or if the metal be dropped on moist filter paper. Sodium combines directly, sometimes very energetically, with most non-metallic elements. It dissolves in liquid ammonia giving a blue solution in which its molecular weight is 23 (Kraus)—*i.e.*, the molecules are monatomic. It also combines with dry ammonia at 300–400° to form sodamide, $NaNH_2$, a white waxy mass when pure, which melts at 155°. Heated in a current of carbon dioxide sodamide yields caustic soda and cyanamide, and with nitrous oxide it gives sodium azoimide; it deflagrates with lead or silver nitrate and explodes with potassium chlorate. Sodamide was introduced by Claisen as a condensing agent in organic chemistry, and has since been applied in many directions. Sodium is largely employed in the manufacture of cyanides and was formerly used in reduction processes leading to the isolation of such elements as magnesium, silicon, boron, aluminium, etc.; it also finds application in organic chemistry. With potassium it forms a liquid alloy resembling mercury, which has been employed in high temperature thermometers. (*See* THERMOMETRY.)

COMPOUNDS

In its chemical combinations sodium is usually univalent; its salts are generally soluble in water, the least soluble being the pyroantimoniate, the dihydroxytartrate, and the triple nitrite $5Bi(NO_2)_3$, $9CsNO_2$, $6NaNO_2$.

Sodium hydride, NaH, is a crystalline substance obtained directly from sodium and hydrogen at about 360°. It burns when heated in dry air, and ignites in moist air; it is decomposed by water, giving caustic soda and hydrogen. Dry carbon dioxide is decomposed by it, free carbon being produced; moist carbon dioxide, on the other hand, gives sodium formate.

Several oxides have been described, but only two are important. The monoxide, Na_2O, is obtained by heating the metal above 180° in a limited amount of slightly moist oxygen. It forms a grey mass, which melts at a red heat and violently combines with water to give the hydroxide. The hydroxide or caustic soda, NaOH, is usually manufactured from the carbonate or by electrolysis of salt solution. (*See* ALKALI MANUFACTURE.) When anhydrous it is a colourless opaque solid which melts at 318°, and volatilizes with partial decomposition at a white heat. It is very soluble in water, yielding a strongly alkaline solution; it also dissolves in alcohol. It absorbs moisture and carbon dioxide from the atmosphere. Several hydrates are known; plus $2NaOH{\cdot}7H_2O$ is obtained crystalline by cooling concentrated solutions, $NaOH{\cdot}H_2O$ by allowing the very concentrated solution to crystallise while hot, and $NaOH{\cdot}2H_2O$ from a solution in 96·8% alcohol.

Sodium peroxide, Na_2O_2, is formed when the metal is heated in an excess of air or oxygen. In practice the metal is placed on aluminium trays traversing an iron tube heated to 300°, through which a current of air, freed from moisture and carbon dioxide, is passed; the process is made continuous, and the product contains about 93% Na_2O_2. When pure, sodium peroxide has a faint yellowish tinge, but on exposure it whitens. When dissolved in water it yields some NaOH and H_2O_2, but from a cold solution $Na_2O_2{\cdot}8H_2O$ separates as large tabular hexagonal crystals, and this is also obtained by precipitating a mixture of caustic soda and hydrogen peroxide solutions with alcohol. Acids yield a sodium salt and free oxygen or hydrogen peroxide; with carbon dioxide it gives sodium carbonate and free oxygen; carbon monoxide gives the carbonate; whilst nitrous and nitric oxides give the nitrate. A solution in hydrochloric acid, consisting of the chloride and hydrogen peroxide, is used for bleaching straw under the name of soda-bleach; with calcium or magnesium chlorides this solution gives a solid product which, when dissolved in water, is used for the same purpose. Sodium peroxide is chiefly employed as an oxidizing agent, being used in mineral analysis and in various organic preparations; it readily burns paper, wood, etc., but does not evolve oxygen unless heated to a high temperature. Sodyl hydroxide, $NaHO_2$, is said to exist in two forms: one, Na·O·OH, obtained from hydrogen peroxide and sodium ethoxide; the other, O:Na·OH, from absolute alcohol and sodium peroxide at 0°. They are strong oxidizing agents and yield alkaline solutions which readily evolve oxygen on heating.

Generally speaking, sodium salts closely resemble the corresponding potassium salts, and their methods of preparation are usually the same. For sodium salts not mentioned below reference should be made to articles wherein the *acid* is treated, unless otherwise indicated.

Sodium combines directly with the halogens to form salts which are soluble in water and crystallize in the cubic system. The fluoride, NaF, is sparingly soluble in water (1 part in 25). For the chloride see SALT. The bromide and iodide crystallize from hot solutions in anhydrous cubes; from solutions at ordinary temperatures in monoclinic prisms with $2H_2O$; and at low temperatures with $5H_2O$. The iodide differs from the other haloid salts in separating from solution in alcohols with "alcohol of crystallization." Sodium sulphide, Na_2S, obtained by saturating a caustic soda solution with sulphuretted hydrogen and adding an equivalent of alkali, is employed in the manufacture of soluble soda glass. Sodium sulphite, Na_2SO_3, which is employed as an antichlor, is prepared (with $7H_2O$) by saturating a solution of sodium carbonate with sulphur dioxide, adding another equivalent of carbonate and crystallizing. The anhydrous salt may be prepared by heating a saturated solution of the hydrated salt. The acid sulphite, $NaHSO_3$, or probably $Na_2S_2O_5$ (*i.e.*, metabisulphite) when solid, obtained by saturating a cold solution of the carbonate with sulphur dioxide and precipitating by alcohol, is employed for sterilizing beer casks. Sodium sulphate, Na_2SO_4, known in the hydrated condition (with $10H_2O$) as Glauber's salt, is manufactured in large quantities for conversion into the carbonate or soda. (*See* ALKALI MANUFACTURE.) For many years sodium was not known to form an alum (*q.v.*), but if a supersaturated solution of sodium and aluminium sulphates is allowed to crystallise below 20° C, the alum $Na_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O$ is obtained, higher temperatures giving monoclinic crystals. The acid sulphate, $NaHSO_4$, also known as bisulphate of soda, is obtained as large asymmetric prisms by crystallizing a solution of equivalent quantities of the normal sulphate and sulphuric acid above 50°.

The manufacture of sodium carbonate, commonly called soda, is treated under ALKALI MANUFACTURE. The anhydrous salt is a colourless powder or porous mass, having an alkaline taste and reaction. It melts at 852°. On solution in water, heat is evolved and hydrates formed. Common washing soda or soda-crystals is the decahydrate, $Na_2CO_3{\cdot}10H_2O$, which appears as large clear monoclinic crystals. On exposure, it loses water and gives the monohydrate, $Na_2CO_3{\cdot}H_2O$, a white powder sold as "crystal carbonate"; this substance, which is also formed on heating the decahydrate to 34°, crystallizes in the rhombic system. Both these hydrates occur in the mineral kingdom, the former as natron and the latter as thermonatrite. The heptahydrate, $Na_2CO_3{\cdot}7H_2O$, is obtained by crystallizing a warm saturated solution in a vacuum; it appears to be dimorphous. The acid carbonate or bicarbonate of soda, $NaHCO_3$, is produced in the ammonia-soda process for alkali manufacture. Another acid carbonate,

$$Na_2CO_3{\cdot}NaHCO_3{\cdot}2H_2O,$$

is the mineral trona or urao. We may here notice the "percarbonates," obtained by acting with gaseous or solid carbon dioxide on Na_2O_2 or $NaHO_2$ at low temperatures. For sodium nitrite *see* NITROGEN; for sodium nitrate *see* SALTPETRE; for the cyanide *see* PRUSSIC ACID; and for the borate *see* BORAX.

Of the sodium silicates the most important is the mixture known as soluble soda glass formed by calcining a mixture of white sand, soda-ash and charcoal, or by dissolving silica in hot caustic soda under pressure. It is a colourless transparent glass mass, which dissolves in boiling water to form a thick liquid. It is employed in certain printing processes, as a cement for artificial stone and for mending glass, porcelain, etc., and also for making the so-called silicated soaps. (*See* SOAP.) Sodium silicates containing excess of silica in solution are useful adhesives.

Sodium is most distinctly recognized by the yellow coloration which volatile salts impart to a Bunsen flame, or, better, by its emission spectrum which has a line (double), the Fraunhofer D

line, in the yellow (the wave-lengths are 5896 and 5890). It is estimated as sulphate by evaporation of its solutions with concentrated sulphuric acid, or as the sparingly soluble triple nitrite, $5Bi(NO_2)_3,9CaNO_2,6NaNO_2$, or, in 50% alcohol, as the triple acetate, $3NO_2(C_2H_3O_2)_2$, $Mg(C_2H_3O_2)_2$, $Na(C_2H_3O_2)$, $9H_2O$.

MEDICINE

Pharmacology.—The metal sodium is not used in medicine, but many of its salts are employed. Besides *liquor sodii ethylatis* the following salts and preparations are used in the British Pharmacopoeia. (1) *Sodii carbonis,* known as washing soda which on heating yields *sodii carbonis exsiccatus; sodii bicarbonas,* from which is made *trochiscus sodii bicarbonatis.* (2) *Sodii phosphas.* From sodium phosphate are made *sodii phosphas effervescens* and *sodii hypophosphis.* (*See* PHOSPHORUS.) (3) *Sodii sulphas* (Glauber's salt), with its sub-preparation *sodii sulphas effervescens.* (4) *Soda tartarata* (Rochelle salt), a tartrate of sodium and potassium, from which is made *pulvis sodae tartaratae effervescens,* known as Seidlitz powder. (5) *Sodii citro-tartras effervescens,* a mixture of sugar, sodium bicarbonate, citric and tartaric acids. (6) *Sodii chloridum,* common salt. (7) *Sodii sulphis.*

For *sodii bromidum, iodidum* and *salicylatum* see BROMINE, IODINE and SALICYLIC ACID respectively. For *sodii arsenas* and *cacodylate* see ARSENIC. *Sapo durus* (hard soap) is a compound of sodium with olive oil, and *sapo animalis* (curd soap) is chiefly sodium stearate.

Poisoning by caustic soda is rare; the symptoms and treatment are the same as described under POTASSIUM. The salts of sodium resemble potassium in their action on the alimentary tract, but they are much more slowly absorbed, and much less diffusible; therefore considerable amounts may reach the small intestine and there act as saline purgatives. They are slowly absorbed into the blood, and are a natural constituent of the blood plasma, which derives them from the food. Sodium is excreted by all the mucous surfaces and by the liver and kidneys. On the latter they act as diuretics, but less powerfully than potassium, increasing the flow of water and the output of urea and rendering the urine less acid.

Therapeutics: External Use.—The liquor sodii ethylatis is a powerful caustic and is used to destroy small naevi and warts. A lotion of sodium bicarbonate is useful to allay itching. Solutions of sodium sulphite are used as mild antiparasitics. *Internal Use.*—Sodium chloride is occasionally used in warm water as an emetic, and injections of it into the rectum as a treatment for thread worms. A 0.9% solution forms what is termed normal saline solution, which is frequently injected into the tissues in cases of collapse, haemorrhage and diarrhoea. It forms a valuable treatment in diabetic coma and eclampsia, acting by diluting the toxins in the blood. From this has developed the intramuscular injection of diluted sea-water in the treatment of gastro-enteritis, anaemia and various skin affections. Sodium chloride is an important constituent of the waters of Homburg, Weisbaden, Nauheim and Kissingen. Sodium bicarbonate is one of our most useful gastric sedatives and antacids, relieving pain in hyperchloridia. It is the constituent of most stomachic mixtures. Effervescent soda water is a mild gastric sedative. Sodium phosphate and sulphate are cholagogue purgatives and are used in the treatment of gall-stones. The sulphate is the chief constituent of Marienbad and Carlsbad waters. Large doses of these salts are used to remove fluid in dropsy. Soda tartarate is purgative and diuretic, as is the citro-tartarate. These purgative sodium salts are most useful in the treatment of chronic constipation, and of the constipation associated with gout and hepatic dyspepsia. They should be dissolved in warm water and taken in the morning, fasting. In visceral gout and chronic catarrhal conditions of the stomach a course of alkaline waters is distinctly beneficial. Sodium salts have not the depressant effect so marked in those of potassium.

SODOMA, IL (1477–1549), the name given to the Italian painter Giovanni Antonio Bazzi. He was born at Vercelli in Lombardy in 1477. His first master was Martino Spanzotto, by whom one signed picture is known. Acquiring thus the strong colouring and other distinctive marks of the Lombard school, he was brought to Siena in 1501 by some agents of the Spannocchi family; and, as the bulk of his professional life was passed in this Tuscan city, he counts as a member of the Sienese school, although not affined to it in point of style. He does not seem to have been a student in Siena, apart from some attention which he bestowed upon the sculptures of Jacopo della Quercia. With Pinturicchio, he was one of the first to establish there the matured style of the *Cinquecento.* His earliest works of repute are a series of 31 paintings executed from 1505 to 1508 in the Benedictine monastery of Monte Oliveto, on the road from Siena to Rome, illustrating the life of St. Benedict, in continuation of the series which Luca Signorelli had begun in 1498. Hence he was invited to Rome by the celebrated Sienese merchant Agostino Chigi, and was employed by Pope Julius II. in the Camera della Segnatura in the Vatican. He executed two great compositions and various ornaments and grotesques. The latter are still extant; but the larger works did not satisfy the pope, who engaged Raphael to substitute his "Justice," "Poetry" and "Theology." In the Villa Farnesina Bazzi painted some frescoes; "Alexander in the Tent of Darius" and the "Nuptials of the Conqueror with Roxana" (by some considered his masterpiece) are more particularly noticed. Bazzi afterwards returned to Siena and later went in quest of work to Pisa, Volterra and Lucca. From Lucca he returned to Siena, not long before his death, which took place on Feb. 14, 1549. He had squandered his property and is said (rather dubiously) to have died in penury in the great hospital of Siena.

It is uncertain whether Bazzi was a pupil of Leonardo da Vinci, though Morelli (in his *Italian Pictures in German Galleries*) speaks of his having "only ripened into an artist during the two years (1498–1500) he spent at Milan with Leonardo"; and some critics see in Bazzi's "Madonna" in the Brera (if it is really by Bazzi) the direct influence of this master.

His most celebrated works are in Siena. In S. Domenico, in the chapel of St. Catherine of Siena, are two frescoes painted in 1526, showing Catherine in ecstasy, and fainting as she is about to receive the Eucharist from an angel—a beautiful and pathetic treatment. In the oratory of S. Bernardino, scenes from the history of the Madonna—the "Visitation" (1518) and the "Assumption" (1532)—are noticeable. In the Academy are the "Deposition from the Cross" (1513) and "Christ Scourged"; by many critics one or other of these paintings is regarded as Bazzi's masterpiece. In the choir of the cathedral at Pisa is the "Sacrifice of Abraham," and in the Uffizi Gallery of Florence a "St. Sebastien."

See *Giovanni Antonio Bazzi,* by Robert H. Hobart Cust (1906), which contains a full bibliography.

SODOM AND GOMORRAH, two of the five "cities of the plain" in the Dead sea region, the others being Admah, Zeboim and Zoar (Bela) (Gen. xiii., xiv., xix.). They were destroyed by a rain of "fire and brimstone." Various identifications of these cities with modern sites have been suggested, based mainly on similarity of names. Jebel Usdum, for instance, the salt hill at the south-west corner of the Dead sea, has radically the same name as Sodom, which, indeed, may have been situated in its neighbourhood. The element of history in the narrative of the "cities of the plain" is as difficult to assess as the sites are to determine. A scientific explanation of the catastrophe is not excluded. (*See* DEAD SEA.)

See Report of the Joint Expedition of the Xenia Seminary and the American School of Oriental Research at Jerusalem to seek for the cities of the Plain in *Bibliotheca Sacra* (1924). (E. Ro.)

SODOR AND MAN, bishopric of the Church of England which includes the Isle of Man and adjacent isles. In 1154 the diocese of Sodor was formed to include the Hebrides and other islands west of Scotland (Norse *Suðreyjar,* Sudreys, or southern isles, in distinction from *Norðreyjar,* the northern isles of Orkney and Shetland) and the Isle of Man. It was in the archdiocese of Trondhjem in Norway. (*See* MAN, ISLE OF.) The Norwegian connection was broken in 1266, and in 1334 Man was detached from the Scottish islands. The cathedral of Sodor was on St. Patrick's isle at Peel (*q.v.*). The termination "and Man" seems to have been added in ignorance in the 17th century by a legal draughtsman. The see, while for some purposes in the archdiocese of York, has its own convocation; its relationship to the

scheme of election of bishops to the House of Lords is not clear.

SOEST, a town in the Prussian province of Westphalia, 33 m. E. of Dortmund, on the main railway Cologne-Elberfeld-Berlin. Pop. (1925) 21,038. Mentioned in documents as early as the 9th century, Soest was one of the largest and most important Hanseatic towns in the middle ages. It was one of the chief emporiums on the early trading route between Westphalia and Lower Saxony. Its code of municipal laws (*Schran; jus susatense*), dating from 1144 to 1165, was one of the earliest and best, and served as a model even to Lübeck. On the fall of Henry the Lion, Soest passed with the rest of Angria to Cologne. In the 15th century the strife between the townsmen and the archbishops broke out in open war, and in 1444 the strong fortifications of the town withstood a long siege. Papal intervention ended the strife, and Soest was permitted to remain under the protection of the dukes of Cleves. The prosperity of the town waned in more modern times: in 1763 its population was only 3,800; in 1816 it was 6,687. Of its churches the most striking are St. Peter's, the Wiesenkirche, a gem of Gothic architecture, Maria zur Höhe with beautiful mural frescoes, founded in 1314 and restored in 1850–1852, and the Roman Catholic cathedral, founded in the 10th century by Bruno, brother of Otto the Great (the present building was erected in the 12th century). Remains of the broad wall and one of the gates remain; but the thirty-six strong towers which once defended the town have disappeared. The town-hall (1701) contains valuable archives; the gymnasium was founded in 1534, through the instrumentality of Melanchthon. Iron-working, the manufacture of soap, sugar, marmalade, machinery, lamps, cigars, bricks and tiles, linen-spinning and brewing, together with market-gardening in the neighbourhood, and trade in timber and grain are the leading industries.

SOFALA, a Portuguese seaport on the east coast of Africa, at the mouth of a river of the same name, in 20° 12′ S. Pop. (1927) 18 Europeans and 21,015 natives. Its trade declined after the establishment of Beira (*q.v.*) a little to the north in 1890. The harbour, once capable of holding 100 large vessels, is silting up and is obstructed by a bar. Previous to its conquest by the Portuguese in 1505 Sofala was the chief town of a wealthy Mohammedan state, Arabs having established themselves there in the 12th century or earlier. At one time it formed part of the sultanate of Kilwa (*q.v.*). Pero de Covilhão was attracted thither in 1489 by the reports of gold-mines. In 1505 Pero de Anhaya sailed up the river and later raised a fortress (San Gaetano) at its mouth. Portuguese settlement dates from that time. The first governors of the Portuguese East African possessions were entitled captains of Sofala. (*See* PORTUGUESE EAST AFRICA.) Thomé Lopes who accompanied Vasco da Gama to India in 1502, identifies Sofala with Solomon's Ophir but this is untenable. The small island of Chiloane with a good harbour, 40 m. S. of Sofala has been colonized from Sofala (the township being named Chingune) as has also the island Santa Carolina, in the Bazaruto archipelago. Chiloane has good anchorage and is a trading settlement.

See G. McC. Theal's *Records of South Eastern Africa*, 1898–1903; Sir R. Burton's notes to his edition of *Camoens; Delagoa Bay Directory* (1927); *South and East Africa Year Book and Guide* (annually).

SOFFIONI or **SUFFIONI,** a name applied in Italy to certain volcanic vents which emit jets of steam, generally associated with hydrogen sulphide and carbon dioxide, sometimes also with a little ammonia and marsh-gas. The soffioni are usually arranged in groups, and are best represented in the Maremma of Tuscany, where they contain a small proportion of boric acid, for which they are utilized industrially. (*See* FUMAROLE.)

SOFIA (sō-fē′ah), capital of Bulgaria, in an upland plain, about 1,700 ft. above sea-level, between the Western Balkans on the north and Mt. Vitoš on the south. Pop. (1926), 213,162. Two small tributaries of the river Isker, the Perlovetz and the Eleshnitza or Boyana, flow respectively on the east and west sides of the town. Since 1880 the city has been entirely renovated in the "European" style. The oldest building in Sofia is the little round chapel of St. George in the Jewish quarter—originally a Roman bath. Of the principal mosques the large Buyuk Djamía, with nine metal cupolas, has become the National Museum; the Tcherna Djamía or Black Mosque, formerly used as a prison, has been transformed into a church; the Banyabashi Djamía, with its picturesque minaret, is still used by Muslim worshippers. Close to the last-named, in the centre of the town, are the public baths with hot springs (temperature 117° F). The old cathedral of Sveta Nedelya (formerly Sveti Kral), in which the remains of the Serbian king Stefan Uroš II. are preserved, was wrecked by an infernal machine on April 16, 1925, but since rebuilt. The ruined church of Saint Sofia (12th century) contains interesting frescoes. The new cathedral of Alexander Nevski was built as a memorial to the Russians fallen in 1877–78. The palace, occupying the site of the Turkish konak was built by Prince Alexander in 1880–82, and enlarged by King Ferdinand. The city is well drained and has a good water supply; it is lighted by electricity and has an electric tram system. It contains breweries, flour-mills, tanneries, sugar, tobacco, cloth and silk factories, and exports skins, cloth, cocoons, cereals, attar of roses, dried fruit, etc. Sofia forms the centre of a railway system radiating to Constantinople (300 m.), Belgrade (206 m.) and central Europe, Varna, Rustchuk and the Danube, and Kiustendil. The climate is healthy; owing to the elevated situation it is somewhat cold, and is liable to sudden diurnal and seasonal changes; the temperature in January sometimes falls to 4° F below zero and in August rises to 100°. The population, which is mainly Bulgarian, was only 20,501 in 1881. It grew very rapidly after the Balkan and European wars, owing to the influx of refugees.

History.—The colony of Serdica, founded here by the emperor Trajan, became a Roman provincial town of considerable importance in the 3rd and 4th centuries A.D., and was a favourite residence of Constantine the Great. Serdica was burnt by the Huns in A.D. 447; few traces remain of the Roman city, but more than 100 types of its coins attest its importance. The town was taken by the Bulgarians under Krum in A.D. 809; the name Serdica was converted into Sredetz by the Slavs, who associated it with *sreda* (middle), and the Slavonic form subsequently became the Byzantine Triaditza. The name Sofia, which came into use towards the end of the 14th century, is derived from the early mediaeval church of St. Sophia. The town successfully resisted the attacks of the emperor Basil II. in 987; between 1018 and 1186, under Byzantine rule, it served as a frontier fortress. During this period Petchenegs were settled around Sofia; these are probably the ancestors of the modern Šops (*see* PETCHENEGS). In 1382 Sofia was captured by the Turks; in 1443 it was for a brief time occupied by the Hungarians under John Hunyady. Under Turkish rule the city was for nearly four centuries the residence of the beylerbey or governor-general of the whole Balkan peninsula except Bosnia and the Morea. During this period the population was mainly Turkish; in 1553 the town possessed 11 large and 100 small mosques. It was occupied by Russian troops in 1829 and 1878. Though less central than Philippopolis and less renowned in Bulgarian history than Trnovo, Sofia was selected as the capital of the newly-created Bulgarian State in view of its strategical position, which commands the routes to Constantinople, Belgrade, Macedonia and the Danube.

SOFT DRINKS, a term widely used in the United States and elsewhere to designate non-alcoholic drinks generally, but particularly beverages that are carbonated (aerated) and flavoured, including ginger ale. (*See* CARBONATED BEVERAGES.) The term likewise embraces mild cereal beverages, cider, grape juice and other non-carbonated beverages which have natural or synthetic flavouring.

SOGDIANA, a province of the Achaemenian empire (O. Pers. *Sughuda*), corresponding to the modern districts of Samarkand and Bukhara; it lay north of Bactriana between the Oxus and the Iaxartes, and embraced the fertile valley of the Zerafshan (anc. Polytimetus). Under the Greeks Sogdiana was united in one satrapy with Bactria, and subsequently it formed part of the Bactrian Greek kingdom till the Scythians (*see* SCYTHIA) occupied it in the middle of the 2nd century B.C. The valley of the Zerafshan about Samarkand retained even in the middle ages the name of the Soghd of Samarkand.

SOGNE FJORD, an inlet of the west coast of Norway, penetrating 136 m. eastward into the mainland. It is the longest fjord in Norway, and the deepest, approaching 700 fathoms in some parts. Sognefest at its entrance is 50 m. by water from Bergen, in 61° 5′ N. For the first 50 m. the flanking mountains are unbroken by any considerable branch, but beyond this point several deep, narrow inlets penetrate the Jostedalsbrae and Jotunfjeld to the north, and the Hardangerfjeld to the south, being walled in at their heads by snow-clad mountains. The chief fjords are Fjaerlands, Sogndals and Lyster fjords to the north, Aardals fjord to the east, Laerdals and Aurlands fjords to the south. Branching from the last is the Naerö fjord, with a precipitous valley of great beauty (Naerödalen) at its head, and traversed by a road, from Gudvangen, across the Stalheim Pass to Vossevangen. Other villages are Vadheim, the terminus of the road from Nord fjord; Balholm and Fjaerlands (centres for visiting the glaciers of Jostedal); Lekinger, Sogndal and Laerdalsören, whence a road strikes south-east for the Valdres and Hallingdal districts.

SOIGNIES (or Soignes, the Walloon form), a busy and flourishing town of the province of Hainaut, owing its prosperity to the important limestone (Carboniferous) quarries in the neighbourhood. It contains a fine abbey church of the 12th century and in the cemetery connected with it are many tombstones of the 13th and 14th centuries. Pop. (1925) 10,676.

The forest of Soignies once extended over south Brabant up to the walls of Brussels and was part of the *Silva Carbonaria* of antiquity; even at the time of the French Revolution it was very extensive. Napoleon ordered 22,000 oaks to be cut down in it to build the Boulogne flotilla for the invasion of England. King William I. of the Netherlands continued the process because he thought it promoted prosperity. A considerable portion of the forest in the neighbourhood of Waterloo was assigned in 1815 to the duke of Wellington, and to the holder of the title as long as it endured. This portion of the forest was converted into farms only in the time of the second duke. The Bois de la Cambre (456 acres) on the outskirts of Brussels was formed out of the forest, and beyond it stretches the Forêt de Soignes, still so called.

SOIL. Soil is the surface layer of earth on which the land plants grow. It is derived from, and therefore is made of the same constituents as the rocks, but it has been subjected to the action of air and water which have altered and removed some of the original components so that the proportions of the various substances in the soil are not the same as in the parent rock. The mineral particles constitute the basis or foundation of the soil, but not the whole of it. In any region where rainfall and temperature conditions are favourable, vegetation rapidly springs up, obtaining its mineral nutrients and its nitrogen from the soil. The plants build up complex organic matter from the carbon dioxide of the air, using for this purpose the energy of sunlight, and when they die and their dead remains fall back on the soil there is introduced a new group of constituents: organic substances containing nitrogen, phosphorus, calcium, potassium, etc., and also stored up energy. These two components, the mineral substances derived from the rock, and the organic substances derived from previous generations of plants, constitute soil.

The obvious method of classifying soils would be to group them according to the rock from which they are derived. This method answers over restricted areas: it was used by Fallou in Central Germany and by Hall and Russell in their survey of Kent, Surrey and Sussex, but it is inapplicable over wide areas where the soil properties are much affected by the changes they have undergone during their formation. The first division, therefore, is:

1. Soils whose properties are determined mainly by the character of the parent rock, called by Glinka endodynamomorphic soils because internal factors have been the chief agents in making them.

2. Soils whose properties are determined mainly by external factors, rainfall, temperature, etc., called by Glinka ectodynamomorphic soils.

To the first division belong the soils of recent origin which have not yet had time to go through much of the decomposition they will still have to suffer: examples are furnished by many British soils which have been in existence only since the last glaciation. In the second group belong many of the continental soils which have been exposed to climatic agencies for long periods. These soils have been much studied by the Russians Dokuchaiev followed by Sibirtzev, Wysotski, Glinka, Neustruev and others who have shown that they are largely the product of climatic conditions: so much so, in fact, that the soil type can be predicted when the climatic type is known. They are subdivided by Glinka according to the amount and nature of the leaching they have suffered through the operation of climatic factors.

I. **Wet Conditions: Material Washed Down: Tendency to Acidity.**—1. *Efficient Leaching: Much Water and High Temperature. "Optimum Moisture Conditions." The Laterite Group.*—The organic matter rapidly oxidises, the carbonic acid dissolves out the sodium and potassium from the rock forming weak alkali carbonate solutions which dissolve out the silica formed by the hydrolysis of the silicates: finally so much of the silica and of the alkaline bases have gone that the residue consists chiefly of iron and aluminium oxides, the so-called sesquioxides. This group includes the laterites, found in the rainy region near the equator: possibly also the red soils of the Mediterranean region.

2. *Less Efficient Leaching: Less Water and Low Temperature. "Average Moisture Conditions." The Podsol Group.*—The organic matter does not decompose completely: alkali carbonate solutions are not formed: the silica formed by hydrolysis of silicates therefore does not wash out. Weak organic acids are, however, formed which dissolve out both the alkalis and the sesquioxides leaving a residue mainly of silica. This group includes the podsols, thoroughly leached acid forest soils: the grey clay soils of deciduous forests mainly oak (these contain some calcium carbonate) and the Brown earths of Ramann. Where the water cannot easily drain away the soil becomes waterlogged for longer or shorter intervals and the bog soils result. The material leached out is deposited not far below the surface where the conditions are somewhat different and usually form a compact layer or pan which is almost impervious to water.

II. **Between I. and III.**—*Still Less Leaching: Less Water but Higher Temperature: "Moderate Moisture Conditions" Steppe Soil Group.*—There are several sub-groups of these. (*a*) The black earths or Chernozens. Here there is good grass vegetation but very incomplete decomposition of the dead residues therefore much accumulation of humus which, however, being saturated with lime is not carried down as in the podsol group. The carbonic acid forms some alkaline carbonates as before and they wash down but the calcium carbonate does not get far before it is deposited. The calcium sulphate, however, washes farther down. These soils are neutral and fertile. (*b*) The chestnut coloured soils, formed in drier conditions where there is not much vegetation and little humus formation: in the cooler regions the surface layer contains humus and differs in colour from the layer below: in the warmer regions, however, the humus layer is either very thin or non-existent. Neither calcium carbonate nor calcium sulphate have washed down as in the preceding soils. There has been but little decomposition of the rock and consequently little or no transfer of bases or of silica from one level to another. Other sub-groups include grey soils and red soils of the desert steppes. These soils are neutral or alkaline.

III. **Dry Conditions:** *Soil Material Brought Up: Saline Soils with Tendency to Alkalinity.*—These soils occur only in arid regions: they are characterised by the presence of soluble salts in quantities that may be sufficient to interfere with vegetation. They fall into two groups: 1. those liable to occasional flooding: the "solonetz" group, 2. those not liable to flooding: the "solonchak." The former possess structure, the latter do not. In the solonetz group the sodium salts form a sodium clay which is less stable than the calcium clay and therefore lose iron and aluminium oxides which wash down leaving the surface layer richer in silica. Some of the humus is also carried down along cracks which, once formed, tend to be planes of weakness: the

soil therefore, on drying breaks into columns or irregular prisms. The solonchaks (no flooding) contain in their upper layers chlorides, sulphates and carbonates of calcium, magnesium and sodium: the group is subdivided according to the preponderance of the various cations: there is no washing down of humus, the different levels have somewhat similar textures, and there is no definite structure.

Finally there are the desert soils.

This method of classifying soils necessitates the study not only of the surface but also of the lower layers. The material dissolved out from the upper layer, or "A horizon," is washed down to the lower layer, or "B horizon," and is there and then precipitated more or less unchanged, or it interacts with other substances. Lower down the unaltered material, the "C horizon" is formed. The three horizons constitute the "profile" of the soil.

In a continental area where the character of the climate varies regularly in passing from one region to another the soils also vary regularly in the same way. The best illustration is in Russia itself: in the north are the frozen tundra: then farther south the podsols under forest: farther south still the grey soils all tending to be acid; then the black earths; then the chestnut coloured steppe soils all neutral, and finally in the dry arid regions come the alkali and the desert soils. Western Europe does not show so simple a zoning, but there still remains the relationship with the climate.

Agricultural and Ecological Groupings.—In many countries including the British Empire and America it is usual to study the soil in its relation to plant growth, and for this purpose a closer classification is necessary, the grouping being according to the texture and physical properties of the soils. The divisions are:—

I. *Mineral soils.* (1) sands, (2) loams, (3) clays.
II. *Calcareous soils.* Chalky soil.
III. *Organic soils.* (1) Peat: acid. (2) Fen or calcareous peat: neutral.

I. **Mineral Soils.**—The properties of the mineral soils are determined largely by the proportions of particles of different sizes. The grouping is only approximate, there being no rigid definitions or boundaries, and sandy soils shade off into loams, and loams into clays, through a continuous series where no sharp lines can be drawn. By international agreement among soil investigators it is now usual to divide the soil particles into groups of the following diameter sizes:

	English	German
Above 2 mm.	Stones	Kies
2·0–0·2 „	Coarse sand	Sand
0·2–0·02 „	Fine sand	Mo
0·02–0·002 mm.	Silt	Schluff, Staub
Below ·002 „	Clay	Schlamm, Ton

This grouping, like that of the soils, is in the main arbitrary, but it has ample justification, even though the actual figures for the limits could not be rigidly defended.

Sandy soils usually contain more than 60% of coarse and fine sand and less than 10 per cent of clay: loams contain 8 to 15 per cent of clay and more silt: clays contain still more clay—occasionally in England up to 40 per cent and not infrequently 20 per cent or more. The physical properties are discussed in detail later; the agricultural properties are:—*sandy soils:* easily permeable by air and water hence the plant roots are well aerated but may suffer from drought; these soils are easily cultivated and hence are much used for fruit, market garden and nursery work; *loams:* less easily permeable but sufficiently to allow ample aeration of roots and to prevent waterlogging: these are suitable for all types of crops; *clays:* much less permeable, liable to be waterlogged, sticky when wet, hard and difficult to cultivate when dry, and usually difficult for plant roots to penetrate. They are greatly improved by lime and by organic matter, usually in Great Britain they are left as grassland, cultivation being too costly, but they are well suited to wheat and beans.

These distinctions are closely connected with the chemical composition of the particles.

Coarse sand, fine sand, and probably also silt consist in the main of the unaltered mineral particles: complex silicates such as orthoclase, the ferrosilicates; and quartz; these can be identified by the mineralogical methods of Delage and Lagatu, van der Kolk, Steinriede and others. These are chemically almost inactive, and their composition plays only a subordinate part in determining their properties: the chief factor is their size, hence the grouping according to size.

Clay (*below ·002 mm.*) differs from sand and silt in two important respects (1) it is a colloid, (2) it differs from the original mineral and consists of much changed silicates, now regarded as compounds of insoluble complex alumino-silicic acids. The particles appear to consist of aggregates of much smaller particles, perhaps as little as 10 $\mu\mu$ in diameter, which however, are only with difficulty kept from joining up to form particles of 50 $\mu\mu$ or more. This fine material is isolated by means of the supercentrifuge and is called "Ultra clay"; it appears to be of the same general nature in all soils, the difference being in degree only; its physical properties are related to its chemical composition, varying approximately as the ratio $\frac{SiO_2}{Al_2O_3+Fe_2O_3}$ which varies in different samples between 1·2 and 3·2. As obtained by R. Bradfield from the prairie soils of Missouri the ultra clay contained 24·5% Al_2O_3; 45·5% SiO_2; 7% Fe_2O_3; 1·7% CaO; 1·4% MgO; 0·3% K_2O; it easily loses bases especially calcium. When these are gone it behaves like a weak acid showing all the usual titration phenomena with sharp end points. The equivalent weight of this "clay acid" is estimated by D. J. Hissink to be between 1,000 and 2,000, while Bradfield assigns it a dissociation constant of the order of 3^{-10}, the same as carbonic acid. The bases and their chemical interchanges have been much studied by Gedroiz in Russia and Hissink in Holland. They are readily displaced by dilute acids and other bases, hence they are called exchangeable bases: they consist mainly of calcium, magnesium, potassium and sodium. From the circumstance that the whole of the calcium of the clay can be so displaced, but only part of the others, it is inferred that the calcium is present entirely as exchangeable base while the others occur partly in some other form. Clay thus behaves like a complex acid and its interactions with soluble salts follow the ordinary stoichiometric laws and can be expressed by the usual type of equation:

$$\underbrace{\left[SiO_2, nAl_2O_3\right]\!\begin{cases}Ca\\H\\Mg, Na, K \text{ etc.}\end{cases}}_{\text{Solid phase}} \underbrace{+K+Cl}_{\text{Solution}} = \underbrace{\left[SiO_2, nAl_2O_3\right]K}_{\text{Solid phase}} \underbrace{+(Ca+Mg+H \text{ etc.})+Cl}_{\text{Solution}}$$

Among its basic radicals or cations there is usually hydrogen *i.e.*, the clay is not a saturated salt, hence in any interaction of this kind some acidity appears: it seems strange that an alumino-silicic acid should be able to displace so strong an acid as hydrochloric but the fact is easily demonstrated.

Little is known about the constitution of the acidic part beyond what is stated above. It is much larger than the ordinary acid molecule: the relative sizes are probably as a wheat grain is to a football, hence surface phenomena come much into play. The rapidity of exchange of cations when the clay is brought into a salt solution suggests that the clay cations are all on the surface, which would imply that the anions should be immediately below the surface of the ultimate particle, the same conception as the Helmholtz double electric layer, the inner being negative, and the outer positive. The flocculation produced by salts or acids under certain conditions accounts for some of the advantages of liming and it is discussed later.

The clay of normal fertile soils is mainly a calcium clay, calcium forming 80 per cent or more of the exchangeable bases: all present agricultural methods and varieties of crops have been developed for this. Two other clays occur fairly commonly in nature: acid or hydrogen clay, and sodium clay. Acid clay is formed in wet regions where, as the result of continual leaching with rain water containing always some carbonic acid, the calcium tends to be displaced by hydrogen: it differs in physical properties from calcium clay and is not amenable to the usual agricultural treatment used for calcium clay: it is less suited for plant growth

partly because of its acidity, partly because it competes with the plant for available bases. It is less stable than calcium clay, and tends to give up iron and aluminium oxides as its acidity increases. The best methods of dealing with acid clays are (1) to find crops tolerant of the conditions, *e.g.*, rye, oats, alsike, etc. and to breed more tolerant varieties: (2) to add sufficient calcium oxide or carbonate to reform the calcium clay. Sodium clay may form whenever sodium chloride comes in contact with soil: when the sea breaks in and floods the land, or, in arid regions, whenever drainage is not good and when the irrigation water contains sodium salts in solution, which it frequently does. As compared with calcium clay it is more easily deflocculated, it has more affinity for water, becomes more sticky and impervious when wet and much harder when dry. It is also less stable and tends to lose iron and aluminium oxides. Its worst property, so far as the plant is concerned, is that in presence of water it readily hydrolyzes and the sodium may combine with the CO_2 in the soil to form sodium carbonate, which not only intensifies its stickiness and imperviousness, but is toxic to plants. It can be reconverted to calcium clay by treatment with calcium sulphate and then flooding to wash out the sodium sulphate, but considerable improvement is effected by treatment with sulphur which oxidises to form sulphur acids and so reduces or neutralises alkalinity, a trouble that cannot be overcome by suitable cultivation.

Organic Matter.—The organic matter, as already stated, is derived from plants and therefore at the outset is composed of cellulose, lignin, protein, carbohydrates, waxes, oils and other plant constituents. In the soil it rapidly undergoes changes, being attacked by the vast population of micro-organisms which use it for food and energy supply. The general direction of the change, therefore, is a decomposition to simple compounds such as CO_2, water and ammonia, which is rapidly oxidised by specific micro-organisms first to nitrite then to nitrate. The reverse changes, however, go on. The micro-organisms during their growth build up their own tissue, which, in the aggregate forms an appreciable part of the soil organic matter. Some of the organisms, *e.g.*, the nitrifying organisms and the algae on the surface, assimilate CO_2 like plants, building it up in new organic matter; others, like *Clostridium* and *Azotobacter* may (though it is not known how far they actually do) assimilate gaseous nitrogen, converting it into protein; others again assimilate the decomposition products and reconvert them into complex organic substances, while still others such as the active amoebae, feed on members of the soil population. The net result is that the soil always contains the whole range of substances: the starting products mentioned alone: the simple end products CO_2, nitrate and inorganic compounds of phosphorus, sulphur, potassium, etc.; and a number of intermediate products in constant state of change. Among these the most characteristic are the black, sticky compounds collectively known as humus, which like clay, are colloidal, and therefore have great power of absorbing water and soluble substances but differ from clay in that they do not make the soil sticky but on the contrary render it more pliable. It is a complex mixture which has been resolved into the following groups:—

- Soluble in alkalis.
  - Soluble in water or dilute acids. Mulder's Apocrenic acid.
  - Precipitated by acids.
    - Soluble in water. Odén's Fulvic acid.
    - Soluble in alcohol. Hoppé-Seyler's and Oden's Hymatomelanic acid.
    - Insoluble in alcohol and organic solvents. Humic acid.
- Insoluble in alkalis, Humin*.

*Cold alkali.

Most investigators have confined their studies to humic acid although there is no evidence that it is any more important than the humin. Humic acid can be (and in the soil apparently is) formed in three different ways (1) from cellulose by micro-organisms (2) from lignin by chemical changes (3) from the mycelium of fungi: there are differences between all three, but all agree in general physical properties and also in their general effects in the soil. Humic acid from soil contains about 5% of nitrogen apparently as part of its molecule: it is therefore not entirely a cellulose or lignin condensation product. Oden regards it as a tetrabasic acid with an equivalent weight of about 300.

Calcium Carbonate and Calcium Phosphate.—These two substances are of vital importance to the plant. *Calcium carbonate* is derived from three sources (1) from the decomposition of plant residues *e.g.*, from calcium oxalate (2) from the weathering of rocks (3) from the calcareous deposits forming the chalk and limestone. As it slowly dissolves from the soil water it tends to wash out from the surface soil in humid and semi-arid regions and is either carried away in the drainage water, or if the rainfall be insufficient, is deposited lower down. Its valuable property in the soil is that it keeps the calcium clay stable, neutralises the humic acid, and maintains both in a flocculated physical state suitable for plant growth. *Calcium phosphate* is derived from fish and other marine animals, which are sometimes segregated as vast deposits many feet in thickness, as in North Africa and parts of the United States, sometimes disseminated through the mass of the formation as in the chalk. Some also occur as crystalline apatite. In the soil it is probably in the form of hydroxyapatite $(Ca_3P_2O_8)_3Ca(OH)_2$, but some of the phosphorus occurs in organic combination.

The Water or Soil Solution.—Soil usually contains some 8 to 15 per cent of its weight of water distributed over its particles and this contains some of all the soluble substances present: the amounts being much influenced by the changes effected with the clay and by the absorption by the colloids. In general it contains in agricultural soils about 0·05 to 0·2 per cent of total solid matter. It appears to contain all the chloride and nitrate present in the soil, along with the equivalent amount of calcium. It seems to be saturated with phosphate (about 1 to 3 parts per million of PO_4 being present whatever the moisture content of the soil). The concentration of potassium, however, increases as the moisture content of the soil decreases, but not proportionately like the chloride and the nitrate: this suggests an equilibrium between the potassium in the liquid and that in the solid phase. The chief constituents of the soil solution are calcium nitrate, bicarbonate and sulphate; its composition, however, varies with the growth of the crop, the season and the activity of the micro-organisms. Its agricultural and ecological significance is that it is the culture solution for the growth of plants. (E. J. R.)

THE PHYSICAL PROPERTIES OF SOIL

From the standpoint of physics the soil is regarded as a mass of particles of all shapes and sizes, between which are innumerable voids and interstices, serving as channels for the movement of water and air. The physical properties of this moist porous material are important, both in their bearing on problems of soil cultivation and in elucidating the environment of soil micro-organisms, on which soil fertility so largely depends.

A century ago, when scientific men first seriously turned their attention to agriculture, the physical properties of soil received much attention, and within the limits of existing knowledge, fairly satisfactory explanations were given of the broad differences in behaviour between light, or sandy, and heavy, or clayey soils. Sandy soils drained readily and were susceptible to drought, while clayey soils although resisting drought would lie wet, or even saturated, in rainy weather; the explanation offered was that the soil particles, and therefore the interstices, were largest in sandy soils and thus permitted easy drainage and quick drying out by evaporation of water into the atmosphere. The water was supposed to rise to the soil surface just as it does in a narrow glass capillary tube; hence the effect of a mulch of dry soil in conserving the moisture below it was attributed to the inability of the water to rise beyond the bottom of the mulched layer into the much wider voids in the mulch itself. This hypothesis, although adequate for a qualitative understanding of some of the broader features, offered no explanation of the supreme characteristic of

soil—the ability of individual particles to aggregate into crumbs or compound particles, that every gardener and farmer recognises as the essential feature of a good tilth. There was no obvious explanation to hand, and in any case, the brilliant achievements of Lawes and Gilbert with their promise of a complete chemical theory of soil fertility focused attention on soil chemistry to the exclusion of all other work. The subject was reopened by competent physicists in the closing years of last century. The underlying hypothesis was that the water was distributed over the surface of the soil particles in a continuous film, that was thinnest where the particles did not touch one another, and thickened into annular rings around the points of contact of particles. This distribution could be predicted, in fact, from the known laws of pure physics. This theory fitted reasonably well with the experimental facts. The slow movement of water from point to point within the soil, the existence of an optimum moisture content for plant growth, the inability of vegetation to extract the full moisture content from the soil, were phenomena that fell within this new theory, but the compound particle or soil crumb, still remained outside its scope. But the study of the colloidal state of matter that has been so actively pursued in recent years has opened a new field in soil science, for there are many suggestive analogies between the behaviour of collodial systems, and soil. Our present picture of the soil particle differs from the earlier form in that the particle surface is no longer regarded as inert, but as coated with colloidal material derived partly from inorganic weathering products of the soil and partly from the decayed organic residues of plants and micro-organisms. This mixed material has a complex composition, and some of the relationships between soil and its water content deduced from the earlier hypothesis are profoundly modified by its presence. This is especially true for moisture contents below saturation, *i.e.*, over the range of most importance to cultivation.

The Soil Material.—The practical man recognizes many different kinds of soil and grades them in a succession from heavy to light. The terms refer to the ease of cultivation; heavy soils are sticky when wet, require great skill in cultivation and may dry into hard clods, while light soils can be cultivated at almost any time. Various descriptive terms, such as clays, heavy, medium and light loams, and sandy soils mark the gradation from heavy to light types. When such soils are examined in the laboratory it is found, in general, that the greater the proportion of coarse or sandy particles present the lighter is the soil in the farmers' sense. A method, known as mechanical analysis, has been devised for sorting out the particles from a soil into groups of different average fineness, thus giving an impersonal and arithmetical specification in place of the purely qualitative terms, that naturally vary with the individual judgment. The method depends on the fact that the smaller the particle the slower will be its velocity of fall in water. If a mixture of soil and water is placed in a beaker, allowed to stand for a time, and the turbid suspension poured off, a sediment will be left in the bottom of the beaker. Water is added to the sediment, to the same height in the beaker as before, the whole is well mixed and allowed to stand for the same time before the fresh turbid suspension is poured off. Repetitions of this process will eventually clear the sediment of all particles whose effective diameter is less than a certain critical value that depends on the height of the liquid in the beaker and the time of settling. The collected turbid suspension can be similarly divided. In practice only some three or four divisions are made. These have already been given: those now in use in Great Britain are:

Name of fraction	Range of diameter
Clay	Less than 0·002 mm.
Silt	0·02 mm. to 0·002 mm.
Fine sand	0·2 ,, ,, 0·02 ,,
Coarse sand	2·0 ,, ,, 0·2 ,,

The sand fractions are separated by sieves, and the remaining two fractions by sedimentation in water as already described. Soils containing more than 25% by weight of the clay fraction are in the heavy class; the light soils contain at least 50–60% of coarse and fine sand. The silt fraction and the finer part of the fine sand fraction are exceedingly valuable constituents, and when present in amounts not exceeding 30%–40% produce the optimum moisture conditions: the soil drains easily and yet retains a good supply of moisture. The class of soils known as loams derive their desirable properties largely from this cause. If the silt fraction is present in greater amount than the clay a very difficult soil type is produced, that is less susceptible to ameliorative cultivation and manurial treatment than even heavy clay soils.

The colloidal character of the soil is associated mainly with the finest particles; the clay fraction therefore is of special interest. If a mechanical analysis of a heavy soil in good tilth were made without any preliminary treatment of the soil to break up the natural aggregates of particles, the clay fraction would be much less in amount than the true value, since each undisintegrated aggregate would behave as a single large particle. The examination of the best means of dispersing these aggregates into their constituent particles, which is essential for purposes of mechanical analysis, has thrown much light on the mechanism of compound particle formation. Calcium carbonate—a normal constituent of most soils—and organic matter both act as cementing agents and are removed by treatment with dilute acid and hydrogen peroxide respectively. Even when this is done the full percentage of the clay fraction is not obtained in the mechanical analysis unless a deflocculating agent such as ammonia is added to the water, when the finest clay particles remain in suspension indefinitely. The compound particle therefore may be regarded as a loose porous aggregate of single soil particles, held together partly by the mechanical cementing action of organic matter and calcium carbonate and partly by physico-chemical forces, analogous to those producing the phenomena of flocculation in many other colloidal materials. Part of the beneficial effect on soil fertility due to additions of chalk, or lime, and organic manures, is due to the improved tilth that results.

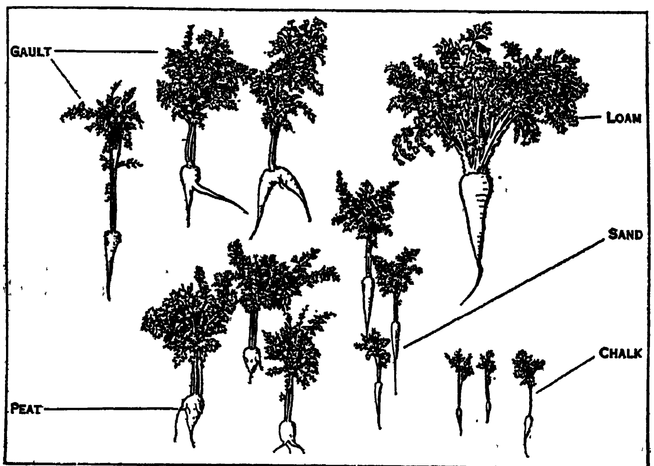
Soil Moisture.—The water requirements of vegetation are very considerable: for each unit of dry weight produced the plant transpires several hundred units of water, that must be taken up by the roots from the moisture in the soil. The moisture content of the soil represents the balance between supplies and withdrawals. Supplies are represented by rainfall (and irrigation where this is practiced) and by water raised by capillary action from the lower depths of the soil; the losses are due to evaporation at the soil surface, transpiration by vegetation, and downward percolation under the action of gravity. It is evident that the losses from causes other than transpiration must be reduced as much as possible if an adequate reserve of soil moisture is to be available for the plant. A soil in good tilth has the maximum water holding capacity; the compound particles act as sponges and provide a kind of water reservoir, while the comparatively large interstices between the adjacent aggregates permit of rapid drainage of excess water after periods of heavy rain. It was formerly thought that this percolation water could be brought back to the top soil by capillary action from a considerable depth, thus constituting a large reservoir of available moisture. Careful experiments show that this is not so. For distances greater than about 3 feet the return of water by capillary action is so slow as to be negligible. Hence the only moisture supply available for plants is that in the soil layers permeated by roots and a layer about three feet thick below this. A long series of records from the percolation gauges at Rothamsted shows that on the average about 50% of the total rainfall passes below the 5 foot depth, and this result emphasizes the necessity, even in a country of adequate and well distributed rainfall, for conserving by appropriate cultivations the soil moisture against direct loss by evaporation.

Soil Temperature.—In general any point on the earth's surface experiences a daily rise and fall, or a diurnal wave of temperature. The amplitude of this wave, or the difference between maximum and minimum temperature for the twenty-four hours progressively increases from winter to summer. When the soil surface is heated a difference of temperature is set up between it

and the subsoil and a heat wave is propagated downwards. The wave travels slowly and the amplitude decreases rapidly; it takes about four hours to reach the 6″ depth, while at 3 feet the daily fluctuations of temperature are inappreciable, only the seasonal change from winter to summer being observed. During the night period for the daily wave, and the autumn and winter for the annual wave the surface soil is cooling, and there is an outward flow of heat. Both daily and annual waves therefore have the character of an ebb and flow of heat.

The soil material even in the continuous or rock form is a poor conductor, and in the discrete particle form its conductivity is smaller still, since, apart from radiation and convection, heat can only pass from particle to particle through the points of contact. The presence of water as an annulus around these points of contact, improves the conductivity, although water itself has a low conductivity and high specific heat; the thermal contact is improved by the presence of the water film and the higher heat conductivity of the soil material is brought into play to an extent more than sufficient to compensate for the low conductivity of the water. Hence a soil that is in the optimum condition of moisture content is also in the best condition for heat conduction. Again, the existence on the surface of a dry mulch of soil, which has a very low conductivity, protects the soil below from extremes of heat and cold and preserves it at a steadier temperature, to the advantage of the vegetation. In general, the average soil temperature in the upper layers of soil in temperate regions varies from 20° C in the summer to 5° C in the winter.

Soil Air.—Analysis of the soil air shows that it differs but little from the composition of the ordinary atmosphere. The content of carbon dioxide is higher—about 2%–3% as against 0·03% and the oxygen content is correspondingly lower. Studies of biological activity in the soil show that about seven litres of carbon dioxide are produced daily for each square metre of soil surface, and the low content of this gas found by actual analysis of soil air, indicates that it readily escapes from the soil and is replaced by oxygen from the atmosphere. The mechanism of this exchange has been much disputed. Many workers have ascribed it to the pumping action of barometric, temperature and moisture changes in the soil causing expansion and contraction of the air in the interstices, and to the action of wind. Careful estimates of the effects of these actions show that they are insufficient to effect the exchange, which must therefore be due mainly to the phenomena of gaseous inter-diffusion. This process is continuous, whereas the other factors are intermittent.



BY COURTESY OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE
DIAGRAMS SHOWING HABIT OF GROWTH OF CARROTS ON DIFFERENT TYPES OF SOIL

Although the normal soil atmosphere closely resembles the ordinary air there is evidence of a second atmosphere in the soil, that is composed very largely of carbon dioxide. It is sometimes referred to as the dissolved atmosphere, as it is slowly evolved after the normal soil atmosphere has been evacuated by suitable means in the laboratory. It appears to come from the moisture in the soil, and from the colloidal material, and it is probable that some of it comes from the excessively minute interstices in the interior of compound particles. The significance of the dissolved atmosphere is that it points to the possibility of anaerobic conditions existing at places even in a soil that is in excellent tilth, a point of considerable importance in connection with the environment of soil organisms.

Processes of Soil Cultivation.—Much of the significance of this section of soil physics has become apparent in the preceding sections. The aim of cultivation is to provide a suitable seed bed for active germination and vigorous early growth of the seedling plants, and to maintain the optimum conditions for subsequent plant growth. The basic operation is ploughing, and the tilth finally obtained is largely dependent on it. The heavier the soil the more important is proper ploughing. If the soil is too wet, the furrow slice suffers plastic deformation as it passes over the mouldboard, and as a result has a tendency to dry into large hard clods that resist the disintegrating action of the cultivators and harrows used in the next stages of seed bed preparation. When less moisture is present the furrow slice, although maintaining its general coherence, becomes permeated by numerous cracks on passing over the mouldboard, and subsequent disintegration of the soil by cultivators is much easier. Alternations of wet and dry spells are also of great service in assisting tilth formation, and the shattering effect of frost on heavy land is well known. As a general rule it may be stated that no cultivation process should be carried out unless the moisture content has fallen to a value that permits air to enter the soil interstices.

(B. A. K.)

BACTERIAL ACTIVITY IN THE SOIL

The organic material produced by green plants by means of photosynthesis provides a source of energy which maintains a dense population of micro-organisms in the soil. The bacteria, fungi and actinomycetes are of fundamental importance in the economy of the soil owing to their action in destroying dead plant remains and in producing those end-products of decomposition, such as nitrates upon which the new crop feeds. Two other necessary functions are performed by soil bacteria, the fixation of atmospheric nitrogen, which balances the washing out of nitrogen compounds from the soil by rain, and the solution of minerals such as potassium compounds and phosphates which are thus rendered available to the crop. Since the soil bacteria have usually been studied in relation to specific biochemical processes which take place, it is convenient to divide them into physiological groups according to the most important changes that they bring about. It must be remembered, however, that most soil organisms are not specific in their activity, but produce different chemical changes according to the nature of the available food supply.

The Decomposition of Plant Residues.—When plant remains are added to the soil the simpler sugars and starches are amongst the first components to be decomposed since they form a readily available source of energy to a great variety of micro-organisms. Pentosans, though not available to so many species are attacked by a number of bacteria and fungi. During the rotting of manure and in compost heaps pentosans play an important part in providing a supply of energy enabling bacteria and fungi to assimilate soluble ammonia and nitrate, thereby reducing the loss of valuable nitrogen. The bulk of dead plant remains consists of cellulose and lignocellulose. These substances, especially the latter, are much more resistant to decomposition and disappear more slowly than the simpler carbohydrates. The first cellulose decomposing organisms to be studied were anaerobic spore-forming rods which break down the cellulose into organic acids, CO_2, H_2 and methane. These organisms are of importance in such waterlogged soils as occur in paddy fields. The majority of agricultural soils, however, are well supplied with air, and the cellulose is attacked by aerobic organisms, a number of which have been isolated and studied. The most interesting of these is *Spirochoeta cytophaga,* an organism of remarkable appearance and doubtful systematic position. It possesses a life-cycle, the most typical stage being that of a flexible tapering filament staining with difficulty. This passes by intermediate stages into a spherical

deeply-staining body resembling a spore, though it is not resistent to heat nor is there evidence that it is a resting condition. In addition to this organism a considerable number of aerobic bacteria claimed to be cellulose decomposers, have been described. The most thoroughly investigated of these, *Microspira agar-liquifaciens* attacks filter paper rapidly and also possesses the unusual property of liquefying agar. Some actinomycetes and fungi are capable of attacking cellulose and it is likely that the latter are mainly operative in destroying the cellulose in acid soils where the environment is unsuited to the bacteria. The relative importance of bacteria, actinomycetes and fungi in this, as in other biochemical processes, is difficult to judge at present owing to the lack of an adequate technique for estimating the population of the latter two groups in soil. The cellulose in plant tissues is commonly combined or associated with lignin. The decomposition of lignin by bacteria, actinomycetes and fungi has been claimed to take place, but an exact study of its decomposition is hindered by the difficulty of obtaining this substance in a state of purity.

In addition to carbohydrates there are a number of other non-nitrogenous organic compounds released in the soil during the decomposition of plant remains. Amongst these are the aromatic compounds, such as phenol and indol, which are derived from proteins. A considerable number of bacteria that can decompose phenol, cresol and naphthalene occur in soil, while three organisms have been isolated which possess the power of oxidising indol into indigotin.

Bacteria and the Nitrogen Cycle.—The second great group of compounds left in the soil by plants and added thereto by manure are the nitrogen compounds such as proteins and their derivatives. Soil organisms themselves provide a further source of such compounds. The decomposition of organic nitrogen compounds can be brought about by a very large number of bacteria, actinomycetes and fungi and the great complexity of the soil microflora has rendered it impossible to isolate and classify more than a small fraction of these, or to follow the stages through by which proteins are decomposed. During the process, the nitrogen is released as ammonia. The production of ammonia is, however, a by-product in the economy of the bacteria, which are deriving energy by decomposing the organic compounds. They can indeed be prevented from attacking the proteins, if a more readily available non-nitrogenous energy source is offered them. Thus the production of ammonia in soil can be depressed by the addition of sugar or straw.

The ammonia that is produced in soil does not usually accumulate there, but is oxidised successively to nitrite and to nitrate. An interesting organism *Nitrosomonas* is able to oxidise ammonia to nitrite. Pure culture study has shown that this organism derives its carbon by synthesis from CO_2, a process which requires a considerable expenditure of energy. It is unable to utilise organic compounds as sources of carbon. The energy necessary for assimilation of CO_2, is obtained by oxidising ammonia to nitrite. The nitrifying organisms are normally very sensitive to acidity and will not work efficiently unless the nitrous acid that they produce is neutralised by an available base which in soil is usually calcium carbonate. Since however, nitrification will take place in certain acid forest soils, there are probably strains of the organism unusually tolerant of acid conditions. A second ammonia oxidising organism named *Nitrosococcus* has been described. It has been suggested that this is a stage in the life-history of *Nitrosomonas.*

The nitrites produced from ammonia do not accumulate in the soil but are rapidly oxidised to nitrates. An organism named *Nitrobacter,* capable of bringing this about, has been studied in pure culture. It resembles *Nitrosomonas* in deriving its carbon from CO_2 and obtains the necessary energy for this by oxidising nitrites. The activity of both *Nitrosomonas* and *Nitrobacter,* when grown in artificial media is hindered by the presence of soluble organic compounds. It is probable that in the soil they are less sensitive, since the formation of nitrate occurs rapidly in such media as richly manured soils and in the purification of sewage.

The nitrates produced in the soil are the principal source of nitrogen available to crop plants. They can also supply nitrogen to the majority of soil micro-organisms. When the soil contains an excess of available carbohydrate materials the energy supplied by these enables an immense multiplication of micro-organisms to take place and these obtain their nitrogen by assimilating nitrates and ammonium compounds, thus depleting the soil of nitrogen that would otherwise have been available to the crop plants. This is the principal reason why the ploughing in of straw and similar substances, in which the ratio of carbon to nitrogen is high, has a depressing action on the crop. The nitrogen locked up in the cells of micro-organisms is, of course, not lost to the soil, but is released by their death and decomposition, so that the loss of nitrates is only temporary. Indeed at times when the soil is uncropped, this assimilation of nitrates may be beneficial since it lessens the loss of nitrogen through the leaching action of rain. When the soil has become exhausted of its available nitrogen compounds, any further supply of carbohydrates can only be utilised by those micro-organisms that possess the power of taking up the free nitrogen in the soil atmosphere. A number of bacteria are now known that possess the power of assimilating or "fixing" elemental nitrogen. The first of these to be described was an anaerobic spore-forming rod, *Clostridium pasteurianum.* It has been shown that this organism increases rapidly in water-logged soil to which sugar is added, so that it may be of importance in wet soils. Recently, moreover, it has been found that *Clostridium* and various aerobic bacteria can grow in mixed culture in the presence of air, the aerobic bacteria presumably removing oxygen and creating an anaerobic environment for *Clostridium.* When sugar or mannitol is added to well aerated soil, however, aerobic nitrogen-fixing bacteria become predominant. Amongst these the most abundant is *Azotobacter.* The widespread distribution of *Azotobacter* and the fact that it is the chief form that appears when soluble carbohydrates are added to soil makes it probable that this organism is chiefly responsible for nitrogen fixation. It is very sensitive to acidity and does not develop in soils whose reaction is on the acid side of pH 6·0. It also requires a considerable supply of phosphates, a deficiency of which limits its development in certain soils. Various other aerobic nitrogen-fixing bacteria have been described but are probably of less importance in the soil than *Azotobacter.* The physiology of both *Azotobacter* and *Clostridium pasteurianum* have been much studied under laboratory conditions. The process by which nitrogen is fixed is not yet understood but it is probable that the nitrogen is combined with hydrogen and not with oxygen. It is claimed on thermodynamical grounds that this combination requires no expenditure of energy. In culture solutions, however, about 100 grams of dextrose are utilised by *Azotobacter* for every gram of nitrogen fixed, though the figure is very variable. No doubt the large amount of dextrose consumed also supplies the energy needed to build up protein from the simpler compounds that are first produced. *Clostridium pasteurianum,* with an anaerobic metabolism, consumes about 400 grams of dextrose per gram of nitrogen fixed. The difference between *Azotobacter* and *Clostridium* in this respect is due to the degree to which the carbohydrate is decomposed. *Azotobacter* breaks down the sugar almost completely to CO_2 and water, whereas with *Clostridium,* the decomposition is only partial, fatty acids, alcohol and H_2 being produced as well as CO_2. This partial decomposition produces far less energy per gram of sugar utilised than is obtained by *Azotobacter.* Indeed, the amount of nitrogen fixed per unit of energy made available, is higher in the case of the *Clostridium.* The efficiency of nitrogen fixation by *Azotobacter* is claimed to be higher in the soil than when it is grown in solution. Moreover, under natural conditions, it is probable that nitrogen fixing bacteria are assisted by the presence of other organisms which remove the by-products of their metabolism. Impure cultures have been found to fix more nitrogen than pure cultures, while the presence of protozoa has been found to stimulate fixation. The association of nitrogen fixing bacteria with green plants provides a special case of symbiosis. In this case the green plant, in addition to removing by-products, also supplies the bacteria with carbohydrate produced by photosynthesis. The association

of nitrogen-fixing bacteria with algae is a simple case. Of greater importance, however, is their association with higher plants, especially legumes. The organism forming nodules on the roots of legumes was first isolated in 1888 by Bejerinck who named it *Bacillus radicicola,* and since then has formed the subject of a great deal of research. The organism passes a portion of its life in the soil where it can exist for years without the presence of its host plant. It exists in several cell forms which appear to constitute a definite life-cycle.

At a certain stage in this life-cycle, small actively motile rounded cells are produced which are able to migrate rapidly through the soil. It is probably in this stage that it reaches the roots of the host legume. The bacteria enter the plant through the unicellular root-hairs. They attach themselves to the root hair near the tip and appear to soften the cell wall at the point of the entrance. Inside the hair they multiply and form a thread-like strand of mucilaginous material in which the bacteria are imbedded. This thread grows down the hair and passes inwards through the cortex of the root, actually penetrating the cells. As it progresses, the cells in its neighbourhood start to divide and the infecting thread of bacteria ramifies through the mass of dividing cells. The infected cells swell in size and the bacteria pass out of the infecting thread and come to lie in the cytoplasm of the host cells. At about this time vascular strands grow out into the cortex so as to surround the mass of infected cells. The presence of these strands is essential to nitrogen fixation within the nodule and it is probable that they are the avenues along which carbohydrates are brought to the bacteria and the products of nitrogen fixation are removed. The bacteria that form nodules on legumes are divisible into physiological varieties each of which can form nodules on only a small group, sometimes a single genus of legumes. These varieties can also be distinguished by serological tests. For many years attempts have been made to improve the growth of legumes by supplying the appropriate variety of the nodule organism either by spreading soil from a field where the said legume has been grown or by treating the seed with a suspension of the bacteria. When a legume has been introduced into a new district the soil of which does not naturally contain the specific variety of nodule organism, considerable benefit may result from such treatment. This is especially the case with lucerne (*Medicago sativa;* alfalfa) which has recently been introduced into new areas all over the world where it often will not make satisfactory growth unless supplied with the bacteria.

Bacterial Activity Under Anaerobic Soil Conditions.—The atmosphere existing in the pore spaces in the soil is usually similar to that of the overlying air though somewhat richer in CO_2. In normal cultivated soil the conditions are therefore suitable for the growth of aerobic bacteria. It is probable that, even in well aerated soil, conditions of deficient oxygen supply exist locally, for example in the centres of the masses of colloidal material. In waterlogged soils, moreover, the oxygen dissolved in the water is soon used up so that anaerobic conditions prevail. As mentioned above, such processes as cellulose decomposition and nitrogen fixation can be brought about by anaerobic organisms. Ammonia production from proteins also takes place rapidly under such conditions. Nitrate formation is, however, inhibited by a deficiency of free oxygen. Many anaerobes obtain their oxygen by reducing nitrates or nitrites and some by reducing sulphates, such reduction processes being therefore characteristic of waterlogged soils.

The Solution of Minerals.—The organic acids and CO_2 produced by bacteria in the soil have an important action in attacking insoluble phosphates and potassium salts and rendering these available to the crop. In the laboratory and probably in the field, rock phosphates can also be attacked by the acids produced by the nitrification of ammonium carbonate. There is also an interesting group of soil bacteria that can oxidise sulphur and sulphides producing sulphuric acid. The solubility of rock phosphates can be increased by composting with sulphur owing to the activity of such bacteria.

The Ecology of the Bacterial Population.—In keeping with the complexity of the biochemical changes that they bring about in soil is the enormous variety of morphological groups of micro-organisms that can be isolated from it. Indeed the number and variety of these has so far defeated efforts at systematic study and classification. The soil is continually liable to contamination from above and there is evidence that many of the bacteria that exist in the soil are not active inhabitants but are present in a resting condition. When a given source of energy is added to soil it usually causes an increase, not in the whole bacterial flora but in one or two specific types. It is thus probable that, in the future, soil bacteriologists will concentrate their attention on those types that multiply in the soil itself when given substances are added thereto. The study of the soil micro-organisms is further complicated by the fact that their numbers in a field soil are constantly fluctuating. These fluctuations take place not only from day to day but from hour to hour and their cause is not yet clearly understood, although they are related to similar fluctuations in the protozoan fauna. There is clearly a changing equilibrium between bacteria and active amoebae and probably between other groups of the soil population. In considering the effect of changes in the physico-chemical environment on the soil bacteria, the existence of this state of equilibrium has to be borne in mind. It is probably for this reason that changes in soil temperature and moisture can seldom be correlated directly with bacterial numbers. Extremes of temperature usually result in an increase in bacterial numbers probably because they are less harmful to the bacteria than to the protozoa which normally keep their numbers down. The reaction of the soil has been found to have a marked effect on soil bacteria, both the numbers and the quality of the flora being affected by it.

Certain groups such as the nitrifying bacteria and *Azotobacter* are very intolerant of acid conditions. The effect of alkali salts on soil bacteria has been studied on account of the importance of these salts in dry districts. There is evidence of antagonistic action between the various ions, two toxic salts being sometimes less harmful in combination than alone. Since potassium and phosphorus are essential constituents of protoplasm, it is found that potash salts and phosphates usually increase the numbers of bacteria in the soil. Lack of available phosphates are indeed a factor limiting bacterial growth in many soils, and this fact has been utilised as a test for phosphate requirement.

(H. G. T.)

SOIL PROTOZOA

Among the biologists of the nineteenth century it was recognized that protozoa could be isolated from soil, but it was not until the early part of the present century that the suggestion was made that such organisms might be taking a share in the general economy of the soil micro-population. The view that the presence of protozoa in large numbers may lead to "soil sickness" was first put forward by Russell and Hutchinson in 1909; and from that time the study of soil protozoology has been steadily pursued.

One of the first criticisms raised against the view that protozoa were of importance in the soil was that they were present only in small numbers and always in the cystic, that is quiescent state. That such an opinion was untenable was first demonstrated by Martin and Lewin who succeeded in isolating several species of flagellates and amoebae in an active condition from normal soils; and subsequent work, using more refined methods of technique, has proved the activity of these animals in many types of soil. In a recent survey by Sandon of soils obtained from all parts of the world no soil, even the most barren, was devoid of protozoa and in some cases the number of species was as great as forty-six. Altogether about 250 species have been recorded, a few of which occur only in soil; while the others being highly adaptable are also found in water rich in organic matter or similar habitats. All the species appear to be world-wide in their distribution, the same species occurring in arctic, temperate and tropical soils and up to the present it has not been possible to associate characteristic species with any particular geographical areas or soil types.

Protozoa are grouped into four main classes viz., the *Rhizopoda* or amoebae, the *Mastigophora* or flagellates, the *Ciliophora* or ciliates and *Sporozoa;* representatives of each of the first three

classes are found living in soil.

The life history of each species has its own characteristic features as regards nuclear division, etc., and in many forms, notably the amoebae, it is impossible to identify them with certainty unless the chief stages of the life history are known. In general, however, the soil protozoa pass through very similar phases and develop in a perfectly straightforward way. Broadly speaking, there are two main phases of the life history—a period of activity often mistermed vegetative, and a period of rest. In the former the animal moves, feeds and reproduces, while in the latter there is secreted round the body a thick wall, capable of resisting adverse external influences. This condition is termed the cystic stage, and by means of it the animals are distributed from place to place by air, water, etc. Indeed, so resistant are the cysts that many of them are capable of withstanding the action of the digestive juices of the intestines of animals, through which they pass to be deposited by the faeces on fresh ground.

Investigations into the activities of soil protozoa was at the beginning hampered by the absence of a method for enumerating their numbers. This difficulty has been overcome and it is now possible to make determinations of the size of the population in a sample of soil, and also to count both the numbers of cysts and active forms. Using this method in 1920 Cutler, Crump and Sandon made an extensive study of the bacterial and protozoal population of one of the field plots at Rothamsted. (Barnfield dunged plot.) Samples were taken every day for a year and the numbers of bacteria and of six species of protozoa counted. The numbers of all the organisms showed large fluctuations of two kinds, daily and seasonal, thus in the former case three consecutive samples gave 58·0, 14·25, and 36·25 millions of bacteria per gram respectively and the changes exhibited by any of the species of protozoa were equally marked. Such oscillations in the size of the population continued throughout the investigation and it is now known to be characteristic of all fertile soils.

The agent causing the bacterial fluctuations is mainly the active amoebae for during the year's count an inverse relationship was established between the active numbers of amoebae and the numbers of bacteria. Thus a rise from one day to the next in the amoebic population was correlated with a fall in the numbers of bacteria and vice versa. This conclusion has been substantiated by inoculation experiments in which sterile soil was inoculated in one case with bacteria alone and in the second case with the same bacteria together with amoebae. Since bacteria constitute the food of amoebae the above inverse relationship between the two groups is to be expected. Superimposed on the daily variations in numbers there are seasonal changes, in all the soil micro-organisms. In the spring and autumn the population rises to a maximum with corresponding falls in the summer and winter. It is interesting that these changes are very similar to those recorded for many aquatic organisms such as the algae and the plankton of the sea.

The action of protozoa on such soil reactions as ammonification, carbohydrate decomposition and carbon dioxide evolution has not been greatly tested; the small amount of evidence available, however, tends to the conclusion that in fertile soils amoebae act as inhibiting agents causing by their removal of bacteria a lessened production of ammonia from organic compounds and of carbon dioxide from carbohydrates. The fixation of atmospheric nitrogen by the bacterium *Azotobacter* is on the other hand increased when protozoa are associated with it although the protozoa use *Azotobacter* as their food supply. The probable explanation of the apparent anomaly is that the nitrogen in the bodies of the consumed bacteria is not lost, but conserved in the protozoan protoplasm; and also that the continued feeding action of the protozoa keeps the bacteria at a high rate of reproduction necessitating high metabolism with consequent increased nitrogen fixation.

Considerably more research is required along these lines, but the information so far obtained shows that the protozoa are important members of the soil population. (D. W. C.)

THE SOIL FUNGI

The serious study of the fungus flora of the soil commenced with the work of Oudemans and Köning a quarter of a century ago and since then our knowledge has shown a rapid growth associated chiefly with the names of Hagem and Traaen in Norway, Lendner in Switzerland, Münter in Germany, Dale and the Rothamsted workers in England, Jensen, Conn and Waksman in the United States of America and Takahashi in Japan. Compared with other soil organisms the fungi have been little studied but their primary importance is being increasingly recognized. For a time indeed there was doubt whether fungi lived vegetatively in the soil or were present merely as inert spores, but work at Rothamsted has shown that they may occur almost entirely in the active mycelial form.

In spite of the very great and in many cases, at present almost insuperable difficulties in the identification of soil fungi, a large number of kinds have been recorded including species of eleven genera of Phycomycetes, eight genera of Ascomycetes, and sixty two genera of Fungi Imperfecti. In addition Actinomycetes are present in great variety, Smut fungi occur and Hymenomycetes are present in very great abundance.

Investigations on the distribution of species of fungi in soil, although numerous, have presented no clear issues. In the work at Rothamsted no good evidence has been obtained of distinct fungal associations conditioned by soil factors. The numerical balance of different species varies considerably but no constant and clearly cut differences in kind have been found such as Hagem has reported for the Mucorineae of forest soils in Norway or as are so evident in the distribution of the larger fleshy forms of woods and meadows. Also the different species do not show any seasonal periodicity, the incidence of any particular form being apparently a matter of chance or determined by purely local conditions. Certain species however seem to penetrate the soil to greater depths than others, in the Rothamsted work species of *Penicillium, Fusarium, Saccharomyces, Zygorrhynchus* and *Trichoderma* always being found at the greatest depths.

Owing to the enormous differences in structure and reproduction of various soil fungi such as seen for example in species of *Saccharomyces, Mucor, Sordaria, Tuber, Coprinus, Phoma, Actinomyces,* it is not possible to obtain an estimate of the number of "individuals" per gram of soil that may be compared with protozoal or bacterial numbers. Yet by critical standardisation of technique, quantitative research is possible and results may be obtained that can be replicated and that do give information as to relative amounts of fungi in different soil samples. At Rothamsted, numbers exceeding "one million fungi" per gram of soil have often been obtained and these represent a fraction only of the fungi present. Different soils vary considerably in their numerical fungal content, the more fertile soils containing the greater numbers. Most of the fungi are in the superficial layers, the numbers fall rapidly in all cases below the 6–10 inch depth, and at greater depths than about three feet fungi are practically absent. Beyond a suggestion of lower numbers in winter and higher numbers in summer there is no good evidence of seasonal periodicity.

In the course of their metabolic activities fungi play an active part in the soil economy and, under aerobic conditions such as occur in most soils, they are probably the most important factor in the decomposition of the cellulosic matter of plant residues. At Rothamsted it has been found that under experimental conditions three thermophilic soil fungi, *Coprinus* (*fimetarius?*), *Aspergillus* (*fumigatus?*) and *Acremoniella* (*velutina?*) can, jointly, rot down cellulosic matter to a manurial condition (the "Adco process") as rapidly as the whole soil population and far more rapidly than a synthesized bacterial flora of the soil. A great deal of the plant residues decomposed by fungi is however utilised by them in the building up of their protoplasm which is an important part of the soil organic matter.

Fungi are active also in the decomposition of organic nitrogen compounds and the liberation of ammonia but, on the other hand, they assimilate available nitrogen compounds in the soil and so compete with crop plants. It has been suggested from time to time that soil fungi can fix atmospheric nitrogen but with the exception of *Phoma* sp. and possibly of *Orcheomyces* sp. this has yet to be proved.

An aspect of the soil fungi that is being increasingly recognised

as of fundamental importance is the mycorrhizal relationship of numerous forms with higher plants. The inner meaning of this symbiosis is not yet clear but there seems little doubt of its vital importance to the life of many host plants, both herbaceous forms and forest trees. On the other hand it is also being increasingly recognised that the soil is a reservoir of vast numbers of disease-causing fungi, some of the most destructive parasites of crop plants such as species of *Colletotrichum, Fusarium, Helminthosporium, Rhizoctonia, Phoma, Macrosporium* and *Alternaria, Botrytis, Thielavia, Sclerotinia, Phytophthora* and *Pythium, Cladosporium, Verticillium, Aphanomyces, Ozonium, Rhizopus, Cercospora, Rosellinia, Actinomyces* and numerous other genera being present in abundance. Certain other important parasites such as *Synchytrium endobioticum, Urophlyctis alfalfae*, etc., find their home in the soil although there is no evidence, as yet, that they carry on any vegetative existence apart from the host-plants. Certain slime moulds such as *Spongospora subterranea, Plasmodiophora brassicae, Cystospora batata, Molliardia triglochinis* and species of Ligniera occur in the soil and there is evidence that they may live vegetatively in this habitat.

The soil fungi are thus so diverse in their activities that it is quite impossible to assess their value in the profit and loss account of the agricultural ledger. The two outstanding facts are their vast importance and the comparatively slight attention they have received in soil science. (W. B. B.)

SOIL FERTILITY

The fertility of the soil is its power to support plant life, and the phrase has meaning because the general requirements of most cultivated plants in any particular region are very similar. A fertile soil has the following properties:—1. Sufficient depth to allow full root development. 2. Supplies sufficient moisture with unfailing regularity. 3. Supplies sufficient air for the roots. 4. Has suitable temperature. 5. Supplies adequate nutrients. 6. Has a suitable reaction. 7. Is free from any harmful factor. No soil is perfectly fertile, and the problem of the agriculturist is to discover the defects from studies of the soil and of the symptoms exhibited by the plant, and then to devise suitable remedies. Depth of soil is improved by deep cultivation, by removing a pan or layer of rock or by drainage to lower the water level. Water supply is improved: (1) by direct addition of water by irrigation, (2) by reducing loss of water: this can be done (a) by maintaining a fine layer of soil on the surface to act as a mulch to reduce evaporation: (b) in tropical countries by growing leafy crops to shade the earth from the sun's rays: (c) by incorporating organic matter (*e.g.*, farmyard manure) with the soil, thereby increasing the amount of colloid material and the power of absorbing water and preventing it from soaking through the soil. The folding of sheep on the land has the same effect and is one of the reasons why sheep are so valuable for the arable cultivation of light lands. Air supply is ensured by adequate cultivation, by drainage to remove excess of water and by the use of sufficient lime to keep the clay properly flocculated. Temperature is usually best improved by drainage: something can be done, however, by setting up the land in ridges and by dressings of soot. Nutrients are supplied in artificial manures, the use of which in proper amounts given at the most suitable time may greatly enhance yields. Many methods have been devised for analysing soil with a view of determining its probable fertiliser requirements: some are purely chemical and depend on the use of acid solvents, others, such as Neubauer's, use the seedling as the extracting agent: none is entirely successful though some in expert hands give useful information. The reaction is ascertained by determining the hydrogen ion concentration (pH value) of the soil, if this is neutral there is usually nothing to be done: if acid there are two methods of procedure: (1) the growth of crops (*e.g.*, rye, oats, alsike clover) specially suited to or tolerant of acidity, (2) the addition of lime or limestone to make the soil neutral. From the pH value alone it is not possible to estimate how much lime is required: several chemical methods have, however, been devised for this purpose. When the soil is alkaline the most suitable remedies are to add calcium sulphate or free sulphur, then to wash out the soluble salt taking care that the drainage is adequate. Harmful factors include (1) marked excess or deficiency of clay: in neither case is the soil usually cultivable; (2) excess of soluble salts: this is remedied by flooding with water and providing adequate drainage—an example is the reclamation of Lake Aboukir near Alexandria (3) in soils actually or recently waterlogged, sulphides, ferrous compounds and other reduction products: the remedy here is cultivation and aeration; (4) disease organisms and pests.

See D. K. Glinka, *Die Bodentypen;* E. J. Russell, *Soil Conditions and Plant Growth.* (E. J. R.)

Soil and Disease.—The influence of different kinds of soil as a factor in the production of disease has long been debated in regard not only to the nature and number of the micro-organisms they contain, but also to the amount of moisture and air in them and their capacity for heat. The moisture in soil is derived from the rain and the ground-water. Above the level of the ground-water the soil is kept moist by capillary attraction and by evaporation of the water below, by rainfall, and by movements of the ground-water; on the other hand, the upper layers are constantly losing moisture by evaporation from the surface and through vegetation. When the ground-water rises it forces air out of the soil; when it falls again it leaves the soil moist and full of air. The nature of the soil largely influences the amount of moisture it takes up or retains. In regard to water, all soils have two actions —namely, permeability and absorbability. Permeability is practically identical with the speed at which percolation takes place; through clay it is slow, but increases in rapidity through marls, loams, limestones, chalks, coarse gravels and fine sands, reaching a maximum in soil saturated with moisture. The amount of moisture retained depends mainly upon the absorbability of the soil, is greater for soils which consist of fine particles and increases with the amount of organic substances present. Above the level of the ground-water all soils contain air, varying in amount with the looseness of the soil. Some sands contain as much as 50% of air of nearly the same composition as atmospheric air. The oxygen, however, decreases with the depth, while the carbon dioxide increases.

Among the most noteworthy workers at the problems involved in the question of the influence of soil in the production of disease were von Foder, Pettenkofer, Levy, Fleck, von Naegeli, Schleesing, Muntz and Warrington. The study of epidemic and endemic diseases generally brought to light facts which were held strongly to suggest that an intimate association exists between the soil and the appearance and propagation of certain diseases; still the rôle played by the soil was not, and even yet, is not so well understood as to make it possible to separate the factors and dogmatize on their modes of action and possible effects. The general evidence indicated that the specific bacteria of cholera discharges, for example, are capable of a much longer existence in the superficial soil layers than was supposed; consequently it is necessary to guard against pollution of the soil, and through it against the probable contamination of both water and air. But it was the dampness of the soil and its temperature that were incriminated. The incidence of diphtheria and of typhoid fever, too, were regarded as associated with dampness of soil from consideration of the behaviour of B. diphtheria and of B. typhosus under appropriate experimental conditions. At the present time, the incidence is ascribed to the relative presence of carriers (*q.v.*) of the respective bacilli, and the influence of the soil becomes merged into the effect produced by soil and climatic factors on general health apart from the possibilities that they afford for leading to contamination of water supplies. The level of the ground-water and the liability of disease-producing bacteria in the soil, subjects to which great attention was given at the beginning of the century, hardly enter into modern discussions on the behaviour of epidemics.

SOISSONS, a city of France, capital of an arrondissement in the department of Aisne, 65 m. N.E. of Paris by the railway to Laon. Pop. (1926) 15,781.

Soissons is generally identified with the oppidum of Gallia Belgica, called *Noviodunum* by Caesar. Noviodunum was the

capital of the Suessiones, whose king, Divitiacus, had extended his authority beyond the sea among the Britons. In 58 B.C. Galba, king of the Suessiones, separated from the confederation of the Belgians and submitted to the Romans.

At the beginning of the empire Noviodunum took the name of *Augusta Suessionum,* and afterwards that of *Suessiona,* and became the second capital of Gallia Belgica, of which Reims was the metropolis. The town had walls and a citadel, and became the starting-point of military roads (to Reims, Château-Thierry, Meaux, Paris, Amiens and St. Quentin). Christianity was introduced by St. Crispin and St. Crispinian. In 297 their successor, St. Sinitius, became the first bishop of Soissons.

After the barbarians had crossed the Rhine and the Meuse Soissons became the metropolis of the Roman possessions in the north of Gaul, and on the defeat of Syagrius by Clovis the Franks seized the town. It was not till the time of Clotaire II., that the kingdom of Soissons was incorporated with that of Paris. Pippin the Short was at Soissons proclaimed king and was there crowned by St. Boniface, before being crowned at Saint Denis by the pope himself. In 923 Charles the Simple was defeated outside the walls by the supporters of Rudolph of Burgundy, and Hugh the Great besieged and partly burned the town in 948. The communal charter of the town dates from 1131. The town suffered severely during the Hundred Years War. It was sacked by Charles V. in 1544 and in 1565 by the Huguenots, who held the town for six months. During the League Soissons joined the Catholics. In 1814 Soissons was captured and recaptured by the allies and the French. In 1870 it capitulated to the Germans after a bombardment of three days. During the war of 1914–18 Soissons was for most of the time just behind the Franco-British lines but the Germans passed it in 1918 in their thrust for Paris (May 27); it was retaken in the Franco-British offensive of July 18, 1918.

In the middle ages Soissons was the chief town of a countship belonging in the 10th and 11th centuries to a family which apparently sprang from the counts of Vermandois. In 1625 the countship passed to the house of Thomas Francis of Savoy. In 1734 the male line of Savoy-Soissons became extinct and the countship was ceded to the house of Orleans who held it until 1780.

Soissons stands on the Aisne, the suburbs of St. Vaast and St. Médard lying on the right bank. The cathedral of Notre-Dame, partly ruined in the World War, was begun in the 12th century and finished by the end of the 13th.

There are still remains, though damaged, of the fine abbey of St. Jean-des-Vignes, where Thomas Beckett resided for a short time. These include the ruins of two cloisters (13th century) and the façade of the church, with three portals (13th century); the two unequal towers (230 and 246 ft.) of the 15th and early 16th centuries are surmounted by stone spires. The 13th century church of St. Léger, also damaged, formerly belonged to an abbey of the Génovéfains. Beneath are two Romanesque crypts. Before the war a barrack occupied the royal abbey of Notre-Dame, founded in 660 for monks and nuns by Leutrade, wife of Ebroïn, the celebrated mayor of the palace. The number of the nuns (216 in 858), the wealth of the library in manuscripts, the valuable relics, the high birth of the abbesses, the popularity of the pilgrimages, all contributed to the importance of this abbey. The wealthiest of all the abbeys in Soissons was that of St. Médard, founded about 560 by Clotaire I., beside the villa of Syagrius, which had become the palace of the Frankish kings. It was there that Childeric III., the last Merovingian, was deposed and Pippin the Short was crowned by the papal legate, and there Louis the Pious was kept in captivity in 833. The abbots of St. Médard coined money, and in Abelard's time (12th century) were lords of 220 villages, farms and manors. In 1530 St. Médard was visited by 300,000 pilgrims. The religious wars ruined the abbey, although it was restored by the Benedictines in 1637. Little remains of the abbey buildings except for the 9th century crypt and the dungeons.

Soissons is the seat of a bishop and a sub-prefect, and has a tribunal of commerce. Among the industrial establishments are iron and copper foundries, and factories for the production of boilers, agricultural implements and other iron goods, rubber goods, glass and sugar. There is a large trade in grain for the provisioning of Paris.

SOISSONS-REIMS, BATTLE OF, MAY-JUNE 1918: see CHEMIN-DES-DAMES, BATTLE OF THE, 1918.

SOKE, a word which at the time of the Norman Conquest generally denoted jurisdiction, but was often used vaguely and is probably incapable of precise definition. In some cases it denoted the right to hold a court, and in others only the right to receive the fines and forfeitures of the men over whom it was granted when they had been condemned in a court of competent jurisdiction.

In some versions of the much used tract *Interpretationes uocabulorum* soke is defined "aver fraunc court," and in others as "interpellacio maioris audientiae," which is glossed somewhat ambiguously as "claim a justis et requeste." Soke is also frequently associated to "sak" or "sake" in the alliterative jingle "sake and soke," but the two words are not etymologically related. The term "soke," unlike "sake," was sometimes used of the district over which the right of jurisdiction extended. (*See* SOCAGE.)

See A. Ballard, *The Domesday Inquest* (1906); F. W. Maitland, *Domesday Book and Beyond* (1907); J. H. Round, *Feudal England* (1909); F. H. Baring, *Domesday Tables* (1909); *Red Book of the Exchequer* (Rolls Series), iii. 1035.

SOKOL-DOBROPOLJE, BATTLE OF, 1918. This is the name usually given to the final offensive of the French, British and Serbian forces in Salonika, launched Sept. 15, 1918. Penetrating the enemy front, it split the Bulgarian forces and, followed up with great rapidity, was soon followed by the capitulation of Bulgaria, the first of the Germanic allies to yield in the World War (*q.v.*). *See* SALONIKA CAMPAIGNS.

SOKOLNIKOV, GREGORY YAKOVLEVICH (1888–), Russian communist, was the son of a doctor. He studied in Moscow and at Paris. From 1909 until the Revolution of Feb. 1917 he lived abroad. After the November Revolution, Sokolnikov at first worked in the Soviet finance department. At the end of 1921, immediately after the proclamation of the new economic policy, Sokolnikov was appointed to the committee of the people's commissariat of finance; at the beginning of 1922 he was deputy people's commissar and commissar soon after. In four years (1922–25) the system of taxes was restored, and the budget was put in order. The reform of the currency was begun at the end of 1922, and the new State bank was given the right of issuing notes; it was completed in 1924 with the reorganization of the treasury bills and the stabilization of the Soviet currency. At the end of 1925, when dissensions arose in the Communist party on the economic-political question, Sokolnikov criticised the Government policy. After the 14th congress of the Communist party in Jan. 1926 he was removed from the post of commissar of finance and appointed deputy president of the "Gosplan," or state-planning commission. In 1929 after the resumption of Soviet relations with Great Britain he became Soviet Ambassador to Great Britain.

SOKOTO, a province of the British protectorate of Nigeria, West Africa; formerly an independent state. The province occupies the north-west corner of the protectorate, and is bounded west and north by French territory; area 38,860 sq.m. Pop. (1926) 1,666,821. The southern part is fertile, with orchard bush. The northern part is more open and sandy merging into semi-Saharan conditions towards the frontier. Running through the province in a south-westerly direction is the Gublin Kebbi or Sokoto river, which rises in high land—the Niger-Chad divide—along the eastern border of the province. The Sokoto river joins the Niger in 11½° N. 4° E. The Niger itself flows through the south-west corner of the province. The capital, also called Sokoto, is in the northern part of the province, on a tributary of the Sokoto river. The province is pastoral and agricultural. The people have large herds of cattle and the trade in hides and skins is important. Horses are numerous. Of food crops guinea corn, millet and rice are extensively grown. Crops for export are groundnuts, produced in large quantities, and cotton. The cultivation of cotton since the World War increased very greatly. In 1928 the province was put in railway communication with Lagos, by the opening of

a line 107 miles long (specially built to serve a cotton area) from Zaria to Gasau. This line was extended in 1929 a further 30 m. to Kawra, a large town some 100 m. south-south-west of Sokoto.

History.—The Sokoto or Fula empire was founded at the beginning of the 19th century. The country over which the Fula ruled has, however, a history going back to the middle ages. Between the Niger and Bornu (*q.v.*) the country was inhabited by various negro tribes, of whom the Hausa occupied the plains. Under the influence of Berber and Arab tribes, who embraced Mohammedanism, the Hausa advanced in civilization, founded large cities, and developed a considerable trade, not only with the neighbouring countries, but, via the Sahara, with the Barbary states. The kingdoms which grew up round each large town had their own rulers, who from time to time fell under the sway of foreign powers. In the 17th century a dynasty of the Habe, a name now believed to be identical with Hausa, obtained power over a large area of what is now Northern Nigeria. The Hausa, whose conversion to Islam began in the 12th century, were still in the 18th century partly pagans, though their rulers were Mohammedans. These rulers built up an elaborate system of government which left a considerable share in the management of affairs to the body of the people.

Fula Empire Founded.—Dwelling among the Hausa were a number of Fula, mostly herdsmen, and these were devout Mohammedans. One of the more cultivated teachers of this race, named Othman Dan Fodio, had been tutor to the king of Gobir (a district north of Sokoto). He incurred the wrath of that king, who ordered the massacre of every Fula in his dominions. The Fula flocked to Fodio's aid, and in the battle of Koto or Rugga Fakko (1804) the king of Gibir was utterly defeated. Thereupon Fodio unfurled the green banner of Mohammed and preached a *jihad* or religious war. In a few years the Fula had subdued most of the Hausa states, some, like Kano, yielding easily in order to preserve their trade, others, like Katsina, offering a stubborn resistance. Gobir and Kebbi (a small state south of Gibir) remained unconquered, as did the pagan hill tribes. The Fula were also defeated in their attack on Bornu. In most places they continued the system of government which had grown up under the Habe, the chiefs or emirs of the various states being, however, tributary to Dan Fodio. That prince established himself at Sokoto and he and his successors are entitled sultans of Sokoto. Each also is known as *Sarikin Muslimin* (Commander of the Mohammedans) as indicating his spiritual authority. In the time of Sultan Bello, Dan Fodio's son, Europeans found their way to Sokoto and were well treated by that monarch. Thereafter intercourse with Europeans and Americans by way of the lower Niger grew. But Fula rule degenerated, and slave-raiding was on such a scale as to devastate and almost depopulate large areas, not only in Sokoto proper but in the neighbouring emirate of Gwandu (Gando).

Submission to the British.—In 1885, during "the scramble for Africa," the then sultan of Sokoto concluded a treaty with the company afterwards known as the Royal Niger Company, giving it certain rights of sovereignty throughout his dominions. These rights were transferred in 1900 to the British Crown, but it was not until 1903, after what is known as the Kano campaign (*see* NIGERIA), that British authority was established. The city of Sokoto made formal submission in March 1903; the sultan fled and was the next year killed in battle. The Fula chose a new sultan, who took the oath of allegiance to the British and retained many of the old rights of the sultans. After the establishment of British rule farmers and herdsmen reoccupied districts and the inhabitants of cities flocked back to the land, rebuilding villages which had been deserted for fifty years.

The emir of Gwandu, treated on the same terms as the emirs of Kano and Sokoto, proved less loyal and had to be deposed, another emir being installed in his place. In 1906 a rising attributed to religious fanaticism occurred near Sokoto, the leader of the insurgents claiming to be a Mahdi inspired to drive the white man out of the country. A British force marched against the rebels, who were overthrown with great loss in March, 1906. The leader was condemned to death in the sultan's court and executed in the market place of Sokoto. The incident was noteworthy for the display of loyalty to the British administration which it evoked from the native rulers after so short an experience of its working. For his loyal action the sultan was made a C.M.G. This sultan, Attahari, showed himself to be a progressive ruler. He died in 1915 and his successor, Mohammed Maiturare, who was, in 1921, also made a C.M.G., continued his policy. A rising of the Taureg in the neighbouring French territory in 1916 had no effect in Sokoto save to show the loyalty of sultan and people to the British. Under the advice of the British resident the native government proved increasingly efficient. Finance, education and public works were departments in which much activity was displayed.

BIBLIOGRAPHY.—*See* the *Travels* of Dr. Barth (London, 1857); Lady Lugard, *A Tropical Dependency* (1905); C. H. Robinson, *Hausaland* (1896); Major J. A. Burdon, "The Fulani Emirates," in *Geogr. Jnl.* vol. xxiv. (1904). (F. L. L.; F. R. C.)

SOKOTRA (also spelt Socotra and formerly Socotora), an island under British protection in the Indian ocean. It is cut by 12° 30′ N., 54° E., lies about 130 m. from Cape Guardafui, and is on the direct route to India by the Suez canal. It is 72 m. long by 22 m. broad and is the largest and most easterly member of a group of islands rising from adjacent coral banks, the others being Abd-el-Kuri, The Brothers (Semha and Darzi), and Kal Farun.

The centre of the island is formed of Archaean gneisses and granites with slightly younger schists. These form the highest peaks (the Haggier mountains 4,686 ft.). Resting on these rocks are Cretaceous and Eocene strata (chiefly limestone), which, scarcely disturbed, form an undulating plateau between 1,000 and 1,500 ft. above sea level. Some of these limestones are pierced by dykes and in the south-east by a small volcanic centre with trachytic and rhyolitic lavas. At many parts of the north coast the edges of the plateau reach the shore in precipitous cliffs, but in others wide alluvial plains, dotted with bushes and date-palms, front the heights behind. There are no harbours but several fairly safe anchorages.

From October to May the weather is almost rainless except in the mountains, where there are nightly showers and heavy mists. During this season the rivers, which are roaring torrents throughout the monsoon, are almost all lost in the dry, absorbent plains. The daily range of temperature of the coast area is from 65° to 85°, it may reach 95°; and on the mountains (3,500 ft.), from 52° to 72°. In the low grounds fever of an acute and hematuric form is very prevalent. The fauna contains no indigenous mammals; there is a wild ass, probably of Nubian origin; while the domestic cattle may be a race developed from cattle imported from Sind or Farther India. Of the flora aloes, dragon's-blood (*Dracaena*), myrrh, frankincense, pomegranate, and cucumber (*Dendrocycios*) trees are its most famous species. The flora and also the fauna present not only Asian and central African affinities, but, what is more interesting, Mascarene, South African and Antipodean-American relationships, indicating that the island represents part of Gondwanaland.

The inhabitants, about 12,000, are composed of two, if not more, elements. On the coast the people are modern Arabs mixed with negro, Indian and European blood; in the mountains live the true Sokotri, supposed to be originally immigrants from Arabia. Some of them are as light-skinned as Europeans, tall, robust, thin-lipped, straight-nosed, with straight black hair; others are shorter and darker, with round heads, long noses, thick lips, and scraggy limbs, indicating perhaps the commingling of more than one Semitic people. Their manner of life is simple in the extreme. Their dwellings are circular, rubble-built, flat, clay-topped houses, or caves in the limestone rocks. They speak a language allied to the Mahra of the opposite coast of Arabia. Both Mahra and Sokotri are probably daughter-tongues of the old Sabaean and Minaean. Sokotri is the older of the two languages, and retains the ancient form, which in the Mahran has been modified by Arabic and other influences. Hadibu (Tamarida), Kallansayia (Gollonsir), and Khadup are the only places of importance in the island. Hadibu (pop. about 400) the capital, is picturesquely

situated on the north coast at the head of the open bay of Tamarida on a semicircular plain enclosed by spurs of the Haggier mountains. A dense grove of date palms surrounds the village.

The chief export is ghi or clarified butter, which is sent to Arabia, Bombay and Zanzibar. Millet, cotton and tobacco are grown in small quantities. The most valuable vegetable products are aloes and the dragon's-blood tree. The Sokotran aloe is highly esteemed. The people live mainly on dates and milk.

Abd-el-Kuri island lies between Sokotra and Cape Guardafui, 60 m. from Sokotra and is 20 m. long by $3\frac{1}{2}$ m. in width. At either end the island is hilly. It is formed chiefly of Archaean rocks and on the north side is a sandy beach; on the south cliffs rise abruptly from the ocean. The highest part (1,670 ft.) is towards its eastern end. It is largely arid and there are no permanent streams. Its zoology resembles that of Sokotra, but the fauna includes land shells and scorpions peculiar to Abd-el-Kuri. The inhabitants (less than 200), speak Sokotri and Arabic and are chiefly engaged in diving for pearl shell on the Bacchus bank. They live chiefly on turtle (which abounds in the island), fish and molluscs. The land is nowhere cultivated.

Kal Farun is the name of two rocky islets rising nearly 300 ft. above the sea 13 m. from the western end of Abd-el-Kuri. Birds flock to them in great numbers; in consequence they are completely covered with guano, which gives them a snow-white appearance. The Brothers lie between Abd-el-Kuri and Sokotra. Semha is $6\frac{1}{2}$ m. long and 3 m. broad. It has rocky shores and rises in a table-shaped mountain to 2,440 ft. As in Abd-el-Kuri ambergris is found on its shores and turtles abound. There is running water all the year and it is a fishing ground of the Sokotri. Darzi lies 9 m. E. of Semha, is $3\frac{1}{2}$ m. long by 1 m. broad and rises almost perpendicularly from the sea to 1,500 feet. The coral banks which surround Sokotra and The Brothers are united and are not more than 30 fathoms below sea-level; a valley some 100 fathoms deep divides them from the bank around Abd-el-Kuri, while between Abd-el-Kuri and Cape Guardafui are depths of over 500 fathoms.

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HISTORY

Sokotra has claims to be reckoned one of the most ancient incense-supplying countries, and it is probably referred to by the Egyptians under the name "Terraces of Incense" (from its step-like contours).

To the Greeks and Romans Sokotra was known as the isle of Dioscorides; this name, and that by which the island is now known, are usually traced back to a Sanskrit form, Dvīpa-Sakhādhāra, "the island abode of bliss." The *Periplus* of the Erythraean Sea speaks of the island as peopled only in one part by a mixed race of Arab, Indian and Greek traders. It was subject to the king of the Incense Country, and was a meeting-place of Arabian and Indian ships. Cosmas in the 6th century says that the people spoke Greek and were largely Christian, with a bishop sent from Persia. They appear to have remained Nestorian Christians, with a bishop under the metropolitan of Persia, through the middle ages, though there are indications pointing to a connection with the Jacobite church. As early as the 10th century Sokotra was a haunt of pirates; in the 13th century Abulfeda describes the inhabitants as "Nestorian Christians and pirates" but the island was rather a station of the Indian corsairs who harassed the Arab trade with the Far East. The population seems in the middle ages to have been much larger than it is now; Arabian writers estimate the fighting men at 10,000.

The Portuguese under Tristão da Cunha and Albuquerque seized Sokotra in 1507 in pursuance of the design to control all the trade routes between Europe and the East, but abandoned it in 1511. They found that Sokotra was held by Arabs from Fartak, but the "natives" (a different race) were Christians, though in sad need of conversion. As late as the middle of the 17th century the Carmelite P. Vincenzo found that the people still called themselves Christians, and had a strange mixture of Jewish, Christian and Pagan rites. The women were all called Maria. No trace of Christianity is now found in the island, all the inhabitants professing Islam.

On the withdrawal of the Portuguese the dependence of Sokotra on Arabia was resumed. In the 19th century Sokotra formed part of the dominions of the sultan of Kishin. The opening of the Suez Canal route to India led to the island being secured for Great Britain. From 1876 onward a small subsidy has been paid to the sultan of Kishin by the authorities at Aden; and in 1886 the sultan concluded a treaty formally placing Sokotra and its dependencies under the protection of Great Britain. Sokotra is regarded as a dependency of Aden, but native rule is maintained, the local governor or viceroy of the sultan of Kishin being a member of that chief's family, and also styled sultan.

SOL, the original monetary unit of Peru. It consisted of 25 grammes of silver, $\frac{9}{10}$ fine, and was therefore equivalent to the French silver 5-franc piece. It was divided into 100 centesimos. In 1897 the Peruvian currency was changed from the silver to the gold standard. The new monetary unit was the libra or pound, equivalent to the British sovereign, which henceforward was also legal tender in Peru. The sol was revalued, and became a subsidiary coin, ten soles being equal to one pound. The sol was divided into 10 dineros and alternatively into 100 centavos.

Notes are not issued directly by the Government, but certain banks are permitted to issue notes of £P.10, 5, 1 and of 5 soles. £P is the conventional sign for the Peruvian pound. Exchange on London is usually quoted at so much per cent. premium or discount. 5% premium means that the pound sterling is worth that much more than the Peruvian pound, *i.e.*, £P.105=£100 sterling, and 5% discount means the reverse.

Since the war, the Peruvian and English pounds have moved far apart. The actual exchange rates for the post-war period, to be interpreted as above, are given in the following table:—

End of		*End of*	
1919	$7\frac{1}{4}$% dis.	1924	$14\frac{1}{2}$% pm.
1920	$17\frac{1}{2}$% dis.	1925	$23\frac{3}{4}$% pm.
1921	17% pm.	1926	$34\frac{3}{4}$% pm.
1922	10% pm.	1927	$23\frac{1}{4}$% pm.
1923	7% pm.		

Compared with many other South American countries, Peru had long had a good financial record, and relations with Great Britain were both close and cordial. This stood Peru in good stead immediately after the war, and though, at the end of 1920, the Peruvian pound only stood in New York at \$4.31 against parity of \$4.866, the pound sterling was as low as \$3.64, so that, comparing the two pounds, £100 sterling only equalled £P.82.5. 1921 witnessed a complete reversal from a rate of $17\frac{1}{2}$% discount to one of 17% premium, now in favour of London. To some extent this reflected a loss of ground by Peru against the United States, but the main cause was an improvement of 15% in the dollar value of sterling from \$3.64 to \$4.20.

Until 1925, the exchange between the two pounds only moved within relatively narrow limits, but during 1925 and 1926, the Peruvian pound depreciated until the London rate was $34\frac{3}{4}$% premium. Bad weather conditions and poor crops affected exports in the former year, and the commercial and credit position was difficult. Exports were further restricted in 1926 by the heavy world fall in the price of cotton and sugar, which form two of Peru's staple crops. A fruitless effort was made to arrest the depreciation of the Peruvian pound by the formation of an exchange pool, and at the end of the year relief to the adverse trade balance was sought by means of a bill giving the Government temporary powers to raise the customs duties on imported luxury articles. The year 1927 witnessed a recovery. (N. E. C.)

SOLANACEAE, in botany, a family of dicotyledons belonging to the sub-class Sympetalae (or Gamopetalae) and to the series Polemoniales, containing 72 genera with about 1,750 species, widely distributed through the tropics, but passing into the temperate zones. The chief centre of the family lies in Central and

South America; 36 of the genera are endemic in this region. It is represented in Britain by three genera including four species: *Hyoscyamus niger* (henbane), *Solanum Dulcamara* (bittersweet) and *S. nigrum* and *Atropa Belladonna* (deadly nightshade).

It is represented in North America by about 40 species, the conspicuous genera being *Solanum* (nightshade, bittersweet, horse nettle), *Physalis* (ground cherry), and *Datura* (jimson weed).

FROM "MEDIZINAL PFLANZEN" (KOEHLER)

THORN-APPLE OR JIMSON-WEED (DATURA STRAMONIUM), A COARSE ANNUAL PLANT OF THE NIGHTSHADE FAMILY (SOLANACEAE), FOUND WIDELY IN RICH SOILS IN TEMPERATE AND TROPICAL REGIONS

Nicotiana (tobacco) is represented by two species, one extending from Colorado to Nevada and California, and the other a native of Oregon, but cultivated by the Indians eastward to the Missouri river. The plants are herbs, shrubs or small trees. *Solanum nigrum,* a common weed in waste places, is a low-growing annual herb; *S. Dulcamara* is an irregularly climbing herb perennial by means of a widely creeping rhizome; *Atropa Belladonna* is a large perennial herb. The genus *Solanum,* to which belong more than half the species in the family, contains plants of very various habits including besides herbs, shrubs and trees. The leaves are generally alternate, but in the flower-bearing parts of the stem are often in pairs, an arrangement which, like the extra-axillary position of the flowers or cymes, results from a congenital union of axes.

In *Atropa Belladonna* one of the branches at each node is undeveloped and there is a pair of unequal leaves; the smaller subtends the branch which has not developed, the larger has been carried up from the node below.

The hermaphrodite, generally regular, flowers have the parts in fives, five sepals, five petals, five stamens in alternating whorls, and two carpels, which are generally placed obliquely. The corolla is regular and rotate as in *Solanum nigrum,* or bell-shaped as in *Atropa,* or somewhat irregular as in *Hyoscyamus;* in the tribe Salpiglossideae, which forms a link with the closely allied family Scrophulariaceae (*q.v.*), it is zygomorphic, forming *e.g.,* as in *Schizanthus,* a two-lipped flower. The stamens are inserted on the corolla tube and alternate with its lobes; in zygomorphic flowers only two or four fertile stamens are present. The flowers are generally conspicuous and honey is secreted on the disk at the base of the ovary or at the bottom of the corolla tube between the stamens. The ovary is usually bilocular, but in *Capsicum* becomes unilocular above, while in some cases an in-growth of a secondary septum makes it 4-celled as in *Datura,* or irregularly 3- to 5-celled as in *Nicandra.* The anatropous ovules are generally numerous on swollen axile placentae. The style is simple and bears a bilobed or capitate stigma. The fruit is a many-seeded berry, as in *Solanum,* or capsule, as in *Datura,* where it splits lengthwise, and *Hyoscyamus,* where it opens by a transverse lid forming a pyxidium. The embryo is bent or straight and embedded in endosperm. The persistent calyx may serve to protect the fruit or aid in its distribution, as in the red bladdery structure enveloping the fruit of *Physalis.*

The family is divided into five tribes after Wettstein; the division is based on the greater or less curvature of the embryo, the number of ovary cells and the regular or zygomorphic character of the flower. The great majority of the genera belong to the tribe Solaneae, which is characterized by a two-celled ovary. *Lycium* is a genus of trees or shrubs, often thorny, with a juicy berry; *L. chinense* (*L. barbarum*) is a straggling climber often cultivated under the name of tea-plant. For *Atropa, see* NIGHTSHADE; for *Hyoscyamus, see* HENBANE. *Physalis,* with 50 species mostly in the warmer parts of North and South America, includes *P. alkekengi,* "winter cherry," and *P. peruviana,* "Cape gooseberry. *Capsicum* (*q.v.*) is widely cultivated for its fruit, which are the so-called chillies. *Lycopersicon esculentum* is the tomato (*q.v.*) and *L. pimpinellifolium* is the currant-tomato; both are native to western South America, as is also *Cyphomandra betacea,* the tree-tomato. For *Mandragora, see* MANDRAKE. To the tribe *Datureae,* characterized by a four-celled ovary, belongs *Datura; D. Stramonium* (thorn apple), sometimes found as an escape in Britain, is officinal. *D. Metel,* native to India, and *D. meteloides,* of the south-western United States, are large-flowered annuals, grown in gardens in warm-temperate countries, as are the tree-like shrubs, *D. sanguinea,* native to Peru; *D. suaveolens,* native to Brazil, and *D. arborea,* of the central Andes. *Nicotiana,* to which belong the tobacco plant (*N. tabacum*) and other cultivated species, and *Petunia,* are American genera belonging to the tribe Cestreae, in which the embryo is straight or only slightly bent, as it is also in the tribe Salpiglossideae; *Salpiglossis* and *Schizanthus* are known in cultivation.

Among other plants of the family grown for ornament are the pepino (*Solanum muricatum*), Jerusalem-cherry (*S. Pseudo-Capsicum*), scarlet eggplant (*S. integrifolium*), tomatillo (*Physalis ixocarpa*) and strawberry-tomato (*P. pubescens*).

Numerous plants of the family are narcotic-poisonous, especially species of *Solanum* (nightshade), *Atropa* (belladonna), *Hyoscyamus* (henbane) and *Datura* (stramonium).

SOLANUM, in botany, one of the largest genera of flowering plants. It belongs to the nightshade family (Solanaceae, *q.v.*) and comprises upwards of 1,200 species, chiefly herbs but including many shrubs. It includes important economic plants, as the potato and egg-plant (*qq.v.*). Two species are found in Great Britain (*see* NIGHTSHADE), and about 25 in N. America.

SOLARIO, ANDREA DA (*c.* 1460–*c.* 1520), Italian painter of the Milanese school, was probably born at Milan, and received his early training from his brother Christofano, a distinguished sculptor and architect, who was employed extensively on work at the cathedral, Milan, and at the Certosa di Pavia. In 1490 he accompanied his brother to Venice, where he seems to have been strongly influenced by Antonello da Messina, who was then active in the city. The fine portrait of a Venetian Senator (National Gallery, London) displays Antonello's plastic conception of form and was probably painted about 1492. The two brothers returned to Milan in 1493. The "Ecce Homo" at the Poldi Pezzoli, notable for its strong modelling, may have been painted soon after his arrival. Solario's earliest dated work is a "Holy Family and St. Jerome" (Brera, Milan), with a fine landscape background, executed for S. Pietro at Murano in 1495. The Leonardesque type of the Madonna proves that Andrea after his return from Venice became strongly influenced by the great Florentine artist who was then carrying everything before him. To this period of Andrea belong a small "Crucifixion" (1503, Louvre) and the portrait of Charles of Amboise (Louvre); the portrait of Longono (1505, National Gallery, London); "The Annunciation" (1506, Fitzwilliam museum, Cambridge); and the beautiful "Vierge au coussin vert" (Louvre), for which a sensitive drawing of the Virgin's head is in the Ambrosiana at Milan; and the "Head of the Baptist in a silver charger" (1507, Louvre). In 1507 Andrea went to France with letters of introduction to

the Cardinal of Amboise, and was employed for two years on frescoes in the chapel of his castle of Gaillon in Normandy (demolished during the French revolution). According to Morelli's suggestion Andrea may have visited Flanders before returning to his native country, and this may account for the Flemish character of his later work. The artist was back in Italy in 1515, the date of the "Flight into Egypt" (Poldi Pezzoli collection) with its harmonious and detailed landscape background. To this period belong the "Procession to Calvary" (Borghese Gallery, Rome); the portrait of the Chancellor Domenico Morone (Palazzo Scotti, Milan); and the "Woman playing a guitar" (Hertz collection, Rome). Andrea's last work was an altarpiece representing "The Assumption of the Virgin," left unfinished at his death and completed by Bernadino di Campi about 1576.

See G. Morelli, *Italian Masters in German Galleries* (1883); K. Badt, *Andrea Solario* (Leipzig, 1914). (I. A. R.)

SOLAR SYSTEM: *see* PLANET.

SOLDER, an alloy easily melted and used as a cement to unite two metallic surfaces. The derivation is through the French from Lat. *soldare,* to make firm.

The soft solders are mainly compounds of tin and lead, and vary widely in composition. Common tinner's solder is composed of equal parts of tin and lead, and melts at 370°; plumber's solder has 2 of lead to 1 of tin. Excess of lead in plumber's solder renders the solder difficult to work; excess of tin allows it to melt too easily. Pewterers add bismuth to render the solder more fusible, *e.g.,* lead 4, tin 3, bismuth 2; or lead 1, tin 2, bismuth 1. Unless these are cooled quickly the bismuth separates out. The hard solders are the spelter and the silver solders. Soft spelter solder is composed of equal parts of copper and zinc, melted and granulated and passed through a sieve. As some of the zinc volatilizes the ultimate proportions are not quite equal. The proportion of zinc is increased if the solder is required to be softer or more fusible. A valuable property of the zinc is that its volatilization indicates the fusing of the solder. Silver solder is used for jewellery and other fine metal work, and has the advantage of high fusing points. The hardest contains from 4 parts of silver to 1 of copper; the softest 2 of silver to 1 of brass. Borax is the flux used with silver solder as with spelter.

The specifications of the American Society for Testing Materials (1921) are of two classes, of which class *A* is made from new or virgin metal and class *B* has at least one-half virgin metal. For galvanized iron and zinc, only class *A* solders should be used. In general, that solder should be selected which has the least amount of tin required to give suitable flowing and adhesive qualities. The specified compositions are given in the following table as well as the temperature at which melting begins, and the temperature of complete liquation.

Melting Points of Solder Metal

Grade	Composition			Melting begins at	Liquation complete
	Tin	Lead	Antimony		
	Per cent.	Per cent.	Per cent.	Degrees Fahrenheit	Degrees Fahrenheit
Tin .	100·00	..	..	449·6	449·6
0A .	63·00	37·00	0·12	357·8	357·8
1A .	50·00	50·00	0·12	357·8	415·4
1B .	49·25	50·00	0·75	365·0	397·4
2A .	45·00	55·00	0·12	357·8	437·0
2B .	43·50	55·00	1·50	370·4	428·0
3A .	40·00	60·00	0·12	357·8	458·6
3B .	38·00	60·00	2·00	370·4	442·4
4A .	37·50	62·50	0·12	357·8	467·6
4B .	35·50	62·50	2·00	370·4	411·8
5A .	33·00	67·00	0·12	357·8	485·6
5B .	31·00	67·00	2·00	370·4	455·0
Lead .	..	100·00	..	620·6	620·6

The permissible variation in the tin is not over 1%. Copper should not exceed 0·08% in class *A,* or 0·15 in class *B* grades. Other impurities not to exceed 0·10%. Grades *1A, 1B, 2A, 2B, 3A* and *3B* practically conform with the similarly numbered specifications of the Society of Automotive Engineers (1922). In addition, S.A.E. specification *No. 4* (1922) is a solder with lead 75%, tin 25, antimony 2·00 max., copper 0·08 max. in the *A* grade; tin, 23%, antimony 2·00 max. and copper 0·15 max. in the *B* grade. This solder is for work that is to be coated with enamel and then baked, as it withstands higher temperatures than the others listed. The complete liquation points are 514·5° for grade *A* and 496·5° for grade *B.*

Brazing Solder, or brazing spelter, consists of 50% to 55% of zinc, the remainder being copper. This is cast into ingots and granulated under a drop hammer into grades known as "long grain," "short grain," "fine grain," etc. The Society of Automotive Engineers specification *No. 45* (1922) calls for copper 50–52%, lead 0·50 max., iron 0·10 max., zinc remainder. This starts to melt at 1,560° and is completely melted at 1,600°. The material to be brazed may be dipped in molten brazing solder, or the solder in powdered form mixed with boric acid as a flux may be melted on the material in a furnace or by a torch. The alloy mainly used as brazing metal consists of 80% copper and 20% zinc. Brazing solder and metal are used to unite brass, copper, iron and steel in strong joints. Silver solder is used by jewellers and for other fine metal work. The hardest consists of 4 parts silver to 1 of copper; the softest, 2 parts silver to 1 of copper.

Fluxes for soft solders consist of powdered rosin, hydrochloric acid "killed" by the addition of zinc scraps, and tallow—when used by plumbers; for brazing and with silver solder, powdered borax. Sal ammoniac is sometimes used in brazing copper. Fluxes used to prevent the oxidization of the metals are borax, cream of tartar, sal ammoniac, resin, chloride of zinc and hydrochloric acid. There are many soldering pastes and solutions on the market.

SOLE, the name of flat-fishes of the genus *Solea,* which have the eyes small, on the right side, the head rounded in front, and the mouth small, curved, with teeth in the jaws of the blind side only. Several species are known from the Indo-Pacific and the eastern Atlantic. The common sole of Europe ranges from the North sea to the Mediterranean; it is a valuable food fish, which attains a length of 2 feet. It often burrows, and feeds mainly at night, seeking worms and other small animals of the sand or mud by smell and touch. The American soles belong to another genus, *Achirus;* they are small and of no value.

SOLENT, THE, a strait of the English Channel, between the mainland (the coast of Hampshire, England), and the coast of the Isle of Wight. Its length from Southampton Water to the Needles is 15 m., and from Southampton Water to a line drawn from Bembridge Foreland to Southsea Castle is 12 m. The breadth is from 2½ to 4 m., but between Stone point and Egypt point it narrows to 1¼ m.; and 3½ m. north of the Needles there springs from the mainland a great shingle bank, nearly 2 m. in length, which reduces the breadth of the Solent to a little over ¾ m. Its eastern portion is on the whole wider than the western. Hurst castle, at the western end, dates from the time of Henry VIII. Here Charles I. was imprisoned in 1648. The low coast of the mainland is broken by the estuaries of the Beaulieu river and the Lym, with the port of Lymington upon it. The coast of Wight rises more steeply, and the Medina, Newton and Yar estuaries open on to it. At the mouth of Southampton Water is a projecting bar like that of Hurst castle, and like it bearing a Tudor fortress, Calshot castle. The Solent is frequently the scene of yacht races, and its eastern portion has unique naval importance. The configuration of the coast causes a double tide in the strait.

SOLESMES, a village of western France on the left bank of the Sarthe in the department of Sarthe, 29 m. W.S.W. of Le Mans by road. In 1010 a priory was founded at Solesmes and placed under the authority of the abbey of LaCouture of Le Mans. Suppressed at the revolution, it was established as a Benedictine monastery in 1830. In 1837 it was raised to the rank of abbey and a nunnery was afterwards founded beside it, but both institutions were abandoned in 1901. The monastery church possesses two masterpieces of early 16th century sculpture; one represents the burial of Christ, the other that of the Virgin.

SOLF, WILHELM (1862–), German colonial politician, was born on Oct. 5, 1862, in Berlin. After studying Sanskrit and oriental languages in Calcutta, he returned to Germany and

entered the German colonial service, being sent to Soma. Here he first held the post of president of the municipal council (1899) at Apia under the old "condominium" of Great Britain, Germany and America, and afterward that of governor of German Samoa (1900). In 1911 he was appointed German colonial secretary and effected considerable reforms in German colonial administration. When Prince Max of Baden's Ministry of desperation was formed towards the end of the World War, Solf was appointed secretary of state for foreign affairs on Oct. 3, 1918. In this capacity he conducted the negotiations for the Armistice. He resigned on Dec. 17, 1918. In 1920 he was appointed German chargé d'Affaires and afterwards ambassador to Tokyo.

He was the author of *Weltpolitik und Kolonialpolitik* (1918), and of *Kolonialpolitik, Mein politisches Vermächtniss* (1919).

SOLFATARA, a volcanic vent emitting vapours chiefly of sulphurous character (whence the name, from Ital. *solfo*, sulphur; the French geologists' term is *soufrière*). The typical example is the famous Solfatara, near Pozzuoli, in the Phlegraean Fields, west of Naples. This is an old crater which has not been in active eruption since A.D. 1198, but which is continuously exhaling heated vapours, chiefly hydrogen sulphide, sulphur dioxide and steam. Sal ammoniac occurs among the sublimates. The term solfatara has been extended to all dormant volcanoes of this type; and a volcano which has ceased to emit lava or ashes but still evolves heated vapours is said to have passed into the "solfataric stage." (*See* VOLCANO and FUMAROLE.)

SOLFERINO, 5 m. W. of the river Mincio, was the scene of a battle between the Franco-Sardinians, commanded by Napoleon III., and the Austrians under Francis Joseph. Defeated at Magenta, June 4, 1859, the Austrians under Gyulai retreated across the Mincio and reorganized their forces around Verona. Francis Joseph then assumed personal command, aided by Gen. Hess. His forces comprised two armies: I., Wimpffen; II., Schlick; 160,000 strong. Early on June 24, when neither army expected to encounter the other, the armies suddenly met at the Mincio, both having assumed the offensive. The Franco-Sardinians, 150,000 men, moved on a 25 m. front from Lake Garda to Castel Goffredo. Outpost firing began at 5.30 A.M., developing later into more serious fighting. At 7 A.M. Napoleon, who watched the encounter from the church tower at Castiglione, ordered his forces to advance on Solferino, situated on an elevation, seemingly strongly occupied. After desperate fighting it was captured by the French Guards, entailing the sacrifice of thousands of lives. This brought about a distinct tactical advantage to the French, the Austrians continuing to make further attempts to recapture this important point. Further south of Solferino, MacMahon captured Cassiano, but the Sardinians, under King Victor Emmanuel, vainly assaulted the Austrian lines south of Lake Garda, being thrown back on Revoltella by Benedek. At 2 P.M. Francis Joseph gave a fresh order to Wimpffen to advance resolutely and to thrust back the enemy south of Solferino, but all his attempts were abortive. About 4 P.M. the oppressive heat was succeeded by a severe thunderstorm, of which the Austrians took advantage to retreat, except Benedek's troops. They accomplished this unmolested, the French being too exhausted to pursue them. The Sardinians then again fell on Benedek, who, seeing the Austrian centre retreat, himself retired, keeping the enemy at a distance. The Austrians re-crossed the Mincio that evening, having lost 22,000 men, the Allies 17,000 troops. A meeting of the two emperors took place shortly afterwards at Villafranca, after which hostilities ceased.

SOLI (mod. *Mezetlü*), an ancient town of Asia Minor, on the coast of Cilicia. Colonists from Argos in Greece and Lindus in Rhodes are described as the founders of the town, which is first mentioned at the time of the expedition of the younger Cyrus. In the 4th century B.C. it was so wealthy that Alexander could exact a fine of 200 talents. In the Mithradatic War, Soli was destroyed by Tigranes, but it was subsequently rebuilt by Pompey, who settled there many of the pirates whom he had captured, and called the town Pompeiopolis. Soli was the birthplace of Chrysippus the Stoic and of the poets Philemon and Aratus. The bad Greek spoken there gave rise to the term σολοικισμός, solecism, which has found its way into all the modern languages of Europe. Little remains of the ruins.

SOLI (mod. *Soliais*), a Greek city on the north coast of Cyprus, in the metalliferous country round Karavostasi. Its territory was bounded by those of Marion, Paphos, Tamassus and Lapathus. It was believed to have been founded after the Trojan War (*c.* 1180) by the Attic hero Acamas; and no remains have been found earlier than this. Soli is probably the town "Sillu," whose king Irisu was an ally of Assur-bani-pal of Assyria in 668 B.C. In Hellenic times Soli had little political importance, though it stood a siege from the Persians soon after 500 B.C.; its copper mines, however, were famous, and a neighbouring monastery is dedicated to "Our Lady of the Slag-heaps" (*Panagia Skourgiótissa*). In recent years the old mines have been reopened, and the tailings exploited.

See W. H. Engel, *Kypros* (Berlin, 1841; classical authorities); J. L. Myres and M. Ohnefalsch-Richter, *Cyprus Museum Catalogue* (Oxford, 1899; antiquities); G. F. Hill, *Brit. Mus. Cat. Coins of Cyprus* (London, 1904; coins).

SOLICITOR, in England, an officer of the Supreme Court of Judicature qualified to conduct legal proceedings for his clients: *see* also ATTORNEY. It seems that until 1873 there was a distinction between the terms "solicitor" and "attorney." Solicitors appear to have been at first distinguished from attorneys as not having the attorney's power to bind their principals; subsequently the distinction was between attorneys as agents in actions at law, and solicitors in chancery. In practice, however, the terms were synonymous, for it was usual for attorneys to be admitted as solicitors also. The Judicature Act 1873 enacted that all persons admitted as solicitors, attorneys or proctors of an English court should thenceforth be called solicitors of the Supreme Court.

Every person, before he can become a duly qualified solicitor, must serve an apprenticeship or clerkship to a practising solicitor for a term of years varying from three to five. Since 1922 he has been required during one of those years to attend a law school provided or approved by the Law Society (long known as the Incorporated Law Society). Service under articles therefore combines academic training with practical experience. The clerk must pass all the necessary examinations, he must be duly admitted, and must take out an annual certificate to practise. The organization of the profession is in the hands of the Law Society. Established 1827, and succeeding a society dating back to 1739, it was incorporated in 1831. The Solicitors Act 1922 transferred to the Law Society disciplinary powers long exercised by the courts. Its Discipline Committee may, after inquiry, strike off the roll or suspend from practice solicitors convicted of crime or found guilty of professional misconduct. In conjunction with the provincial law societies it has taken over the organization of the voluntary services of solicitors in the conduct of poor persons' cases. Apart from its judicial and administrative authority the Law Society has frequently exercised powerful influence by the attitude which it has taken towards proposed legislation. Membership of the society, which is not compulsory, is open to any duly qualified practising solicitor.

No person can be admitted as a solicitor unless he is a British subject, and has attained the age of 21 years. Though admitted as a solicitor and his name entered on the roll, he is not at liberty to practise until he has taken out his annual certificate, the fee for which is larger for London than for country practitioners. The disqualification of women to become solicitors ceased in 1919.

Solicitors now have a right to practise in any court, *i.e.*, in every division of the High Court, in every inferior court, in the ecclesiastical courts (*see* PROCTORS), in the court of appeal, in the Privy Council and in the House of Lords. Their right of audience, however, is restricted. They may appear as advocates in most of the inferior courts, as before justices, magistrates, coroners, and county courts. They have no right of audience, however, in the High Court of Justice (except in certain bankruptcy matters), nor in the Privy Council or House of Lords, where, from time immemorial, the right has pertained to the bar; but they have right of audience in chambers.

Solicitors have for more than two centuries done all kinds of

conveyancing, which, at one time, was claimed to be the exculsive business of the bar and scriveners. The Conveyancing Act 1881 having made changes in the practice of conveyancing, the remuneration of solicitors was placed upon a new basis by an order which provided scales of fees based on the amount involved in the transaction, not, as was generally the case before, simply on the length of the documents perused or prepared.

All communications which pass between a solicitor and his client are privileged; so also is any information or document which he has obtained in his professional capacity on behalf of his client. The relation of solicitor and client disqualifies the former from dealing with his client on his own behalf, while it gives him a lien for his professional charges, over the deeds, etc., of the client in his possession. A solicitor's remuneration is minutely arranged by statute. He has no power of recovering more from his client than his statutory charges, and he is liable to be sued for damages for negligence in his client's behalf. Certain personal privileges belong to a solicitor. He is free from serving on juries, nor need he, against his will, serve as a mayor, sheriff, overseer or churchwarden.

In Scotland "law agent" is the general term devised by the legislature to embrace the various writers, solicitors and procurators entitled to practise as agents in the supreme and inferior courts. The Law Agents (Scotland) Act 1873 now regulates the admission of applicants to the roll of law agents entitled to practise in Scotland. The apprenticeship varies from three to five years and the applicant must also pass a general examination and an examination in law unless he is a university graduate. A law agent is removable from the roll upon a petition to the court of session. Separate rolls are kept of law agents entitled to practise (a) in the court of session and (b) in each of the sheriff courts. As in England, the law agent has a limited right of audience, *i.e.*, only in the bill chamber of the court of session and in the inferior courts. Many law agents are members of one or other of the incorporations of which the principal are His Majesty's writers to the signet, the solicitors in the supreme courts, the faculty of procurators in Glasgow, and the society of advocates in Aberdeen. In the United States the term solicitor is used in some States in the sense of a law agent practising before a court of equity.

Some of the great public offices in England and the United States have their solicitors. In England the Treasury solicitor fills an especially important position. He is responsible for the enforcement of payments due to the Treasury, and conducts generally its legal business and that of most Government departments. The office of king's proctor is combined with that of Treasury solicitor. The Treasury solicitor as nominee of the Crown acts as administrator of the personal estate of an intestate which has lapsed to the Crown, and as king's proctor intervenes in cases of divorce where collusion is alleged (*see* PROCTOR). In Ireland solicitors called Crown solicitors are attached to each circuit, their duty being to prepare the case for the Crown in all criminal prosecutions. In the United States the office of solicitor to the Treasury was created by Act of Congress in 1830. His principal duties were to take measures for protecting the revenue and to deal with lands acquired by the United States judicial process or vested in them by security for payment of debts.

See E. B. V. Christian, *A Short History of Solicitors* (1896); A. Cordrey, *The Law Relating to Solicitors* (1878); A. P. Poley, *Law Affecting Solicitors* (1897).

SOLICITOR-GENERAL, in England, one of the law officers of the Crown, first appointed by letters patent in 1461 as deputy of the attorney-general (*q.v.*), and so called because he was more concerned with matters in chancery. His duties are now practically the same as those of the attorney-general, to whom he is subordinate, and whose business and authority devolves upon him in case of a vacancy. The position of the solicitor-general for Scotland in the main corresponds with that of the English solicitor-general. He ranks next to the lord-advocate. In the United States the office of solicitor-general was created by Act of Congress in 1870.

SOLIDS, GEOMETRIC. The term solid is not widely used in geometry as a precise generic term, but it commonly appears in the names of certain special classes of geometric configurations. A geometric configuration is any set of points in space which, unless the contrary is stated, is understood to be the space of euclidean three-dimensional geometry. We may set down that any geometric configuration is a geometric solid, or simply a solid, if every point of the configuration is the centre of a sphere whose interior contains only points of the configuration, and if the configuration is not composed of two configurations which have no points in common and which are such that every point of each configuration is the centre of a sphere whose interior contains only points of that configuration. It will be seen readily that according to this definition the interior of a sphere is a solid, while the configuration consisting of that interior and the sphere, *i.e.*, the spherical surface, is not a solid. It is easy to modify the given definition so as to permit calling the latter configuration a solid. This requires making precise the idea of the boundary of a configuration. A *boundary point* of a configuration is a point such that every sphere having it as centre contains points of the configuration and also points which do not belong to the configuration. A boundary point of a configuration need not belong to the configuration. The set of all boundary points of a configuration is called the *boundary of the configuration.* We shall now define a solid as any configuration consisting of a solid according to the original definition and the boundary of the latter configuration, and shall refer to the latter configuration as the interior of the solid thus newly defined. There are simple solids such as those commonly referred to as the sphere, cube, pyramid, ellipsoid, cylinder and the less simple ones, such as the torus or anchor ring and a sphere with a number of holes bored through it, and so on to solids of great complexity; *e.g.*, the abstract analogue of natural objects, such as a sponge or the steel framework of a building. The task of making a complete detailed classification of solids is thus an enormous one. For certain restricted, though important, classes of solids the problem of classification has been solved to such an extent that the associated theory is an interesting and important chapter of mathematics. An example of such a class is the class of polyhedra, which is taken up in some detail below.

A useful procedure in attacking the general problem of classification is the study of the boundaries of solids. Although several solids may have the same boundary the ambiguity thus arising in the determination of a solid by its boundary is easily settled in the case of a great class of solids; viz., all those which have been studied in a systematic way. Thus a classification of the boundaries of solids determines a classification of solids. The boundaries of solids may be extremely complicated configurations, but in the case of the solids of the large class just referred to the boundaries have a speciality which is sufficient for a quite complete classification and theory. The solids referred to are those whose boundaries are closed surfaces. A sphere, a torus, a polyhedron are examples of closed surfaces, and a more complicated example of such a surface is the surface of the solid which results from boring any number (finite or infinite) of holes, properly located, through a sphere. A precise definition of the concept of closed surface will not be given now and an ordinary intuitive counterpart of that concept will serve provisionally.

In studying the properties of solids, it is helpful to divide those properties into metric and non-metric properties. A general property of the latter kind involves merely the way in which parts of the solid are attached to each other, *i.e.*, the connection of the solid; while a metric property refers to size and shape, thus involving a comparison with other solids in regard to such relations as congruence and similarity. A special kind of non-metric property, sometimes called descriptive, involves such notions as linearity, parallelism and convexity. The non-metrical properties are the more primitive and simple, but metrical relations (such as congruence) are also fundamental.

Polyhedral Solids.—In the study of solids aid is obtained from the study of a special class, polyhedral solids, *i.e.*, solids bounded by configurations formed by polyhedra. The theory of polyhedra suggests means of classifying more general solids and also methods of attack in the solution of problems of more general solids. Furthermore, the fact that any solid can be approximated to as closely as desired by a polyhedral solid adds to the impor-

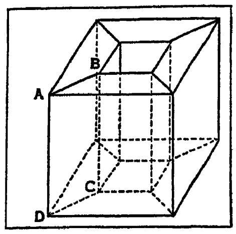
tance of the theory of such solids to a study of solids in general. A precise formulation of the fact just alluded to is the following: If S denotes any solid, then there exists a sequence of polyhedral solids, $P_1, P_2, P_3, \ldots, P_n \ldots$, such that every point of the solid P_n is a point of the interior of S and also of the interior of the solid P_{n+1}, and every point of the interior of S is a point of the interior a polyhedral solid P_m of the sequence. In particular, there exist such sequences of polyhedral solids such that each polyhedral solid is composed of a finite number of cubes such that no two of the cubes have interior points in common and every cube has a face in common with another one of the cubes. Another method of approximating to a solid by means of polyhedral solids is that in which the vertices of the approximating polyhedral solids are points of the boundary of the given solid, or, as it is usually stated, the polyhedron which bounds the polyhedral solid is inscribed in the boundary of the given solid. However, the existence of sequences of approximating polyhedral solids of the latter kind has been established only in the case of special solids.

POLYHEDRA

Definitions.—According to the definition of polyhedral solids, it is immediately evident that the theory of polyhedra is of much importance in the study of those solids. Preparatory to the consideration of the properties of polyhedra the following definitions are made. A *segment* is the set of all points of a (straight) line which are between two points of that line, and each of the latter points is called an *end* of the segment. A *simple polygon* is a finite set of points (*vertices* of the polygon) and segments (*sides* of the polygon) such that (a) each point of the set is the end of two and only two segments of the set, (b) the ends of each segment of the set are points of the set, (c) no two elements (*i.e.,* points or segments) of the set have a point in common, and finally (d) no proper subset of the set of points and segments satisfies (a), (b) and (c). It is a theorem of euclidean plane geometry that every simple polygon in a plane π is the planar boundary of a unique connected region of finite extent which is contained in π. The planar boundary of a set of points in a plane and a connected region in a plane are the two-dimensional analogues of the boundary of a solid and the interior of a solid respectively as defined above, circles of the plane replacing the spheres in the definitions referred to. Saying that a set of points is of *finite extent* means that it is contained in the interior of a sphere. The planar region thus determined by a simple plane polygon is called a *polygonal region.*

A finite set of points, segments and polygonal regions is called a *polyhedron,* if and only if (a) every segment of the set is a side of the boundaries of two and only two polygonal regions of the set, and every side of the boundary of a polygonal region of the set is a segment of the set, (b) every point of the set is an end of at least one segment of the set, and the ends of any segment of the set are points of the set, (c) if P is any point of the set, the set σ of all polygonal regions of the set whose boundaries have P as a vertex form a cycle, *i.e.,* every segment of the set which has P as an end is a side of the boundaries of two polygonal regions of the set σ and no proper subset of σ has that property, (d) no two elements (*i.e.,* points, segments or polygonal regions) of the set have a point in common, and (e) there is no proper subset of the set of points, segments, and polygonal regions which satisfies (a), (b), (c) and (d). By omitting some of the conditions of this definition, more general configurations which are also called polyhedra are defined thereby, and the set just defined is called a *simple* or an *ordinary polyhedron.* Just so there are polygons which are not simple and which are defined by less restrictive definitions than that given above. In what follows, the words polygon and polyhedron signify respectively, simple polygon and simple polyhedron. Despite the qualifying term simple, the class of simple polyhedra has a most interesting and important theory which still leaves much to be done.

Non-metrical Properties.—That every polyhedron is the boundary of a unique solid of finite extent and also the boundary of a unique solid not of finite extent is a theorem of euclidean three-dimensional geometry which requires a proof of considerable length. This theorem is analogous to the theorem of euclidean two-dimensional geometry concerning the separation of a plane by a polygon contained in it; but at this point the spatial theory becomes much richer. Considering merely the internal connection of the elements of a polygon, one is very much like the other, but in the case of polyhedra that is not so. Besides polyhedra such as the tetrahedron, cube octahedron, etc., there are those which can be obtained by cutting one or more square holes out of the limited solid bounded by a cube, tetrahedron, etc. Between a polyhedron thus obtained and a cube or tetrahedron there is a fundamental difference. The diagram illustrates one of these polyhedra of more complicated structure. It consists of 16 vertices, 32 edges and 16 faces. In the case of a cube any polygon P consisting of vertices and edges of the cube separates the cube; *i.e.,* there is a pair of points (and, of course, many pairs) of the cube, which do not belong to any polygonal line which is made up of points of the cube and which contains no points of the polygon P. (It should be emphasized that the terms cube, tetrahedron, octahedron, etc. are used here to denote polyhedra and not solids bounded by certain polyhedra.)



In the case of the polyhedron of the illustration the polygon $ABCDA$ does not separate that polyhedron in the above sense; however, any pair of polygons contained in the polyhedron, *i.e.,* every vertex and every point of the sides of the polygon, are points which are either vertices or belong to edges and faces of the polyhedron, and having no points in common separates the polyhedron in the sense that a set S of polygons separates a polyhedron π if the polygons of S are contained in π and if there are two points of π such that any polygonal line which contains them and which is contained in π also contains a point of a polygon of S. For any polyhedron there exists a finite set T of polygons which have no points in common and such that the set T does not separate the polyhedron, while any set of non-intersecting polygons on the polyhedron, which contains more polygons than T, separates the polyhedron. The number of polygons in the set T is called the *genus* of the polyhedron. Thus it can be easily shown that the cube, tetrahedron, and the more common polyhedra are of genus zero, while the genus of the polyhedron of the above illustration is one. Speaking roughly, a polyhedron of genus p is not disconnected when it is cut along the circuits (polygons) of a certain set of p circuits, but it is disconnected when cut along any $p+1$ circuits.

A most important theorem may now be stated. If $v=$ the number of vertices, $e=$ the number of edges, and $f=$ the number of faces of a polyhedron of genus p, then $v-e+f=2-2p$. Thus in the case of the polyhedra of genus zero (such as the cube, octahedron, and icosahedron) $v-e+f=2$, while for the polyhedron illustrated above $v-e+f=0$. The number $v-e+f$ is called the *characteristic* of the polyhedron. A remarkable fact in this connection is that, if two polyhedra have the same characteristic (or genus), then a subdivision of the elements of each exists so that the polyhedra thus derived are isomorphic; *i.e.,* any vertex, edge and face of one is paired respectively with a vertex, edge and face of the other such that a pair of elements of the first polyhedron which are incident corresponds to a pair of elements of the second polyhedron, which also are incident, and conversely. Thus, if a vertex A' and an edge a' of the second polyhedron are paired with the vertex A and the edge a of the first polyhedron respectively, and if A is an end of a, then A' is an end of a'; and similarly if a vertex and a face or an edge and a face are incident. The integer 2 minus the characteristic of a polyhedron is known as the *connectivity number* of the polyhedron and, as implied above, for a polyhedron in euclidean three-dimensional space it is either positive and even, or zero.

Classes of Polyhedra.—In the theory of polyhedra, considered merely as sets of objects, called vertices, edges and faces, which satisfy the relations of incidence and order of the definition of a polyhedron given above and which are not sets of points in any particular space, it is shown that there exists a polyhedron having any positive integer or zero as its connectivity number. In this

theory two classes of polyhedra are distinguished. Any polyhedron of one of these classes has the property that there is at least one polygon on it which does not separate any region which is on the polyhedron and which contains the polygon. The term region is used here in a sense which, though analogous to, is a simple extension of, its meaning given above. All other polyhedra make up the other class. Polyhedra of the latter class are sometimes said to be *two-sided;* those of the former *one-sided.* The basis of this terminology is suggested above in reference to the separation of euclidean space by polyhedra. Only two-sided polyhedra exist in euclidean space and any two-sided polyhedron is isomorphic with a polyhedron in euclidean space. A generalized polyhedron (*see* below) in euclidean space may be one-sided.

The terms *non-orientable* and *orientable* are also applied to polyhedra of the former and latter classes respectively, because either of two senses can be defined on an orientable polyhedron just as in the case of the euclidean plane or sphere, while that is impossible in the case of so-called non-orientable polyhedra. In the general theory of polyhedra, also called *manifolds* (*q.v.*) in that context, the above equation relating v, e, f and p holds for all orientable polyhedra, while the equation $v-e+f=2-p$ is the corresponding equation for non-orientable polyhedra, the letters in both cases having analogous meanings. In the following, as in what preceded this digression, it is understood that the polyhedra are in euclidean three-dimensional space, and are therefore two-sided or orientable.

Classification of Polyhedra.—It is suggested immediately that polyhedra may be classified according to genus but then the question of a finer classification arises. The goal is the complete description of the classes so that any two polyhedra of the same class and no two of different classes are isomorphic. Each of the classes of such a classification shall be called a *type.* It is obvious that the polyhedra of the same class have the same genus, but that the converse is not true. It is also obvious that polyhedra which are not isomorphic may form the boundary of the same solid. No such exhaustive classification has ever been completed, not even for the class of all polyhedra of genus zero.

A most useful general method of thus classifying polyhedra is based on the problem of the determination of all types of polyhedra of $f+1$ faces or $v+1$ vertices, assuming that all the types of polyhedra of f faces or v vertices, respectively, are known. For example, any type of convex polyhedron (for definition *see* below) of $f+1$ faces can be obtained by cutting with a plane all the faces of a certain convex polyhedron of f faces, which are incident with the same vertex. In the case of the special convex polyhedra which have only vertices which are incident with three and only three edges, this process of "cutting off the corners" results in a polyhedron of the same speciality and gives a comparatively complete result. If $\psi(f)$ denotes the number of types of convex polyhedra which have f faces and all of whose vertices are incident with exactly three edges, then $\psi(4)=1$, $\psi(5)=1$, $\psi(6)=2$, $\psi(7)=5$, $\psi(8)=14$, $\psi(9)=50$, and $\psi(10)=233$.

Very little, indeed, is known of the general behaviour of the function $\psi(f)$. If the polyhedra also satisfy the special condition that each polyhedron contains a face which is adjacent to all of the remaining faces, then a recursion formula for the value of $\psi(f)$ is known, but even in this very special case it is sufficiently complicated. A similar degree of completeness exists in the theory of the convex polyhedra, *i.e.,* the so-called duals of those just considered, *i.e.,* those which have only triangular faces. A polyhedron is said to be the dual (*see* DUALITY) or *reciprocal* of another if each vertex of the former is paired with a unique face of the second, so that thereby every face of the second is paired with just one vertex of the first, and if each edge of the first is paired with a unique edge of the second in a reciprocal way, and if a pair of incident elements of the second polyhedron corresponds to a pair of incident elements of the first.

Another general procedure in studying different types of polyhedra consists of making simple replacements of some of the elements of a polyhedron by new elements. For example, a face may be replaced by the two faces and the edge, which result from the division of the original face by a line which cuts its boundary in exactly two points, and different replacements are made according as the dividing line passes through no vertex, one vertex or two vertices incident with the face. For some such replacements the type of the polyhedron is not changed, while for others the type of the resulting polyhedron is different from but simply related to that of the original one. Many important theorems result from the consideration of such replacements of elements.

Regularly Connected and Convex Polyhedra.—In the case of certain special but important classes of polyhedra, the general ideas considered above lead to quite complete information about those classes. An important sub-class of polyhedra is that which consists of regularly connected polyhedra. A polyhedron is said to be *regularly connected* if every pair of vertices of the polyhedron which are incident with two of its faces are the ends of an edge of the polyhedron, which edge is also incident with those two faces. The type of a regularly connected polyhedron is completely determined by the incidence relations of its vertices and faces. Also, if the boundary of a face of a regularly connected polyhedron is removed the remaining set of vertices and edges is connected, but the converse, as is easily seen, is not true. It is interesting to note that the converse of the original statement with the phrase "regularly connected polyhedron" replaced by "polyhedron of genus zero," is true but not the modified statement. Finally there is the important special case of a regularly connected polyhedron of genus zero. Such a polyhedron will be said to be *convex-like,* because with regard only to incidence relations of its elements it does not differ from a convex polyhedron. The precise fact is given in the fundamental theorem that every convex-like polyhedron is of the same type as that of a certain convex polyhedron. As an important preliminary theorem here we have that every convex-like polyhedron is derivable from a tetrahedron by simple replacements of elements such as referred to above.

A convex polyhedron, already referred to several times, is defined in several equivalent ways. One definition requires that no line which is not in the plane of any face of the polyhedron contains more than two points of the elements of the polyhedron, and another is that, if α is any face of the polyhedron, then all of the elements of the polyhedron except α and the vertices and edges incident with α are on the same side of the plane which contains α. Again, a polyhedron which forms the boundary of a convex solid is a convex polyhedron, where by a *convex solid* is meant a solid which is such that, if two ends of a segment are points of the solid, then every point of the segment is a point of the solid. It is worth noting that these definitions require that a convex polyhedron be contained in a three-dimensional space, while the concept of a convex-like polyhedron is independent of any surrounding space.

Some further results of the foregoing will now be noted. If v, e and f respectively denote the number of vertices, of edges and of faces of a polyhedron then, since at least three edges are incident with each vertex and also with each face, $3v \leqq 2e$ and $3g \leqq 2e$; and if the polyhedron is of genus zero, then $v-e+f=2$. Conversely, it is proved that, if v, e and f are positive integers which satisfy these three conditions, the two inequalities and the equality, then there exists a polyhedron, in particular a convex polyhedron, with v vertices, e edges and f faces. Further, it follows easily from the latter equality that every polyhedron of genus zero and, therefore, in particular every convex polyhedron (for it is shown easily that the genus of a convex polyhedron is zero) has at least one face that is bounded by a polyhedron of either 3, 4 or 5 sides, and at least one vertex which is incident with 3, 4 or 5 edges, and has at least either one triangular face or one trilinear vertex, *i.e.,* a vertex incident with exactly three edges. Also, there exist polyhedra and. in particular, convex polyhedra having any number of edges, if that number is an integer greater than five and different from seven. There is no polyhedron having exactly seven edges. Finally a fact that is remarkable (even in view of the greater richness of the theory of polyhedra in euclidean three-dimensional space as compared to the theory of polygons in a plane) is that there exist polyhedral solids, evidently not convex, in

euclidean three-dimensional space, which are not decomposable into a finite number of tetrahedral regions which have no points which are not on their boundaries in common, and whose vertices are vertices of the polyhedral solid. That an analogous decomposition of a polygonal region into triangular regions always exists is a theorem of euclidean plane geometry.

Metrical Properties of Polyhedra.—The preceding exposition has been concerned largely with non-metrical properties. In succeeding paragraphs metrical properties of polyhedra are also considered. These properties being based on the intuitive notions of size and shape were the chief objects of study in the very early development of the subject. The chief topics here are the congruence of polyhedra and the properties of polyhedra which have elements or groups of elements which are congruent respectively. Two configurations are said to be *congruent* in the narrow sense if, and only if, one can be transformed into the other by a rigid motion. Two configurations are said to be congruent in the broad sense if, and only if, one can be transformed into the other by a succession or product of a finite number of rigid motions and planar symmetries; *i.e.,* reflections in a plane. An equivalent set of definitions is the following: Two configurations are congruent in the broad sense if, and only if, the points of one are in one-one correspondence with the points of the other such that the distances between pairs of corresponding points are equal. If sense as well as distance is preserved by the correspondence, then and only then are the two configurations congruent in the narrow sense. The terms of these definitions have precise abstract meanings but in order to save space they are omitted here; their ordinary meanings should give a sufficient understanding.

An outstanding theorem on the congruence of polyhedra is that if two convex polyhedra are isomorphic such that corresponding faces are congruent, then the polyhedra are congruent in the broad sense. The theorem is obviously not true in the case of polyhedra which are not convex, and an interesting theory concerning the infinitesimal and finite deformations of non-convex polyhedra, which preserve length, presents itself.

Regular and Semi-regular Polyhedra.—The question of the congruence of polyhedra suggests the consideration of a single polyhedron whose elements satisfy certain relations of congruence. At the extreme of speciality there are the so-called regular polyhedra. Because of their very conspicuous regularity they are among the oldest objects of study in the theory of polyhedra. A polyhedron is a *regular polyhedron* if, and only if, the boundary of each face is a regular polygon which is congruent to the boundary of every other face and each polyhedral angle of the polyhedron is regular, *i.e.,* having congruent face angles and dihedral angles resp., and congruent to every other polyhedral angle of the polyhedron. There are exactly five types of regular polyhedra; further details of these are given in the table below. A generalization of the regular polyhedra are the *Archimedian polyhedra;* all the faces of such a polyhedron are bounded by regular polygons, not all congruent to each other, and all the polyhedral angles are convex and congruent to each other. There are thirteen types of such polyhedra besides the semi-regular prisms and prismoids.

A *prism* is a polyhedron of which two faces, called its bases, lie in parallel planes and each of the remaining faces is bounded by a parallelogram and is adjacent to each base. A *prismoid* is a polyhedron which also has two faces, its bases, which are in parallel planes, while each of its other faces is triangular and incident with a vertex of one base and a side of the other. If every face of a prism or prismoid is regular, *i.e.,* bounded by a regular polygon, and if the bases of the prismoid are congruent, then the prism or prismoid are said to be semi-regular. The Archimedian polyhedra and their reciprocals form the class of the so-called *semi-regular polyhedra.* The semi-regular polyhedra can be obtained by such simple operations as taking plane sections of and combining regular polyhedra, and by dualizing. For example, the cuboctahedron is obtained by cutting off the vertices of the cube or octahedron by planes passing through the mid-points of the edges; the icosidodecahedron by a similar treatment of the dodecahedron or icosahedron. The reciprocals of these two Archimedian polyhedra are respectively the rhombic-dodecahedron and the rhombic triacontahedron, which have in all twelve and thirty faces respectively, each face being a rhombus. For further details of semi-regular polyhedra, *see* table p. 945.

The idea of semi-regular polyhedra leads to the later generalization of the notion of regularity, which is contained in the idea of a polyhedron transformable into itself by a congruence transformation, in the broad sense, such that any polyhedral angle of the polyhedron is transformed thereby into any other. Reciprocally there is defined a polyhedron which is transformable into itself by a congruence transformation so that any face of the polyhedron is transformed into any other. Polyhedra of the former kind have a circumscribing sphere while those of the latter have an inscribed sphere. The mere requirement of the congruence of all of the polyhedral angles or of all of the faces of a polyhedron does not imply the existence of a circumscribing or an inscribed sphere respectively. Archimedian polyhedra are polyhedra of the former kind which have their faces bounded by regular polygons which are not all congruent to each other. A complete classification of the convex polyhedra satisfying this more general definition of regularity has been made, according to the kind of faces and the various relations of symmetry which are satisfied, and the number of distinctive types is finite. When the requirement of convexity is removed the complexity of the problem of classification is very great, and no classification of any satisfying degree of completeness has been made. In conformity with the present viewpoint a regular polyhedron may be defined as a polyhedron which is transformable into itself by a congruence transformation, in the broad sense, so that any vertex is transformed into any other vertex, any edge incident with the former vertex into any edge incident with the latter vertex, and any face incident with the former edge into any face incident with the latter edge.

The notion of symmetry furnishes another basis for the investigation of properties of regularity of polyhedra. It is a fundamental concept in the definition of an important class of polyhedral solids known as crystals. A configuration is called *symmetrical* if it admits of a congruence transformation, in the broad sense, into itself, which is not the identity. In this scheme of classification, two configurations are in the same class if the group of congruence transformations which transform one of the configurations into itself is the same as the group of congruence transformations which transform the other into itself.

A Crystal.—A *crystal* is a solid whose boundary is a polyhedron which has the following properties: In the first place its vertices, edges and faces are respectively on points, lines and planes of a rational space net. A rational space net is the set S of all points, lines and planes such that there are five points, P_1, P_2, P_3, P_4 and P_5, no four of which are in a plane, such as the vertices of a tetrahedron and a point interior thereto, with the property that if α denotes any element (point, line or plane) of S, then there exists a finite sequence of elements of S, $P_1, P_2, P_3, P_4, P_5, \alpha_1, \alpha_2, \alpha_3, \ldots, \alpha_n, \alpha$, such that the first five elements are the five points mentioned above and any other element of the sequence is uniquely determined by being common to or containing preceding elements of the sequence. Secondly, the polyhedron is transformed into itself by the transformations of a finite group of congruence transformations, in the broad sense, which transform a rational space net into itself. Such a group is known as a crystallographic group. There exist thirty-two crystallographic groups which thus determine the same number of classes of crystals.

Generalized Polyhedra.—At this point, perhaps, there should be mentioned a generalization of the notion of regular polyhedron, which is obtained by generalizing the idea of a polyhedron itself, although these generalized polyhedra are not the boundaries of unique solids. The boundary of a face of a polyhedron is, as stated early in this article, a simple plane polygon. A *generalized polygon* satisfies the conditions of the definition of a simple polygon, except that one which states that no elements of the polygon have a point in common. (One might generalize further by requiring an even number, not necessarily two, of sides inci-

Tables Giving Data of Regular and Semi-regular Polyhedra

	Name	f	v	e	m	m_1	m_2	n	n_1	n_2	s	s_1	s_2
Regular polyhedra	Tetrahedron	4	4	6	3	4	3	..	..	..	..	..	..
	Cube	6	8	12	4	6	3	..	..	..	..	..	..
	Octahedron	8	6	12	3	8	4	..	..	..	..	..	..
	Dodecahedron	12	20	30	5	12	3	..	..	..	..	..	..
	Icosahedron	20	12	30	3	20	5	..	..	..	..	..	..
Archimedian polyhedra	Truncated tetrahedron	8	12	18	3	4	1	6	4	2	..	..	..
	Truncated cube	14	24	36	3	8	1	8	6	2	..	..	..
	Truncated octahedron	14	24	36	4	6	1	6	8	2	..	..	..
	Truncated dodecahedron	32	60	90	3	20	1	10	12	2	..	..	..
	Truncated icosahedron	32	60	90	5	12	1	6	20	2	..	..	..
	Semi-regular prism	n+2	2n	3n	4	n	2	n	2	1	..	..	..
	Cuboctahedron	14	12	24	3	8	2	4	6	2	..	..	..
	Small rhombicuboctahedron	26	24	48	3	8	1	4	18	3	..	..	..
	Icosidodecahedron	32	30	60	3	20	2	5	12	2	..	..	..
	Semi-regular prismoid	2n+2	2n	4n	3	2n	3	n	2	1	..	..	..
	Snub cube	38	24	60	3	32	4	4	6	1	..	..	..
	Snub dodecahedron	92	60	150	3	80	4	5	12	1	..	..	..
	Great rhombicuboctahedron	26	48	72	4	12	1	6	8	1	8	6	1
	Great rhombicosidodecahedron	62	120	180	4	30	1	6	20	1	10	12	1
	Small rhombicosidodecahedron	62	60	120	3	20	1	4	30	2	5	12	1

	Name	f	v	e	m	m_1	m_2	a_1	a_2	a	p
Regular generalized polyhedra	Small stellated dodecahedron	12	12	30	5	12	5	1	2	3	4
	Great dodecahedron	12	12	30	5	12	5	2	1	3	4
	Great stellated dodecahedron	12	20	30	5	12	3	2	1	7	0
	Great icosahedron	20	12	30	3	20	5	1	2	7	0

dent with each vertex.) A *regular generalized polygon* is defined accordingly; *e.g.,* any regular generalized polygon, sometimes called a *star polygon,* with n vertices is obtained by joining in order every k th vertex of a regular simple polygon of n vertices, where k is any integer between 1 and $n/2$.

In an analogous way the notion of a *generalized polyhedron* is defined; *i.e.,* by relinquishing the condition that two elements have no points in common, and at the same time allowing a face to be determined by a generalized plane polygon. The generalized polygon is not the boundary of the face in the ordinary sense. For example, the sides of each pentagon which bounds a face of a regular dodecahedron when prolonged form a star pentagon, and all such star pentagons determine the faces of the great dodecahedron. The latter generalized polyhedron is regular in a sense which is an obvious extension of the meaning of that term as applied to ordinary polyhedra. There are just four such *regular generalized polyhedra* and detailed data concerning them are given in an accompanying table. The other definitions involving the idea of regularity as applied to ordinary polyhedra evidently admit of like extension so as to apply to generalized polyhedra, and many interesting types of generalized polyhedra accordingly present themselves.

Explanation of Tables.—The symbols of the tables have the following meanings: f denotes the number of faces of the polyhedron, v the number of vertices, and e the number of edges; of the f faces, m_1 are bounded by polygons of m sides, and m_2 of these m_1 faces are incident to each vertex. Similarly, in the case of the numbers n, n_1, n_2 and s, s_1, s_2. a is the number of times that the projection of the generalized polyhedron from its centre on to a sphere about that centre covers the sphere; a_1 and a_2, are respectively the analogous numbers for a polygon which determines a face of the polyhedron, and for a polyhedral angle of the polyhedron; p is the genus of the polyhedron (the genus of all polyhedra in the first table is, of course, zero). Each polyhedron of a bracketed pair is dual to the other; the tetrahedron is self-dual.

GEOMETRIC SOLIDS IN GENERAL

The boundary of a solid may consist, of course, of several polyhedra; *e.g.,* a cube and one or more smaller cubes inside of the former. Some of these polyhedra may have points in common. The great diversity of such disconnected boundaries makes classifying them difficult; a rough classification is according to the number of pieces into which the boundary falls. As remarked earlier, the boundary of a solid may be a closed surface or consist of a number of such, or it may be a set of points of great irregularity. Solids with such irregular boundaries can be obtained by limiting processes in which certain constructions are repeated an infinite number of times.

The study of the general properties of solids of the class of solids whose boundaries are closed surfaces is made along lines suggested by the theory of polyhedral solids, a sub-class of the former; for a closed surface can be transformed continuously into a polyhedron. This property may be taken as the defining property of a closed surface. The concept of genus carries over directly, when simple continuous curves are used in place of the polygonal lines and polygons of the definition of that term given above. Simple examples of closed surfaces are the sphere, ellipsoid, the surface of a cone, of a cylinder, and of an anchor ring, *i.e.,* a torus. With regard only to the primitive properties of continuity and connectivity, the first four closed surfaces are not different; the torus, however, is different from all of the other four. The genus of each of the first four is zero, that of the torus, one; it is impossible to transform continuously the torus into any of the others, but any one of the first four can be continuously transformed into any other. The similarity between the torus and the polyhedron illustrated above should be noted; the genus of each is unity and either is continuously transformable into the other. When projective or metric properties are regarded, distinctions between any two of the examples cited immediately appear. (*See* MATHEMATICAL MODELS.)

See V. Eberhard, *Zur Morphologie der Polyeder* (Leipzig, 1891); M. Brückner, *Vielecke und Vielfläche* (Leipzig, 1900); E. Steinitz, "Polyeder und Raumeinteilungen," *Encyklopädie der math. Wissenschaften,* Bd. III$_1$, Heft 9 (Leipzig, 1922); C. Wilner, *Ueber Vielecke und Vielfläche* (Leipzig, 1864); O. Veblen and J. W. Young, *Projective Geometry,* vol. ii., ch. 9 (N.Y., 1918); H. G. Forder, *The Foundations of Euclidean Geometry,* ch. 12 (London, 1927). (G. A. P.)

SOLID STATE, THEORY OF. It is often said that a solid has volume and shape, a liquid volume, but no shape, and a gas neither definite volume nor shape. Though it sums up neatly the main characteristics of the three states of aggregation, this statement scarcely forms an accurate or adequate definition. The volume of both solids and liquids can be modified, if only to a slight degree, by external pressure. Similarly the shape of a solid can be changed by applied forces. Conversely, a liquid unstrained, has the tendency to assume a spherical shape, though it is true that this tendency is slight. Again large masses of gas under the influence of the mutual attraction of the molecules, tend to form those vast spheres which we know as stars. The definitions, such as they are, describe in reality the viscosity and

surface tension, rather than the state of aggregation. Nevertheless, they form a rough working picture upon which a more searching examination may be based.

From the molecular point of view the three states of aggregation of matter may be described in terms of the forces acting between the molecules. Besides the ordinary gravitational attraction, there is as is well known, a molecular force of attraction

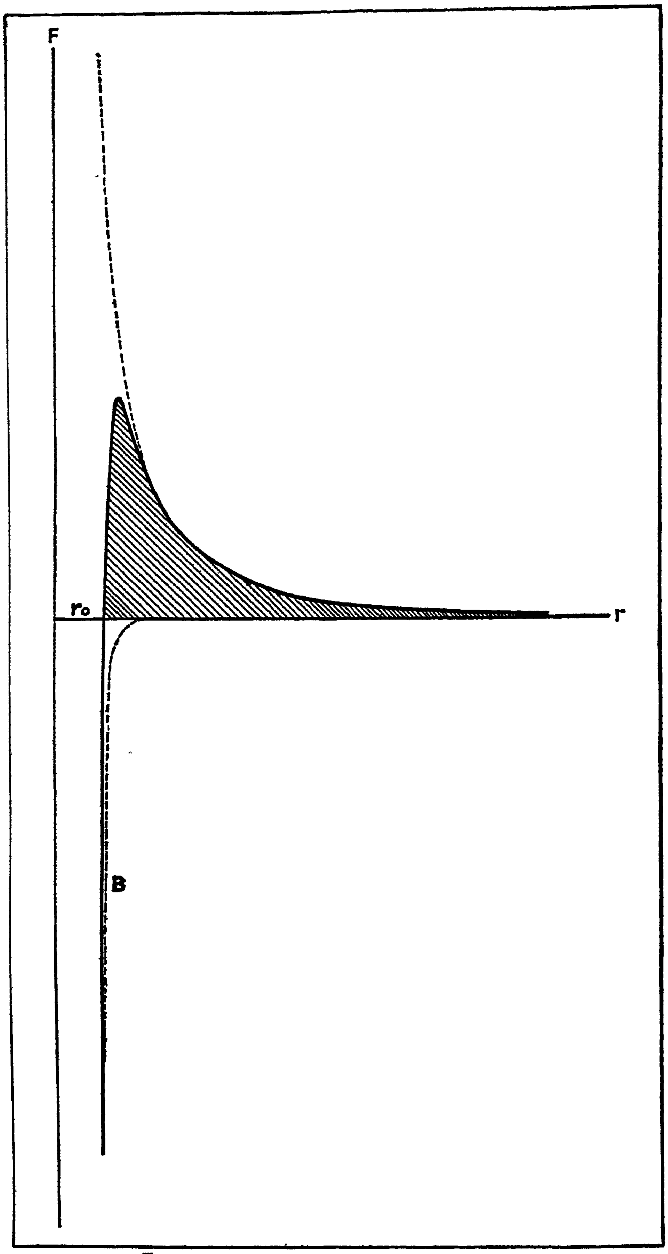


FIG. 1.—FORCE BETWEEN ATOMS IN SOLIDS

or cohesion which comes into play at distances small compared to our ordinary standards, but large compared to the molecules themselves. This force of attraction which is probably electromagnetic in origin, may be represented by the curve A as shown in fig. 1, which diminishes with considerable rapidity as the distance between the molecules measured along the abscissa increases. When the molecules approach very close to one another there is a force of repulsion which philosophers, though not perhaps physicists, might attribute to the unscientific axiom, that two things cannot occupy the same place at the same time. This force is undoubtedly closely related to what may be called the shape of the molecule and is presumably due to the mutual repulsion of the peripheral negative electric charges. Whatever its origin, it is undoubtedly very small until the molecules approach one another within a distance comparable with their own diameter where it rapidly becomes extremely large. If this force be represented by curve *B* then it is evident that the interplay of the attraction and repulsion lead to a force of repulsion when the molecules approach one another within a given distance which changes over to a force of attraction as this distance is exceeded. On increasing the distance the attraction increases until it attains a maximum value after which it rapidly diminishes to become negligible at distances large compared to the molecular diameter.

The existence of forces between molecules which may be represented by curves of this type explains the existence of the three states of aggregation to matter. If the energy of the molecules is large compared to the total energy necessary to separate them from their closest approach to infinity, then the substances will be in the gaseous state for the collisions will be so violent that the particles rebound without coalescing. When the energy is diminished the violence of the collisions decreases and occasions will arise when the molecules coalesce and ultimately condense to a liquid. In the liquid the molecules move about rapidly colliding with one another, but only in exceptional cases have they enough energy to overcome the attraction of the surface molecules and to escape into the vapour phase. Their velocities being distributed, according to Maxwell's expression, there will always be a few with the necessary abnormally large energy; in general however these form only a small fraction of the whole, a fraction which varies of course with the temperature and is a measure of the vapour pressure.

It may be remarked that the energy required by a molecule, to enable it to overcome the attraction of all its neighbouring molecules at the surface of a liquid is greater (though only about three times greater) than the work necessary to separate two molecules from contact to infinity. This explains the phenomenon of supersaturation. If no drop of liquid is present, only molecules will coalesce whose relative speed when they collide is so small as to be insufficient to overcome their mutual attraction. As soon as a drop of liquid is formed all these comparatively slow molecules will condense upon it; for to escape from the attraction of all the molecules in a surface requires considerably more energy than to prevail over the attraction of a single molecule.

The solid state is that in which the energy of the molecules is insufficient to overcome their mutual repulsion sufficiently to enable them to collide. This distinction between mutual repulsion and collision presupposes an enormously rapid increase in the force at a given point corresponding to the distance which, in old fashioned language, would have been called the surface of the molecule. This very rapid increase certainly exists; exactly what causes it we need not here consider. At low temperatures when the energy of the molecules is small they will approach one another until their average distance is such that their mutual attraction balances their mutual repulsion, in other words, until their mean distance corresponds to the point at which the curve cuts the axis in fig. 1. About this position of equilibrium the molecules oscillate under the influence of their mutual repulsion. As the temperature rises the magnitude of their excursions increases until the molecules reach a point at which the mutual repulsion becomes suddenly very large, in other words until they collide.

We must here call attention to the fact that there are two very definite classes of so-called solids, the crystalline and the amorphous solids. If one considers a number of molecules of similar type acting upon one another as described above it is clear that the most stable arrangement will be that in which the attractive forces have been able to exert themselves to the full, in other words the molecules will tend to arrange themselves in the closest packed order. If the fields of forces are symmetrical the closest packed form will correspond to the closest arrangement of a number of spheres. As has been known ever since cannon balls were piled into heaps, this closest array corresponds to a pyramid. Hence molecules with symmetrical fields of force will tend to arrange themselves in octahedral order, and will form a regular space-lattice. If the fields of force are not symmetrical they will still form a space-lattice, but the distance between them will not be the same along different axes, the axes will not

be orthogonal, and the substance will not crystallize in the regular system. The crystalline state is characterized by the arrangement of molecules at regular intervals in the most stable condition.

One might almost question whether the amorphous bodies, sometimes called glasses, should properly be classed as solids. They are, strictly speaking, undercooled liquids and are formed when cooling from the liquid state takes place too rapidly for the forces of attraction to have time to collect the molecules into their most stable positions. In this state the positions of the molecules are irregular, though of course their average distance is not very much greater than in the crystal. They are close together but not equally spaced, they correspond to a crowd rather than to a regiment. When the attraction is great even the most rapid cooling may not suffice to prevent the molecules arranging themselves in regular order. If the energy to be gained by arranging them in regular array is not very great, *i.e.,* if the work of attraction is not very much greater than the work of repulsion, there is no great tendency to crystallize, and the substance may be supercooled, that is to say, solidified in the amorphous form even though cooled comparatively slowly. This is particularly likely to happen when one has large irregular molecules, especially if they are not all alike. Thus in the case of glass only a very prolonged exposure to an appropriate temperature causes devitrification, *i.e.,* crystallization to occur. Temperature in this connection is of supreme importance, for at low temperatures the energy of the particles is too small to enable them to make excursions from their position of equilibrium which might in favourable circumstances result in their changing places and achieving a more stable regular arrangement. It is high temperatures near, but not too near, the melting point where the viscosity is low, that favour crystallization.

Having defined these two classes we may examine the transition from the solid to the liquid state. As a crystal is heated the amplitude of the oscillations of the molecules about their positions of equilibrium increases until those molecules with an exceptionally high energy content collide with their neighbours. Such a collision results in the sharing of the momentum with a neighbour and the distribution of the energy between the two molecules. In this way the crystal may be heated without any material change until the temperature is reached at which the average amplitude of oscillation is such that all molecules collide. At this temperature sharing the energy does not diminish the oscillation below the point of collision and the whole structure collapses into a liquid. Thus the crystals have a perfectly well defined melting point which cannot be exceeded. No crystal can be heated in any circumstances above the melting point.

The amorphous bodies behave very differently. As the energy of the molecules is augmented the amplitude of oscillation of those which happen to be so placed that their neighbour's repulsion is small, increases very rapidly. In favourable circumstances, here and there collisions take place at temperatures well below that of liquefaction proper. The number of these go up rapidly as the temperature is raised. What might be called local liquefaction occurs in innumerable minute regions dispersed at random through the body. It becomes soft and viscous and changes gradually by imperceptible degrees into a liquid. It is precisely this property which gives glasses their valuable qualities. A temperature can always be found at which their viscosity is such that they can be worked and moulded, into any desired shape or form. From a scientific point of view this condition is less satisfactory; glasses have no definite melting point and in their case the solid state can only be defined as that in which few of the molecules have a sufficent amplitude of oscillation to collide.

Thus we see that the characteristic of having shape, in the case of a solid reduces to the fact that the molecules are held in position by the forces they exert upon one another, whether in regular array as in a crystal, or distributed irregularly as in a glass, until external agencies intervene. Unless forces large compared to the molecular forces are applied no great movement of the molecules or change in the shape can be expected. The effect of smaller forces, as might be expected, is to modify slightly the relative positions of the molecules. If, say, a solid is subjected to pressure from all sides this corresponds to a general increase of the attractive forces. The positions of equilibrium approach one another, the solid is compressed into a smaller volume. The compressibility is thus a measure of the forces holding the molecules in their positions of equilibrium. Its small value shows how large these forces are.

There is one very remarkable class of objects, the metallic crystals in which the stress necessary to produce a change of shape is comparatively small. It has been found that metals which normally consist of an agglomeration of small crystals may be converted into large single crystals by alternate stretching or heating at appropriate temperatures. These single crystals exhibit a very small resistance to deformation, so much so that they are apt to bend and break up under their own weight. The reason for this abnormal behaviour has not been clearly established, though it is possible that it is due to the constitution of the metallic space-lattice. Reasons have been adduced for the view that this consists of two interleaved lattices, one consisting of electrons and the other of the ions formed by their dissociation from the parent atoms. It has been suggested by Hume-Rotheray that such a lattice consisting alternately of particles of finite size and particles of comparatively negligible size would have a very small resistance to deformation.

The best known characteristic of crystals is their regular shape. This is readily explained on the view put forward above. The number of atoms in any given volume being fixed, the distance between planes of closely packed atoms must be greater than the distance between planes in which the atoms are farther apart. If the attractive force between the atoms diminishes with distance, the strength of the crystals at right angles to such a closely packed plane must be a minimum and hence cleavage will tend to occur along such a plane. The same argument explains why molecules which are deposited upon a crystal will seek out this plane and thus give rise to the shapes so well known to crystallographers.

The mutual attraction of the molecules gives rise of course on the surface of a solid to an uncompensated inward attraction which is known in liquids as surface tension. This corresponds to an external pressure of a very considerable amount. Its order of magnitude may be gauged by considering the work consumed in causing the solid to expand. The amount which varies from substance to substance is measured in tens of thousands of atmospheres. Connected with this, in theory though not in practice, is the tensile strength of a solid. As shown by the curve, the attraction between two neighbouring molecules grows as they are removed from one another up to a limit after which it decreases. This limit should be a measure of the ultimate strength of the material and the point at which it is reached should bear some relation to the maximum tension. Though we do not know the exact form of the curve an estimate of the amount can be made. The shaded area represents the work done in removing a molecule to infinity, *i.e.,* the latent heat of evaporation which of course is known; the angle under which the curve cuts the abscissa, gives the measure of the restoring force acting upon the molecules; as mentioned above, it is related to the compressibility. An estimate of the theoretical strength of some of the metals is some twenty or thirty times higher than anything observed, presumably because the metals form an agglomeration of small crystals and their tensile strength no more gives a measure of the ultimate forces between the molecules than does the strength of a piece of wool, of the fibres composing it. Tensile strengths of the theoretical order of magnitude are found in glass immediately after and in silica for some hours after drawing in a flame. This presumably represents the period before submicroscopic crystallization sets in.

The forces acting upon a molecule in the interior of a solid, are obviously equal from all sides when it is in its position of equilibrium. No matter what the law of force may be a small displacement from this position will give rise to a restoring force proportional to the displacement. For by Taylor's Theorem, the function of a given argument, plus a small quantity, is equal to the function of the argument plus the small quantity multiplied

by the derivative of the function. Since the forces from both sides are equal at equilibrium and the small displacement corresponds in the one case to an addition to, and in the other a subtraction from the argument, the resultant restoring force is twice the derivative of the function multiplied by the displacement. This result which of course means no more physically than that every curve may over a sufficiently small distance be treated as a straight line, is the reason for the approximate validity of Hooke's law, that the strain is proportional to the stress, the extension to the applied force or the compression to the applied pressure. Though accurate to a first approximation, it has long been known that it is really only true as a limiting case for small forces.

As will appear below several important characteristics of solids depend entirely upon the deviations from the simple linear expression. If one confines oneself to the first order and considers only a quasi-elastic restoring force α and it follows that the molecules in a solid will oscillate with a definite proper frequency

$$\nu = \frac{1}{2\pi}\sqrt{\frac{\alpha}{m}},$$

m being their mass. The reality is not quite so simple since the motion of one molecule will be communicated to its neighbours and the whole system will quiver with a number of different proper frequencies which depend upon the lattice structure, the force between the molecules and the molecular weight. The highest frequency, however, will be that given by the above formula for a body of mass m vibrating under the elastic restoring force α. This can be observed directly in solids which contain ions. In the case for instance of rock salt or sylvin, the crystal is built up of a cubical array of alternating alkali ions and halogen ions. The restoring forces acting on these may be derived from the compressibility, and their mass, the atomic weight divided by Avogadros number, is of course known. Hence their frequency of oscillation can be calculated; for NaCl it is about -6×10^{12} and for KCl about 5×10^{12}. If an alternating electromagnetic field, in other words, radiation of this frequency, is allowed to fall upon these crystals the ions, being in resonance, are set in motion and the radiation is reflected.

Another method of estimating molecular frequencies makes use of the definition of the melting given above, namely that the melting point is the temperature at which the amplitude of oscillation of the molecules enables them to collide with one another. As in the case of a musical string or pendulum, the amplitude of oscillation is completely determined if the mass, frequency and energy are known. Since the energy at the melting point and the atomic mass are ascertainable, the frequency can be derived if the free space between the molecules is known. Conversely if the frequency is known the amplitude of oscillation at the melting point, in other words the distance between the surfaces of the molecules, can be calculated. It appears to be much the same fraction in all monatomic substances, 10% to 12% of the distance between the centres of neighbouring atoms.

The frequencies are of importance, since it has been shown by Einstein following Planck, that they determine the course of the specific heats of substances at low temperatures. The classical statistical mechanics of Boltzmann, showed that the mean kinetic energy resolved along any one axis of particles capable of motion and capable of interchanging momentum, averaged over the time, should be equal provided the particles are in thermal equilibrium, *i.e.*, at the same temperature. Hence the molecules in a solid, since they are capable of oscillation along each of three axes, just as the molecules in a gas are free in three dimensions, should contain the same amount of kinetic energy as a monatomic gas, *i.e.*, $\frac{3}{2}$ RT. In a solid, as we have seen the molecules excursions are restrained by the repulsion of their neighbours. During part of their oscillations therefore, the kinetic energy is converted into potential energy. If the restoring force is proportional to the displacement the oscillations are harmonic and it may be shown that the potential energy averaged over a long time is equal to the kinetic energy. Hence the atomic heat of a solid at constant volume, should be exactly twice that of a monatomic gas at constant volume, which latter is 3 R. This result is of course in good agreement with Dulong Petit's and Kopp's law and was at one time held to be an important confirmation of these empyrical approximations. Ordinary measurements of atomic heats of solids are of course carried out at constant pressure and not at constant volume, but a simple thermal dynamical consideration enables one to show that the difference $c_p - c_v = \frac{9\beta^2}{\kappa}T$ where β is the thermal expansion coefficient, κ the compressibility and T the temperature.

Without making too extended an incursion into that large body of hypotheses and doctrine usually grouped under the heading Quantum Theory (*q.v.*), it is impossible to give an accurate derivation of the formula which represents the atomic heat as a function of the temperature. Roughly, one may summarize the quantum condition by saying that the oscillating system at any given time can only be in one of a number of discrete states, these states corresponding to energy levels, differing from one another by one quantum of energy. If the classical statistical mechanics were true, every energy level would be possible and the probability of any one corresponding to an energy ϵ would be given by $e^{-\epsilon/kT}$, k being Boltzmann's constant and T the temperature. The sum of all the energies of N molecules each having three degrees of freedom would thus be $U=3NkT=3RT$ for one gramme molecule. With the quantum restriction a system of oscillating particles will contain less energy, for the energy which on the classical view would be contained by molecules having less than one quantum ϵ, would not be present, similarly all the molecules which on the classical view would contain energies between one and two quanta, would only have one quantum, and again those molecules which should contain between two and three quanta, would have exactly two quanta. Hence the total energy instead of being given by the above expression is equal to

$$\begin{aligned} U &= 3N\left[\epsilon(e^{-\epsilon/kT}-e^{-2\epsilon/kT})+2\epsilon(e^{-2\epsilon/kT}-e^{-3\epsilon/kT})+\cdots\right] \\ &= 3N\epsilon\left[e^{-\epsilon/kT}+e^{-2\epsilon/kT}+e^{-3\epsilon/kT}+\cdots\right] = \frac{3N\epsilon}{e^{\epsilon/kT}-1}\cdots \end{aligned}$$

This formula shows that the atomic heat of a solid

$$\frac{dU}{dT} = 3R\frac{\left(\frac{\epsilon}{kT}\right)^2 e^{\epsilon/kT}}{(e^{\epsilon/kT}-1)^2}$$

reaches a value $3R$ asymptotically at temperatures high compared to ϵ/k but that it falls far below this value and indeed to zero at low temperatures. It is clear that if the quantum ϵ becomes zero one arrives at the classical result; it is its finite value which leads to the discrepancy. One of the most fundamental requirements of the quantum theory is that the quantum is proportional to the frequency ν *i.e.*, $\epsilon = h\nu$. Hence elements with high proper frequencies have large quanta, and elements with low frequencies small quanta. But as we have seen high proper frequencies are characteristic of elements which combine a large restoring force with a small atomic weight. Hence deviations from the classical value for the atomic heat, *i.e.*, Dulong Petit's law, are to be expected at comparatively high temperatures in elements such as carbon or boron, which combine small compressibility or high melting point with low atomic weight. On the other hand elements of high atomic weight, which are soft and have low melting points, such as lead or mercury, have a low frequency, *i.e.*, they obey Dulong Petit's law down to very low temperatures. That carbon and boron deviated from the normal was known to Dulong Petit, but it is only within the last 20 years that the explanation has been found.

The above formula can only be correct if all the particles have the same proper frequency. As was mentioned above, this is not the case since a large number of lower frequencies can also occur. Strictly speaking therefore, one should substitute for the above formula an expression of the form $\int f(\nu)\frac{3Nh\nu}{e^{h\nu/kT}-1}d\nu$ when $f(\nu)d\nu$

represents the probability of a frequency between ν and $\nu+d\nu$. The calculation of this probability is extremely complex and depends of course upon the assumptions made about the lattice and the intermolecular forces. It has been carried out in a number of the more straightforward cases by Born, but the expressions are in general too complicated to be of practical use.

A simpler line of attack was developed by Debye. The slow frequencies really are nothing but the harmonics upon the fundamental frequency, *i.e.*, the fundamental note of the solid. Each mode of vibration may be regarded as a stationary wave and the probability of any given frequency merely corresponds, on this view, to the number of ways in which one can arrange stationary waves of a given wave length in a solid. This number is obviously proportional to $\sqrt{(p^2+q^2+r^2)}$ where p, q and r are whole numbers, hence the probability is proportional to the number of ways in which one can arrange a set of whole numbers so that the sum of their squares lies between given limits. It may readily be shown that this is proportional to the square of the frequency so that the probability function, according to Debye, may simply be written $f(\nu) \propto \nu^2$. This derivation is of course accurate only for long waves and breaks down for the more numerous higher frequencies. Nevertheless, to facilitate computation and avoid complication Debye extended this formula right up to the higher frequencies, determining his constant by the condition that the sum of all probabilities must be equal to one, *i.e.*, the total of all the modes of vibration must amount to the total number of degrees of freedom, $3N$. Thus he gave for the final formula for the atomic heats $\frac{d}{dT}\left(3RT\frac{3}{x}\int_0^x \frac{\xi^3 d\xi}{e^\xi - 1}\right)$ where x is θ/T, $\theta = \frac{h\nu_m}{k}$ being the quantity he termed a characteristic temperature and ν_m the maximum frequency being defined by $\int_0^{\nu_m} f(\nu)d\nu = 1$.

These formulae of course only apply to monatomic substances. When one is dealing with substances in which the atoms are combined in molecules, much more complicated conditions prevail. Strictly speaking all these problems could be attacked by the method developed by Born, but this requires a knowledge of the chemical forces as well as the cohesive force. This knowledge is at present almost entirely lacking but for practical purposes the method adopted by Nernst is adequate. He assumed that in a crystalline compound the molecules could be treated as forming a space-lattice and their contribution to the heat capacity expressed by Debye's formula. The oscillations of the atoms in the molecule he regarded as being little affected by the neighbouring molecules and therefore applied to them Einstein's formula which corresponds to a line spectrum. By this means he was able to represent with great fidelity the molecular heats of various compounds. The large deviations found from Kopp's law are readily explained on this view; for the atomic frequencies under the comparatively large restoring forces inside the molecule, are often very high and their contribution to the specific heats, even at comparatively high temperatures, may be well below the classical value.

Like practically all substances, solids expand on heating. Their thermal expansion, however, is smaller than that of liquids and far less than that of gases. This is intelligible in view of the picture of their constitution which has been outlined. In a space-lattice formed of molecules held in place by their mutual attractions and repulsions, the primary effect of increasing the temperature is to increase the kinetic energy and consequently the amplitude of oscillation of the particles. If the restoring force is strictly proportional to the displacement, *i.e.*, if the oscillations are strictly harmonic, there will be no tendency to expand, for the molecules will remain equally long at either extremity of their swing and exert equal forces of attraction and repulsion upon their neighbours. This condition is of course not strictly possible in reality, for it leaves out of account the conditions at the surface. Here at any rate there must be asymmetrical oscillations in which the molecules on their inward incursions are repelled by their neighbours, but on their outward swings are limited by the attraction of these same neighbouring molecules. As has been said, it is this very attraction which gives rise to the internal pressure in solids. It is clear that this same internal pressure limits the volume since this is determined by equating the total excess outward pressure of the oscillating particles to their mutual attractions. As has been shown, to a first approximation, the curve representing the force between the molecules near their positions of equilibrium, can be treated as a straight line, in other words a given deviation gives rise to just as much attraction from one side as repulsion from the other. This however is only a first approximation. Strictly speaking, the repulsion increases more rapidly than the attraction, otherwise the substance would not be stable and would collapse. Therefore any increase in the amplitude of the oscillations must give rise to an outward force equal to the aggregate of these differences which will lead to a general expansion of the solid. As has been stated, of course this is only a second order effect due to the nonlinearity of the function representing the restoring force, *i.e.*, to the fact that the restoring force is not strictly elastic. If it were, that is to say if Hooke's law were strictly true and the extension of a solid were accurately proportional to the applied force, there would be no tendency to expand on heating. The extension which is observed, is due to and indeed a measure of this small deviation from the perfect elastic properties which an idealized solid would possess and real solids at low temperatures approach. This being so it is plain that the expansion coefficient will vary with the temperature. At sufficiently low temperatures where the amplitude of oscillation is small the thermal expansion diminishes and approaches zero as the absolute zero is reached. To a first approximation it is proportional to the atomic heat.

Another property of solids, whose relation to this same phenomenon was formerly not recognized, is the thermal conductivity. All solids conduct heat to a greater or less degree, their conductivity being measured by the amount of heat which flows through unit cross-section in unit time under the influence of unit temperature gradient. There are, however, two classes whose conductivity differs considerably, the metals and the non-metals. The metals in general conduct very much better than the non-metals; the mechanism of their thermal conduction however is almost certainly of a different type being due to the dissociated electrons which give to them their specific property of electrical conductivity. The non-metals conduct in a varying degree, some of them such as the precious stones, more especially the diamond conducting extremely well, whilst others such as glass or mica have a conductivity very much smaller. The reason for this is intelligible, when one considers the model we have described. If one had completely elastic substances obeying Hooke's law accurately, the heat conductivity, as measured in the ordinary way, would be infinite, for heat in the form of elastic waves would be propagated from one end to the other with the speed of sound, and in equilibrium no temperature gradient could exist. At first sight this may seem paradoxical since a perfect vacuum in which heat is transmitted by radiation, which for this purpose may be regarded as harmonic waves, is usually considered to be a bad conductor. Nevertheless if its conductivity were measured in the ordinary way, it would be found to be infinite, since the amount of heat transmitted is independent of the temperature gradient and the fact that it is small is a consequence not of bad conductivity, but because only a comparatively small amount of heat can be transferred from the solid wall to the vacuum. The fact that solids have a finite heat conductivity is due to their elastic properties not being strictly linear. Thus an elastic wave passing over a region in which there happens to be, say, a small excess compression due to another elastic wave is slightly scattered, since owing to the compression already existing and the lack of the linearity of the compressibility, this latter is slightly reduced and the velocity of propagation slightly increased. Hence in traversing the solid, the waves are scattered and a certain proportion returns instead of going for-

ward. If one defines a length l in which the elastic wave amplitude is reduced by scattering to $\frac{1}{e^{th}}$, it may be shown that the thermal conductivity will be given by $\frac{\rho qsl}{4}$, ρ being the density, q the velocity of propagation of the wave and s the specific heat.

This consideration shows that there will be an essential difference between the heat conductivity of crystals and amorphous solids. A crystal, until one comes down to molecular dimensions, may be regarded at the absolute zero as a completely homogeneous body. As the temperature rises owing to the random distribution of energy, there will be regions of excess strain and the reverse. If the forces were strictly elastic this would not affect the velocity of propagation of compressional or torsional waves. But the forces are not strictly elastic, consequently as the temperature is raised the scattering of the elastic waves increases. Hence, as shown by the above expression, the thermal conductivity should decrease with rising temperature; calculation shows that in the region in which the specific heat is constant, it should be inversely proportional to the absolute temperature. This result was confirmed by measurements of the thermal conductivity of crystals at different temperatures.

The amorphous solids behave quite differently. In these, as we have seen, the molecules do not form a space-lattice, but may be regarded as distributed more or less evenly, without being in any special regular order. In glasses therefore, there are inhomogeneities of density and compressibility which are inherent in the structure itself, neither due to nor affected by the temperature. The elastic waves, therefore, will be scattered in an amorphous body even at the absolute zero, indeed an increase in temperature is just as likely to improve as to diminish the homogeneity of such a substance. Hence there should be no variation in thermal conductivity with temperature due to modification in scattering; any variation which occurs must be attributed to a change in the specific heat, in general a much less important factor. Thus the heat conductivity of glasses is not very much affected by temperature.

The metals as has been stated, form a class apart. In these, electrons are dissociated from the atoms and play a large part in conduction, as is shown by the proportionality of thermal and electrical conductivity. If one assumes that the electrons form an interleaved space-lattice with the parent ions, then, owing to their small mass, they would have a very high proper frequency. Such an electron space-lattice might thus be regarded, as far as thermal properties are concerned as corresponding to a crystal at a very low temperature. From this point of view, the high thermal conductivity of metals is intelligible, but it is a point of view which has certain difficulties and is not fully established.

We have seen that the properties characteristic of the solid state may all be explained on the assumption that the forces acting between the molecules are of the type indicated by the curve in figure 1. The definite volume of the solid is due to the rapid increase of the force of repulsion when the atoms approach one another. Its density is determined by the molecular weight and the distance at which repulsion balances attraction. The shape of the solid is determined by the quasi-elastic forces arising when molecules are displaced from their positions of equilibrium and these forces are merely another expression of the intramolecular forces holding the molecules in place. Crystals are solids in which the attractive forces have been given full play and the molecules have attained the closest packed order. Glasses are merely under-cooled liquids in which the viscosity is too high to permit crystallization to take place. The melting point is that temperature at which the oscillations of the molecules are so great as to cause them to collide; the latent heat is at any rate in part the work done against attraction when they expand on fusion.

Hooke's law expresses the fact that the law of force is approximately linear near the position of equilibrium. Deviations from it account for the thermal expansion and determine the heat conductivity. The variation of the atomic heat with temperature depends according to the very much more recondite quantum theory upon the molecular frequency; this is obviously determined merely by the molecular restoring force and the molecular weight. Thus substances with large intramolecular forces and small atomic weights such as occur in the middle columns of the periodic table, will be hard and incompressible with high melting points and latent heats, with small thermal expansion coefficients, but great thermal conductivities and their atomic heats will deviate even at high temperatures from the normal value. Where the intramolecular forces are small, more especially if the atomic weights are high, we have soft compressible, low melting solids with large expansion coefficients and small heat conductivity. Owing to the dissociation of the electrons, metals are in another category whose special characteristics lie outside the scope of this article. The same may be said of those other properties, whether optical or electrical, magnetic or radioactive which solids possess in common with matter in other states of aggregation. (F. A. L.)

SOLIMAN I.,[1] the "Magnificent" (1494–1566), sultan of Turkey, succeeded his father Selim I. in 1520. His birth coincided with the opening year of the 10th century of Mussulman chronology (A.H. 900), the most glorious period in the history of Islam. Though in Turkey he is distinguished only as the lawgiver (*kanuni*), in European history he is known by such titles as the Magnificent. He was the most fortunate of the sultans. He had no rival worthy of the name. From his father he inherited a well-organized country, a disciplined army and a full treasury. He united in his person the best qualities of his predecessors, and possessed the gift of taking full advantage of the talents of the able generals, admirals and viziers who illustrated his reign. If his campaigns were not always so wisely and prudently planned as those of some of his predecessors, they were in the main eminently fortunate, and resulted in adding to his dominions Belgrade, Budapest, Temesvar, Rhodes, Tabriz, Baghdad, Nakshivan and Rivan, Aden and Algiers, and in his days Turkey attained the culminating point of her glory.

The alliance concluded by him with France reveals him as superior to the narrow prejudices of his race and faith, which rejected with scorn any union with the unbeliever, and as gifted with political insight to appreciate the advantage of combining with Francis I. against Charles V. His Persian campaign was doubtless an error, but was due in part to a desire to find occupation, distant if possible, for his janissaries, who were always prone to turbulence while inactive at the capital. He was perhaps wanting in firmness of character, and the undue influence exercised over him by unscrupulous ministers, or by the seductions of fairer but no less ambitious votaries of statecraft, led him to make fatal concessions. It is from Soliman's time that historians date the rise of that occult influence of the harem which has so often thwarted the best efforts of Turkey's most enlightened statesmen.

Soliman's claims to renown as a legislator rest mainly on his organization of the Ulema, or clerical class, in its hierarchical order from the Sheikh-ul-Islam downwards. He reformed and improved the administration of the country both civil and military, inaugurated a new and improved system for the feudal tenures of limitary fiefs, and his amelioration of the lot of his Christian subjects is not his least title to fame. He wrote verses under the pseudonym of "Muhibbr." (*See* Hammer-Purgstall, *Gesch. d. Osman. Reichs*, ii. 331; and further TURKEY: *History*.)

Soliman died on Sept. 5, 1566, at the age of 72, while conducting the siege of Szigetvār.

SOLIMAN II. (1641–1691), sultan of Turkey, was a son of Sultan Ibrahim, and succeeded his brother Mohammed IV. in 1687. Forty-six years of enforced retirement had qualified him for the cloister rather than for the throne, and his first feeling when notified of his accession was one of terror for his brother's vengeance. Nor were the circumstances following on his elevation to the throne of a nature to reassure him, as one of the most

[1] Soliman, eldest son of Bayazid I., who maintained himself as sultan at Adrianople from 1402 to 1410, is not reckoned as legitimate by the Ottoman historiographers, who reckon Soliman the Magnificent as the first of the name. By others, however, the latter is sometimes styled Soliman II.

violent of the revolts of the janissaries ended in the murder of the grand vizier and the brutal mutilation of his family, with general massacre and pillage throughout Constantinople. The war with Austria was for Turkey a succession of disasters. At this time, fortunately for the Ottoman empire, a third great Kuprili (Mustafa) arose and re-established order in the sorely-tried State. (*See* KUPRILI.) In the reforms which followed, whereby the situation of the Christian subjects of the Porte was greatly improved, Soliman is at least to be given the credit of having allowed Mustafa Kuprili a free hand. With an improved administration Turkey's fortunes in the war began to revive, and the reconquest of Belgrade late in 1690 was the last important event before Soliman's death in 1691. (*See* also TURKEY: *History*.)

SOLINGEN, a town in the Prussian Rhine Province, on a height above the Wupper, 13 m. E. of Düsseldorf, and 20 m. N.E. of Cologne by rail. Pop. (1925) 52,002. Sword-blades have been made here since the early middle ages, and tradition affirms that the art was introduced during the Crusades by smiths from Damascus. Solingen is one of the chief seats of the German iron and steel industry, its speciality consisting in all kinds of cutlery, knives, razors, scissors, files, steel frames and the like, produced in enormous quantities. Other metal wares are also manufactured. These articles are largely made by the workmen at their own homes and supplied to the dépôts of the large dealers. Solingen received its municipal charter in 1374.

SOLINUS, GAIUS IULIUS, Latin grammarian and compiler, probably flourished during the first half of the 3rd century A.D. He was the author of *Collectanea rerum memorabilium*, a description of curiosities in a chorographical framework. Adventus, to whom it is dedicated, is identified with Oclatinius Adventus, consul A.D. 218. It contains a short description of the ancient world, with remarks on historical, social, religious and natural history questions. The *Collectanea* was revised in the 6th century under the title of *Polyhistor* (subsequently taken for the author's name). It was popular in the middle ages, hexameter abridgments being current under the names of Theodericus and Petrus Diaconus.

The commentary by Saumaise in his *Plinianae exercitationes* (1689) is indispensable; best edition by Mommsen (1895), with valuable introduction on the mss., the authorities used by Solinus, and subsequent compilers. *See* also Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 389; and Schanz, *Geschichte der römischen Litteratur* (1904), iv. 1. There is an old English translation by A. Golding (1587).

SOLIPSISM, a philosophical term, applied to an extreme form of subjective idealism which denies that the human mind has any valid ground for believing in the existence of anything but itself (Lat. *solus*, alone, *ipse*, self). "It may best be defined, perhaps, as the doctrine that all existence is experience, and that there is only one experient. The Solipsist thinks that *he is the one!*" (Schiller). It is presented as a solution of the problem of explaining the nature of our knowledge of the external world. We cannot know things-in-themselves: they exist for us only in our cognition of them, through the medium of sense-given data. In F. H. Bradley's words (*Appearance and Reality*): "I cannot transcend experience, and experience is *my* experience. From this it follows that nothing beyond myself exists; for what is experience is its (the self's) states." Solipsism is now mostly regarded, for example, by Bertrand Russell, as a *reductio ad absurdum* of subjective idealism.

See IDEALISM.

SOLITAIRE (*Pezophaps solitarius*), an extinct bird allied to the dodo (*q.v.*) and formerly inhabiting Rodriguez. It became extinct about 1761. The male stood about 2ft. 9in. high and was brownish grey in colour, the female being brown with a whitish breast. The male bore a knob of bone on each wing, and used this as a weapon. Like the dodo, the solitaire was flightless.

Of the New World solitaires, related to the thrushes, the melodious Townsend solitaire of the Rockies is the best known.

SOLOGNE, a region of France extending over portions of the department of Loiret, Loir-et-Cher and Cher. Area 1,800 sq. miles. Its boundaries are, on the north the Loire, on the south the Cher, on the east the districts of Sancerre and Berry. The Sologne is watered by the Cosson and the Beuvron, tributaries of the Loire, and the Sauldre, an affluent of the Cher, all three having a west-south-westerly direction. The impermeable mixture of sand and clay has given rise to numberless pools and marshes; portions were being drained largely by Huguenots, when persecution scattered them and the work was delayed until Napoleon III. led the way in the reclamation of swamps, the planting of pines and other trees and other improvements. These changes have much improved the climate of the district. Arable farming and stock-raising are flourishing in the Sologne, but there is little manufacturing activity, the cloth manufacture of Romorantin being the chief industry. Game is abundant, and the region owes much of its revived prosperity to the creation of large sporting estates; it was a hunting country centuries ago.

SOLOGUB, FEDOR, pen name of Fedor Kuzmich Teternikov (1863–1927), Russian man of letters, was born on Feb. 17, 1863 in St. Petersburg (Leningrad), the son of a tailor. He died on Dec. 6, 1927. On the latter's death, his mother became a domestic servant and the son was brought up by her employers. He studied at the Teachers' Institute in St. Petersburg and was a schoolmaster for 25 years, retiring in 1907. In 1897 he published his first volume of poetry and also some short stories. He is considered the greatest figure of the Symbolists in prose and poetry. His best novel is *The Little Demon* (1907), in which he has created a universal type of evil in the central figure, the schoolmaster, Peredonov. He also wrote several plays.

His other works include *The Sorcery of Death* (a series composed of *The Created Legend, Drops of Blood, Queen Ortruda*, and *Smoke and Ashes*). *The Little Demon, The Created Legend, The Old House and other Tales* have been translated into English.

SOLOLÁ, the capital of the department of Sololá, in Guatemala; near the northern shore of lake Atitlán, 46 m. W.N.W. of Guatemala city. Pop. (1925) 17,334. Sololá is the ancient capital of the Cakchiquel Indians, who form the bulk of the population. In the city coarse cloth, pottery, cigars and soap are manufactured, and there is a large prison and reformatory. Among the surrounding mountains are large and successful coffee plantations, some owned by German settlers. On April 18, 1902 Sololá was wrecked by an earthquake, but as most of the houses were constructed of wood it was speedily rebuilt.

SOLOMON, son of David, succeeded his father on the throne of Israel *c.* 974 and reigned until *c.* 937. In the story of David's intrigue with Bathsheba (2 Samuel xi.–xii. 25) Solomon is the second child of the union, born after David had made her his wife, and after the death of the illegitimate child. But in the lists of David's children, 2 Samuel v. 14, 1 Chronicles iii. 5, xiv. 4, he seems to be the fifth child of the union, a discrepancy indicative of the uncertainty attaching to many particulars of his history. The name *Solomon* may mean "peaceful"; according to 1 Chron. xxii. 6–19, David was directed by Yahweh so to name his son as symbolizing the "peace and quietness" which, in contrast to the turbulence of his own reign, should be the characteristics of Solomon's. A variant reading in 2 Sam. xii. 24, however, states that Bathsheba herself chose the name, which is not improbable, for other instances are found in the Old Testament where the mother, not the father, names a child. The following verse says that the prophet Nathan gave to the child the name Jedidiah, "beloved of Yahweh," the first element in which is from a root akin to *David*. This name is found nowhere else, and presumably never came into common use.

The Accession.—In contrast to the summary notices given in the books of Kings to the beginning of a new reign the circumstances of Solomon's accession are related with very full detail. To call Solomon "not the true heir to the throne" is mistaken, for in the case of a monarchy such as that of Israel there was no rule that the king's eldest son was his legitimate successor; the king might nominate any one of his sons to take his place: yet it is probable that Solomon had not been regarded as the son most likely to succeed David. The eldest son, Amnon, had been slain by Absalom, the third son, who was himself killed in an abortive revolt against his father. Of the intermediate son, Chileab, nothing is known.

When David was evidently on the point of death his son Adonijah, who "was born after Absalom," set to work to ensure for himself the right of succession. Like Absalom he was a man of fine appearance, and seemingly popular. He appears also to have been a favourite with his father (1 Kings i. 6). He surrounded himself with a royal bodyguard, and enlisted the aid of the two foremost men in David's court, the warrior Joab and the priest Abiathar. At a feast he prepared he seems to have received support from the men of Judah and most of the king's sons, but his deliberate exclusion of the prophet Nathan, the warrior Benaiah, the "mighty men," and Solomon, from the invitation would suggest that the question of the succession had already been the subject of palace intrigue, and that there was a "pro-Solomon" party.

At Nathan's instigation Bathsheba reminded the feeble old king of an oath he had sworn to make Solomon his successor, which story the prophet came in and confirmed. Whether this was really the case or not—on one view of the narrative it would seem that David in his weakness was persuaded that he had made such a promise—the king immediately caused Nathan, Benaiah and Zadok the priest, to proclaim Solomon. This action met with approval on the part of the citizens, and Adonijah's party, rather surprisingly, collapsed without a struggle, he himself seeking asylum at the altar, and being sentenced to confinement in his own house.

Subsequently Joab was killed by Benaiah, and Abiathar replaced by Zadok, at Solomon's command, Adonijah having been previously slain for preferring a request that Abishag, the damsel who had cherished David in his last days, should be given to him as wife. This would, according to Oriental ideas, have been equivalent to claiming the succession, and it is indeed difficult to believe the story that Adonijah made such a request through Bathsheba. It is possible that this narrative, and also the instruction given by David to Solomon that Joab should be slain, are invented to palliate the ruthlessness with which Solomon removed from his path those who had challenged his position.

The King.—The general impression which the Biblical narratives seek to convey is that Solomon's reign was most prosperous and peaceful. Nor can it be denied that this impression has substantial evidence in its favour. To take one simple point, the fact that the reign of Solomon endured for forty years shows that he must have consolidated firmly the kingdom he inherited, though he had no great love for military adventure and made no attempt to enlarge its borders. Rather he sought to make his position secure by allying himself with his more considerable neighbours. Early in his reign he ensured the friendship of Egypt by espousing the Pharaoh's daughter. This alliance brought about also a further gain, for the Pharaoh, who had attacked and reduced the important Canaanite fortress Gezer, handed it over to Solomon as a dowry for his daughter, and Solomon rebuilt it. Perhaps even more advantageous was the extension of the alliance which David had earlier concluded with Hiram, the ruler of Tyre. This afforded Solomon security on his northern frontier, and enabled him to use freely the Mediterranean Sea. The erection of high places near Jerusalem for the worship of the deities of Zidon, Moab, and Ammon (2 Kings xxiii. 13) is indicative of friendly relations with those peoples. That he was able to use a port at the head of the Gulf of Akaba (1 Kings ix. 26) for commerce with Ophir implies that Solomon controlled Edomite territory on his southeast border.

The commercial activity of Solomon seems to have been extensive. In this respect he reminds us of the Pharaohs, who appear almost to have monopolized the foreign commerce of Egypt. His imports were on a scale so lavish that he is said to have made silver as common as stones, cedars as sycamores, in Jerusalem. There was an extensive trade in horses (1 Kings x. 27–29). In partnership with Hiram of Tyre he maintained a fleet of ocean-going ships trading at regular intervals to Mediterranean ports, bringing "gold, silver, ivory, apes and peacocks" (1 Kings x. 22). In his trading ventures down the Gulf of Akaba he was assisted by skilled Tyrian navigators supplied by Hiram (1 Kings ix. 27–28)—his own people never did take kindly to the sea. This passage was evidently misunderstood by the Chronicler, who took it to mean that Hiram supplied the ships (2 Chronicles viii. 18): how they were transported is a problem he leaves unexplained. Ophir, the land to which these vessels ventured is not identified with certainty, but may be S. Arabia. Solomon brought Israel for the first time fully into the current of oriental commerce and civilization, and during his reign Jerusalem, at any rate, was a city of wealth and luxury.

The Builder.—The long and peaceful reign of Solomon permitted him to indulge his passion for building, and his activities completely transformed his capital city, Jerusalem. David had built a palace there, being furnished with artificers and material by Hiram. This was, however, not regarded by Solomon as sufficiently splendid, and he spent thirteen years in constructing a magnificent royal dwelling. He built also a temple, the details of which occupy a disproportionate space in the records, for it was, after all, in the nature of an appanage to the palace, and took little more than half the time devoted to the latter. Like his father, he relied largely upon Hiram for material and artisans. Round his new buildings he erected a wall. He also built and fortified numerous cities which were used as barracks, arsenals and storehouses.

In order to obtain supplies for his grandiose schemes he divided the land into twelve districts, seemingly independent of the old tribal divisions, upon which levies were made in rotation. Forced labour was exacted from the Canaanites. But though the boast is made that the Israelites were not treated as "bond-servants," the exactions made from them for the upkeep of the costly court and harem, and the expenses of building, must have reduced many of the poorer people to a condition hard to distinguish from slavery. However splendid the court and capital may have been, the state of the ordinary folk must have been far from happy, and in the lavish expenditure of Solomon may be found a prime cause of the discontent which led under his successor to the division of the kingdom.

Factors of Unrest.—Nor was the political situation quite as easy as the picture in Kings might lead us to suppose. The exact interpretation of 1 Kings ix. 12–14 is uncertain, but evidently Solomon was compelled to part with territory in the north to placate Hiram. An Edomite, Hadad, who had escaped the ruthless slaughter of Edomites by Joab under David, took refuge at the Egyptian court, where he attained a considerable position. He returned to his native country after the death of Joab, and evidently was a thorn in Solomon's side (1 Kings xi. 25). Rezon, an Aramean, too, established himself in Damascus, and was "an adversary to Israel all the days of Solomon." And, though the attempt of the able Jeroboam at revolt was crushed by the king so that he was compelled to seek asylum in Egypt, he had established a sufficient personal ascendancy to gain the allegiance of the northern tribes after Solomon's death. Undoubtedly the shadows have been toned down in the Old Testament records of Solomon's reign. This does not, however, prevent us from recognizing that he was, with all his limitations, an able ruler. Though very little of the "wisdom" which is attributed to him in the Old Testament is correctly assigned, it is extremely unlikely that the attribution would have been made had not the facts of his rulership provided a basis for the picture of "Solomon the Wise."

Religion.—Solomon was a sincere worshipper of Yahweh, more cultured but less passionate in his devotion than David. His erection of altars to foreign deities for the sake of his foreign wives, and even his participation in the rites connected with them, would not be in his eyes apostasy from Yahweh. These things were of the political rather than the religious sphere. But in the eyes of later puritans they were departures from orthodoxy. So we have the curious double picture of Solomon as on the one hand a most pious benefactor to the national religion in his building of the temple and care for its ceremonial—though even here the doubt insinuates itself as to whether he did not consider to some extent the prestige which was reflected on himself; on the other hand as an apostate, who when his obituary notice is written (1 Kings xi. 43) receives no glowing testimonial, and about whom it is said that he "went not fully after Yahweh, as did David his father"

(1 Kings xi. 6). Yet even the passage which contains this censure shows that the other side of the picture was not forgotten, because it represents with more charity than truth the participation of Solomon in the rites of foreign altars as a lapse of his old age (1 Kings xi. 4).

For Mohammedan and other stories of Solomon, the queen of Sheba, etc., *see* Salzberger, *Die Salomo-Sage in der Semitischen Literatur* (1907). (W. L. W.)

SOLOMON, ODES OF, a collection of 42 hymns known to the early Christian Church. In the 6th century they appear in a list which includes most of the books in the Old Testament Apocrypha, and again in the 9th century they are placed in the Stichometry of Nicephorus between the books of Ecclesiasticus and of Esther, and bracketed with the collection of 18 so-called Psalms of Solomon, which was composed in the 1st century B.C. Both the collections are, of course, pseudonymous.

A complete manuscript of the odes was recovered in 1908 by Dr. Rendel Harris from a 16th century Syriac manuscript in his possession (which also contained the Psalms of Solomon). The version is written on paper possibly between three and four hundred years old, and came it is believed from the Valley of the Tigris, together with a miscellaneous collection of other Syriac leaves. Prior to this the only places where the text of any of these odes could be read was in the Pistis Sophia, though there is a short extract from one in the Institutes of Lactantius. In Dr. Harris's manuscript the first, second, and part of the third odes are missing, but the first has been restored from the Pistis Sophia.

This latter volume is a curious compilation purporting to record a series of conversations which took place on the Mount of Olives between the Risen Christ and his disciples in the 12th year after the Resurrection, and is interspersed with a series of hymns called Metanoiai or acts of penitence. It is believed to have been written in Egypt between A.D. 200 and 250, and to be the handbook of a Gnostic "mystery" or religious service. The occurrence in it of the five odes of Solomon is felt by some students to throw a light upon the use and object of the entire collection. They are in fact thought to be baptismal hymns, psalms of initiation into a Christian "mystery." While there are thoughts and expressions which lend themselves to Gnostic use there is nothing in the odes which is of distinctively Gnostic origin. Many of them indeed are unmistakably Christian though some may be Jewish, and the writer of the Pistis Sophia seems to have regarded them as almost if not quite canonical. Dr. Harris would date several of them between A.D. 75 and 100.

They contain few traces of the New Testament, and the words "Gospel" and "Church" are not found. Here and there a Johannine atmosphere is to be detected, but not sufficiently to justify the assumption that the author knew the Johannine literature, though the expression "the Word" occurs. References to the life and teaching of Christ are rare, though the Virgin birth is alluded to in ode 19 in a passage marked by legendary embellishment, and the descent into Hades is also mentioned several times. There are no clear allusions to baptism and none at all to the Eucharistic celebration. One passage speaks of ministers (perhaps deacons) who are entrusted with the Water of Life to hand to others. The word priest occurs once in the beginning of ode 20. "I am a priest of the Lord, and to Him I do priestly service, and to Him I offer the sacrifices of His thought."

Mgr. Batiffol argues that Solomon stands spiritually for Our Lord, and that the general doctrine of the odes is Docetic. His argument is somewhat weakened by the fact that in many of the odes the speaker appears to be a redeemed human being and not the Messiah. The odes seem to have been originally written in Greek. They vary in execution and spiritual tone, though most of them represent a very high level of spiritual experience and an intense warmth of personal devotion and great buoyancy and joy. They abound in puzzles, and there is some exceptionally striking or eccentric feature about nearly half of them.

Harnack considers that they form a Jewish *Grundschrift,* with a number of Christian interpolations; he finds in them a link between the piety and theology of the Testaments of the twelve Patriarchs and that of the Johannine Gospel and Epistles. The symbol of the wheel and also that of the letter in ode 23 resemble passages in Oriental literature, and indeed the Psalms show a strong resemblance to some of the lyric poems of Hinduism.

BIBLIOGRAPHY.—J. Rendel Harris has provided an Eng. ed. (1909; 2nd ed. 1911; 3rd ed. in co-operation with A. Mingana, 2 vols., 1916–20). *See* also a German trans. with notes by A. Ungnad and W. Staerk (1910, in Lietzmann's *Kleine Texte*); A. Harnack u. Flemming in *Texte u. Untersuchungen,* III. s. 4 (1910); J. H. Bernard, an Eng. ed. (1911); Mgr. Batiffol and J. Labourt, a French crit. ed. (1911); H. Grimme (1911); G. Diettrich (1911); G. Kittel (1914). (A. C. B.)

SOLOMON, PSALMS OF. These psalms, 18 in all, enjoyed but small consideration in the early Christian Church; for only six direct references to them are found in early Christian literature, though in the Jewish Church they must have played an important rôle; for they were used in the worship of the synagogue. They were not written by Solomon, but were subsequently ascribed to him. The fact that they do not contain a single reference to Solomon is in favour of their having been first published anonymously. On the other hand, their author (or authors) may have placed over them the superscription "Psalms of Solomon" in order to gain currency for this new collection under the shelter of a great name of the past.

Language and Date.—All modern scholars are practically agreed that the Psalms were written in Hebrew. The date can be determined from references to contemporary events. The book opens with the alarms of war (i. 2, viii. I.), in the midst of a period of great prosperity (i. 3, 4, viii. 7), but the prosperity is merely material, for from the king to the vilest of his subjects they are altogether sinful (xvii. 21, 22). The king, moreover, is no descendant of David, but has usurped his throne (xvii. 6–8). But judgment is at hand. "A mighty striker" has come from the ends of the earth (viii. 16), who when the princes of the land greeted him with words of welcome (viii. 18) seized the city (viii. 21), cast down its walls (ii. 1), polluted its altar (ii. 2), put its princes and counsellors to the sword (viii. 23), and carried away its sons and daughters captive to the west (viii. 24, xvii. 14). But the dragon who conquered Jerusalem (ii. 29), and thought himself to be more than man (ii. 32, 33), at last meets with shameful death on the shores of Egypt (ii. 30, 31).

The above allusions are easy to interpret. The usurping kings who are not descended from David are the Maccabeans. The "mighty striker" is Pompey. The princes who welcomed his approach are Aristobulus II. and Hyrcanus II. Pompey carried off princes and people to the west, and finally perished on the coast of Egypt in 48 B.C. Thus Ps. ii. was written soon after 48 B.C., while Ps. i., viii., xvii. fall between 63 and 48 B.C., for they presuppose Pompey's capture of Jerusalem, but show no knowledge of his death. Ps. v., vii., ix., xiii., xv. belong apparently to the same period, but iv. and xii. to an earlier one. On the whole Ryle and James are right in assigning 70–40 B.C. as the limits within which the psalms were written.

Authorship.—The authors were Pharisees. They divide their countrymen into two classes—"the righteous" (ii. 38–39, iii. 3–5, 7, 8) and "the sinners" (ii. 38, iii. 13, iv. 9); "the saints" (iii. 10) and "the transgressors" (iv. 11). The former are the Pharisees; the latter the Sadducees. The authors protest against the Asmonaeans (*i.e.* the Maccabees) for usurping the thrones of David and laying violent hands on the high priesthood (xvii. 5, 6, 8), and proclaim the coming of the Messiah, the true son of David (xvii. 23–25), who is to set all things right and establish the supremacy of Israel. The Messiah is to be pure from sin (xvii. 41), purge Jerusalem from the defilement of sinners and of the Gentiles (xvii. 29, 30, 36), destroy the hostile nations and extend His righteous rule over all the remaining peoples of the earth (xvii. 27, 31, 32, 34, 38). Ps. xvii., xviii. and i.–xvi. can hardly be assigned to the same authors. The hopes of the Messiah are confined to the former, and a somewhat different eschatology underlies the two works (*see* Charles, *Eschatology: Hebrew, Jewish and Christian,* pp. 220–225).

BIBLIOGRAPHY.—Ryle and James, *Psalms of the Pharisees* (1891); G. B. Gray, in Charles, *Apoc. and Pseudepig,* vol. ii. (1913). (R. H. CH.)

SOLOMON ISLANDS (Ger. *Salomon Inseln*), an archipelago of the Western Pacific Ocean, included in Melanesia, and forming a chain (in continuation of that of the Admiralty Islands and New Mecklenburg in the Bismarck Archipelago) from N.W. to S.E. between 154° 40′ and 162° 30′ E., 5° and 11° S., with a total land area of 17,000 sq.m.

History.—The Spanish navigator Alvaro Mendaña must be credited with the discovery of these islands in 1567, though it is doubtful whether he was actually the first European who set eyes on them. In anticipation of their natural riches he named them Islas de Salomon. The expedition surveyed the southern portion of the group and named the three large islands San Cristoval, Guadalcanal, and Ysabel.

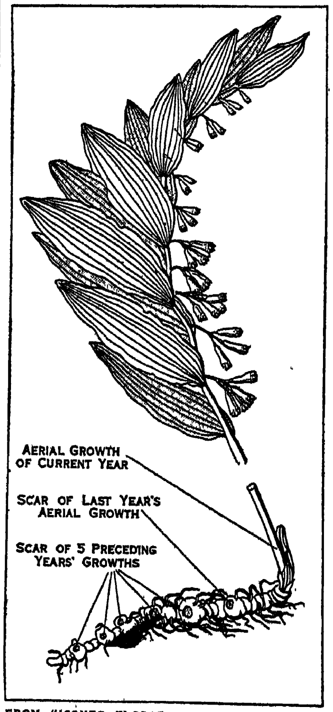
Even the position of the Solomon islands was now in uncertainty, for the Spaniards, fearful lest they should lose the benefits of the discoveries, kept secret Mendaña's narrative. The Solomon islands were thus lost sight of until, in 1767, Philip Carteret lighted on their eastern shores at Gower island and passed to the north of the group, without, however, recognizing that it formed part of the Spanish discoveries. In 1768 Louis de Bougainville found his way thither, discovered the three northern islands (Buka, Bougainville, and Choiseul), and sailed through the channel which divides the two last and bears his name. In 1769 a French navigator, M. de Surville, was the first, in spite of the hostility of the natives, to make any lengthened stay in the group. He gave some of the islands the French names they still bear, and brought home some detailed information concerning them, and their identity with Mendaña's Islas de Salomon was soon established by French geographers. In 1788 the English Lieut. Shortland coasted along the south side of the chain, and, supposing it to be a continuous land, named it New Georgia. In 1792 and 1793, d'Entrecasteaux surveyed portions of the coast-line of the large islands. Dumont d'Urville in 1838 continued the survey.

Traders and missionaries now endeavoured to settle in the islands; neither met with much success, and little was heard of the islanders save accounts of murder and plunder. In 1845 the French Marist Fathers went to Isabel, where Mgr. Epaulle, first vicar-apostolic of Melanesia, was killed by the natives soon after landing. Three years later this mission had to be abandoned; but in 1881 work was again resumed. In 1856 John Coleridge Patteson, afterwards bishop of Melanesia, had paid his first visit to the islands, and native teachers trained at the Melanesian mission college subsequently established themselves there. About this date, Benjamin Boyd, while cruising in the yacht "Wanderer," was kidnapped by the natives and never afterwards heard of. In 1873 the "foreign-labour" traffic in plantation hands for Queensland and Fiji extended its baneful influence from the New Hebrides to these islands. In 1893 the islands Malaita, Marovo, Guadalcanal, and San Cristoval with their surrounding islets were annexed by Great Britain, and a delimitation of German and British influence in the archipelago was made by the convention of Nov. 14, 1899. The German Solomon islands were occupied by an Australian force in Sept. 1914, and under mandate from the League of Nations the islands were assigned to Australia in 1920. In 1927 an outbreak of the natives, resulting in the death of several missionaries, caused the imposition of martial law.

See H. B. Guppy, *The Solomon Islands* (1887), with references to earlier works; J. Lyng, *Our New Possession,* (Melbourne, 1920).

SOLOMON'S-SEAL, the common name for perennial herbs of the genus *Polygonatum,* family Liliaceae (*q.v.*), comprising about 30 species native to north temperate regions. The plant springs from a creeping, fleshy rootstock upon which the annual shoots in dying away each year leave curious seal-like marks, whence the popular name. Three species occur in Great Britain and two in eastern North America. The single erect or arching stem, 1 to 8 ft. high, bears ovate or lance-shaped, sharp-pointed, sessile leaves in the axils of which appear narrow greenish, whitish or pinkish flowers, on slender, drooping flower stalks, followed by globular, pulpy, usually bluish berries. In the United States various species of *Smilacina,* a closely allied genus, are called false Solomon's-seal.

SOLON, Athenian statesman, the son of Execestides of the family of Codrus, was born about 638 B.C. The prodigality of his father made it necessary for Solon to maintain himself by trade, especially abroad. In his youth he became well known as the author of amatory poems and later of patriotic and didactic verse. Hence his inclusion among the Seven Sages. Solon's first public service was the recovery of Salamis from the Megarians. A law had been passed forbidding any reference to the loss of the island; Solon solved the difficulty by feigning madness, and reciting an inflammatory poem in the agora. It appears that Solon was appointed to recover the "fair island" and that he succeeded in expelling the Megarians. Sparta finally arbitrated in favour of the Athenians (*c.* 596), who ascribed their success to Solon. About a year later he seems to have moved a decree before the Amphictyons declaring war on Cirrha. At this period the distress in Attica and the accumulating discontent of the poorer classes, for whom Draco's code had proved inadequate, reached its height. Solon was summoned by all classes unanimously to discover a remedy; under the legal title of Archon, he received unlimited powers which he exercised in economic and constitutional reforms (*see* below). From various sources we learn that these reforms met with considerable opposition, to escape from which Solon left Athens for ten years. After visiting Egypt, he went to Cyprus, where Philocyprus, king of Aepea, received him with honour. Herodotus (v. 113) says that Philocyprus, on the advice of Solon, built himself a new town called, after his guest, Soli. The story that Solon visited Croesus in Lydia, and made to him the famous remark—"Call no man happy till he is dead"—is unfortunately discredited by the fact that Croesus seems to have become king nearly 30 years after Solon's legislation, whereas the story must be dated within ten years of it. Subsequently Solon returned to Athens, to find civil strife renewed, and shortly afterwards his friend (perhaps his relative) Peisistratus made himself tyrant. About 558 B.C. Solon died and, according to the story in Diogenes Laërtius i. 62 (but *see* Plutarch's *Solon,* 32), his ashes were scattered round the island of Salamis. If the story is true, it shows that he was regarded as the oecist of Salamis.



FROM "ICONES FLORAE GERMANICAE ET HELVETICAE" (BARTH)
SOLOMON'S SEAL (POLYGONATUM MULTIFLORA), A NATIVE OF EUROPE

Reforms.—The date of Solon's archonship has been usually fixed at 594 B.C. (Ol. 46, 3), a date given by Diog. Laërt. (i. 62) on the evidence of the Rhodian Sosicrates (fl. 200–128 B.C.; *see* Clinton, *Fast. Hell.* ii. 298, and Busolt, 2nd ed., ii. 259). The date 594 is confirmed by statements in the Aristotelian *Constitution of Athens* (ch. 14). For various reasons the dates 592, 591 and even 590 have been suggested by various historians (for the importance of this question *see* the concluding paragraph of this article). The historical evidence for the Solonian reforms has always been unsatisfactory. There is strong reason to conclude that in the 5th and 4th centuries there was no general tradition as to details. In settling differences there is no appeal to tradition, and this though there occur radical and insoluble contradictions. Thus the *Constitution of Athens* (ch. vi.) says that the Seisachtheia ("shaking off of burdens") consisted in a cancelling of all debts public and private, whereas Androtion, an elder contemporary, denies this specifically, and says that it consisted in the reduction of the rate of interest and the debasement of the coinage. The *Constitution* denies the existence of any connection between the coinage reform and the relief of debt-

ors. The absence of tradition is further confirmed by the fact that the *Constitution* always appeals for corroboration to Solon's *Poems*. Of the *Laws* it is probable that in the 4th century, though some dealing with agrarian distress were in existence, those embodying the Seisachtheia were not, and few if any of the purely constitutional laws remained. The main source of the account in the *Constitution* is, therefore, the *Poems* of Solon, from which numerous quotations are made (*see* chs. 5–12).

The reforms of Solon may be divided under three heads—economic, constitutional and miscellaneous. They were necessary owing mainly to the tyrannical attitude of the rich to the poorer classes. Of these many had become slaves in lieu of payment of rent and loans, and thus the land had fallen gradually into the hands of capitalists. It was necessary to readjust the economic balance and to provide against the evil of aristocratic and capitalist predominance.

A. Economic Reforms.—Solon's economic reforms consisted of the Seisachtheia and certain commercial laws (*e.g.*, prevention of export trade except in olive oil, Plut. *Solon* 24). By far the most important of these was the law encouraging trade and manufactures (Plut. *Solon,* 22) which laid the foundation of the future commercial greatness of Athens. Even within a century from the time of its making the trade of Athens with Sicily increased, as is shown by archaeological discovery in that island, to such an extent that, though negligible in quantity at the beginning of the century, it almost rivalled that of Corinth at the end of it. (*See* Grundy, *Thucydides and the History of his Age,* p. 66 ff.). Among all the problems connected with the Seisachtheia, it is clear (1) that Solon abolished the old Attic law of debt which permitted loans on the security of the debtor's person; (2) that he restored to freedom those who had been enslaved for debt; (3) that he refused the demand for the division of the land (γῆς ἀναδασμός). As to the cancelling of all debts (χρεῶν ἀποκοπή) there is some controversy; Gilbert and Busolt maintain that all debts were cancelled; strong reasons may, however, be advanced against it, amongst others, that the Greek, unlike the Roman revolutionary, though ready to deal freely with the property of others, did not seek to remedy financial difficulties by abolishing debts. It is possible that the statement in the *Constitution* is a hypothesis to explain the restoration of the slaves to freedom. Further, Solon seems to have regulated the accumulation of land (*cf.* in Rome the legislation of Tiberius Gracchus) and the rate of interest; and to have simplified commerce by replacing the Pheidonian standard by the Euboic, which was in use among the Ionian traders, in commerce with whom he foresaw that prosperity lay. It is impossible here to enter into the details of the controversy in connection with Solon's land reforms; it must suffice to give the bare outlines of the dispute. There is no question that (1) the distressed class whom Solon sought to relieve were the *Hektemoroi,* and that (2) the achievement on which he prided himself was the removal of the ὅροι or stones which were seen everywhere in Attica, and were symbolic of the slavery of the soil. Almost all writers say that these ὅροι were mortgage-pillars: that they were originally boundary stones and that when land was mortgaged the terms of the agreement were carved on the stones, as evidence. Now, firstly, though such mortgage-pillars existed in the time of Demosthenes, none are found earlier than the year 400 B.C., nor is there any reference before that year to this special sense of the word. If then these stones which Solon removed were mortgage-pillars, it is strange that none should have been found till 200 years later. Secondly, it is highly improbable that the terms on which land was then cultivated admitted of mortgaging at all. The *Hektemoroi* who, according to the *Constitution,* paid the sixth part of their produce as rent,[1] were not freeholders but tenants, and therefore, could not mortgage their land at all. From this it follows that when Solon said he had "removed the stones" he referred to the fatal accumulation of land by landowners. The tenants failed to pay rent, were enslaved, and the "boundary stone" of the landowner was moved forward to include their land. Thus the removal of the ὅροι was a measure against the accumulation of land in the form of enclosures (τεμένη), and fits in with the statement at the end of chapter iv. of the *Constitution,* "the land was in the hands of a few." It should be noted (1) that from this releasing of the land it follows that Solon's law against lending on the security of the person must have been retrospective (*i.e.,* in order to provide a sufficient number of freeholders for the land released); and (2) that it is one of the most remarkable facts in Athenian economic history that when at the end of the Peloponnesian War a proposal was brought forward to limit the franchise to freeholders, it was found that only 5,000 failed to satisfy this requirement. It is noteworthy that the *Hektemoroi* disappear from history after Solon's time. This looks as if they had been converted into freeholders. Antiquity ever tended to regard the cultivation of land as the best title to its possession, a development of an earlier idea that property in respect to land did not reside in the land itself but in the crop grown on it. The Diacrii of the time of Peisistratus are quite a different class.

[1]Others say they were: (1) labourers who received one-sixth of the produce as wages; (2) tenants who paid five-sixths as rent and kept one-sixth, or (3) tenants who paid one-sixth as rent and kept five-sixths. As to (3) it is said such tenants could not have been in real distress, and as to (1) and (2) it is said that such a position would have meant starvation from the first.

B. Constitutional Reform.—It is on this part of his work that Solon's claim to be considered a great statesman is founded. By his new constitution, he laid the foundations of the Athenian democracy and paved the way for its later developments. It should be noted in the first place that the following account is written on the assumption that the Draconian constitution described in chapter iv. of the *Constitution of Athens* had never existed (*see* DRACO). In some respects that alleged constitution is more democratic than Solon's. This, coupled with the fact that Solon is always spoken of as the founder of democracy, is one of the strongest reasons for rejecting the Draconian constitution. It will be seen that Solon's state was by no means a perfected democracy, but was in some respects rather a moderate oligarchy in which political privilege was graduated by possession of land. To Solon are generally ascribed the four classes—Pentacosiomedimni, Hippeis, Zeugitae and Thetes. Of these the first consisted of those whose land produced as many measures (*medimni*) of corn and as many measures (*metretae*) of oil and wine as together amounted to 500 measures. The Hippeis (the horsemen, *i.e.,* those who could provide a war-horse for the service of the state) were rated at over 300 and under 500 *medimni;* the third class (those who tilled their land with a yoke of oxen) at 200 *medimni* and the Thetes below 200 *medimni.* The Zeugites, probably served as heavy-armed soldiers, and the Thetes were the sailors of the state. It is likely that the Zeugites were mainly *Hektemoroi* (*see* above) whom Solon converted into freeholders. Whether Solon invented these classes is uncertain, but it seems clear that he first put them into definite relation with the political organism. The Thetes (who included probably the servants of the Eupatridae, now secured as freemen), the fishermen of the Paralia (or sea-coast), and the artisans (cerameis) of Athens for the first time received political existence by their admission to the sovereign assembly of the Ecclesia (*q.v.*). Of these classes the first alone retained the right of holding the offices of archon and treasurer; other offices were, however, opened to the second and third classes (*sc.* the Poletae, the Eleven and the Colacretae; *see* Cleisthenes [1]). It is of the utmost importance to observe that the office of Strategus (*q.v.*) is not mentioned in connection with Solon's reform. It is often said that Solon used his classification as the basis of a sliding scale of taxation. Against this, it is known that Peisistratus, whose faction was essentially the poorer classes, established a uniform 5% tax, and it is highly unlikely that he would have reversed an existing arrangement which was particularly favourable to his friends. The admission of the Thetes to the Ecclesia was an important step in the direction of democracy (for the powers which Solon gave to the Ecclesia, *see* ECCLESIA). But the greatest reform of Solon was undoubtedly the institution of the Heliaea (or courts of justice). The jury was appointed by lot from all the citizens (including the Thetes), and thus the same people elected the magistrates in the Ecclesia and subsequently tried them in the Heliaea. Hence Solon trans-

ferred the sovereign power from the areopagus and the magistrates to the citizens as a whole. Further, as the archons, at the expiry of their year of office, passed into the areopagus, the people exercised control over the personnel of that body also (*see* AREOPAGUS). In spite of the alleged Draconian constitution, alluded to above, it is still very generally held that Solon invented the Boulē or Council of Four Hundred, 100 from each of the old tribes. The importance of this body as an advisory committee of the Ecclesia, and the functions of the Prytaneis are explained under BOULĒ. It is sufficient here to point out that, according to Plutarch's *Solon,* (ch. 19) the state henceforth rested on two councils "as on anchors" and that the large powers exercised by the Cleisthenean Boulē were not exercised by the Solonian. From this and the articles AREOPAGUS, BOULĒ, ECCLESIA and GREEK LAW, it will be seen that Solon contrived an absolutely organic constitution of a "mixed" type, which had in it the seeds of the great democratic growth which reached its maturity under Pericles. It should be added here, in reference to the election of magistrates under Solon's constitution, that there is discrepancy between the *Politics* and the *Constitution;* the latter says that Solon gave to the Thetes nothing but a share in the Ecclesia and the courts of justice, and that the magistrates were elected by a combination of selection and lot (κληρωτοὶ ἐκ προκρίτων), whereas the *Politics* says that Solon gave them only the power to elect the magistrates and try them at the end of their year. It seems likely for other reasons that the former scheme should be assigned to the years after Marathon, and, therefore, that the account in the *Politics* is correct (but *see* ARCHON).

C. Miscellaneous.—The miscellaneous laws of Solon are interesting primarily as throwing light upon the social condition of Athens at the time (*see* Evelyn Abbot, *History of Greece,* I. xiii. §18). In the matter of trade it has been said that he favoured one export only, that of olive oil, in which Athens was peculiarly rich; further he encouraged the settlement of aliens (*metoikoi*) engaged in commerce, and compelled fathers to teach their sons a useful trade under penalty of losing all right to support in old age. The influence of women Solon regarded as most pernicious. Wealthy wives he forbade; no bride might bring more than three changes of raiment and a little light furniture to the house; all brothels and gymnasia were put under stringent state-control (*see* PROSTITUTION). Solon also regulated intestate succession, the marriage of heiresses, adoption, the use and sinking of wells, bee-farming, the planting of olives and figs, the cutting down of olive trees, the calendar. Further, he ordained that each citizen must show how he obtained his living (Herod. ii. 177) and must, under penalty of losing the franchise, adhere to one or other party in a sedition (for these laws *see* Plutarch's *Solon,* chs. 20–24).

The laws were inscribed on *Kyrbeis* or tablets framed in wood which could be swung round (hence also called *axones*). The boulē as a body swore to observe the laws, and each archon undertook to set up a life-size golden statue at Delphi if he should be convicted of transgressing them.

Solon appears to have supplemented his enactments by a law that they should remain in force for 100 years, and according to another account that his laws, though not the best, should stand unchanged for ten years (Plut. *Solon,* 25; *Herod.* i. 29). Yet according to the *Constitution of Athens* (chs. 11–13) (without which the period from Solon to Peisistratus was a blank), when Solon went abroad in 593 (?) the city was disturbed, and in the fifth year dissension became so acute that no archon was elected (for the chronological problem, *see* J. E. Sandys, *Constitution of Athens,* ch. 13, note); again four years later the same *anarchia* (*i.e.,* no archon elected) occurred. Then four years later the archon Damasias (582?) continued in office illegally for two years and two months. The office of the archon was then put into commission of ten: five from the Eupatrids, three from the Agroeci and two from the Demiurgi, and for 20 years the state was in a condition of strife. Thus we see that 12 years of strife (owing to Solon's financial reforms) ended in the reversal of Solon's classification by assessment. We are, therefore, driven to conclude that the practical value of his laws was due to the strong and enlightened government of Peisistratus, whose tyranny put an end to the quarrels between the Shore, the Upland and the Plain, and the *stasis* of rich and poor.

See editions with notes of *Constitution of Athens* (*q.v.*); histories of Greece later than 1891 (*e.g.,* Busolt, Eduard Meyer, etc.). *See* also Gilliard, *Quelques reformes de Solon* (1907); Cavaignac, in *Revue de Philol.,* 1908. All works anterior to the publication of the *Constitution* are so far out of date, but reference should be made to the work of Grote.
(J. M. M.; X.)

SOLOR and ALOR ISLANDS, a group of islands between Flores and Timor, an eastward extension of Flores, one of the Lesser Sunda islands, in the Dutch East Indies. They are from west to east Solor, Adunara (both small), Lomblen, Pantar and Alor (the largest). Alor, divided from Timor by Ombai passage, 17 m. wide, is very mountainous (Mt. Kolana in the east, is 6,000 ft. and Mt. Muna, in the south-west, is 4,680 ft., both old volcanoes), and is much broken up by steep ravines, with only one plateau, and some small coastal plains. It is mostly covered with low trees and *alang alang* grass. The coast is mostly rocky, with few indentations, but on the west coast, Kalabahi bay, 10 m. long and nearly a mile wide, divides a north-western promontory from the rest of the island, with which it is connected by a very low alluvial isthmus about 2½ m. wide. Pantar is high (Mt. Laki in the south is 4,450 ft.), with a rugged coast; Lomblen has mountains in the north and south (Mt. Kedang in the north-east is 4,979 ft. and Mt. Lamahero in the south is 3,350 ft.), one of which Lobetola (5,400 ft.) is an active volcano; Adunara has a volcano, Ili Buleng (5,446 ft.), in the south-east and a plateau, ringed with hills, reaching 3,000 ft.; Solor is hilly also. All the islands are attached, administratively, to the residency of Timor and Dependencies. Alor (including Pantar) has a *Gezaghebber;* the other islands come under the *Controleur* of East Flores. Alor has a population of about 50,000, resembling the natives of Timor, a warlike race of strong physique, suspicious of strangers, fond of hunting and fishing (bow and arrow the chief weapon) and leaving agriculture to the women and children, but direct Dutch rule is curbing the warlike spirit. Villages, in the hills, are in well-nigh inaccessible positions, with strong bamboo fences, the houses being on piles, and solidly built; houses on the coast are better built. Most of the people are pagans (some Mohammedans live in the north-west), the mountain folk being divided into tribes, worshipping animals (snakes and crocodiles), observing *pomali* (Tabu), growing rice, maize, tobacco, fruit and vegetables, and keeping pigs. Clothing, except at places along the coast, is very primitive. The coastal folk weave sarongs. Many tongues are spoken, differing greatly. Pantar has about 8,000 people, in the northern part of the island, pagans, tall and strongly-built, with Mohammedans on the coast. Conditions of life, etc., resemble those of Alor, but Pantar is poor, and the people often emigrate to Timor. Houses and villages are scattered and unfenced. As in Alor, many languages are spoken, one an Alorese. The population of Lomblen, Adunara and Solor is estimated at 70,000, the people being Malayo-Papuan (Wallace terms them "of dark Papuan type"), with dark skin, curly hair and strong frame. Agriculture and fishing are practised; many coco-nut trees are found on Lomblen and Adunara; the Lomblen folk weave sarongs and build boats, and all three islands have smiths. Horses, buffaloes and chickens are kept. In coastal villages houses are on the steep hill-side, almost overhanging the water. Inland villages are larger and grouped about a square, in which stands a large tree, and sometimes a round platform, where feasts are celebrated. Under European influence the defensive method of village- and house-planning tends to disappear, houses being built on flat ground. Each village has its barns and *pomali* house. Stone-carved seats for graves are known, also stone offering-places. The Adunara people prize very greatly elephants' teeth, imported, in earlier days, from Further India. Marriage is by dowry, the woman having no freedom of choice, and young girls are so highly prized that kidnapping is known on Lomblen and Adunara. The standard of married morality is high. In one part of Lomblen, some time after burial, the head is dug up and preserved in a shed. The languages spoken vary considerably from those of Alor. There is communication with Dilly, in Portuguese Timor, and with Flores and Macassar, by

vessels of the Royal Packet Navigation company, calling at Kalabahi, in Alor and at Waiwerang, in Adunara. A Portuguese claim to Larantuka, in East Flores, and the Solor islands, led the Dutch, in 1757, when there was a fear lest the Portuguese should cede Larantuka to the French, to send an agent to Solor to acquire the island for the Dutch East India company, but Portuguese claims to both Solor and Adunara were not given up until 1848, when a Dutch agent was sent to Lawajong, in Solor, to recruit labour, and the treaty between Holland and Portugal by which Larantuka, Solor, Adunara, Alor and Pantar, were surrendered was not ratified until 1859, though Dutch garrisons were placed in Larantuka and Lawajong in 1851. Disturbances at Lawajong in 1889 compelled the Dutch official there to withdraw to Larantuka, and in 1909 armed intervention in Solor became necessary, after which Solor, Adunara and Lomblen were formed into a subdivision and included in the province of the Civil Governor of East Flores. (E. E. L.)

SOLOTHURN (Fr. *Soleure*), a canton in north-west Switzerland; total area (1923–24) is 305·5 sq.m., of which 96·7% are reckoned as productive. This is higher than for any other Swiss canton. Solothurn has a most irregular shape, dependent on the fact that the canton consists of territories won at different dates by the town from which it takes its name; the whole of it, except its southern penetration into Berne, is Jura country, and it includes a great part of the river Aar, which receives the Emme near Solothurn and the Wiggern at Aarburg near Olten. It is the most irregular in shape of all the Swiss cantons, this being accounted for by the fact that it consists simply of the territories won at different dates by the town from which it takes its name. It includes most of the Aar valley between the towns of Bienne and Aarau, neither of which is in the canton, while in its northern portion the waters join the Birs River, and in its southern portion is the last bit of the Emme before its junction with the Aar. It comprises three isolated districts, of which one (Steinhof) on the south is an "enclave" in the canton of Bern, while the others, Hofstetten, that includes the famous pilgrimage resort of Mariastein, and Klein Lutzel, are on the Alsatian frontier, and bounded by the cantons of Bern and of Basel. The highest point in the canton is the Hasenmatt (4,751 ft.) summit of the Weissenstein ridge, which rises immediately north-west of the cantonal capital. Highroad and railway communications are excellent. Olten is a great railway junction where the direct lines from the St. Gotthard via Lucerne, from Geneva, from Zürich, and from Basle all unite. Formerly various districts were in the dioceses of Lausanne, Basle and Constance, but since 1814 they have all ranked as part of the diocese of Basle, with the town of Solothurn as the site of the bishop's palace. In 1920 the population was 130,617, of whom 125,183 were German speaking, 2,621 French-speaking and 2,514 Italian-speaking; 81,989 were Catholics, 47,441 Protestants and 163 Jews. The capital is Solothurn (13,550 pop. in 1925), and the only other fairly large town is Olten (12,400), both on the Aar. Between Solothurn and the small industrial town of Grenchen, to the west-south-west, lies the village of Selzach, noted for its annual passion-play. The estimated population in 1926 for the canton was 138,600.

Till about 1850 the cantonal activities were mainly agricultural and pastoral, and though these are still important, yet its density of population (433 per sq.m. in 1920, against 243 for Switzerland as a whole), is largely dependent on the variety of its manufactures, *e.g.*, watches, jewellery, shoes, cotton, motor parts and cement, particularly around Solothurn and Grenchen.

Soleure is divided into ten administrative districts with 132 communes. The cantonal Constitution dates from 1887, but was substantially revised in 1895. The *Kantonsrat*, or legislative assembly, is now elected according to the principles of proportional representation. The 130 deputies are chosen on the basis of one member for each 1,000 of the total resident population in 1920. The *Regierungsrat* or executive consists of five members. Both groups hold office for four years, but any 4,000 citizens can demand a popular vote on *Abberufung*, or recall, to decide as to whether the existing members shall continue to sit or not. In addition, the "obligatory referendum" and the "initiative" exist. By the former, since 1869, all laws and financial resolutions passed by the *Kantonsrat* must be approved by a popular vote. By the latter, since 1869, 2,000 electors can compel the legislative assembly to consider any legislative proposal. Further, since 1856, the demand of 3,000 electors is sufficient to necessitate a popular vote as to the advisability of effecting some constitutional change. The two members of the federal *Ständerat* and the seven members of the federal *Nationalrat* are also chosen by a popular vote.

SOLOTHURN (Fr. *Soleure*), the capital of the Swiss canton of that name, an ancient little town, situated on the river Aar. In 1920 it had 13,440 inhabitants, almost all German-speaking, with a small Catholic majority. A 16th-century rhyme claims for the town of Solothurn the fame of being the oldest place in "Celtis" save Trier. Certainly its name, "Salodurum," is found in Roman inscriptions and the remains of the Roman "castrum" still exist. Its position as commanding the approach to the Rhine from the south-west has led to its being more than once strongly fortified. The mediaeval town grew up round the house of secular canons founded in the 10th century in honour of St. Ursus and St. Victor by Queen Bertha, the wife of Rudolph II., king of Burgundy. The prior and canons had many rights over the town; but in 1218 it became a free imperial city, and in 1252 shook off the jurisdiction of the canons and took them under its protection. In 1295 we find it allied with Bern, and this connection is the key to its later history. In the 14th century the government of the town fell into the hands of the gilds, whose members practically filled all the public offices. Through Bern, Solothurn was drawn into association with the Swiss Confederation. An attempt to surprise it in 1382, made by the Habsburgs, was foiled, and resulted in the admittance of Solothurn in 1385 into the Swabian League and in its sharing in the Sempach War. It was included in the Sempach ordinance of 1393 and in the great treaty of 1394 by which the Habsburgs renounced their claims to all territories within the Confederation. In 1411 Solothurn sought in vain to be admitted into the Confederation, a privilege only granted to it in 1481 at the diet of Stans. It was also in the 15th century that by purchase or conquest the town acquired the main part of the territories forming the present canton. In 1529 the majority of the "communes" went over to the reformed faith, and men were sent to fight on Zwingli's side at Kappel (1531), but in 1533 the old faith regained its sway, and in 1586 Solothurn was a member of the Golden, or Borromean, League. Solothurn was the usual residence of the French ambassador from 1530 to 1797. From 1681 onwards, it had an aristocratic form of government; but this was finally broken down in 1831, Solothurn in 1832 joining the league to guarantee the maintenance of the new cantonal constitutions. Though distinctly a Roman Catholic canton, it did not join the "Sonderbund," and voted in favour of the federal constitutions of 1848 and 1874.

The position of Solothurn at the foot of the Jura and close to the navigable portion of the Aar has always made it a meeting-point of various routes. Six railway lines now branch thence. Its chief building is the minster of SS. Ursus and Victor, which dates from the 18th century, though it stands on the site of a far older edifice. Since 1828 it has been the cathedral church of the bishop of Basel. The ancient clock tower and the older portions of the town-hall date still further back. The early 17th century arsenal contains the finest collection of armour and old weapons in Switzerland, while the modern museum houses a splendid collection of fossils from the Jura, rocks collected by F. J. Hugi (1796–1855), a native of Soleure, and a Madonna by the younger Holbein. The building now used as the cantonal school was the residence of the French ambassadors to the Swiss confederation from 1530 to 1797. There are some fine 16th century fountains in the town, which in its older portions still keeps much of its mediaeval aspect, though in the modern suburbs and in the neighbouring villages there is a certain amount of industrial activity (watch-making, motor manufactures, etc.). One mile N. of the town is the Hermitage of St. Verena, in a striking rock gorge, above which rises the Weissenstein ridge.

See K. Meisterhaus, *Kurze Entwicklungsgeschichte der Stadt Solothurn* (1895).

SOLOVIEV, SERGEI MIKHAILOVICH (1820–1879), Russian historian, was born in Moscow on May 17, 1820, and died on Oct. 16, 1879. From 1842–44 he travelled in Europe as tutor in Count Stroganov's family. He wrote treatises on *The Relations between Novgorod and the Grand Princes* (1845), and on the *History of the Relations among the Russian Princes and the House of Rurik* (1847), and was appointed professor of history at and later rector of the university of Moscow. His *History of Russia* (29 vols.; Moscow, 1851–79), was the first complete scientific treatment of Russian history, from its origins up to 1774, since Karamzin's *History of the Russian State* (1818–29). Other works by him are *Historical Letters* (1858); *History of the Fall of Poland* (1863); and *The Political and Diplomatic History of Alexander I.* (1877).

SOLOVIEV, VLADIMIR SERGEVICH (1853–1900), Russian idealistic philosopher, critic and poet, son of the historian, Sergei Soloviev (*q.v.*), was born in Moscow on Jan. 16, 1853, and died at Uzkoe, near Moscow, on July 31, 1900. Vladimir studied theology at the University of Moscow, publishing in 1875 his Ph.D. thesis on *The Crisis of Western Philosophy.* After visiting England and Egypt, where he studied eastern philosophical ideas, he returned to Russia and was appointed reader in philosophy at Moscow university in 1877. But his outspoken criticism of the Government cut short his career as a lecturer; a speech against capital punishment lost him his readership at Moscow, and he was soon removed from the minor professorship at St. Petersburg (now Leningrad) to which he was next appointed. The rest of his life was devoted chiefly to writing. The chief tenet of Soloviev's theology, the union of eastern and western beliefs in a universal church, led him to take up a pro-Roman attitude for a time, and in 1889 he published in French *La Russie et l'Église Universelle* (3rd ed., 1922). He upheld the Christian ideal of universal brotherhood as opposed to Slavophilism. Philosophically he laid stress on the spirituality of all being, the idea of absolute one-ness, and the evolution of the God-man. His best known works are a *History of Materialism* (1894); *History of Ethics* (1896–98); *The Justification of the Good* (1898; Eng. trans. in Constable's Russian Library, 1915); *War, Progress, and the End of History, including a short story of the Anti-Christ* (1900; Eng. trans. 1915, with biographical notice by Dr. Hagberg Wright). *See* also *War and Christianity from the Russian Point of View,* three conversations, translated 1915, with an introduction by Stephen Graham. For a brief account of Soloviev's philosophy *see* L. M. Lopatin, *The Philosophy of Vladimir Soloviev* (1916).

SOLSTICE, in astronomy either of the two points at which the sun reaches its greatest declination north or south (Lat. *solstitium,* from *sol,* sun, and *sistere,* to stand still). Each solstice is upon the ecliptic midway between the equinoxes, and therefore 90° from each. The term is also applied to the time at which the sun reaches the point thus defined (about June 21 and Dec. 21).

SOLUNTUM (Gr. Σολόεις or Σολοῦς), an ancient town of Sicily, one of the three chief Phoenician settlements in the island, situated on the north coast, 10 m. E. of Panormus (Palermo), 600 ft. above sea-level, on the south-east side of Mte. Catalfano (1,225 ft.), in a naturally strong situation, and commanding a fine view. It was a Carthaginian possession until the First Punic War, when, after the fall of Panormus, it opened its gates to the Romans. Excavations have brought to light considerable remains of the ancient town, belonging entirely to the Roman period.

SOLUTIONS. When sugar is put in contact with water it dissolves and the liquid so obtained has the following properties which are characteristic of solutions:—

(1) It is homogeneous, *i.e.,* it is not possible to distinguish by any means, as for example by the most powerful microscope, parts which are sugar and parts which are water; the smallest amount which can be distinguished contains both sugar and water. In this a solution differs from a mixture which is heterogeneous, *i.e.,* in which it is possible to distinguish parts which are different from others. It may be supposed that in solutions the ultimate particles or molecules of which substances are made are intimately mingled together. If the single molecules of bodies could be made visible, the distinction between solutions and mixtures would fail. But except in some very special circumstances the smallest quantity of matter which can be distinguished contains some thousands of molecules, so that the distinction is of practical value.

(2) The composition of a solution can be varied: either water or sugar can be added to a sugar solution (within certain limits) and the solution still remains homogeneous. In this a solution differs from a chemical compound, which is homogeneous but has a definite composition which cannot be varied.

Types of Solutions.—The property of forming solutions is a very general one. All gases mix with each other in all proportions forming homogeneous gaseous "mixtures," which are technically solutions. Liquids may dissolve not only solids, but also other liquids and gases. It is also possible to obtain "solid solutions." Thus if two solid substances are melted together and then allowed to solidify, we may get a homogeneous solid substance of variable composition, containing the two substances, *i.e.,* a solid solution (*see* CHEMISTRY: *Physical*).

There is a limit to the amount of a solid substance which can dissolve in a given quantity of a liquid at any particular temperature. When this limiting amount is reached the solution is said to be *saturated.* The concentration of the dissolved substance in the saturated solution, expressed in a proper way, is known as its *solubility.* In some cases two liquids are completely miscible, *i.e.,* they form homogeneous solutions when mixed in all proportions. In others they are only partially miscible. Thus, when ether is added to water it dissolves at first, but ultimately a saturated solution is obtained and if more ether is added it forms a separate layer in contact with the water solution. This ether dissolves water from the aqueous solution until it is saturated with water. Thus two liquid layers are obtained, a saturated solution of ether in water and a saturated solution of water in ether.

In solutions of gases in liquids it is necessary to take into account another factor, the pressure of the gas. It was found by William Henry in 1803 that the solubility of a gas at a given temperature is proportional to its pressure (Henry's law). A familiar application of this is the soda-water syphon, which contains an aqueous solution of carbon dioxide, saturated at a pressure somewhat greater than the pressure of the atmosphere. Since this solution contains more carbon dioxide than corresponds to saturation at atmospheric pressure, gas is liberated when the excess pressure is released, causing effervescence.

Expression of Composition.—The substances of which a solution is composed are termed its components. Frequently the substance which dissolves is distinguished as the *solute,* and the liquid or medium into which it dissolves is called the *solvent.* But this is a matter of convenience, for there is no fundamental distinction between the two, and in many cases it is not clear which component is to be regarded as solute, and which as solvent. The composition of a solution is best expressed in terms of the relative numbers of the molecules of the components. Thus if we have a binary solution containing n_a molecules of a substance A, and n_b molecules of a substance B, the fraction $n_a/(n_a+n_b)=N_a$, *i.e.,* the ratio of the number of molecules of A to the total number of molecules in the solution, is known as the *molar fraction* of A. Similarly the ratio $n_b/(n_a+n_b)=N_b$ is the molar fraction of B.

The concentration of any component may be expressed as the amount of it in a given volume (volume concentration) or in a given weight (weight concentration) of the solution. If the amount of a substance be expressed in terms of the number of molecules, the corresponding molecular concentration is obtained. A convenient unit for stating molecular concentration is the *gram-molecule.* This is the amount of a substance which contains as many molecules as there are atoms in one gram of hydrogen. The number of gram-molecules of a substance in a litre of solution is often termed the *molar concentration;* whilst the same quantity in 1,000 grams of solvent is distinguished as the *molal concentration.*

THE PROPERTIES OF DILUTE SOLUTIONS

Vapour Pressures.—When a pure liquid, at a given temperature, is put in an evacuated space it gives off vapour until the

latter has a definite pressure which is known as the vapour pressure of the liquid. If a non-volatile substance (*i.e.*, a substance whose vapour pressure is inappreciable) is dissolved in the liquid it is found that the vapour pressure of the latter is thereby lowered. A. Wüllner found (1858–60) that the lowering of the vapour pressure was proportional to the concentration of the dissolved substance. Somewhat later (1886) François-Marie Raoult made the fundamental discovery that equal numbers of molecules of different substances, dissolved in the same solvent, produced the same lowering. A little later he found a more general relation, namely, that in dilute solutions the fractional lowering of the vapour pressure (*i.e.*, the ratio of the observed lowering to the original vapour pressure) was equal to the molar fraction of the dissolved substance. Thus if p_0 is the vapour pressure of the pure solvent, p that of the solution and N_2 the molar fraction of the solute, we have $(p_0-p)/p_0=N_2$. Table I. gives values of these two quantities obtained by Raoult for solutions of aniline, a liquid with a comparatively low vapour pressure, in ether.

TABLE I.
Fractional lowerings of the vapour pressure of solutions of aniline in ether

N_2 . . .	0·040	0·081	0·154	0·197	0·424	0·596
$\frac{P_0-p}{P_0}$ . .	0·038	0·077	0·148	0·205	0·496	0·687

Since $N_2=1-N_1$ (N_1 being the molar fraction of the solvent), it follows that $1-p/p_0=1-N_1$, or $p=p_0N_1$, *i.e.*, the vapour pressure of the solvent is proportional to its molar fraction. This relation is known as Raoult's law. Its limitations are discussed later.

Elevation of the Boiling Point.—The boiling point of a liquid is the temperature at which its vapour pressure is equal to the pressure of the atmosphere (boiling points are usually stated for the standard pressure of 76cm. of mercury). Since a solution of an involatile solute has a lower vapour pressure than the pure solvent at the same temperature, a greater rise of temperature is required to bring its pressure up to the atmosphere pressure; so that its boiling point is higher than that of the solvent. Since equal numbers of molecules of different solutes in the same solvent produce the same vapour-pressure lowering, they also cause the same elevation of the boiling point. The magnitude of the elevation produced by a given number of solute molecules depends, however, on the rate at which the vapour pressure of the solvent increases with the temperature, a quantity which is characteristic of each solvent, and which depends on the heat absorbed in vaporization. Thus every solvent has a characteristic *molecular elevation* of the boiling point, which is usually stated as the elevation produced by one gram-molecule of dissolved substance in 1,000 grams of solvent.

Making use of the laws of energy, J. H. van't Hoff showed in 1887 that the molecular elevation of a solvent, ΔT is given by $\Delta T=0{\cdot}002L_v/T^2$ where L_v is the heat absorbed in the vaporization of one gram of solvent and T is the absolute temperature at which it boils. The measurements of Raoult, Beckmann, and others showed that, while many solutes gave "normal" molecular elevations in good agreement with those calculated by van't Hoff, in some cases "abnormal" values are obtained, considerably greater or less than the van't Hoff figures. The study of these "abnormal" cases, as will be discussed later, played a great part in the subsequent development of the subject. Table II. gives the molecular elevations of some typical solvents as calculated by the van't Hoff formula, and the average observed elevations produced by "normal" solutes.

TABLE II.
Molecular elevations of the boiling point (for 1,000 grams of solvent)

Solvent	Boiling point	Molecular elevation	
		Calculated	Observed
Water	100° C	0·515	0·52
Carbon disulphide . .	46·2	2·41	2·37
Ethyl alcohol . . .	78·8	1·198	1·15
Methyl alcohol . . .	67	0·875	0·88
Acetic acid . . .	118·5	3·13	3·07
Benzene	80·3	2·67	2·67
Acetone	56·3	1·72	1·725

Freezing Points of Solutions.—The freezing point of a liquid is the temperature at which the solid form can exist in contact with the liquid. Thus at the freezing point and only at that temperature, can water and ice exist together. If the temperature is raised the ice melts to water; if it is lowered the water freezes. The freezing point of a solution is lower than that of the pure solvent; thus it is well known that sea water, which contains dissolved salts, freezes at a lower temperature than pure water. As early as 1788, Sir Charles Blagden made measurements of the freezing points of salt solutions and showed that the depression was roughly proportional to the concentration of the salt.

Van't Hoff showed that the depression of the freezing point is, like the elevation of the boiling point, proportional to the number of dissolved molecules. He obtained for the *molecular depression* of the freezing point, *i.e.*, the depression produced by one gram-molecule of a solute in 1,000 grams of solvent, an expression similar to that giving the molecular elevation, viz., $\Delta T=0{\cdot}002\ L_f/T^2$ where L_f is the heat absorbed in the fusion of one gram of solvent and T the absolute temperature of its freezing point. Table III. gives the molecular depressions of a few typical solvents, as calculated in this way.

TABLE III.
Molecular depressions of the freezing point (for 1,000 grams of solvent)

	Freezing point	Molecular depression (calculated)
Water	0·0° C	1·858
Benzene	5·5	5·19
Formic acid . . .	8	2·74
Acetic acid . . .	17	3·82
Phenol	41·5	6·81
Nitrobenzene . . .	3·9	6·80

The researches of Raoult, Beckmann and others showed that, whereas many substances gave rise to molecular depressions which agreed well with the calculated values, others behaved abnormally. Thus in aqueous solutions, the depressions produced by non-electrolytes are in good agreement with the calculated values, but those of strong electrolytes are considerably greater (*see* Table VI.) In benzene solutions, substances of a similar nature give rise to the normal depressions, but substances of a polar nature, *e.g.*, the alcohols, give smaller values.

Osmotic Pressures.—In 1748 the Abbé Nollet published the results of his experiments on the diffusion of substances through animal membranes. He found that if a vessel, full of spirits of wine, is closed with a bladder and immersed in water, the bladder expands and a considerable pressure, which may ultimately burst the bladder, is set up inside. Further experiments of this kind were made from time to time, but it was not until 1867 that Moritz Traube showed that similar effects could be obtained with artificially prepared membranes. W. Pfeffer in 1877 was the first to make measurements of the pressures set up. His membrane consisted of a deposit of copper ferro-cyanide, formed in the walls of a porous clay vessel by the interaction of solutions of copper sulphate and potassium ferro-cyanide. This membrane allows water to pass through it freely, but prevents the passage of dissolved substances such as cane sugar. Pfeffer's apparatus consisted (fig. 1) of the prepared porous pot, completely filled with a sugar solution and attached to a mercury manometer or pressure gauge. When the pot was immersed in water, the latter tended to diffuse through the walls into the sugar solution so as to dilute it, but the sugar was unable to diffuse outwards. The volume of sugar solution thus tended to increase (which forced the mercury up the manometer tube), giving rise to a pressure inside the cell which increased until it was sufficient to prevent

any more water diffusing into the solution. The hydrostatic pressure inside the cell when equilibrium is reached is the osmotic pressure of the solution.

In 1885 van't Hoff pointed out that, according to Pfeffer's measurements, dilute solutions obey the laws of gases. The osmotic pressure produced by a substance in solution is the same as the gas pressure which would be exerted if the same number of molecules were present in the same volume in the gaseous state. On this basis he built up a comprehensive theory of dilute solutions, and, making use of the laws of energy, derived the foregoing relations for the boiling points and freezing points of solutions. On account of this analogy between gases and solutions, the osmotic pressure has frequently been ascribed to the bombardment of the membrane by solute molecules which are unable to pass through it, and exert on it the same pressure as if they were present in the same space in the gaseous state. Its true origin, however, appears to be the tendency of the solvent to diffuse into the solution. When the two liquids are separated by a membrane which the solute molecules cannot pass, and are at the same pressure, the solvent will flow through the membrane into the solution. The osmotic pressure is the pressure which must be applied to the solution to stop this flow. That it is equal to the equivalent gas pressure is a consequence of the inter-relations of the properties of solvent and solute which are necessitated by the laws of energy. Exact measurements of the osmotic pressures of solutions have been made by H. N. Morse and J. C. W. Frazer (1902–12) in America and by the earl of Berkeley and E. G. J. Hartley in England (1906–09). These investigators found that in dilute solutions the osmotic pressure agrees with the corresponding gas pressure within the limits of experimental error; in more concentrated solutions deviations occur similar to those in gases at high pressures.

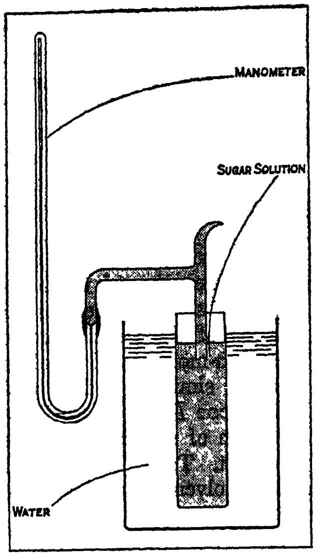


FIG. 1.—THE MANOMETER RECORDS PRESSURE PRODUCED BY WATER DIFFUSING INTO SUGAR SOLUTIONS

A simple means of recognizing solutions having the same osmotic pressure was discovered in 1888 by the botanist, Hugo de Vries. He observed the behaviour of the cells of certain plants, particularly *Tradescantia discolora,* in aqueous solutions. These cells consist of a woody framework, lined by a membrane containing a protoplasmic fluid which is permeable by water but not by dissolved substances. When such a cell is placed in a solution having the same osmotic pressure as that of the cell contents, it retains its normal appearance; if the osmotic pressure of the solution is greater or less the cell membrane expands or shrinks. It is thus possible to identify solutions of different substances which have the same osmotic pressure; that is, which are *isotonic.* Saline solutions which are isotonic with human blood are employed in surgery to replace a serious loss of blood.

CONCENTRATED SOLUTIONS

The Ideal Solution.—In solutions of two liquids, which are miscible in all proportions, and may both be volatile, each contributes to the total vapour pressure of the solution. If the relative proportions of the two substances in the vapour are known, the proportion of the total vapour pressure due to each component can be found. In this way the total vapour pressure is divided into the *partial vapour pressures* of the two components. Now in dilute solutions of a non-volatile solute, according to Raoult's law, the vapour pressure of the solvent is proportional to its molar fraction. A solution in which Raoult's law holds for all the components, over the whole range of compositions, is known as an *ideal* or perfect solution. Thus an ideal solution may be defined as one in which the partial vapour pressure of each component is proportional to its molar fraction through the whole range of composition, *i.e.,* Raoult's relation, $p=p_0N$, holds for the partial vapour pressure of each component.

The behaviour of solutions may be represented by a graph in which the partial vapour pressures of the components are plotted against the corresponding molar fractions (figs. 2 and 3). Points along the base line represent the molar fractions of the two substances, the extremities representing the two pure liquids, and the vertical distances from the base line the corresponding partial pressures. In ideal solutions the partial pressures, being proportional to the corresponding molar fractions, are represented by straight lines, extending from the point which represents the vapour pressure of the pure liquid to zero pressure at the other extremity of the base line. Deviations from the ideal relation are indicated by deviations of the partial vapour pressures from this straight line. The partial vapour pressures of many binary solutions were determined by Jan von Zawidski in 1900. Two substances which are closely related in constitution and properties usually form solutions which are nearly ideal. This is the case with ethylene bromide and propylene bromide (fig. 2). Substances not closely related may deviate. Fig. 3 shows some typical examples.

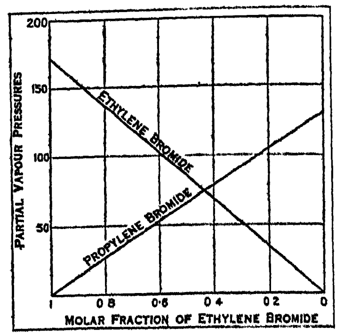


FIG. 2.—PARTIAL VAPOUR PRESSURES IN IDEAL SOLUTIONS

Deviations from Raoult's Law.—The deviations from Raoult's law which are exhibited in many solutions have been the subject of much experiment and speculation. On the one hand an explanation was sought in physical effects of the same nature as those which cause deviations from the law of perfect gases (J. D. van der Waals, 1890; J. J. van Laar, 1910). On the other hand a group of workers, led by Friedrich Dolezalek (1906), attempted to show that all deviations were capable of explanation by purely chemical effects, such as the formation of compounds between the components of the solution and "association" or the combination of two or more molecules of one component. While it has become certain that purely physical effects are capable of producing deviations, it cannot be said that chemical effects never occur.

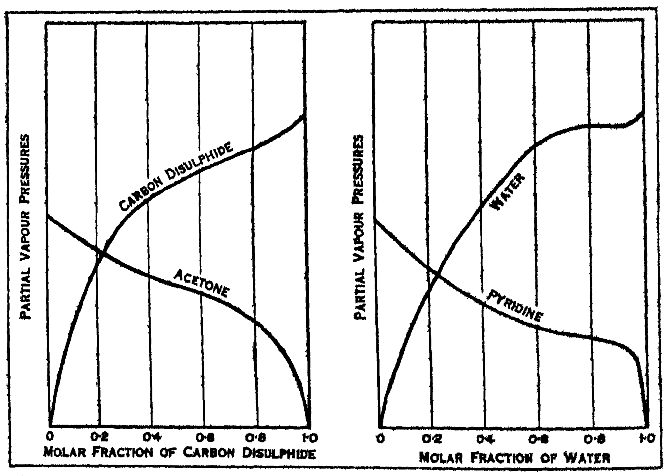


FIG. 3.—PARTIAL VAPOUR PRESSURES IN NON-IDEAL SOLUTIONS FOR ANY ONE CONSTITUENT

In a solution which obeys Raoult's law, the properties of a substance are the same as in its pure liquid, except in so far as they are modified by a reduction in the *number* of molecules present. Thus in an ideal solution containing 50% of molecules of a kind A, its vapour pressure is half that of pure liquid A at the same temperature. The change in vapour pressure is accounted

for entirely by the change in the number of molecules present in the liquid. Thus each molecule in the solution makes the same contribution to the vapour pressure as in the pure liquid. Now the molecules of a liquid are in a condition of thermal agitation, vibrating about their mean positions, and are held together by attractive or cohesive forces acting between them. Molecules which escape into the vapour are those which acquire sufficient energy to overcome the attractive forces exerted on them in the liquid. The greater these attractive forces, the less is the chance of a molecule getting loose, and the smaller is the vapour pressure. It is evident that in an ideal solution in which the vapour pressure of each component depends only on the number of molecules present, the forces exerted on each molecule must be the same as in the pure liquid.

It is easy to see that this can only be the case with substances which are very similar in nature. Thus if we have a liquid made up of molecules of a kind W, say water (fig. 4), and we replace half of them by molecules of another kind A, *e.g.,* alcohol, it is evident that the attractive forces acting on a single molecule W can only be the same in the pure liquid (*a*) and in the solution (*b*) if the attraction between a molecule W and a molecule A is the same as that between two molecules W. This can only be the case when the two substances are very closely related. If the molecules of a substance are held in the solution by forces greater than those acting in the pure liquid, the vapour pressure will be less than that given by Raoult's law; if the forces are less, the vapour pressure will be greater.

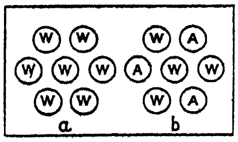


FIG. 4.—MOLECULAR CONDITION OF PURE WATER (a), (b) A SOLUTION OF ALCOHOL IN WATER

In a theory of solutions first put forward in 1916, J. H. Hildebrand has taken the internal pressure as a convenient measure of the attractive forces between molecule and molecule in a liquid. The internal pressure can be regarded as the cohesive force acting across a surface 1 sq.cm. in area in the interior of a liquid. If the internal pressures of two liquids are the same it may be possible to replace molecules of one by molecules of the other without changing the cohesion. If the internal pressures are different, it is unlikely that the cohesive forces acting on a molecule in the solution can be the same as in its pure liquid. Hildebrand has shown that liquids having nearly identical internal pressures do in fact form ideal solutions, while deviations from it are the greater the greater the difference of internal pressures. Table IV. gives the relative internal pressures of some typical substances (taking that of naphthalene as a standard).

TABLE IV.
Relative internal pressures in the liquid state

Hexane	0·56	Pyridine	1·10
Ethyl ether	0·66	Carbon disulphide	1·13
Ethyl acetate	0·83	Acetone	1·32
Carbon tetrachloride	0·84	Aniline	1·46
Benzene	0·94	Sulphur	1·70
Toluene	0·93	Iodine	1·85
Chloroform	0·95	Acetic acid	1·95
Naphthalene	1·00	Ethyl alcohol	2·90
Anthracene	1·05	Methyl alcohol	3·35
Nitrobenzene	1·07	Water	4·60

Activities.—In order to express the behaviour of non-ideal solutions, G. N. Lewis and M. Randall in 1907 introduced a quantity which they called the *activity.* In ideal solutions the partial vapour pressure of a component is proportional to its molar fraction; in non-ideal solutions the quantity to which it is proportional is called its activity, α, so that we have:

(1) in ideal solutions, $p=p_0N$;
(2) in non-ideal solutions $p=p_0\alpha$.

The ratio of the partial pressure of a component in a given solution to its vapour pressure as pure liquid (i.e., p/p_0), which in ideal solutions is equal to the molar fraction, is thus in general equal to the activity. The ratio of the activity to the corresponding molar fraction is called the *activity coefficient.* In ideal solutions the activity coefficient is therefore equal to unity; its difference from unity indicates the extent of the deviation from the ideal behaviour in the solution. Table V. gives the activities and activity coefficients of pyridine in pyridine-water solutions.

TABLE V.
Activities and activity coefficients of pyridine in pyridine-water solutions at 80·5° C.

Molar fraction of pyridine	1·000	0·892	0·747	0·541	0·336	0·160	0·000
Activity	1·000	0·802	0·686	0·581	0·474	0·438	0·000
Activity coefficient	1·000	0·956	0·963	1·074	1·412	2·737	..

Partially Miscible Liquids.—When the deviation from Raoult's law is very great two liquids may no longer form homogeneous solutions when mixed in all proportions. There may be a limit to the extent to which each liquid dissolves the other, and if the proportions are not within these limits two liquid layers are formed.

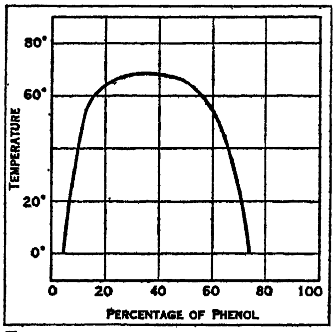


FIG. 5.—GRAPH SHOWING THAT ABOVE 68° WATER AND PHENOL ARE MISCIBLE IN ALL PROPORTIONS

The mutual solubility of two such liquids at different temperatures may be represented by a graph. Thus in fig. 5 the left-hand branch represents the solubility of water in phenol, the right-hand branch that of phenol in water. In this case the mutual solubility of the two liquids increases as the temperature rises and the two curves meet at a temperature of 68·8° C, which is known as the critical solubility temperature. Above this the liquids are miscible in all proportions.

It is usually the case that deviations from Raoult's law decrease, and the mutual solubility increases, as in fig. 5, with rise of temperature. But a few cases have been observed in which the reverse happens. Thus the mutual solubilities of triethylamine and water increase as the temperature is lowered, and there is a lower critical solubility temperature below which the two liquids are miscible in all proportions. Solutions of nicotine and water have the extraordinary property of having two critical solubility temperatures, an upper and a lower one. Thus above 210° and below 60° C the two liquids are miscible in all proportions; at intermediate temperatures they are only partially miscible. The mutual solubilities are thus represented by a closed curve. (*See* CHEMISTRY: PHYSICAL.)

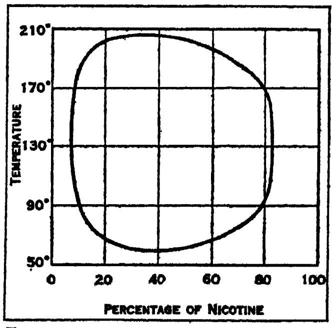


FIG. 6.—GRAPH SHOWING THAT WATER AND NICOTINE ARE MISCIBLE IN ALL PROPORTIONS BELOW 60° AND ABOVE 205°

SOLUTIONS OF ELECTROLYTES

Properties of Electrolytes.—An electrolyte is a substance which is a conductor of electricity either in the molten state or in solution (*see* ELECTROLYSIS, and ELECTRICITY, CONDUCTION OF, IN LIQUIDS). In order to account for this electrical conductivity, R. Clausius (1857) surmised that these substances were dissociated to some minute extent into electrically charged particles or ions which acted as carriers of the electric current. Soon after 1880 two lines of evidence converged to show that salt-like substances are in fact dissociated in solution to a considerable extent.

In the first place it was found that electrolytes in aqueous solution gave abnormally large values for the molecular elevation of the boiling point and the molecular depression of the freezing point. Table VI. shows a few values of the latter.

The molecular depressions produced by non-electrolytes are in fairly good agreement with the value 18·9 calculated by van't Hoff on theoretical grounds. The values for electrolytes are approximately twice this figure. Clearly, this could be interpreted to mean that the actual number of molecules in the solutions of the

Table VI.

Molecular depressions of the freezing point of water

Non-electrolytes		Electrolytes	
Solute	Molecular depression	Solute	Molecular depression
Urea	17·2	Hydrochloric acid	39·1
Acetamide	17·8	Nitric acid	35·8
Ethyl acetate	17·8	Caustic potash	35·3
Tartaric acid	19·5	Potassium chloride	33·6
Acetic acid	19·0	Sodium chloride	35·1
Cane sugar	18·5		
Ethyl alcohol	17·3		

latter is considerably greater than the number of molecules of the substance introduced, in fact that the electrolyte has undergone dissociation in solution. Van't Hoff however contented himself with introducing a factor *i*, the ratio of the observed to the normal calculated effect.

About the same time studies were being made of the electrical conductivities of solutions of electrolytes and their change with concentration. In order to find if there is any change in the state of the electrolyte when the concentration is varied, it is necessary to express the results as the quantity of electricity carried *by the same number of molecules* in the different solutions in a given time, the measurements being otherwise made under the same conditions. The quantity so obtained is the *molecular conductivity* of the electrolyte in solution. F. Kohlrausch found that the molecular conductivities of electrolytes increased with their dilution (*i.e.*, the amount of solvent containing one molecular weight in grams of the electrolyte), but that two classes could be distinguished:

(1) *Strong Electrolytes,* having large molecular conductivities which approach a constant limiting value when the dilution becomes very great. This class includes most salts; mineral acids such as nitric, hydrochloric, sulphuric; and strong bases such as caustic potash and caustic soda.

(2) *Weak Electrolytes,* the molecular conductivities of which are smaller and show no signs of reaching a constant value at great dilutions. To this class belong most organic acids and bases, *e.g.*, acetic acid; also ammonium hydroxide.

Electrolytic Dissociation.—These two groups of facts were correlated in the theory of electrolytic dissociation developed by Svante Arrhenius (1882–87), who conceived the idea that strong electrolytes are largely dissociated in their aqueous solutions into charged parts or ions. Thus a molecule of a binary electrolyte such as sodium chloride yields two ions on dissociation, a positively charged sodium ion and a negatively charged chloride ion: $NaCl \rightarrow Na^+ + Cl^-$; similarly barium chloride yields three ions: $BaCl_2 \rightarrow Ba^{++} + 2Cl^-$. In order to account for the change of molecular conductivity with dilution, Arrhenius assumed that at very great dilutions strong electrolytes were completely dissociated in this way. Now the molecular conductivity is determined by (1) the number of ions formed from one gram-molecule of the salt in solution, (2) their mobility or the rate at which they move in a given electric field. Arrhenius assumed that in fairly dilute solutions the mobility of the ions was constant, so that he ascribed the changes in the molecular conductivity to changes in the number of ions. Thus the decrease in the molecular conductivity as the concentration is increased is due to a decrease in the number of molecules dissociated into ions. The fraction dissociated, or degree of dissociation, in a given solution is the ratio of the molecular conductivity in that solution to its limiting value at infinite dilution (corresponding to complete dissociation).

In order to explain the abnormal freezing point depressions, etc., of solutions of electrolytes, Arrhenius supposed that the ions formed by dissociation had the same effect on the behaviour of the solutions as independent molecules. Then if the degree of dissociation is γ, the fraction of the electrolyte remaining undissociated is $1-\gamma$. If a molecule of an electrolyte γ dissociated into k ions, the number of ions formed is proportional to $k\gamma$, so that the total number of undissociated molecules and ions in the solution is greater than the number of molecules introduced in the ratio $(1-\gamma)+k\gamma=1+(k-1)\gamma$. Arrhenius clinched his theory by showing that the values obtained for this quantity by conductivity measurements were in good agreement with the van't Hoff factor *i*, as shown in Table VII.

Table VII.

Degree of dissociation, etc., of electrolytes (1 gram-molecule in 10 litres of water)

	Degree of dissociation	i from freezing point	$i=1+(k-1)\gamma$
Hydrochloric acid	0·90	1·98	1·90
Sulphuric acid	0·60	2·06	2·20
Sodium hydroxide	0·88	1·91	1·88
Potassium chloride	0·86	1·82	1·85
Sodium chloride	0·82	1·90	1·82
Silver nitrate	0·86	1·60	1·86
Zinc sulphate	0·38	0·98	1·38

In solutions of weak electrolytes the limiting value of the molecular conductivity, corresponding to complete dissociation, cannot be determined directly, because at the greatest dilution at which measurements can be made these substances are only partially dissociated. It can, however, be calculated by means of a relation given by Kohlrausch; and from it the degrees of dissociation are obtained in the same way as with strong electrolytes.

Difficulties of Arrhenius' Theory.—The theory of Arrhenius met at first with vigorous opposition. The more conservative chemists refused to accept the view that common salt, for example, is largely dissociated in aqueous solutions into sodium ions and chloride ions. This opposition was largely based on a misconception of the nature of ions and in course of time died down. Nevertheless, although the Arrhenius theory provided a new basis for our knowledge of salt solutions and served to inspire a great number of investigations for more than 20 years, there remained outstanding difficulties.

Thus it was found that, in some of their properties, the behaviour of salt solutions was more uniform than the varying degrees of dissociation calculated from conductivity measurements, according to the Arrhenius theory, would lead us to expect. For example, A. A. Noyes found in 1904 that the optical rotatory powers of β-bromocamphoric acid and its metallic salts in solutions of equivalent strengths were almost identical, although conductivity measurements indicated degrees of dissociation varying from 70 to 93%. Noyes remarked, "If there were not other evidence to the contrary these facts would almost warrant the conclusion that the salts are completely ionized up to the concentration in question." Again, it was found by Ostwald that the variation of the degree of dissociation of weak electrolytes with their concentration was in accordance with the ordinary laws of chemical equilibrium, but no such relation could be obtained with strong electrolytes. Although attempts were made to introduce the effect of the electrical charges of the ions on the equilibrium between undissociated salt and its ions, no satisfactory explanation was found. In the earlier stages the methods of measurements available were not very accurate and it was only possible to show the approximate equality of the degree of dissociation as given by conductivity measurements with the value corresponding to the van't Hoff factor *i*. In later years many exact measurements were made of the two quantities, but these only confirmed or accentuated the differences between them.

The Theory of Complete Dissociation.—As we have seen, Arrhenius made the initial assumption that the speeds of ions in a given electric field were independent of the concentration, at any rate in dilute solutions; so that changes in the molecular conductivities were due to changes in the degree of dissociation. In view of the difficulties mentioned above, the correctness of Arrhenius' assumption began to be questioned. Might not a strong electrolyte be completely dissociated at all concentrations, the changes in the molecular conductivities being due to changes in the mobility of the ions? This view, which had been tentatively

suggested earlier by W. Sutherland, S. R. Milner and others, was put in a definite form by N. Bjerrum in 1918.

The early prejudice against the idea of electrolytic dissociation had now disappeared. In the light of the greater insight into the structure of salts afforded by studies in atomic physics, the dissociation of salts into ions appeared, not as something abnormal and astonishing, but as a natural consequence of their structure. Thus the work of Sir William Bragg and his son, W. L. Bragg, on crystal structures has shown that crystals of sodium chloride, for example, are built up of sodium ions and chloride ions arranged alternately on a cubic lattice. Each sodium ion is surrounded at equal distances by six chloride ions and there is no reason for believing that any of these is associated with it by a special bond. It is thus reasonable to suppose, unless evidence to the contrary is found, that there is no tendency for the ions to "pair off" into molecules in solution. It was therefore necessary to see if the properties of salt solutions could be explained in any other way than as due to variations in the degree of dissociation.

Activities of Strong Electrolytes.—The actual behaviour of solutions of strong electrolytes, like that of solutions of miscible liquids, can be expressed in terms of *activities*. In this case, however, it is convenient to take as standard the behaviour of very dilute solutions, in which Raoult's law holds, and in which the activity of each ion can be put equal to its concentration. Owing to deviations from Raoult's law and to other effects, including the possible combination of ions to form molecules, the behaviour of more concentrated solutions may not be identical with that of an ideal completely dissociated solution of the same concentration. The quantities which express the actual behaviour of ions in such solutions, in place of their concentrations, are their activities.

The activity of a strong electrolyte is taken as the (geometrical) mean of the activities of its ions and in very dilute solutions is also equal to the concentration. Activities can be determined by a variety of methods, from measurements of the freezing points, boiling points and related properties of solutions, and in the case of slightly soluble salts, from their solubilities. These measurements all depend on the equilibrium of the solution with either the solvent in the solid or vapour state or, in the case of solubilities, with the solid solute. They all depend on the tendency of either solvent or solute to leave the solution. Thus the vapour pressure measures the tendency of the solvent to leave the solution and enter the coexistent vapour; a change in the freezing point measures the corresponding change in the tendency of the solvent to separate out as the solid, and a change in solubility measures the change in the tendency of the solute to deposit from the solution. These are all measures of what G. N. Lewis has called the "escaping tendency" of either solvent or solute from the solution. The escaping tendencies of solute and solvent are inter-related and a change in the one can be calculated, by thermodynamical methods, from the corresponding change in the other. In ideal solutions the escaping tendencies of the components are related in a simple way to their molar fractions (or molecular concentrations, suitably expressed). The activities are the quantities which measure the escaping tendencies in actual solutions.

If we divide the activity of an electrolyte by its concentration (usually the molal concentration is used) we get the *activity coefficient*. The activity coefficients of many strong electrolytes in aqueous solution have been determined by G. N. Lewis, G. A. Linhart, A. A. Noyes, H. S. Harned and others. American physical chemists have been particularly active in this field. Table VIII. gives some representative values.

The effect of concentration on the activity coefficients of a few typical electrolytes is shown in fig. 7. As the concentration increases the activity coefficients at first decrease. Usually they reach a minimum and then rise, becoming greater than unity in concentrated solutions. This behaviour is decisive against Arrhenius' theory. An activity coefficient less than unity might possibly be interpreted as a degree of dissociation, but some other explanation must be found for activity coefficients which are greater than unity. The magnitude of the effect is shown by the fact that the activity coefficient of hydrochloric acid in a solution in which its molal concentration is 16, is 43·2. This cannot possibly be interpreted as a "degree of dissociation."

Table VIII.

Activity coefficients of strong electrolytes at 25° C in aqueous solutions

Molal concentration	Hydrochloric acid	Lithium chloride	Sodium chloride	Potassium chloride	Potassium hydroxide	Sulphuric acid
0·01	0·924	0·922	0·922	0·922	0·920	0·617
0·05	0·860	0·843	0·842	0·840	0·822	0·397
0·1	0·814	0·804	0·798	0·794	0·792	0·313
0·5	0·762	0·754	0·689	0·682	0·740	0·178
1·0	0·823	0·776	0·650	0·634	0·775	0·150
3·0	1·35	1·200	0·704	0·575	1·136	0·166
5·0	2·51	..	0·892	..	..	0·242

The Ionic Strength.—In dilute solutions the change of the activity coefficient with concentration is very uniform. In solutions of salts of the same type the activity coefficients are practically identical up to a molal concentration of 0·1. In mixed solutions containing two or more salts of the same type, it is found that the activity coefficient depends only on the total ion concentration when the latter is small. In studying mixtures containing ions of different types (*i.e.*, having different electric charges), G. N. Lewis and M. Randall found that the effect of a bivalent ion on the activity coefficients of the salts in the solution was four times that of a univalent ion, or that the effect is proportional to the square of the ionic charge. They therefore introduced a quantity which they termed the *ionic strength* of the solution; this is obtained by multiplying each ion concentration by the square of its valency (or electric charge in electronic units) and dividing the sum by two. They were then able to state the rule that *in dilute solutions the activity coefficient of a particular strong electrolyte is the same in all solutions of the same ionic strength.*

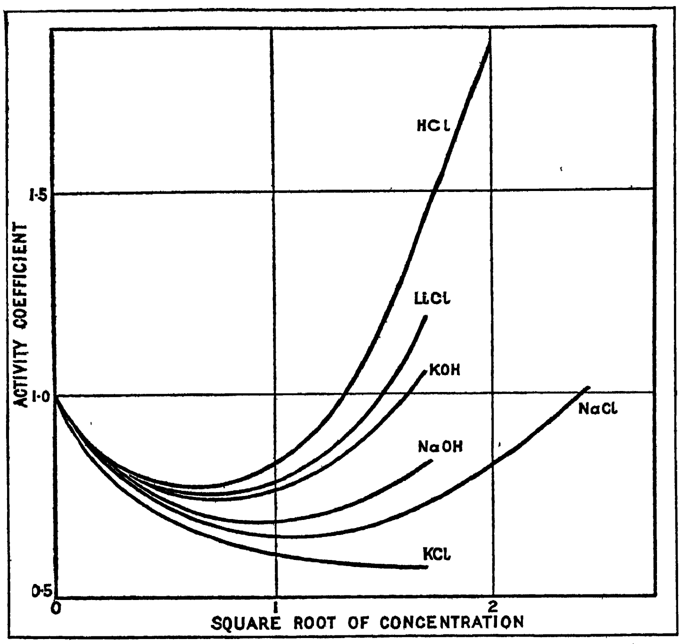


Fig. 7.—Activity co-efficients of some strong electrolytes

At concentrations greater than about 0·1 molal each electrolyte begins to exhibit an individual behaviour, both in solutions of it alone and in mixed solutions.

Interionic Attraction Theory.—That the electric forces between ions must have an important influence on the properties of salt solutions was pointed out by van Laar (1900), Sutherland (1902) and Bjerrum (1909). The first successful calculation of these forces was made in 1913 by S. R. Milner. Unfortunately his calculations were mathematically very complex, since he evaluated the electric forces between a given ion and every other ion present in the solution and summed the effect for all the ions.

His results could only with difficulty be applied to actual cases. J. Chandra Ghosh in 1918 attempted a partial solution of the problem, and in 1923 P. Debye and E. Hückel found a comparatively simple method of calculating the effect. Since ions with electric charges of opposite sign attract each other and the attraction is greater the closer the ions approach, it is more difficult to remove a given ion from a strong solution than from a more dilute one. Thus the electric forces cause a decrease in the "escaping tendencies" of the ions, and the more concentrated the solution the greater is the effect.

Debye and Hückel based their calculations on the fact that a particular ion tends to attract into its vicinity ions of unlike sign and to repel those of like sign, so that on the average it is surrounded by more ions of unlike sign than of like sign. Making use of the Boltzmann equation, which gives the distribution of molecules in a region under the action of electric and other forces, and the Poisson equation (*see* ELECTROSTATICS), which defines how the forces vary in a known distribution of electric charges, they were able to calculate the work done in removing an ion, on account of the electric forces exerted on it by the surrounding ions. This is the quantity which determines the deviation from Raoult's law. In dilute solutions, in which the diameter of the ions is small in comparison with their distance apart, they found that the calculation gave the result that the activity coefficient of a strong electrolyte is given by the formula

$$\log f = z_1 z_2 B \sqrt{\mu}$$

where f is the activity coefficient and μ the ionic strength of the solution; z_1 and z_2 are the charges (in electronic units) on the two ions of the substance and B is a constant which is approximately $\frac{1}{2}$ for aqueous solutions at 0° C. Not only does this formula agree with the ionic strength rule, already stated, that the activity coefficient of a strong electrolyte is determined by the ionic strength of the solution, but it is in numerical agreement with the values in dilute solutions.

Debye and Hückel attempted to account for the individual behaviours of salts in more concentrated solutions by taking account of (1) the diameters of the ions, (2) the effect of the dissolved electrolytes on the dielectric constant of the solution. Although they were able to account qualitatively for the general form of the activity coefficient curve, they were not completely successful in calculating the activity coefficients from the known properties of the substances.

An important factor to be taken into account is the effect of the electric forces round the ions on the molecules of the solvent. Water, like all substances which dissolve strong electrolytes, has strongly "polar" molecules, *i.e.*, its molecules are attracted towards regions in which electric forces are greatest. Thus water molecules tend to congregate round ions, forming "water sheaths," which in strong solutions keep them apart, thus acting in the opposite sense to their attractive forces. It is probable that the rise in the activity coefficient in strong solutions is due to this effect.

Hydration of Ions.—It had previously been found in many phenomena that, in aqueous solutions, ions behaved as if they were associated with a certain amount of water, but in spite of many attempts no reliable estimate was made of the degree of hydration or amount of water associated with each ion. In 1919 K. Fajans showed that, knowing the lattice energies (*see* CRYSTALLOGRAPHY) of solid salts, it was possible to determine the *energies of hydration* of the ions. This quantity is the amount of energy liberated when a free ion in the gaseous state is introduced into water. Table IX. gives the energies of hydration of ions (in kilogram calories per gram-atom) obtained by W. M. Latimer (1926).

TABLE IX. *Hydration Energies of Ions*

H^+	242	Rb^+	72	Ba^{++}	289
Cu^+	128	Zn^{++}	494	Al^{+++}	1,068
Li^+	119	Mg^{++}	454	Cl^-	(161)
Ag^+	107	Cd^{++}	440	Br^-	(140)
Na^+	96	Ca^{++}	379	I^-	(122)
K^+	77	Sr^{++}	338		

As Max Born first pointed out in 1920, the energies of hydration of ions agree closely with the changes of electrical energy to be expected according to electrical theory, when a charged sphere the size of which is equal to that of the ion is moved from a vacuum into a medium having the dielectric constant of water. (The figures for Cl^-, Br^-, I^-, given in parentheses are calculated in this way.) It thus appears that the energy effects on the solutions of ions are electrical in origin, and this gives powerful support to the idea that the "water of hydration" of ions is held by purely electrical forces and is not chemically combined with the ion. (For colloidal solutions, *see* COLLOIDS.)

BIBLIOGRAPHY.—Comprehensive accounts of solutions are to be found in most treatises on physical chemistry. Specialized works are: A. Findlay, *Osmotic Pressure* (1919); C. A. Kraus, *The Properties of Electrically Conducting Systems* (1922), deals exhaustively with electrolytic solutions; J. H. Hildebrand, *Solubility* (American Chemical Society monographs), treats the subject mainly from the point of view of the author's own theory; D. A. Clibbens, *The Principles of the Phase Theory* (1923), deals with the solubility relations of mixtures of salts. (J. A. V. B.)

SOLUTRIAN PERIOD, in archaeology, the name given by G. de Mortillet to the second stage of his system of cave-chronology, synchronous with the third division of the Quaternary period, from the Solutré cave, Mâcon district, Saône-et-Loire. The period is chiefly characterised by "laurel-leaf" blades (knives or daggers) of flint, beautifully flaked on both sides, and readily distinguishable from the flints of the preceding Mousterian epoch. Large thin spear-heads, scrapers with the edge not on the side but on the end, flint knives and saws, all still chipped, not ground or polished, arrow-heads with tang and shoulder on one side only, are also characteristic of this transitional period. Among the fauna are the horse, reindeer, mammoth, cave lion, rhinoceros, bear and urus. Solutrian "finds" have also been made in the caves of Les Eyzies and Laugerie Haute, and in the lower beds of Creswell cave, Derbyshire. The Solutrian technique or fashion of flint-working represents the acme of palaeolithic craft.

See J. Déchelette, *Manuel d'Archaeologie,* vol. i. (1908), A. Keith, *Antiquity of Man,* vol. i., 2nd ed. (1925).

SOLVAY, a village of Onondaga county, New York, U.S.A., on Lake Onondaga, adjoining Syracuse on the west; served by the New York Central railroad and for freight also by the Lackawanna. Pop. (1920) 7,352, and it was 7,986 in 1930. It is a manufacturing and residential suburb, with large soda-ash works (employing 3,000 persons), a steel plant and various other industries. The village was incorporated in 1894.

SOLWAY FIRTH, estuarine inlet of the Irish Sea, 50 m. long, between England and Scotland. The breadth at the mouth is 32 m.; near the head, where the Solway viaduct of the L.M.S. railway crosses the firth, it is nearly 1½ miles. The general direction is north-easterly from the mouth. The Scottish counties bordering the firth are Wigtownshire, Kirkcudbright and Dumfriesshire; the English coast belongs to Cumberland. On the English side the low Solway plain borders the firth, except for a short distance above St. Bee's Head. The Scottish shore, however, is not continuously flat, and such elevations as Criffell (1,866 ft.), Bengairn and Cairnharrow, above Wigtown bay, rise close to it. The Cree and other streams enter Wigtown bay; the Dee, Kirkcudbright bay; and the Nith discharges through a long estuary. The Annan has its mouth near the town of that name; and the Esk and Eden have theirs at the head of the firth, in Cumberland. On this shore Morecambe bay receives the Wampool and Waver, the Ellen has its mouth at Maryport, and the Derwent from the Lake District at Workington. The waters of the firth are shallow, and a tidal bore occurs periodically.

SOMA, in Vedic India personified the *Asclepias acida,* whose sap, fermented, is an intoxicant. As a Bacchus-like god Soma is lauded in 114 hymns of the *Rig-veda* IX. and as a co-equal of Indra, Agni and Rudra in other Books. Its uses, like its name (*Haoma* in the *Avesta*), go back to Iranian times, and it was prized both in India and Irān as a medicine conducing to longevity. The celestial variety, distinct from that of earth, was drunk by the gods, and incited Indra to establish the universe. In the post-Vedic Epics Soma is the Moon, who wanes when drunk by gods but is replenished by the Sun. For the theft of the first *soma* by Indra's eagle *see* ZEUS and ODIN.

SOMA, in biology, the tissues that form the body of the organism in contrast to the reproductive tissues. (*See* ZOOLOGY; EMBRYOLOGY; HEREDITY.)

SOMALILAND, a country of East Africa, so named from its Somali inhabitants. It is sometimes called the "Eastern Horn of Africa," because it projects sharply into the Indian ocean. In general outline it is an irregular triangle, with apex at Cape Guardafui. From the apex the north side extends over 600 m. along the south shore of the Gulf of Aden westwards to Tajura bay, and the east side skirts the Indian ocean south-west for some 1,200 m., the Tana river being about the limit of Somali settlement. Inland the limits of Somaliland correspond roughly with the Shoan and Harrar hills, the Galla district south of Shoa and east of Lake Rudolph and 40° E. as the western limit. The triangular space thus roughly outlined has an area of about 396,000 square miles. It includes the 36,000 sq.m. of Jubaland added to Italian Somaliland by transferences from Kenya Colony. It is partitioned as under, the figures for area and population being in some cases estimates:—

	Area in square miles	Population
British Somaliland	68,000	344,000
French Somaliland	8,000	56,000
Italian Somaliland	190,000	700,000
Abyssinian Somaliland*	100,000	350,000
Total	366,000	1,450,000

*This is a rough estimate. *See* also ABYSSINIA.

Somaliland was not generally adopted as the name of the country until the early years of the 19th century. The northern and central districts were previously known as Adel, the north-east coast as Ajan. By the ancients the country was called *regio aromatica,* from the abundance of its aromatic plants.

Physical Features.—The region as a whole is a vast plateau of an average elevation of 3,000 ft., bounded westwards by the Ethiopian and Galla highlands and northwards by an inner and outer coast range, skirting the south side of the Gulf of Aden in its entire length from the Harrar uplands to Cape Guardafui.

The incline is uniformly to the south-east, and apart from the few coast streams that reach the Gulf of Aden during the rains, all the running waters are collected in three rivers—the Nogal in the north, the Webi Shebeli in the centre, and the Juba (*q.v.*) in the south—which have a parallel south-easterly direction towards the Indian ocean, though the Juba alone reaches the sea. The Nogal sends down a turbulent stream during the freshets, while the Shebeli, notwithstanding the far greater extent of its basin, does not reach the sea. At a distance of about 12 m. from the coast it is intercepted by a line of dunes, which it fails to pierce, and is deflected southwards, flowing in this direction for nearly 170 m. parallel with the coast, and then disappearing in a swampy depression (the Bali marshes) before reaching the Juba estuary.

The Somaliland plateau is chiefly composed of gneiss and schist. In the north the plateau is overlain by red and purple unfossiliferous sandstones, capped near its edge by a cherty limestone also unfossiliferous but possibly of Lower Cretaceous age. The plains inland from Berbera, and the maritime margins between the coast and foot of the plateau, consist of Lower Oolitic limestones.

Temperature varies from 60° or less in the early morning to 100° or over in the early afternoon. On an average the coast-belt temperatures are some 10° higher than those of the plateau. Four seasons are recognized—January–April, very dry and great heat; May–June, cooler and the "heavy" rains; July–September, the season of extreme heat and the south-west monsoon; October–December, the "light" rains.

Flora and Fauna.—The flora of Somaliland is isolated because it lies east of the great belt of high ground of East Africa. In the mountainous north the flora resembles, however, to some extent, that of the Galla country and Abyssinia. The greater part of the country is covered either with tall coarse grasses (these open plains being called *ban*), or more commonly with thick thorn-bush or jungle, among which rise occasional isolated trees. The prevalent bush plants are *khansa* (umbrella mimosa), acacias, aloes, and, especially, *Boswellia* and *Commiphora,* which yield highly fragrant resins and balsams, such as myrrh, frankincense (*olibanum*) and "balm of Gilead." The billeil is a thorn-bush growing about 10 ft. high and covered with small curved hooks of great strength. The bush contains also numerous creepers, one of the most common is called the *armo.* Of the thorns, the *guda* and the *wadi* often grow from 30 to 50 ft. high and have large flat-topped branches. In places there are forests of these trees. On the summit of the Golis range the cedars form forests. Among the larger trees are the mountain cedar, reaching to 100 ft.; the *gob,* which bears edible berries in appearance something like the cherry with the taste of an apple, grows to some 80 ft., and is found fringing the river beds; the *hassādan,* a kind of euphorbia, attaining a height of about 70 ft.; and the *darei,* a fig tree.

Somaliland is rich in the larger wild animals. Among them are the lion (Somali name *libah*) and elephant; the black or double-horned rhinoceros, common in central Ogaden; leopards, abundant in many districts, and daring—they have given their name to the Webi Shebeli ("River of the Leopards"); panthers; spotted and striped hyenas (the latter rare); foxes, jackals, badgers and wild dogs; giraffes and a great variety of antelopes. The antelopes include the beisa oryx, fairly common and widely distributed, the greater and lesser kudu (the greater kudu is not found on the Ogaden plateau); the Somali hartebeest (*Bubalis Swaynei*), found only in the Haud and Ogo districts; waterbuck, rare except along the Webi Shebeli and the Nogal; the dol or Somali bushbuck; the dibatag or Clarke's gazelle; the giraffe-like gerenuk or Waller's gazelle, very common; the aoul or Soemmering's gazelle, widely distributed; the dero (*Gazella Speki*); and the small dikdik or sakaro antelope, found in almost every thicket. The zebra (*Equus grevyi*) is found in Ogaden and places to the south, the wild ass in the northern regions. There are wart hogs, baboons (maned and maneless varieties), a tree monkey, jumping shrews, two kinds of squirrel, a small hare, rock rabbits and a weasel-like animal which hunts in packs. Ostriches are found in the open plains; the rivers swarm with crocodiles, but hippopotami are rare. Birds of prey are numerous and include eagles, vultures, kites, ravens and the carrion stork. Among game birds are three varieties of bustard, guinea fowl, partridges, sand grouse and wild geese. Snakes are common, an adder, a variegated rock snake and a black snake called *muss* being those most dreaded.

Inhabitants.—The Somali belong to the Eastern (Ethiopic) Hamitic family of tribes, of which the other chief members are the neighbouring Galla and Afar, the Abyssinian Agau and the Beja tribes between the Nubian Nile and the Red sea. They have been identified with the people of Punt, known to the Egyptians of the early dynasties. The Somali, however, declare themselves to be of Arab origin, alleging their progenitor to have been a certain Sherīf Ishak b. Ahmad, who crossed from Hadramut with 40 followers about the 13th century. Other traditions trace their origin to the Himyaritic chiefs Sanhāj and Samamah, said to have been coeval with a King Afrikus, who is supposed to have conquered Africa about A.D. 400. These legends should perhaps be interpreted as pointing to a series of Arab immigrations, the last two of which are referred to the 13th and 15th centuries.

The present Somali peoples are possessed of no general type. They are not pure Hamites, and their physical characteristics vary considerably, showing signs of interbreeding with Galla, Afar, Arabs, Abyssinians and negroes. They are a race of magnificent physique, tall, active and robust, with fairly regular features, but showing negro blood in their complexion and hair.

There are four classes in Somaliland: (1) nomads who breed camels, ponies, sheep and cattle, live on milk and meat, and follow the rains in search of grass; (2) settled Somali, comparatively few, living in or near the coasts; (3) outcast races, not organized in tribes but living scattered all over Somaliland; they are hunters, workers in iron and leather, and the chief collectors of gum and resin; (4) traders. The national dress is the "tobe," a simple cotton sheet of two breadths sewn together, about 15 ft. long. Generally, it is thrown over one or both shoulders, a turn given round the waist, and allowed to fall to the ankles. The "tobes"

are of all colours from brown to white. A ceremonial "tobe" of red, white and blue, each colour in two shades, with a narrow fringe of light yellow, is sometimes worn.

The Somali are a fighting race and all go armed with spear, shield and short sword and, since they have been procurable, guns. During the rains intertribal lootings of cattle are common, save where the authority of the paramount power is sufficient to preserve peace. Among certain tribes those who have killed a man have the right to wear an ostrich-feather in their hair. They are great talkers, keenly sensitive to ridicule, and quick-tempered. The Somali love display; they are inordinately vain and avaricious; they are very intelligent and quick witted and make loyal and trustworthy soldiers. The great interest in life with the nomads, the most numerous class, is their camels.

The Somali are divided into a multiplicity of *rers* or *fakidas* (tribes, clans). Three main divisions have been clearly determined.

1. The *Hashiya* (Abud's *Asha*), with two great subdivisions: *Daroda,* with the powerful Mijertins, War-Sangeli, Dolbohanti and others; and *Ishak,* including the Gadibursi, Issa (Isa), Habr-Wal, Habr-Tol, Habr-Yuni, Babibili, Bertiri. All these claim descent from a member of the Hashim branch of the Koreish (Mohammed's tribe), who founded a powerful State in the Zaila district. All are Sunnites, and, although still speaking their Somali national tongue, betray a large infusion of Arab blood in their oval face, somewhat light skin, and remarkably regular features. Their domain comprises the whole of British Somaliland, and probably most of Italian Somaliland.

2. The *Hawīya,* with numerous sub-groups, such as the Habr-Jalet, Habr-Gader, Rer-Dollol, Daji, Karanlē, Badbadan, Kunli, Bajimal and Ugass-Elmi; mostly fanatical Mohammedans forming the powerful Tarika sect, whose influence is felt throughout all the central and eastern parts of Somaliland. The Hawīya domain comprises the Ogaden plateau and the region generally between the Nogal and Webi-Shebeli rivers. Here contact has been chiefly with the eastern Galla tribes.

3. The *Rahanwīn,* with numerous but little-known sub-groups, including, however, the powerful and warlike Abgals, Barawas, Gobrons, Tuni, Jidus and Kalallas, occupy in part the region between the Webi-Shebeli and Juba, but chiefly the territory extending from the Juba to the Tana, where they have long been in contact, mostly hostile, with the Wa-Pokomo and other Bantu peoples of British East Africa. Of all the Somali the Rahanwīn betray the largest infusion of negroid blood.

Of the outcast races the best known are the Midgan, Yebir, and Tomal. The Midgan, who are of slightly shorter stature than the average Somali, are the most numerous of these peoples. They are great hunters and use small poisoned arrows to bring down their game. The Yebir are noted for their leather work, and the Tomal are the blacksmiths of the Somali.

Prehistoric Remains.—The discovery of flint implements of the same types as those found in Egypt, Mauritania, and Europe shows Somaliland to have been inhabited by man in the Stone age. That the country was subsequently occupied by a more highly civilized people than the Somali of to-day is evidenced by the ruins which are found in various districts. Many of these ruins are attributable to the Arabs, but older remains are traditionally ascribed to a people who were "before the Galla." Blocks of dressed stone overgrown by grass lie in regular formation; a series of parallel revetment walls on hills commanding passes exist, as do relics of ancient water-tanks. Of more recent origin are the ruins known as Galla graves (*Taalla Gālla*). These are cairns of piled stones, each stone about the size of a man's head.

Exploration.—The ancients were acquainted with the northern coast, and the Arabs had settlements on the Eastern coast. In modern times the exploration of the country dates from the occupation of Aden by the British in 1839, Aden being the chief port with which the Somali of the opposite coast traded. The first explorers of the interior were officers of the Indian army quartered at Aden—Lieut. Cruttenden (1848), Lieut. (afterwards Captain Sir Richard) Burton, and Lieut. J. H. Speke (the discoverer of the Nile source). In 1854 Burton, unaccompanied, penetrated inland as far as Harrar. Later on an expedition was attacked by Somali near Berbera, both Burton and Speke being wounded, and another officer, Lieut. Stroyan, R.N., killed. For 20 years afterwards no attempt was made to explore the interior. The occupation of Berbera by the Egyptians in 1875 led, however, to new endeavours. Of those who essayed to cross the waterless Haud more than one lost his life. In 1883 a party of Englishmen—F. L. and W. D. James (brothers), G. P. V. Aylmer, and E. Lort-Phillips—penetrated from Berbera as far as the Webi-Shebeli, and returned in safety. Surveys of the country between the coast and the Webi-Shebeli and also east towards the Wadi Nogal were executed by Maj. H. G. C. Swayne and his brother Capt. E. J. E. Swayne between 1886 and 1892.

The first person who reached the Indian ocean, going south from the Gulf of Aden, was an American, Dr. A. Donaldson Smith (b. 1864). He explored (1894–95) the headstreams of the Shebeli, reached Lake Rudolf, and eventually descended the Tana river to the sea. Meanwhile the greater part of the eastern seaboard had fallen under Italian influence. In 1891 Brichetti-Robecchi went from Mukdishu to Obbia, and thence crossed through Ogaden to Berbera on the Gulf of Aden. In 1892 Capt. Vittorio Bottego and a companion left Berbera and made their way past Imi to the upper Juba, which Bottego explored to its source, both travellers finally making their way via Lugh to the east coast. In 1895 Bottego, with three European companions, left Brava to investigate the river system north of Lake Rudolf, and succeeded in tracing the Omo to that lake. Subsequently in the Abyssinian highlands the expedition was attacked by Galla and Capt. Bottego was killed. Dr. Sacchi, who was returning to Lugh with some of the scientific results of the mission, was also killed by natives. An English expedition under H. S. H. Cavendish (1896–97) followed somewhat in Donaldson Smith's steps, and the last named traveller again crossed Somaliland in his journey from Berbera via Lake Rudolf to the Upper Nile (1899–1900). In 1902–03 a survey of the Galla-Somali borderlands between Lake Rudolf and the upper Juba was executed by Capt. P. Maud of the British army. Military operations against the "Mad" Mullah in the period 1900–20 led to a more accurate knowledge of the south-eastern parts of the British protectorate and of the adjacent districts of Italian Somaliland. Of later travellers the duke of the Abruzzi, in 1919–20 explored the mid region of the Webi-Shebeli. The demarcation of the new frontier between Kenya and Italian Somaliland, in 1926, rectified several errors on the map.

BRITISH SOMALILAND

The British Somaliland protectorate extends along the Gulf of Aden for about 400 m. from the Lahadu Wells, near Jibuti, in the west, to Bandar Ziyada in 49° E., 180 m. W. of Cape Guardafui, and stretches from the coast inland for a breadth varying from 80 to 220 miles. The protectorate is bounded west by French Somaliland, south-west by Abyssinian territory, and south-east and east by Italian Somaliland.

Topography.—Between the Harrar plateau and Cape Guardafui the coast ranges maintain a mean altitude of from 4,000 to 5,000 ft., and fall generally in steep escarpments down to the sandy lowlands skirting the Gulf of Aden. At some points the cliffs, furrowed by deep ravines, approach close to the sea; elsewhere the hills leave a considerable maritime plain between their base and shore line. South of Berbera are two ranges, nearly parallel with the coast. The inner and loftier range is that of Golis, about 9,500 ft. high, its crest covered with mountain cedar. The country between the two ranges is known as Guban. South of the Golis the ground falls gradually to the central plateau known as the Haud, a waterless but not unfertile district. The Haud (only the northern part of which is British territory—the rest is Abyssinian) consists partly of thorn jungle, the *haud* of the Somali, partly of rolling grass plains, called *ban,* and partly of semi-desert country called *aror.*

The average annual rainfall at Berbera is about 8 in., and more than half of this amount has fallen in one day. The mean annual rainfall is greater on the slopes of the ranges, by which the moisture-bearing clouds are intercepted. These slopes are the home of

aromatic flora which yields myrrh and frankincense. The chief domestic animals are the camel and the ass, both of prime stock. The camels make excellent mounts, swift and hardy. The Somali have also large numbers of oxen, sheep and goats. They possess a hardy breed of ponies, for which the Dolbahanta country is famed.

Towns and Trade.—Berbera (*q.v.*), the capital and chief seaport, is in regular communication by mail boat with Aden. About 45 m. W. of Berbera is the exposed port of Būlhar. Close to the French frontier stands the seaport of Zaila (*q.v.*). East of Berbera are Las Korai, Karam, Hais and other small seaports. Inland the most important settlement is Hargeisa (*i.e.*, little Harrar), 60 m. S.S.W. of Būlhar, a centre for caravans from Shoa and Ogaden. Sheikh, Burao and Bohotle are all on the caravan route from Ogaden to Berbera. Transport is either by camel or motor car; no other means of conveyance are used. There is a motor road from Berbera to Hargeisa (130 m.) and another motor road via Sheikh and Burao to Enigavo in the east (300 miles).

Gums and resins are collected for export, fibre is obtained from the aloe plant, ostriches are reared for their feathers, and millet is cultivated, but the chief wealth of the people consists in their livestock. A large number of sheep and goats and smaller numbers of cattle are exported, and on occasion thousands of camels (as during the World War, for the Egyptian Expeditionary Force). The most valuable export is that of skins, the Somali goat and sheep skins being of very high quality; they go chiefly to the United States. The imports are mainly sheeting and longcloth, dates, rice and sugar. Formerly American sheeting had a practical monopoly; since 1923 it has had to meet Japanese competition. A carrying trade of fair size used to be done with Abyssinia via Zaila; it has been largely superseded by the railway from Jibuti, French Somaliland, to Addis Ababa. In 1899–1900, when the French railway had just been begun, the value of trade in British Somaliland was £751,000; by 1902–03 it was £487,000. Twenty years later the value of transit trade with Abyssinia via Zaila, which cannot compete with the railway beyond Harrar, was only £33,000, but the total trade had reached £561,000. In 1927 imports were valued at £427,000 and exports at £357,000. The mineral resources of the country are undeveloped; it is known to contain oil fields, coal and mica in the coastal region.

Revenue is derived mostly from customs, and is much below the cost of administration. In 1910–11 revenue was £30,000 and expenditure £99,000. In 1926–27 the figures were: revenue £90,–000 (customs £67,000), expenditure £149,000. Normal deficits are made good from the British Treasury, which also met the cost of military operations. Since 1921–23 part of the deficit had been met not by free grant but by loan, and hopes of balancing the budget were entertained. Both executive and legislative power is in the hands of the governor. District commissioners supervise local affairs.

HISTORY

An Arab sultanate, with its capital at Zaila (Zeyla), was founded by Koreishite immigrants from the Yemen in, it is said, the 7th century A.D. In the 13th century it had become a comparatively powerful state, known as the empire of Adel. In the 16th century the capital of the state (in which Arab influence was a decreasing factor) was transferred to Harran (*q.v.*). The state was harassed by Galla invaders in the 17th century, and broke up into petty independent emirates and sultanates under Somali chiefs. Zaila became a dependency of Yemen and thus nominally part of the Turkish empire. The British connection with the Somali coast dates from the early years of the 19th century and arose from the desire of the East India Company to obtain a suitable place "for the harbour of their ships without any prohibition whatever." Treaties with that object in view were concluded with the Sultan of Tajura and the governor of Zaila in 1840 and from that time the Indian Government exercised considerable influence on the Somali coast, though British authority was not definitely established. In 1874–75 the ambition of Ismail Pasha, khedive of Egypt, led him to occupy the ports of Tajura, Berbera and Bulhar as well as Harrar in the hinterland. In 1884, in consequence of the revolt of the mahdi in the Egyptian Sudan, the khedival garrisons were withdrawn. Thereupon Great Britain, partly because they were on the route to the East *via* the Suez canal, occupied Zaila, Berbera and Bulhar. During 1884, 1885, 1886 treaties guaranteeing British protection were concluded with various Somali tribes and in 1888 the limits of the British and French spheres were defined, all claims to British jurisdiction under the 1840 treaties in the Gulf of Tajura and the islands of Musha and Bab being abandoned. The other inland boundaries of the protectorate were defined by agreements with Italy (1894) and Abyssinia (1897). At first regarded as a dependency of Aden the protectorate was transferred to the Foreign Office in 1898. In 1905 it passed under the control of the Colonial Office.

The "Mad" Mullah.—In 1899 troubles arose with a mullah of the Habr Suleiman Ogaden tribe, Mohammed bin Abdullah, who had acquired great influence in the Dolbahanta country and had married into the Dolbahanta Ali Gheri. He had made several pilgrimages to Mecca, where he had attached himself to a sect which enjoined strict observance of the tenets of Islam and placed an interdiction on the use of the leaves of the kat plant—much sought after by the coast Arabs and Somali for their stimulating and intoxicating properties. At first the mullah's influence was exerted for good, and he kept the tribes over whom he had control at peace. Accredited with the possession of supernatural powers he gathered around him a strong following. In 1899 he began raiding tribes friendly to the British, and declared himself the mahdi. From that time, with certain intervals of inactivity, the "mad" mullah, as he was popularly called, caused infinite trouble for many years. The tribes hostile to the mullah sought British aid and operations were undertaken by Col. (Sir) E. J. E. Swayne. After severe fighting in 1900–01 the enemy was driven to take refuge into the Mudug territory (Italian Somaliland). On Oct. 6 of that year the British forces—Somali levies and Yaos from Nyasaland—were ambushed in dense bush at Erigo and lost 101 killed and 85 wounded. While the mullah was repulsed, and retreated to Galadi, Col. Swayne was unable to continue the pursuit. In 1903 another campaign was undertaken with the co-operation of the Abyssinians and the Italians, the base chosen being the roadstead of Obbia in Italian territory. Brigadier-General W. H. Manning was in command and besides Indian and African troops a small number of British and Boer mounted infantry were employed. Again there was desperate fighting and though Galadi was occupied the mullah broke away and crossing the British lines of communication established himself in the Nogal district. During the operations 200 Yaos and Sikhs under Lieut.-Col. Plunket were attacked (April 17) and overwhelmed. All ten British officers were slain; of the whole force only 40 Yaos, of whom 36 were wounded, escaped. Reinforcements bringing the fighting force up to 7,000 men were sent, and Major-General Sir C. C. Egerton assumed supreme command. In a pitched battle fought on Jan. 10, 1904 at Jidballi in the Nogal country the enemy were routed, losing over 1,000 men in killed alone, while the British loss in killed and wounded was 58. By May the mullah had been driven out of the British protectorate and became a refugee among the Mijertin. It was decided therefore to abandon offensive operations. In 1905 the Italians effected an arrangement apparently satisfactory to all parties.

Dervish Power Broken.—For some three years the mullah remained quiescent, but in 1908 he quarrelled with the Mijertins and in 1909 he was again raiding tribes in the British protectorate. The British Government (the Asquith cabinet) came to the conclusion that another expedition against the mullah would be useless; that they must either effectively occupy the whole of the protectorate, or else abandon the interior completely. The latter course was decided upon, and during the first months of 1910 the advanced posts were withdrawn and the British administration confined to the coast towns.

This policy of "strict coast concentration" before long broke down. Efforts to restore order were inevitable; they began inauspiciously. In Aug. 1913 a camel constabulary party under R. C. Corfield was cut up, Corfield being killed. In May 1914 Mr. (later Sir) Geoffrey Archer became commissioner (a title changed in 1919 to that of governor), and further operations were

authorised. Major T. A. Cubitt inflicted severe punishment on the dervishes in Nov. 1914–Feb. 1915, but the mullah subsequently again overran a large part of the protectorate. An end was, however, put to his activities in 1920, when by operations planned by Archer and carried out by Lt.-Col. (later Sir) Gerald Summers almost the whole dervish force was destroyed. The success of these operations was primarily and mainly due to the Royal Air Force. The mullah himself escaped, fleeing into Abyssinian Somaliland, where, at the town of Imi, he died in Jan. 1921.

The overthrow of the mullah marked the deliverance of the country from 21 years of dervish oppression. The succeeding period was chiefly notable for the efforts made, with satisfactory results by the British authorities to improve the moral and material conditions of the Somalis. (F. R. C.)

FRENCH SOMALILAND

French Somaliland (*Côte française des Somalis*) lies at the entrance to the Red sea. The sea frontier extends from Ras Dumeira on the Straits of Bab-el-Mandeb, a little north of Perim Island, to Ras Gurmarle, a few miles south of the Gulf of Tajura. The protectorate is bounded north by the Danakil country; south by British Somaliland; west by the Harrar province of Abyssinia. It extends inland at its greatest depth about 130 miles.

The country consists chiefly of slightly elevated arid plains, largely waterless save along the southern frontier. The Gulf of Tajura is 28 m. across at its entrance and penetrates inland 36 miles. At its western end an opening 870 yd. wide leads into the circular bay of Gubbet-Kharab (Hell's Mouth), behind which rise a chaotic mass of volcanic rocks, destitute of vegetation and presenting a scene of weird desolation.

The inhabitants are, on the north side of the Gulf of Tajura, chiefly Danakils (Afars, *q.v.*); on the southern shore Galla and Somali. There are a number of Arabs, Abyssinians, Indians and about 400 Europeans. The chief town, which is also the only good harbour and the seat of administration, is Jibuti (*q.v.*), pop. (1921), 8,366 (of whom 354 were Europeans).

The value of this small, largely arid and sparsely populated region lies in Jibuti, the only French port on the Suez canal route and the main artery of trade with Abyssinia. The railway to Addis Ababa, owned by a French company, begun in 1897, was, after many delays, completed in 1917. Four-fifths of the trade of Jibuti is in the conveyance of goods to or from Abyssinia. It serves also as a coaling station, the coal being previously imported. The chief local industries are shark and mother-of-pearl fisheries and the collection of salt from the Bahr-Assal.

The colony is administered by a governor, assisted by a nominated council composed of official and unofficial members. It is self-supporting, the budget (1927) balancing at about 6,000,000 francs.

History.—French interest in the Somali and Danakil coasts dates from the days of the Second Empire. In 1856 France acquired Ambabo and Obok. It was not, however, until 1883 that, in consequence of events in Egypt and the Sudan (*see* EGYPT: *History*), formal possession was taken of Obok by the French Government. Between 1883 and 1887 treaties with Somali sultans gave France possession of the whole of the Gulf of Tajura. An agreement with Great Britain (Feb. 1888) fixed the southern limits of the protectorate; protocols with Italy (Jan. 1900 and July 1901) the northern limits. The transference of the seat of government to Jibuti in May 1896 and the building of the railway to Addis Ababa (completed in 1917) gave the protectorate a stability which it had previously lacked. Salt mines were opened in 1912 and there was later some development of agriculture, but the colony depends for prosperity upon its port and the transit trade with Abyssinia. During 1917–18 Lej Yasu, the deposed emperor of Abyssinia, tried to raise the tribes against the French, but his efforts failed. Apart from occasional raids by the nomads the country, then and subsequently, remained tranquil.

ITALIAN SOMALILAND

Italian Somaliland extends on the coast from Bandar Ziyada, a point on the Gulf of Aden intersected by 49° E., eastward to Cape Guardafui, and thence southward to Dick's Head. Bounded north and east by the Indian ocean it is bounded south by Kenya Colony and west by Abyssinian and British Somaliland. From the east coast the protectorate extends inland from 100 to 300 miles.

The coast-line is largely rock-bound and little indented, and throughout its extent there is only one tolerable natural harbour, Kismayu. The coast presents a succession of hills (fringed by a narrow margin of beach) until Cape Guardafui is reached. Cape Guardafui is in 11° 75′ N., 51° 26′ 32″ E., and forms, as it were, the tip of the Horn of Africa. The cape, which faces north and east, presents on its northern face a nearly vertical wall of rock rising from the sea to a height of 900 feet. The water is deep right to the base of the cliff, and owing to the winds and the strength of the ocean currents, navigation is dangerous. The headland is known to the Somali as Girdif or Yardaf.

Rounding Guardafui the coast trends southwards, and some 90 m. from that cape is Ras Hafun or Medudda—the most easterly point of the continent of Africa—being in 10° 45′ S., 51° 27′ 52″ E., or about 1½ m. east of Guardafui. Ras Hafun is a rocky peninsula rising 600 ft. above the sea, and is connected with the mainland by an isthmus 12 m. long.

The interior of the country presents, in general, the same arid aspect as the rest of Somaliland. Italian territory has a depth from the coast of 200 to 250 m., the frontiers with Abyssinia and British Somaliland being arbitrary straight lines. The most fertile districts lie between the equator and 4° N. This region includes the lower courses of the Webi-Shebeli and the Juba. The sand dunes which separate the Shebeli from the sea have already been mentioned; the land beyond, under irrigation, is very fertile. But the most fertile region is the valley of the lower Juba, which is annually inundated. For over 100 m. on either bank of the river is a rich strip of land varying in width from a few hundred yards to over 4 m. at the estuary. Away from the river and in the region west of it, ceded to Italy by Great Britain in 1925, the normal scrub and thorn plains prevail.

Towns, Trade and Administration.—The chief towns are on the coast. They are Mukdishu, population over 20,000, the seat of government, Brava (4,000), Marka (5,000), Warsheik (3,000) and Kismayu (10,000). These are all in the southern part of the protectorate and are known generically as El-Benadir (the ports), a name also applied to the coast between the ports. Obbia, 5° 22′ N., and Illig in 7° 60′ N., are points of departure for the Ogaden and Dolbahanta countries. Alula, on the Gulf of Aden, is the chief town of the Mijertin Somali.

In the interior are Bardera, on the left bank of the Juba, Lugh, a populous city also on the left bank of the Juba and about 240 m. from the coast, and further inland is Dolo at the confluence of the Daua and Ganale to form the Juba.

While the Somali carry on their usual trade in dressed skins, cattle, frankincense, myrrh and gum arabic, the Italians, since 1922, have taken up in earnest the cultivation of cotton, the sugar cane, rice, durra and maize in the Webi Shebeli and Juba regions. Some few hundreds settled on the land, the total number of Italians in the colony in 1928 being about 1,000. Over 11,000 ac. were under cotton in 1927, the production being 13,000 centals. Irrigation works were carried out in the Webi Shebeli region in the hinterland of Mukdishu, wherefrom a railway was begun to aid the colonists. By 1928 some 40 m. of line had been built, the ultimate objective being Lugh. About 3,000 m. of roads had also been built. Though cotton and other crops were promising, the chief exports up to 1928 were the produce of the Somalis, as indicated and of goods from Abyssinia.

The southern part of the country had been a Crown colony under a civil governor since 1910; the northern part consisted of sultanates under Italian protection. Over this northern part direct Italian authority was imposed in 1925–26 and in 1927, with the Jubaland province transferred from Kenya, the whole of Italian Somaliland was divided into seven districts, each under a civil commissioner responsible to the governor. The colony has required constant and heavy subventions from Italy, colonial revenue (up to 1925) being scarcely a tenth of the cost of

administration, which was 24,000,000 lire in 1924.

History.—The Somali coast, as has been seen, early fell under Muslim influence. The towns on the eastern seaboard, of which Mukdishu and Brava were the chief, formed part of the Zenj "empire" (*see* Zanzibar) and shared its fate, being conquered in turn by the Portuguese (16th century), the imans of Muscat (17th century), and the sultans of Zanzibar (1866). By treaties with Somali sultans in 1889 and by agreements with England, Zanzibar and Abyssinia, the coast east of the British Somali protectorate fell within the Italian sphere of influence. (*See* Africa: *History.*) In Aug. 1892 the sultan of Zanzibar leased the Benadir ports of Italy for 50 years. They were administered first by the Filonardi company, and from 1898 by the Benadir company. By an agreement dated Jan. 13, 1905, the sultan of Zanzibar ceded his sovereign rights in the Benadir ports to Italy in return for the payment of a lump sum of £144,000. Thereafter the Italian Government assumed the direct administration of the ports. In 1905 also Great Britain leased to Italy a piece of land near Kisimayu.

A notable event in the history of the protectorate at the beginning of the 20th century was the co-operation of the Italian authorities in the campaigns against the Mullah Abdullah.

The station of Lugh, the most advanced point occupied by Italy, had been founded by Capt. Vittorio Bottego in 1895. In 1896 negotiations were opened for defining the Italian-Abyssinian frontier in the Somali regions. In 1897 it was agreed that from the point on the British Somaliland frontier where 47° E. intersected 8° N. the frontier line should be drawn, at a distance of about 180 m. from the Indian ocean, to the Juba. By the arrangement of 1907 with the Negus Menelik (ratified by a convention dated May 16, 1908) the Benadir coast obtained a suitable hinterland. As a result of the Treaty of London of 1915, and colonial rearrangements consequent on the World War, Britain ceded to Italy in 1925 territories on the right bank of the Juba with the port of Kisimayu (*see* Jubaland).

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SOMBART, WERNER (1863–), German economist, was born at Ermsleben in the Harz on Jan. 19, 1863; he studied in Pisa and Berlin, and in 1888 became secretary of the chamber of commerce in Bremen. He taught at the University of Breslau from 1890, at the Berlin commercial high school from 1906, and in 1917 was appointed professor at the University of Berlin. Sombart has written prolifically on economic, historical and social problems. His best known work is *Der Moderne Kapitalismus*, which first appeared in 1902 and was followed by a series of monographs, the substance of which was largely incorporated in the much enlarged and amended second edition of 1916. The work was finally completed in 1926 by two volumes bringing the history of capitalism down to the present day. Sombart combines great learning with brilliancy of style and fertility of ideas.

Sombart's published works include *Sozialismus und soziale Bewegung im 19. Jahrhundert;* the 10th revised edition of this treatise, published in 1924, bears the title: *Der proletarische Sozialismus. Wirtschaft und Mode* (1902), *Die deutsche Volkswirtschaft im 19. Jahrhundert* (1903, 5th ed. 1921), *Das Proletariat* (1906), *Das Lebenswerk von Karl Marx* (1909), *Die Juden und das Wirtschaftsleben* (1911), *Luxus und Kapitalismus* (1912), *Die Ordnung des Wirtschaftslebens* (1925). Sombart is the editor of *Grundlagen und Kritik des Sozialismus* (1919).

SOMBOR, a town of the Voivodina, Yugoslavia. Pop. (1921) 31,332, two-thirds Serbian. It is situated in a fertile plain and is the centre of the corn and cattle trade of an extensive area.

SOMERS, JOHN SOMERS (or Sommers), Baron (1651–1716), English lord chancellor, was born on March 4, 1651, near Worcester, the eldest son of John Somers, an attorney, and of Catherine Ceaverne of Shropshire. Educated at Worcester and at Trinity College, Oxford, he studied law under Sir Francis Winnington, and soon became intimate with the leaders of the country party, especially with Essex, William Russell, and Algernon Sidney, but never entered into their plans so far as to commit himself beyond recall. He was reputed to have written the *Just and Modest Vindication of the Two Last Parliaments*, in answer to Charles II.'s declaration of his reasons for dissolving them. This, however, was by Sidney, though probably Somers was responsible for the final draft. As counsel for the sheriffs Pilkington and Shute before the court of King's Bench, and junior counsel in the trial of the seven bishops, Somers won a reputation which was further enhanced by the part which he took in the secret councils which preceded the revolution. Elected to the Convention Parliament, he was appointed one of the managers for the Commons in the conferences between the houses, and was further distinguished by being made chairman of the committee which drew up the Declaration of Right.

In May 1689 Somers was made solicitor-general and knighted, and he now became William III.'s confidential adviser. In the controversy which arose between the Houses on the question of the legality of the decision of the court of King's Bench regarding Titus Oates, and of the action of the Lords in sustaining this decision, Somers was again the leading manager for the Commons, and has left a clear and interesting account of the debates. He was appointed chairman of the select committee of the House of Commons on the Corporation Bill (1690), by which those corporations which had surrendered their charters to the Crown during the last two reigns were restored to their rights. On March 23, 1693, the great seal having meanwhile been in commission, Somers was appointed lord-keeper and a privy councillor. Somers now became the most prominent member of the Junto, the small council which comprised the chief members of the Whig party. When William left in May 1695 to take command of the army in the Netherlands, Somers was made one of the seven lords-justices to whom the administration of the kingdom during his absence was entrusted; and he was instrumental in bringing about a reconciliation between William and the princess Anne.

In April 1697 Somers became lord chancellor, and was created a peer by the title of Baron Somers of Evesham. Somers had been free from attack at the hands of political opponents; but his connection in 1699 with Captain William Kidd, to the cost of whose expedition Somers had given £1,000, afforded an

opportunity for a vote of censure, in the House of Commons which was rejected by 199 to 131. The attack was renewed shortly on the ground of his having accepted grants of Crown property to the amount of £1,600 a year, but was again defeated. On the subject of the Irish forfeitures a third attack was made in 1700, a motion being brought forward to request the king to remove Somers from his counsels; but this again was rejected by a large majority. In consequence, however, of the incessant agitation Somers was finally compelled to resign. In 1701 he was impeached by the Commons for his share in the negotiations relating to the Partition Treaty in 1698, and defended himself most ably before the house, answering the charges seriatim. The impeachment was voted and sent up to the Lords, but was there dismissed. On the death of the king Somers retired into private life, but he actively opposed the Occasional Conformity Bill (1702), and in 1706 was one of the managers of the union with Scotland. In the same year he carried a bill regulating and improving the proceedings of the law courts. He was made president of the council in 1708 upon the return of the Whigs to power, and retained the office until their downfall in 1710. He was also president of the Royal Society from 1699–1704. He died on April 26, 1716. Somers wrote *The History of the Succession of the Crown of England,* as well as several poems and pamphlets.

For a contemporary character of Somers Addison's paper in the *Freeholder* for the 14th of May 1716 should be referred to; and there is in Macaulay's *History* (iv. 53) an eloquent tribute to his character and comprehensive learning. A catalogue of his publications will be found in Walpole's *Royal and Noble Authors.*

SOMERSET, EARLS AND DUKES OF. In the 11th century Somerset and Dorset were under the jurisdiction of one sheriff, and for a considerable period titles derived from each of these shires were borne by the same person. (*See* DORSET, EARLS, MARQUESSES AND DUKES OF.)

The earldom of Somerset in the Beaufort family dated from 1397, in which year it was granted by Richard II. to JOHN BEAUFORT (*c.* 1373–1410), the eldest of the three illegitimate, but afterwards legitimated, sons of John of Gaunt, duke of Lancaster, by Catherine, wife of Sir Hugh Swynford, and daughter of Sir Payne Roelt. He was followed in the earldom successively by his three sons: Henry, who died unmarried in 1418; John (1404–1444), who in 1443 was created earl of Kendal and duke of Somerset, both of which titles became extinct at his death; and Edmund, who was created earl of Dorset in 1441, marquess of Dorset in 1443, and duke of Somerset in 1448. (*See* SOMERSET, EDMUND BEAUFORT, DUKE OF.) On the execution of Edmund's son Henry, 5th earl and 2nd duke of Somerset, by the Yorkists in 1464, his titles were forfeited by act of parliament; but his brother Edmund was from that date styled duke of Somerset by the Lancastrian party till his death in May 1471, when the house of Beaufort became extinct. (*See* BEAUFORT.) The title, conjoined with the dukedom of Richmond, was, however, borne by Henry Fitzroy, illegitimate son of Henry VIII., from 1525 till his death without heirs in 1536.

EDWARD SEYMOUR, duke of Somerset (*q.v.*), known as the Protector, was the first of the line of dukes to which the holder of the title at the present day belongs, having been created Viscount Beauchamp of Hache, Co. Somerset, in 1536; earl of Hertford in 1537; and in 1547 Baron Seymour and duke of Somerset. His honours, which were entailed on the issue of his second in priority to that of his first marriage, being forfeited by attainder in 1552, Robert Carr became earl of Somerset (*q.v.*) in 1613, but died without male issue in 1645, when his title became extinct. A curious incident in the history of this title was the grant by Charles I. in 1644 of a commission to Edward Somerset, son of Henry, 1st marquess of Worcester, empowering him to fill up certain blank patents of peerage with a promise of the title of duke of Somerset for himself. After the Restoration this instrument was cancelled in consequence of a resolution of the House of Lords declaring it to be "in prejudice to the peers"; and the grantee, who had meantime succeeded to the marquessate of Worcester, surrendered his claim to the dukedom of Somerset in Sept. 1660. In the same month the dukedom of Somerset and barony of Seymour were restored to WILLIAM SEYMOUR (1588–1660), great-grandson of the Protector, who in 1621 inherited the titles of earl of Hertford and Baron Beauchamp which had been granted to his grandfather Edward Seymour in 1559, and who, in 1640, had himself been created marquis of Hertford. He died in Nov. 1660, a few weeks after his restoration to the dukedom, and was succeeded by his grandson William, 3rd duke of Somerset (*c.* 1651–1671). As the latter died unmarried, the Somerset title devolved on John Seymour (*c.* 1628–1675), the 2nd duke's fifth and youngest son, at whose death without issue in 1675 the marquessate of Hertford became extinct; his cousin Francis Seymour (1658–1678) becoming 5th duke of Somerset.

CHARLES SEYMOUR, 6th duke of Somerset (1662–1748), who succeeded his brother Francis, the 5th duke, was educated at Trinity college, Cambridge; and in 1682 he married Elizabeth, daughter of Joceline Percy, earl of Northumberland, who brought him immense estates, including Alnwick castle, Petworth, Syon House and Northumberland House in London. (*See* NORTHUMBERLAND, EARLS AND DUKES OF.) In 1683 Somerset received an appointment in the king's household, and two years later a colonelcy of dragoons; but at the revolution he bore arms for the prince of Orange. He became a great favourite with Queen Anne, receiving the post of master of the horse in 1702. He made friends with the Tories, and succeeded in retaining the queen's confidence, while his wife replaced the duchess of Marlborough as mistress of the robes in 1711. In the memorable crisis when Anne was at the point of death, Somerset acted with Argyll, Shrewsbury and other Whig nobles who, by insisting on their right to be present in the privy council, secured the Hanoverian succession to the Crown. Dismissed from his office of master of the horse in 1716, he retired into private life, and died at Petworth on Dec. 2, 1748. At the death of his son ALGERNON (1684–1750), 7th duke, without male issue, the earldom of Hertford, and the baronies of Beauchamp and of Seymour of Trowbridge became extinct; and the dukedom of Somerset, together with the barony of Seymour, devolved on a distant cousin, Sir Edward Seymour, 6th baronet of Berry Pomeroy, Devonshire. (*See* SEYMOUR OR ST. MAUR.)

The Seymours of Berry Pomeroy were the elder branch of the family, being descended from the protector Somerset by his first marriage, the issue of which had been excluded from succession to the titles and estates until after the failure of the issue of his second marriage. (*See* above.) SIR EDWARD SEYMOUR (1695–1757), who thus became 8th duke of Somerset, was grandson of Sir Edmund Seymour, Speaker of the House of Commons in the reign of Charles II. EDWARD ADOLPHUS, 12th duke (1804–1885), held various offices in Lord Melbourne's administration from 1835 to 1841; was a member of Lord John Russell's cabinet in 1851; and first lord of the admiralty from 1859 to 1866. In 1863 he was created Earl St. Maur of Berry Pomeroy. He married (1830) Jane Georgiana, youngest of the three celebrated daughters of Thomas Sheridan, who was the "Queen of Beauty" at the famous Eglinton Tournament in 1839. The duke was the author of *Christian Theology and Modern Scepticism* (1872), and *Monarchy and Democracy* (1880). At his death the family titles, except the earldom of St. Maur, which became extinct, devolved on his two brothers successively.

See SEYMOUR OR ST. MAUR, and the authorities there cited.

SOMERSET, EDMUND BEAUFORT, DUKE OF (*c.* 1404–1455), was the younger son of John, earl of Somerset, and grandson of John of Gaunt, duke of Lancaster. He was taken prisoner at Baugé in 1421 during his first campaign, and did not return to England till 1431. He was then styled earl of Mortain, and in 1432 was one of the envoys to the council of Basel. In 1436 he served at the relief of Calais, two years later he commanded with some success in Maine, and in 1440 recovered Harfleur. Next year he was made earl, and in 1443 marquess of Dorset. In 1444 on the death of his elder brother he became duke of Somerset. As head of the Beaufort party he was the rival of Richard of York, whom in 1446 he superseded as lieutenant of France. He lacked statesmanship, and as a general could do nothing to stop French successes. The loss of Rouen and Nor-

mandy during the next four years was precipitated by his incompetence, and his failure naturally made him a special object of Yorkist censure. The fall of Suffolk left Somerset the chief of the king's ministers, and the Commons in vain petitioned for his removal in January 1451. In spite of York's active hostility he maintained his position till Henry's illness brought his rival the protectorate in March 1454. For a year he was kept a prisoner in the Tower "without any lawful process." On the king's recovery he was honourably discharged, and restored to his office as captain of Calais. Mistrust of Somerset was York's excuse for taking up arms. The rivalry of the two leaders was ended by the defeat of the Lancastrians and death of Somerset at St. Albans on May 22, 1455.

For further information *see* Sir James Ramsay's *Lancaster and York* (Oxford, 1892), and C. Oman's *Political History of England, 1377–1485* (1906), with authorities there cited. (C. L. K.)

SOMERSET, EDWARD SEYMOUR, DUKE OF (*c.* 1506–1552), protector of England, born about 1506, was the eldest surviving son of Sir John Seymour (d. 1536) of Wolf Hall, Wiltshire, by his wife Margaret, eldest daughter of Sir Henry Wentworth of Nettlested, Suffolk. The Seymours claimed descent from a companion of William the Conqueror, who took his name from St. Maur-sur-Loire in Touraine; and the protector's mother was descended from Edward III. Edward was "enfant d'honneur" to Mary Tudor at her marriage with Louis XII. in 1514, served in Suffolk's campaign in France in 1523, and accompanied Wolsey on his embassy to France in 1527. Henry VIII., to whom he became (1529) squire of the body, married his sister Jane in 1536, and Edward was created Viscount Beauchamp, and, after the birth of Edward VI., earl of Hertford.

In 1541, during Henry's absence in the north, Hertford, Cranmer and Audley had the chief management of affairs in London; in September 1542 he was appointed warden of the Scottish marches, and a few months later lord high admiral, a post which he almost immediately relinquished in favour of the future duke of Northumberland (*q.v.*). In March 1544 he was made lieutenant-general of the north and instructed to punish the Scots for their repudiation of the treaty of marriage between Prince Edward and the infant Mary Queen of Scots. He landed at Leith in May, captured and pillaged Edinburgh, and returned a month later.

In May 1545 he was again appointed lieutenant-general in the north to avenge the Scottish victory at Ancrum Moor; this he did by a savage foray into Scotland in September. Political and religious rivalry separated him and Lisle from the Howards, and Surrey's hasty temper precipitated his own and his father's ruin.

Protector.—Their overthrow had barely been accomplished when Henry VIII. died. He had no statutory power to appoint a protector, but in the council of regency which he nominated Hertford and Lisle enjoyed a decisive preponderance; and the council at its first meeting after Henry's death determined to follow precedent and appoint a protector. They chose Hertford (now duke of Somerset), and he emancipated himself from the trammels originally imposed on him as protector; he was king in everything but name. In his first parliament, which met in November 1547, he procured the repeal of all the heresy laws and nearly all the treason laws passed since Edward III. Even with regard to Scotland he had protested against his instructions of 1544, and now ignoring the claim to suzerainty which Henry VIII. had revived, sought to win over the Scots by those promises of autonomy, free trade, and equal privileges with England, which many years later eventually reconciled them to union. But Scottish sentiment, backed by Roman Catholic influence and by French intrigues, money and men, proved too strong for Somerset's amiable invitations. The Scots turned a deaf ear to his persuasions; the protector led another army into Scotland in September 1547, and won the battle of Pinkie (Sept. 10).

Somerset apparently thought that the religious question could be settled by public discussion, and throughout 1547 and 1548 England went as it pleased so far as church services were concerned; all sorts of experiments were tried, and the country was involved in a grand theological debate, in which Protestant refugees from abroad hastened to join. The result convinced the protector that the government must prescribe one uniform order which all should be persuaded or constrained to obey; but the first Book of Common Prayer, which was imposed by the first Act of Uniformity in 1549, was a studious compromise between the new and the old learning, very different from the Protestantism of the second book imposed after Somerset had been removed, in 1552. The Catholic risings in the west in 1549 added to Somerset's difficulties, but were not the cause of his fall. The factious and treasonable conduct of his brother, the lord high admiral, in whose execution (March 20, 1549) the protector weakly acquiesced, also impaired his authority; but the main cause of his ruin was the divergence between him and the majority of the council over the questions of constitutional liberty and enclosures of the commons. He was divided in mind between his sympathy with the rebels and his duty to maintain law and order. France seized the opportunity to declare war on August 8; and the outlying forts in the Boulonnais fell into their hands, while the Scots captured Haddington.

His Fall.—These misfortunes gave a handle to Somerset's enemies. Warwick combined on the same temporary platform Catholics who resented the Book of Common Prayer, Protestants who thought Somerset's mildness paltering with God's truth, and the wealthy classes as a whole. In September he concerted measures with the ex-lord-chancellor Wriothesley; and in October, after a vain effort to rouse the masses in his favour, Somerset was deprived of the protectorate and sent to the Tower. But the hostile coalition broke up as soon as it had to frame a constructive policy; Warwick jockeyed the Catholics out of the council and prepared to advance along Protestant lines. He could hardly combine proscription of the Catholics with that of Somerset, and the duke was released in February 1550. For a time the rivals seemed to agree, and Warwick's son married Somerset's daughter. But growing discontent with Warwick made Somerset too dangerous. In October 1551, after Warwick had been created duke of Northumberland, Somerset was sent to the Tower on an exaggerated charge of treason, which broke down at his trial. He was, however, as a sort of compromise, condemned on a charge of felony for having sought to effect a change of government. Few expected that the sentence would be carried out, and apparently Northumberland found it necessary to forge an instruction from Edward VI. to that effect. Somerset was executed on Jan. 22, 1552, dying with exemplary patience and fortitude.

See A. F. Pollard's *England Under Protector Somerset* (1900; full bibliography, pp. 327–339), also his article in *Dict. Nat. Biog.* and vol. vi. of *Political History of England* (1910).

SOMERSET, ISABELLA CAROLINE (LADY HENRY SOMERSET) (1851–1921), English philanthropist, was born in London on Aug. 3, 1851, the eldest daughter and co-heiress of the third and last Earl Somers. She married in 1873 Lord Henry Somerset, son of the eighth duke of Beaufort, from whom she later separated. She was long president of the National British Women's Temperance Association. In 1894 she founded the *Woman's Signal* in the interests of women's work, becoming its editor. She died in London on March 12, 1921.

See Kathleen Fitzpatrick, *Lady Henry Somerset; a Memoir* (1923).

SOMERSET, ROBERT CARR (or KER), EARL OF (*c.* 1590–1645), Scottish politician, younger son of Sir Thomas Ker of Ferniehurst by his second wife, Janet, sister of Sir Walter Scott of Buccleuch. He accompanied James I. as page to England, but being then discharged from the royal service, sought for a time to make his fortune in France. Returning to England he happened to break a limb at a tilting match, at which James was present, and was recognized by the king. Entirely devoid of all high intellectual qualities, Carr was endowed with good looks, excellent spirits, and considerable personal accomplishments. These advantages were sufficient for James, who knighted the young man and at once took him into favour. In 1607 the king conferred on Carr Sir Walter Raleigh's forfeited manor of Sherborne. Carr's influence was already such that in 1610 he persuaded the king to dissolve the parliament, which had shown signs of attacking the

Scottish favourites. On March 25, 1611 he was created Viscount Rochester, and subsequently a privy councillor, while on Lord Salisbury's death in 1612 he began to act as the king's secretary. On Nov. 3, 1613 he was advanced to the earldom of Somerset, in December was appointed treasurer of Scotland, and in 1614 lord chamberlain. Somerset fell from favour in 1615, when the circumstances of the murder of Sir Thomas Overbury in 1613 were disclosed, and he and his wife, who had secured a divorce from the earl of Essex to marry him, were implicated. For this story *see* SIR THOMAS OVERBURY. Possibly Somerset was no more than an accessory after the event. He was pardoned in 1624, and from that time disappears from history. He died in July 1645.

See the article by S. R. Gardiner in *Dict. Nat. Biog.*, with authorities there cited, and the same author's *History of England; State Trials* II.; *Life and Letters of Bacon,* ed. by Spedding; *Studies in Eng. Hist.*, by Gairdner and Spedding.

SOMERSETSHIRE, a south-western county of England, bounded north and north-west by the Bristol Channel, north and north-east by Gloucestershire, north-east and east by Wiltshire, south-east by Dorsetshire, south-west and west by Devonshire. The area is 1,630·3 sq. miles. The county, orographically, consists of a basin surrounded on three sides by hills and limited on the fourth by the sea. The northern hills are the Mendips, composed of Carboniferous limestone, stretching from Nunney to the sea and appearing again in the islands of Steep Holm and Flat Holm, which link the structure of Somerset with that of South Wales. The summit of the Mendips is a long tableland between 500 and 1,000 ft. in height, but rising in the west to just over that figure. To the north they die away gently, as a number of low hills, towards the Avon, which forms the county boundary first with Wiltshire and then with Gloucester. Here the limestone is covered in places by coal measures, but most of the rocks are Triassic. Southward the Mendip hills drop steeply in an abrupt line broken by many coombes, *e.g.*, the gorge of Cheddar. The basin to the south is composed mainly of Triassic rocks, which, near the sea and along the valleys, are covered by recent alluvium. The basin is usually lower in its western than in its eastern part, which is known generally as Sedgemoor, but with different names in different parts. The large basin is subdivided into those of the Parrett and the Brue by the Polden hills, which run parallel to the Mendips from Lydford to Puriton. To the west of the Parrett rise the Quantock hills, which are outliers of the Devonian moorlands of Exmoor and the Brendon hills. These three hill groups consist almost entirely of Devonian rocks, and their highest points respectively are Will's Neck (1,261 ft.), Dunkery Beacon (1,707 ft.) and Lype hill (1,391 ft.). From Crewkerne along the southern and eastern borders of the county as far as the Avon runs a more or less continuous line of low Jurassic hills, while around Chard in the south there is a fair extent of Cretaceous rocks.

In early postglacial times the low lands were morasses and the clay lands forested, and so man, when he came to the district, settled on the open heights—the sterile old rocks of the west, the chalk of the south, the limestone of the Mendips and the oolites on the east—and the caves of Mendip and Cheddar have yielded valuable evidence of late Palaeolithic and Epipalaeolithic cultures. The evidence of finds of weapons, and of tumuli with beakers and other pottery, shows that the distribution of the population in the early ages of metal was very largely on the unforested areas. In the Chew valley, just south of Bristol, a few stone circles show connections with the Megalithic culture, and it is probable that some of the fortified camps date from the Bronze age. At a later time invaders, who knew of iron, penetrated into the county, and we have finds of their weapons, their pottery and of the remains of their animals along with traces of their crops. They had many earthworks here, *e.g.*, Worlebury, north of Weston-super-Mare, at other points on the Mendips, and in the south, at Cadbury; and were the first to settle in the lake-village at Glastonbury (*q.v.*).

History.—The Romans overran Somerset after the Claudian conquest of A.D. 43, and remains of the period of the Roman occupation are numerous, particularly east of 3° W. Bath, which was probably a settlement in earlier times, became, on account of the medicinal properties of its waters, an important Roman centre where the Fosse Way from Cirencester met another road from Silchester. From Bath another road ran north-westward, north of the Avon to the Severn and a Roman station guarded the crossing to Caerleon. The Fosse Way was continued from Bath to Exeter, and on it we have stations at Camerton and at Ilchester, where it crossed the Yeo. Besides these four settlements, remains of about 50 Roman villas have been discovered in the county.

In the 6th century Somerset was the debatable borderland between the Welsh and Saxons, the latter of whom pushed their way slowly westward. Their frontier was gradually advanced from the Axe to the Parrett, and from the Parrett to the Tamar. By 658 Somerset had been conquered by the West Saxons as far as the Parrett, and there followed a struggle between the kingdoms of Wessex and Mercia, which led to the organization of the lands east of the Parrett as part of the kingdom of Wessex. About this time the monastery of Glastonbury was restored by Ine. The next 150 years were the period of Danish invasions. In the 7th century Somerset, as part of the kingdom of Wessex was included in the diocese of Winchester. The new bishopric of Sherborne, founded in 704, contained Somerset until 910 when the see was divided into the dioceses of Salisbury, Exeter and Wells, the latter including the whole county of Somerset. The diocese was divided into three archdeaconries. King Alfred's victory in 878, followed by the Peace of Wedmore, ended the incursions of the Danes for a time, but 100 years later they were again a great danger, and made frequent raids on the west coast of Somerset. At some time before the Conquest, England was divided into shires, one of which was Somerset.

At the Conquest Somerset was divided into about 700 fiefs, held almost entirely by the Normans. The king's lands in Somerset were of great extent and importance; the bishop of Winchester owned a vast property of which Taunton was the centre.

The chief families of the county in the middle ages were those of De Mohun, Malet, Revel, De Courcy, Montacute, Beauchamp and Beaufort, which bore the titles of earls or dukes of Somerset from 1396 to 1472. Edward Seymour was made duke of Somerset in 1547, and in 1660 the title was restored to the Seymour family, by whom it is still held. The marquess of Bath is the representative of the Thynne family, which has long been settled in the county. About this time or a little later many Norman castles were built, some of which have survived.

Somerset was too distant and isolated to take much share in the early baronial rebellions or the Wars of the Roses, and was really without political history until the end of the middle ages. The attempt of Perkin Warbeck in 1497 received some support in the county, and in 1547 and 1549 there were rebellions against enclosures. Disputes between the chapters of Bath and Wells as to the election of the bishop led to a compromise in 1245, the election being by the chapters jointly, and the see being known as the bishopric of Bath and Wells. In ecclesiastical architecture the two great churches of Wells and Glastonbury supply a great study of the development of the Early English style out of the Norman. But the individual architectural interest of the county lies in its great parish churches, chiefly in the Perpendicular style, which are especially noted for their magnificent towers. The churches at Bath, Taunton, Glastonbury, Bridgwater, Cheddar, Crewkerne, Dunster, Ilminster, Kingsbury, Leigh-on-Mendip, Martock and Yeovil may be specially indicated.

Somerset took a considerable part in the Civil War, and with the exception of Taunton, was royalist, the strongholds being garrisoned and held for the king, but they all fell in 1645, and the county was subdued by the parliamentary forces. Somerset was the theatre of Monmouth's rebellion, and he was proclaimed king at Taunton in 1685. The battle of Sedgmoor on July 4 was followed in the autumn by the Bloody Assize held by Judge Jeffreys.

The county was represented in the parliament of 1290, and in 1295 it was represented by two knights, and twelve boroughs returned two burgesses each. The county continued to return two members until 1832, when it was divided into Somerset East and Somerset West, each of which divisions returned two members.

Two additional members were returned after 1867 for a third—the Mid-Somerset—division of the county, until by the act of 1885 the whole county was divided into seven divisions.

Somerset has always been an agricultural county. Grain was grown and exported from the 11th to the end of the 18th century. Cider-making has been carried on for centuries. Among other early industries, salmon and herring fisheries on the west coast were very profitable. Stone quarrying at Hamdon Hill and Bath began very early in the history of the county; and the lead mines at Wellington and the slate quarries at Wiveliscombe and Treborough have been worked for more than a century. Coal has been mined at Radstock from a very remote date, but it did not become of great importance commercially until the county was opened up by canals and railways in the 19th century. Sheep-farming was largely carried on after the period of enclosures, and the woollen trade flourished in Frome, Bath, Bridgwater, Taunton and many other towns from the 14th to the 19th centuries. Glove-making was centred at Stoke and Yeovil in the 18th century. Cheese is made in various parts, notably Cheddar Cheese, which is made on the farms lying south of the Mendips. Sheep-farming is practised both in the lowlands and on hill pastures, Leicesters and Southdowns being the favourite breeds.

Wild deer are still found on Exmoor, where there is a peculiar breed of ponies, hardy and small. The Bristol channel and Bridgwater bay abound in white- and shell-fish; salmon and herring are also caught, the principal fishing stations being Porlock, Minehead and Watchet.

Coal, from the Mendips, and freestone, largely quarried near Bath, are the chief mineral products of Somerset, although iron, manganese, limestone, and slate are also found. The chief manufactures are those of woollen and worsted goods, made in a large number of towns; gloves at Yeovil, Stoke, Martock and Taunton; lace at Chard; linen and sailcloth at Crewkerne; crape at Dulverton and Shepton Mallet. There are large potteries at Bridgwater, where the celebrated bath-brick is made, and at Weston-super-Mare. On the Avon, copper and iron are smelted, while several other rivers provide power for cotton, worsted and paper mills. The bulk of the export trade passes through Bristol, which is situated mainly in Gloucestershire, though it has large docks on the Somerset side of the Avon, and others at Portishead.

Somerset is well furnished with railways. The G.W.R. runs between Frome, Radstock, Bath and Bristol, and from Bristol it curves south-west through Weston and Bridgwater to Taunton, dividing there and passing on into Devon. Branches leave the main line for Portishead, Clevedon and Minehead on the north, and for Witham Friary via Wells, Yeovil via Langport, and Chard via Ilminster on the south. The S.R. main line from London passes through the south-west of Somerset, running from Templecombe to Axminster in Devon, and the Somerset and Dorset runs from Bath to Shepton Mallet via Radstock.

Area of administrative county and associated county borough is 1,036,818 ac.; pop. (1931) 475,120. The county contains 40 hundreds and two liberties. The municipal boroughs are—Bath, a city and county borough, Bridgwater, Chard, Glastonbury, Taunton, Wells, a city, and Yeovil. The county is in the western circuit, assizes are held at Taunton and Wells and it has one court of quarter sessions. The boroughs of Bath and Bridgwater have separate courts of quarter sessions. Somerset is in the diocese of Bath and Wells, excepting small parts in the dioceses of Bristol and Salisbury. There are six parliamentary divisions—Wells, Frome, Taunton, Weston-super-Mare, Bridgwater and Yeovil, each returning one member; while the parliamentary borough of Bath returns one member; and the county includes part of the parliamentary borough of Bristol.

See J. Collinson, *History and Antiquities of the County of Somerset* (Bath, 1791); W. Phelps, *History and Antiquities of Somerset* (1839); R. W. Eyton, *Domesday Studies: Analysis of the Somerset Survey* (1880); F. T. Elworthy, *West Somerset Word-Book* (1886); *Victoria County History: Somerset;* also various publications by the Somerset Record Society.

SOMERSWORTH, a city of Strafford county, New Hampshire, U.S.A., 17 m. N.W. of Portsmouth, on the Salmon Falls river, opposite Berwick, Me. It is served by the Boston and Maine railroad. Pop. (1920) 6,688 and it was 5,680 in 1930. Water-power is abundant, and the city has large woollen and cotton mills. A settlement was established here before 1700.

SOMERVILE, WILLIAM (1675–1742), English poet, whose works include *The Two Springs* (1725), a fable; *Occasional Poems. . .* (1727); *The Chase* (1735) *Hobbinol, or the Rural Games* (1740), a burlesque poem; and *Field Sports* (1742), a poem on hawking. Somervile died on July 19, 1742.

His *Chase* passed through many editions. It was illustrated by Bewick (1796), by Stothard (1800), and by Hugh Thomson (1896), with a preface by R. F. Sharp.

SOMERVILLE, a city of Middlesex county, Massachusetts, U.S.A., on the Mystic river, surrounded by Boston (Charlestown), Cambridge, Arlington and Medford. It is served by the Boston and Maine railroad. Pop. (1920) 93,091 (26% foreign-born white, over half from Canada, England and Ireland) and 103,908 in 1930 Federal census. The assessed valuation for 1927 was $116,406,900. Somerville, originally part of Charlestown, was settled in 1630. The greater part of John Winthrop's "Ten Hills Farm" lay within the present bounds of the city, and here in 1631 he built and launched the "Blessing of the Bay," the first ship built in Massachusetts. For more than a century the region was a sparsely settled farming community and the only manufacturing industry of any importance was brick-making. On a hill in Nathan Tufts park stands a circular building of slate stone (30 ft. high, with a conical cap) originally built (about 1703) for a windmill, and used for a powder house from 1756 to 1822, where Gen. Gage on Sept. 1, 1774, seized 250 half-barrels of powder. In 1775 it became the magazine of the American forces besieging Boston, and Somerville was the headquarters of Nathanael Greene and Charles Lee. On Prospect Hill, on July 18, 1775, Israel Putnam raised the "Appeal to Heaven" flag; and one of the earliest of the continental standards, the Union Jack and stripes, was raised here on Jan. 1, 1776. The opening of the Middlesex canal through Somerville in 1803 and of the Boston and Lowell railroad in 1835 gave an impetus to its growth. It was incorporated as a town in 1842, and in 1871 was chartered as a city. The output of its factories in 1927 was valued at $66,440,533.

SOMERVILLE, a borough of north-central New Jersey, U.S.A., the county seat of Somerset county; on the Raritan river, 36 m. S.W. of New York city, and served by the Central railroad of New Jersey. Pop. (1920) 6,718 (80% native white); 1930 Federal census 8,255. Adjoining it on the west is the town of Raritan (pop. in 1920: 4,457). Somerville is a residential community and trading centre and has a number of factories. There is a fine county court-house (1909) of white Alabama marble, and a large State armory is located here. Among other interesting buildings are the old parsonage of the Dutch Reformed church, built (1750–51) of brick imported from Holland, and the Wallace house (1778), Washington's headquarters while his main army was in camp at Bound Brook. Settlements were made here in the last quarter of the 17th century and the village was at first called Raritan. It became the county seat in 1783, was incorporated as a town in 1863 and as a borough in 1909.

SOMME, a department of France, formed in 1790 of a large part of the province of Picardy (comprising Vermandois, Santerre, Amiénois, Ponthieu, Vimeu and Marquenterre) and a small portion of Artois. Pop. (1926), 473,916. Area, 2,443 sq. miles. It is bounded on the north by Pas-de-Calais, east by Aisne, south by Oise, and south-west by Seine-Inférieure, and its sea-coast extends 28 m. along the English channel. Two streams flowing into the channel—the Authie on the north and the Bresle on the south-west—bound it in these directions. The department is part of the chalk plateau of north-west France, cut by the English channel on the west, with the result that it is seamed by well-marked valleys, showing a succession of terraces which have become classical ground for the student of geology and of palaeolithic man. On the plateau, which rises to about 700 ft. where it approaches the Pays de Bray in the south-west, there are large stretches of *limon,* a fine-grained, porous, fertile material. The Somme is a historic zone of defence of Paris, and the whole district east of Amiens bears the

traces of ceaseless fighting during the war of 1914–18. The river Somme has been made navigable by canalization of stretches. It also supplies considerable power. From Abbeville to the sea its canalized course can take ships of considerable size. From the mouth of the Authie to the Bay of the Somme the coast is lined with sand dunes about 2 m. broad, behind which is the Marquenterre, a tract of 50,000 ac. reclaimed from the sea by dykes, and traversed by drainage canals. The Bay of the Somme, obstructed by dangerous sandbanks, contains the fishing ports of Le Crotoy, St. Valery, which is also the chief commercial port, and Le Hourdel. Next come the shingle banks, behind which the low fields of Cayeux (25,000 ac.) have been reclaimed; and then at the hamlet of Ault begin the chalk cliffs, which continue onwards into Normandy. Near Amiens the Somme is joined by the Ancre from the north-east, the Avre from the south-east and the Selle from the south. The Bresle is a small river south of the Somme, reaching the sea at Tréport.

The department, especially in the north-east, is one of the best cultivated in France. Beetroot for sugar is the staple crop of the Péronne arrondissement; cereals, chiefly wheat and barley, sugar-beet, fodder and mangel-wurzels, oil plants, colza, flax, hemp and potatoes are grown throughout the department. Stock-raising of all kinds is successful.

The chief towns are Amiens (the capital), Abbeville, Montdidier, Péronne, Doullens, St. Riquier, Crécy and Ham (*qq.v.*). Albert (pop. 6,389) is a centre for machine construction; Villers-Bretonneux (pop. 3,542), a centre of hosiery manufacture; Corbie was once celebrated for its Benedictine abbey (founded in the 7th century) the church of which (16th–18th century) is still to be seen, though now ruined. Folleville has a church (15th century) containing the Renaissance tomb of Raoul de Lannoy; Picquigny has the remains of a château of the 14th, 15th and 16th centuries, once one of the chief strongholds of Picardy; Rue has a 15th century chapel; and Tilloloy a Renaissance church.

SOMME, BATTLES OF THE, 1916. This series of battles, or, more strictly, succession of limited engagements, constituted the offensive campaign of the Franco-British armies in 1916. Into it was thrown the entire British effort of the year on the Western Front and such part of the French effort as was available after the exhausting strain of the long defensive "battle" at Verdun (*q.v.*). The genesis of the Somme offensive is dealt with under WORLD WAR.

The original intention had been that the French should play the larger part in the attack, but as they were drained of their strength at Verdun (*q.v.*) so did their share of the Somme plan evaporate. Eventually their front of attack on the Somme shrank from 25 miles to eight and their force from an intended 40 divisions to 16, of which only five assaulted on July 1. From now onward the British were to take up the major burden of the Western Front campaign, and this alone invests the attack of July 1, 1916 with a special significance. Yet the aims of the British commander-in-chief were not reduced in proportion to his resources. His intention was, in the first place, to break the German front between Maricourt and Serre. Secondly, to secure the high ground between Ginchy and Bapaume while the French seized its continuation past Sailly and Rancourt. Next, to wheel to the left and roll up the German flank as far as Arras, so widening the breach. With this aim all available troops, including the cavalry, would drive northwards from the line Bapaume-Miraumont while a converging attack was launched in co-operation against the German front south-west of Arras. Fourthly was to come a general advance towards Cambrai-Douai. If the Higher Command did not visualise quite so rapid a break-through as had been expected in 1915, the conception was of an advance immeasurably swifter and deeper than came about.

Topography.—To understand both the problem and course of the battle a brief description of the ground is necessary, for in few battles did topography have so far-reaching an influence and make so deep an impression on the minds of the combatants. Between Ham and Arras the river Somme runs first from south to north as far as Péronne and then bends sharply to the west, on its way to the sea. From Péronne a low range of hills runs somewhat to the north of west, forming the watershed between the Somme and the basins of the Scarpe and the Schelde. This ridge had fallen into German hands in Oct. 1914 in the course of the operations usually described as "the race to the sea" and the line in this quarter, indeed on the whole front from Arras southward to the Oise, had remained substantially unaltered during 1915, the chief change being that in July 1915 a British III. Army had been formed which relieved the French between the Ancre and the Somme. Subsequently a IV. Army was also formed, and early in 1916 the British had relieved the French X. Army on the Arras front, making their line continuous from Ypres southward. The right boundary between the British and French had varied considerably and in June 1916 was near Maricourt, about 3,000 yd. north of the Somme. Here the Allied line, which southward of this point ran north and south, turned sharply and following the lower slopes of the watershed already described ran west for another 7,000 yd. to make another sharp turn at Fricourt, whence it ran north to and beyond the Ancre, which pierces the ridge between Thiepval and Beaumont Hamel.

German Positions.—The German positions had become extremely formidable. Their defenders had been in undisturbed possession of the high ground for over a year and a half, and since the British had taken over this part of the front the previous autumn, the application of the usual British policy of aggressive trench-warfare had stirred the Germans to strengthen their defences, to develop artificially the advantage of nature. Woods and villages had become fortresses, two elaborate trench systems had been constructed about two to three miles apart, each containing several lines and connected up by intermediate lines or "switches" which greatly complicated the task of the attacker who should penetrate any part of the front. Deep "dug-outs," easy to construct in a chalk country, protected the trench garrisons against bombardment, broad belts of barbed wire obstructed the approaches, the lines bristled with well-placed and protected machine-guns, and every point of tactical importance had been specially fortified. The advantage of the ground for observation lay with the Germans. Masefield in his book "The Old Front Line" expressed the situation aptly: "Almost in every part of this old front our men had to go uphill to attack. . . . The enemy had the look-out posts, with the fine views over France and the scenes of domination. Our men were down below, with no view of anything but stronghold after stronghold, just up above, being made stronger daily."

For an attack on such positions the most elaborate preparations were necessary, both tactical and administrative. Roads and railways had to be made, vast dumps of ammunition and stores formed, gun positions selected and dug, bivouacking and encamping grounds prepared, the water supply expanded. It was not till the end of June that the offensive could be initiated; and it had been practically impossible to conceal from the Germans the scale and nature of the preparations or the intended extent of the attack. Surprise, difficult in face of such commanding positions, was the more difficult because the art of camouflage and of concealing preparation was still immature. Had not the vast preparations given it away, the fact that the bombardment lasted a week would in any case have announced all but the actual day of the attack.

Dispositions.—The British share of the attack was entrusted to Rawlinson's IV. Army of 17 divisions, of which only two, together with 3 cavalry divisions, were in army reserve. In addition a corps of three divisions and the headquarters of a reserve army—under Gough—were placed in the battle area under the hand of the commander-in-chief. Two divisions of the III. Army were to make a subsidiary attack near Gommecourt. The artillery concentration totalled 1,500 guns, averaging one gun to every 20 yards of front, a record at that time, although far eclipsed later. Rawlinson expressed doubts whether it was sufficient but his suggestion that the frontage should be reduced was not acceptable. The bombardment began on June 24, the attack being originally intended for June 29, but subsequently postponed until July 1. This involved not only spreading out the ammunition over a longer period, but a greater strain on the assaulting troops

who, after being keyed up for the effort had to remain another 48 hours in cramped trenches, flooded by a torrential downpour, under the din of the bombardment and the enemy's retaliation.

I. THE FIRST STAGE

July 1, however, dawned dry and with the promise of broiling heat. At 7 A.M. the bombardment rose in intensity and at 7.30 A.M. the British infantry advanced in close-packed waves. These 1916 formations were designed to enable the assaulting infantry to swarm into the opposing trenches as soon as their own guns had lifted. But they exacted a heavier penalty in case of any interval or any insufficiency of the bombardment. And they cramped initiative and hindered the infantry taking sensible advantage of cover—for the infantry were taught to advance at a slow walk in strict alignment. Here the penalty was fully exacted by the stout-hearted and skilful German machine-gunners who, sheltering in dug-outs or shell-holes while the bombardment flattened their trenches, dragged out their weapons and opened fire directly it lifted.

Fricourt, on the right centre, was a turning point not only in the front but in the fortune of the day. All to the north was failure, with the heaviest British loss of any day in the war. On the British left the VIII. Corps attacked from Serre to Beaumont Hamel, but though its centre penetrated some way into the German lines north of Beaumont Hamel the flanks were checked and the central division was finally dislodged. Equal ill-success befell the X. Corps and the left division of the III. Corps to the south, in their attacks on the formidable defences of Thiepval and Ovillers. The right division (the 34th) pressed past La Boisselle to Contalmaison but was forced to fall back, its flank being enfiladed from Ovillers. The next corps, the XV., partially achieved its task of pinching out the bastion of Fricourt village and wood. On its north, next the 34th division, the 21st division gained and held a narrow salient, with both its flanks exposed until Fricourt fell next day. On the other side of Fricourt the 7th division and the XIII. corps (18th and 30th divisions) attacking in a northerly direction were all successful, taking Mametz and Montauban. Beyond them, again, the French astride the Somme fared brilliantly, reaching Hardecourt and Curlu north of the river, while south of it they actually penetrated to and captured six miles of the German second line. They took 6,000 prisoners at little cost.

The Germans had not expected a French attack and were less well prepared on the Fricourt-Montauban front than on the line running north from Fricourt, where both their positions and their fortifications were strongest. The success achieved by the British right and by the French went some way towards compensating for the disastrous failure elsewhere. The Germans could justly claim a victory, for with only six divisions available, and roughly a regiment holding each British division's sector of attack, they had yielded only 1,983 prisoners and a small tract of ground. Yet, although a military failure, July 1 had proved the moral quality of the new armies of Britain who, in making their heaviest sacrifice of the war, came through the ordeal with courage unshaken and fortitude established. These quondam civilians had borne a percentage of loss such as no professional army of the past had been deemed capable of suffering without being incapable of continued action. For five months more they were to continue.

For, on the morrow Haig, realizing the formidable nature of the frontage astride the Ancre, concentrated his attention on exploiting the success of the right—refusing to accede to Joffre's wish for a renewal of the attack on Thiepval. In the course of 10 days of hard fighting in which some six fresh divisions were thrown into the struggle, La Boisselle, Contalmaison and Mametz Wood were cleared and the line was advanced on a front of over six miles to within reach of the enemy's second system of defences on the southern crest of the main ridge.

Second Line of Defence Assaulted.—This system, less strong than that stormed on July 1, was formidable enough and the stubborn resistance of the Germans in their front system and intermediate lines had allowed large reserves of men and guns to be brought up and the defence to be reorganized. If Haig had been unduly ambitious and optimistic before July 14, he now perhaps tended to the other extreme. In contrast the IV. Army command held that in bold and rapid measures lay the only chance to forestall the building of freshly fortified systems in the rear. Rawlinson framed a plan to attack and break the second system on a four-mile front between Delville Wood and Bazentin-le-Petit Wood. His right was still three-quarters of a mile distant. If the obvious course was followed and an attack delivered only on the left, the prospects were barren. For the experience of 1915 had shown that an attack on a narrow frontage might gain an initial success, only to be "blown" out of the captured fragment of ground by the concentration of enemy gun-fire thus facilitated. Rawlinson proposed to cross the intervening and exposed area on the right under cover of darkness and then to attack along the whole frontage at dawn, preceded by a hurricane bombardment of only a few minutes duration.

In 1916 the ideas of a night advance and of such a brief bombardment were so unorthodox as to be a shock and appear a gamble to cautious opinion, especially as it would have to be carried out by troops of the new armies. The commander-in-chief preferred a more limited alternative but Rawlinson persisted, his confidence reinforced by that of the actual troop-leaders in their ability to carry out the night operation. He gained his way, but the debate caused a day's delay which had serious consequences. The attack was delivered by the 9th and 3rd divisions of the XIII. corps on the right and by the 7th and 21st divisions of the XV. corps on the left. Cavalry divisions were brought up close and placed under the two corps commanders.

The hazardous and difficult approach march on the right was successfully carried out and at 3.25 A.M. on July 14, five minutes after the barrage fell, the whole line advanced to the assault. Surprise was achieved, originality vindicated. The whole of the German second system was rapidly overrun. On the right the resistance soon hardened and the 9th division only fought its way with difficulty through Longueval and to the outskirts of Delville Wood. On the left, opportunity—and the open country—stretched out its arms. Soon after midday the German resistance was obviously disintegrating in front of High Wood, and an effort was made to exploit the opportunity. But delay occurred and not until after 6 P.M. did the 7th division move forward afresh, with two squadrons of cavalry working on their flank—the first mounted cavalry seen on a British battlefield since 1914. The second advance, however, was less vigorous than the first and although most of High Wood was cleared, the northern corner and the flanking trenches held out. Worst of all the 24 hours' postponement had enabled fresh German reserves to arrive on the battlefield and as their strength steadily swelled, the German hold tightened, the British relaxed. Late on July 15 the Wood was evacuated under pressure of counter-attacks, and two months were to pass before it was regained. On July 14 the British offensive came within reach of open country and within sight of a strategic decision; thenceforward it degenerated into a campaign of attrition. Two months of hard fighting followed during which the British were unable to make more than very gradual progress at disproportionate cost.

Progress was especially slow on the right, where Ginchy, Guillemont and Falfemont Farm formed a barrier against which many attacks were shattered even after Delville Wood had been won. It was important to extend on this side to get touch with the French who were gaining ground north of the Somme: High Wood in the centre, Pozières on the left, were equal obstacles, and behind Pozières were all the formidable defences of which Thiepval was the centre. Division after division was thrown into the fight, fought desperately, lost heavily and apparently achieved little, though Pozières was taken by the Australians before the end of July. The strain was at last beginning to tell heavily on the Germans: they checked the Allied progress but their resources in men, guns and ammunition were, by Ludendorff's admission, severely taxed and they had to relinquish entirely their attacks on Verdun.

II. THE SECOND AND THIRD STAGES

On Sept. 3 a renewed attack astride the Ancre by the V. Army,

formed from troops taken out of Rawlinson's IV. Army and placed under Gough, was unsuccessful, but the IV. Army on the right at last mastered Guillemont and in the next few days added Falfemont Farm, Ginchy (Sept. 9), Leuze Wood and Bouleaux Wood to its gains, while the French made substantial progress north of the Somme and gained a big success south of it, taking 7,000 prisoners and storming three m. of the old German front line as far as Chaulnes. These successes removed the main obstacles to the advance of the British centre, freeing it from the menace of being enfiladed.

Haig thereupon planned a big spring forward for Sept. 15, second only in scale and ambition to July 1. The attack was to pivot on the left wing—Gough's Army. The object of the main blow, by Rawlinson's IV. Army, was to break through the Germans' original last line between Morval and Le Sars, in co-operation with a French thrust to the south between Combles and the Somme—"pinching out" Combles. If the opening success warranted the attempt the attack was to be extended on the left to seize Courcelette and Martinpuich. Eight divisions were deployed for the original attack, and two detailed for the "extension." A special feature was the employment for the first time of tanks (*q.v.*), the armoured cross-country machines which had been invented as an antidote to the defensive obstacle of machine-guns and barbed wire. In disregard of the opinions of the tank's progenitors, and of their own expressed agreement with these opinions, the British Higher Command had decided to utilise such machines as were available, to redeem the fading prospects of the Somme offensive. When this decision was taken only 60 of the initial 150 machines had been transported to France. Forty-nine were actually employed, to work in tiny detachments of two or three machines—another breach of the principles laid down by Colonel Swinton (*q.v.*). The rushed preparation combined with the mechanical defects of these early models to reduce the total, so that only 32 reached the starting point. Of these, nine pushed ahead with the infantry, nine failed to catch the infantry but helped in clearing the captured ground, nine broke down and five were "ditched" in the craters of the battlefield. The first nine rendered useful aid, especially in capturing Flers, but the greater prize of a great surprise stroke thus lost was a heavy forfeit to pay for redeeming in a limited degree the failure of the Somme offensive.

The attack was launched at dawn on the 15th in a slight mist, and the XV. corps in the centre made early and good progress, and by 10 A.M. its left division was beyond Flers. But on the right the XIV. corps lost heavily and was held up long before it could reach Morval and Lesboeufs. The III. corps, on the left, also fell short of its objectives, although its 47th division finally cleared the long-sought High Wood. On the extreme left the projected "extension" of the attack was carried out and both Martinpuich and Courcelette were taken. As a result of the day the crest of the ridge had been gained, except on the right, and with it the commanding observation which the Germans had so long enjoyed. A fresh attack on Sept. 25, swept over Morval, Lesboeufs and Gueudecourt and by joining up with the French who had again secured substantial successes both north and south of the Somme, compelled the Germans to evacuate Combles (Sept. 26).

Simultaneously with this success operations were resumed by the V. Army on the British left and Thiepval was at last taken (Sept. 26). This left the Germans with only the scantiest foothold on the main ridge. Thus by the beginning of October the enemy had been driven back to his last completed line of defences, which ran from Sailly-Saillisel on the right, past Le Transloy and in front of Bapaume: he was busily engaged on fresh lines further in rear but as yet these were unready. On the other hand, these days had proved the continued strength of the German resistance, and the limited success held out little hope of a real breakthrough or its exploitation. The early onset of the autumn rains daily made this hope more slender. Continuous and heavy rain combined with the effects of the bombardments to make the ground a sea of mud, across which guns and transport could hardly be moved, and even lightly equipped men could only struggle slowly forward. Attacks under such conditions were terribly handicapped; that most of them failed was not remarkable, for when a trench was taken the difficulties of consolidating it were greater than ever. Eaucourt l-Abbaye (Oct. 3) and Le Sars (Oct. 7) were taken, though repeated attacks on the Butte de Warlencourt were foiled by the mud. Eventually the weather improved enough for a renewal of the attack on the left and the last important operation in the Somme offensive took the shape of an attack on Beaumont Hamel by seven divisions on Nov. 13. This proved successful on the right and centre, taking Beaumont Hamel itself, and Beaucourt-sur-Ancre with 7,000 prisoners. On the left, however, Serre again proved impregnable. Before the success could be expanded the return of bad weather again put a stop to active operations, which were not resumed on any considerable scale until well after the New Year, just before the carefully planned German retreat to the Hindenburg line. The folly of the third phase was that having at last won the crest of the ridge and its commanding observation, the advantage was thrown away, without adequate prospect of compensation, by fighting a way down into the depression beyond. Thereby the British troops were doomed to spend the winter in flooded trenches, and the battles of the Somme closed in an atmosphere of disappointment and with such a drain on the British forces that the coincident strain on the defence was obscured. For the fighting sometimes known as the second battle of the Somme, *see* ST. QUENTIN, BATTLE OF, 1918.

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(B. H. L. H.)

SOMMER, SUMMER or **SUMMER BEAM,** in architecture, a girder or main beam of a floor; if supported on two storey posts and open below, it is called a *bress* or *breast-summer.*

SOMNAMBULISM or **SLEEP-WALKING,** the condition under which people walk while asleep, apparently unconscious of external impressions, return to bed, and when they awake have no recollection of any of these occurrences. Sometimes the actions performed are of a complicated character and bear relation to the daily life of the sleeper. Frequently somnambulists have gone along dangerous paths, executing delicate movements with precision.

Somnambulists may: (1) speak without acting, common in children and not usually considered somnambulistic; (2) act without speaking, the most common type; (3) act and speak, more exceptional and (4) act, speak and have the senses of touch, sight and hearing. The fourth class merges into hypnotism (*q.v.*).

It should never be forgotten that somnambulism is an indication of a nervous disposition requiring careful treatment so as to avoid more dangerous maladies.

SOMNATH, an ancient decayed city of Kathiawar in the province of Bombay, India. Pop. (1921), 6,867. The city was most famous for the temple just outside its walls in which stood the great columnar emblem of Siva called Somnath (Moon's lord), which was destroyed by Mahmud of Ghazni. The famous "Gates of Somnath," which were supposed to have been carried off by Mahmud to Ghazni are now in the arsenal at Agra.

SOMNUS, Sleep, the son of Night and the twin brother of Death, with whom he dwells in the darkness of Hades. In Ovid (*Metam.*, xi. 592) the home of Sleep is placed in a dark grotto in the land of the Cimmerians, where he dwells surrounded by a band of Dreams.

See Homer, *Iliad*, xiv. 231 to xvi. 672; Hesiod, *Theog.*, 212, 758; Pausanias v. 18, 1.

SOMOV, KONSTANTIN ANDREEVICH (1869–), Russian painter, was born in St. Petersburg (Leningrad), Nov. 30, 1869, his father being director of the Hermitage Museum. Early in his career he worked under Ilia Repine, the realist painter and professor of the Academy of Arts. He was greatly influenced by the masters of the "Fêtes Galantes" and by the art of Aubrey Beardsley and Charles Conder. Somov was one of the founders of the group known as "The Artistic World." In 1919 he issued *The Book of the Marquise*, which he illustrated with a number of

characteristic drawings. His best portraits, which are drawn in coloured crayon, show remarkable delicacy of execution and masterly delineation of character. Somov, who was a connoisseur of ceramics, also produced a number of groups painted on china. *See* Oscar Bie, *Constantin Somoff* (1907).

SONANCE: *see* VOICE.

SONATA, in music, originally a piece "played" as opposed to "cantata," a piece sung. By the time of Corelli the term had come to mean a group of instrumental movements. (A movement is a piece of music forming or starting as if to form, a complete musical design.) The sonatas of Corelli are classified as *sonata da chiesa* (church sonata) and *sonata da camera* (chamber sonata). Both kinds were usually for one or two violins with *continuo* bass (*see* CHAMBER MUSIC and INSTRUMENTATION). Handel, when a boy, wrote six for two oboes, and in later years several for flute, and also for one oboe.

The *sonata da chiesa* consists typically of a slow introduction, a loosely fugal allegro, a cantabile slow movement and a lively finale in melodic "binary" form (*see* SONATA FORMS). The *sonata da camera* consists mainly of dance-tunes (*see* SUITE). Bach, who uses neither title, keeps the two kinds unmixed in his six sonatas for violin alone, the first, third and fifth being *sonata da chiesa* and the others *partitas.* A fusion of the two styles persisted in Italian violin music almost to the end of the 18th century.

The sonatas of Domenico Scarlatti (*q.v.*) are small harpsichord pieces, of which the best known are extremely brilliant single movements in binary form. The complete collection of 545, published by Longo, shows that Scarlatti experimented audaciously in remote modulations; that he also wrote some orthodox violin sonatas; and that he sometimes followed a lively movement by a slow cantabile, as Paradies did in his sonatas. Clementi's early sonatas are at their best when they resemble a sober and heavy-handed Scarlatti in a first movement which maintains a uniform rush of rapid motion; and Mozart has left a fine example of the kind in the first movement of his F major violin sonata (K 377).

The main classical sense of the term indicates a work for not more than two instruments, containing at least two, and in the complete scheme, four well-contrasted movements, of which the first and last are on the same tonic, and the others in demonstrably related keys (*see* HARMONY, sec. 5); the forms being those dealt with in the following article. (D. F. T.)

SONATA FORMS, in music. The sonata forms (*see* SONATA above) cover the whole ground of instrumental music from C. P. E. Bach to the advent of Schumann's pianoforte lyrics and Liszt's symphonic poems, and are still living forms. Their rise made Gluck's reform of opera possible; for they represent a general change in the language of music which made it a truly dramatic medium. They comprise the largest and most central problems of pure music; and the outward forms must be studied in constant connection with instrumentation, harmony, melody, counterpoint and rhythm (*qq.v.*).

Elements of Form.—Two types of form are externally common to the true dramatic sonata style and the earlier melodic forms used in the suite (*q.v.*). The terms *binary* and *ternary* have been chosen for these; and, as we shall see, badly chosen. A binary melody falls into two portions, of which the first ends away from tonic, and the second ends on the tonic. *Barbara Allen,* quoted in the article MELODY, is an exquisite example on the smallest possible scale. A ternary melody, such as *The Bluebells of Scotland,* has a complete first clause, a second clause not as complete, and a third clause consisting of the first over again; a form conveniently symbolized as ABA.

No view of music can be correct that neglects the fact that it moves in time; though a composer may develop Mozart's capacity for seeing music spatially, *i.e.,* like a picture, all at once. Now, when do we know that a melody is going to be "ternary"? Obviously when its first clause has shown itself to be complete. If the sequel refuses to divide itself according to a "ternary" rule the ear is not going to reverse its judgments merely because we have chosen a bad term of classification. After the first clause, anything may happen. The rest of the tune may be no longer than the first clause. All that we can expect of it is that it will cover a wider ground than the first clause, even if in fewer notes or in less time. But this is not all. Every tune of several clauses lends itself to repeating its sections. Binary tunes repeat their two sections. Does a ternary tune repeat its three sections? Try the experiment on the very typical ternary theme of the variations in Beethoven's Kreutzer sonata. Play the first clause with its repeat and try repeating the second clause before returning to the first. You will hardly have the patience to finish the experiment. It will at once reveal that under the test of repeats our "ternary" melody is not ABA but A, BA.

Ex. 1

Thus while both these forms divide only into two repeatable portions the one named "binary" has an incomplete first part while the first part of the other is complete. Our pundits would make musical terminology less misleading if they would kindly find Greek or Latin names, not longer than the forms themselves, that should express "form-with-an-incomplete-first-part" on the one hand, and "form-with-a-complete-first-part" on the other. Clearly the distinction is that between higher organizations and lower, or sectional, forms. From the so-called binary form originates the sonata-form *par excellence,* that of the first movement of a sonata. From the so-called ternary form originate all those sectional forms of music that begin with a complete symmetrical melody, however many sections the form may eventually develop. Thus the "ternary" type underlies the *rondo* (*q.v.*).

The Sonata Style.—Sonata form represents a style that is evident in every bar from the outset, however its themes may be distributed. We are told that the binary form of a dance-movement in a suite has a polyphonic texture and a single theme; and that Philipp Emanuel Bach created the true sonata form by inventing the "second subject." Good teachers make sure that their pupils understand that the "subject" of a sonata is not a single theme, like the subject of a fugue; but in spite of all precautions a host of bad musical forms and crooked musical doctrines have grown up from the provincial fact that English musicians have fastened on the terms "first" and "second subject" instead of translating the excellent German terms *Hauptsatz* (principal member) and *Seitensatz* (subordinate member).

Some of Sebastian Bach's most typical gigues have at least two distinct themes, while more than one of Haydn's ripest sonata movements derive everything from their first themes. Accordingly we may illustrate the true distinction of style by examples which refute superficial doctrines.

These two examples are almost exactly the same length, yet

Haydn is beyond Bach's scope in the first eight bars. If Bach could have accepted so trite a theme as Haydn's, he would have postulated that it did not end with a bump: and bars 5–8 would have horrified him, for he would have supposed that a movement that began so vulgarly was condemned to continue in the same style. Bar 8, however, enters on matters that Bach had never known. In it the first bar of a new period overlaps with the last

Ex. 2. Bach. Gigue from 3rd Suite for Violoncello

bar of the old; and therewith we are plunged into a polyphony quite lively enough for Bach, and quite unpredictable in rhythm and key, its fourth bar overlapping with the answer in A minor, and the viola and violoncello entering in F major at intervals of two bars. Then, arising from bar 18, there are four bars on the dominant of F, with that merely jingling figure (c). We need not set limits to Bach's intelligence, and we may suppose that such a composition would have convinced him that here was no trivial *divertissement,* as he called the non-polyphonic sonatas that were becoming fashionable in 1745, but a new art with enormous possibilities.

Bars 23–26 transform the two notes of (a) into rich sustained harmonies. Then figure (b) bursts out in a new type of phrase, built up in 3-bar periods, which the ear need not trouble to recognize as such in the general bustle. The third of these periods abandons the figure and makes a melodious close into 5 bars of cadence on figure (b) with upper notes that merge into (c), nicely phrased. It is idle to say that all this has more than one theme, and worse than idle to deny that Bach's gigue has at least two distinct themes, that of the beginning, and that in bars 29–36. But Bach's relatively uniform texture will tolerate neither interruption nor irregularity of rhythm.

Haydn's exposition groups itself clearly into bars 1–8, the first group (*Hauptsatz*), asserting the tonic and overlapping with bars 8–22, which effect the transition (plus the sustained chords 23–26) to the second group (*Seitensatz*) in F major, bars 27–40, with its cadence-phrase (*Schlussgruppe*) in bars 36–40. These sections could not be more distinct with any number of themes.

There are no rules whatever for the number or distribution of themes in sonata-form. When critics tell us that Mendelssohn is weak "in second subjects, where the human element is required," they disqualify themselves by a terminology as useless as that of the friend who did not see where the painter was going to put his brown tree. Any generalized criticism of sonata themes is bound to be nonsense; for themes stand in endless variety of relation to the whole. They are details, which give pleasure in themselves as well as in their relation to the scheme. But it is foolish and vexatious to lay down rules as to what pleasure the details shall give. If you examine frescoes with a microscope or miniatures with a telescope you will not enjoy them; and if you expect Beethoven's "Harp" quartet to show you the purport of its first movement in its themes you might as well try to study foreign poetry through a traveller's phrase-book.

So much, then, for the vital element of drama in the sonata. Historically it originates wholly with Haydn and Mozart; and Philipp Emanuel Bach contributed to it nothing but a romantic rhetoric. His chief pride was in his invention of *Sonaten mit veränderten Reprisen;* that is to say sonatas in which the repeats were written out in full in order to control the fashion of altering and amplifying the ornaments on repetition. Now, could anything more clearly betray a non-dramatic style? The survival of repeats in the most dramatic works of Beethoven and Brahms shows how powerfully an architectural symmetry can dominate a series of emotional tensions: but imagination boggles at the thought of using these repeats to display a new set of ornaments.

Haydn saw that the only place for C. P. E. Bach's device was in purely lyric slow movements. Even there he never had the patience to plod and pose (as C. P. E. Bach did to the bitter end) through a repetition of both parts. When his second part comes to recapitulate the second group it combines both versions. This form appears for the last time in history in one of Haydn's "London" symphonies, in the wonderful movement of which the theme is quoted in Rhythm, Ex. 1. Though "binary" it is manifestly lyric, and could no more be applied to active movements than the Spenserian stanza could be applied to drama.

A more important step toward the true sonata style was made by Philipp Emanuel's less romantic brother, Johann Christian, who settled in London, founded the Bach and Abel Concerts, and had a great influence on the boy Mozart. J. C. Bach is the first composer to lay a dramatic emphasis on the transition between his first and his second group. In crude or deliberately formal examples this has been wittily described as "presenting arms" to the new key. Its point is not that there is any difficulty in apprehending the new key, but that the move into it is dramatic and not decorative. Whether the move be made with intellectual music or with common forms makes no difference. Beethoven preferred, in his most characteristic early works, to disguise it cleverly. In later works he acquired the grand formal breadth of Mozart's chamber-music in this transition.

First-movement Form.—The general scheme of the first-movement form or, *par excellence,* sonata form, is as follows. There is a first group in the tonic, followed by a transition to another key, where there is a second group that usually ends with a neat little cadence-theme. These groups constitute the exposition, which may be repeated. Then follows the development, the function of which is to put the previous materials into new

Ex. 3 Exposition in sonata style

lights, regrouping the figures into new types of phrase, modulating freely and settling, if at all, only in new keys. Eventually a return is made to the tonic, and so to the Recapitulation. This recapitulates the exposition, but it gives the second group in the tonic, and so completes the design. The development and recapitulation may be repeated; a coda may follow the recapitulations.

This account has required so many words that the illusion is apt to arise that it conveys more information than, say, the statement that the plan of a cathedral is cruciform and that the arms of the cross are called transepts, and so on. It gives us no means of distinguishing an ambling decorative movement by Boccherini from the first movement of a Beethoven symphony; and the description of the development is the only point which would rule out the sequel of our second example as a specimen of sonata-form. Haydn, Mozart and Beethoven differ widely in their handling of every part of the scheme.

The most regular form is to be found in Mozart, whose transitions are always broad and smooth. The effect of "presenting arms" is evident only in small or perfunctory works; and if it is found at all in larger works it is on such a scale and with such a purpose as Beethoven would give it. The second group contains at least one definite new theme and a number of cadence-phrases in various rhythms. The development is short, consisting of one broad sequential process that leads through a wide range of keys back to the tonic. Sometimes it contains an entirely new theme. Such an episode, which is generally placed at the beginning, by no means always indicates a lighter style and texture. It may be a relief from unusually concentrated figure-work in the exposition; and the developments of two of Mozart's most serious works (the C minor serenade for 8 wind instruments, better known as a string quintet, and the G minor pianoforte quartet) are episodic. The return to the tonic always has the effect of being accurately timed after a delightful period of anticipation.

The recapitulation is full and has a deceptive appearance of regularity. In reality it is anything but mechanical. It has just that kind of difference by which stereoscopic pictures produce the effect of binocular vision. In the light of the recapitulation the listener finds that points that were superficial in the exposition have now become solid. The composer instinctively conceives his exposition in relation to the question "How will this sound when it returns?" The minimum change happens automatically with the transition to the second group, for this transition must no longer lead to the complementary key of the exposition. One quaint primitive device in the transition is that of making it not leave the tonic at all but simply come to a pause *on* (but not *in*) the dominant. This dominant is then taken literally as a key. In such a case the recapitulation need alter nothing; the second group merely follows in the tonic instead of in the dominant. Even this automatic device makes the recapitulation give a more solid impression than the exposition; for the pause on the dominant, treated paradoxically in the exposition, is now treated rationally.

We need not deny that formal devices are apt to become mechanical; but we have no right to the *a priori* opinion that Mozart is writing unimaginatively every time that he decides that

the most familiar course is the wittiest. It is much wiser to regard the most exact recapitulation as the extreme case of delicate balance, and even in the most exact the crucial detail will appear. Here is a case in a difference of a single bar, Mozart's string quartet in E flat (K. 428) has the following clause in the first theme:

Ex. 4

In the recapitulation you have this—

Ex. 5

The little comment of the second violin is expanded and made to turn the following "added 6th" chord into a momentarily solid supertonic key. Similar points make the recapitulation of the second group also stand out in higher relief. Most interesting of all are the ways in which Mozart in a minor movement translates the second group from the major into the minor mode. It is worth while trying the experiment of literal translation (not always an easy task) and then seeing what Mozart has done in such cases. For codas Mozart either finds a slight expansion in the recapitulation of his second group adequate, or else he adds a neat final paragraph. If the development contained an episode Mozart's coda may allude to it. In the finale of the so-called "Jupiter" symphony he uses the coda for his quintuple counterpoint on all the five themes of the movement. (*See* COUNTERPOINT.)

Haydn's practice in his later works differs from Mozart's in almost every particular. His second group often contains no new theme until the cadence-group at the end; his development is long and divisible into several stages, often including an illusory early return to the main theme in the tonic followed by a new excursion into remote regions; and as to recapitulation, the term is seldom applicable at all. The first theme, indeed, returns, but it is followed by a brilliant peroration full of new developments and giving the repose of recapitulation only in the fact that it remains firmly in the tonic. If after such a peroration Haydn chooses to end quietly and abruptly with his cadence-theme, the effect is witty. But it does not make him a formalist. He is a master not only of form but of spaciousness in the smallest possible compass. One main theme for both groups gives him more room for expansion than two; and instead of saying that his recapitulations are free we ought to say that he invented the most brilliant type of Beethoven's coda. And these features of his form are not, as has sometimes been alleged, primitive. They are only partially visible in quartets before Op. 50. Then they appear in full vigour, and Haydn's admiration for Mozart only confirms him in his independence.

Mozart's more symmetrical form is a function of two things, a more polyphonic style and a larger scale. We may sum up the relation between Mozart's form and Haydn's thus: that in Haydn we are aware of an expansive freedom which proves, on scrutiny, to have an all-pervading sense of proportion; while in Mozart we are aware of beautiful and symmetrical proportions which prove on scrutiny to be handled with an all-pervading freedom.

Beethoven combined the forms of Haydn and Mozart, writing on a scale large enough to contain Mozart's regular recapitulations together with Haydn's free perorations, and developing a tragic power all his own. Such new power was not to be obtained without a new technique. A passage from Haydn and one from Beethoven, may be chosen to show how Beethoven set to work. In the first movement of Haydn's A major quartet (op. 20, No.

Ex. 6

6) the second group has been duly ushered in by a highly-organized transition passage and has already started a new theme. This, however, comes to a pause on the dominant, and then we have the following modulating themes—Ex. 6. The harmonic colour of these keys is delightful, and their mutual relations are of direct importance. The passage is improvisatorial and ruminating. Its modulations are within the local range of its start in E minor, and its windings only confirm the drift towards E major. Without them the passage would lose its freedom: with wider modulations it would lose coherence.

Now take the opening of the second group in the first movement of Beethoven's sonata, Op. 2, no. 2. Here is its skeleton outline—

Ex. 7

To analyse the enharmonic modulations and keys (including the unrelated $\flat$V) of this passage is, in Kingsley's admirable parable, like making an exhaustive chemical analysis of a plum-pudding and omitting to ascertain that the cook had boiled it in a cloth. The gist of the matter is the steadily rising bass, with its accelerated later steps and the profound psychology of its pause for 8 bars (after the quotation) before plunging into the final codential steps G♯, A and B, in widely different octaves. This is one of the epoch-making passages in musical history. Its importance does not lie in its wonderful enharmonic modulations. These could not in themselves have achieved more than had been already achieved by C. P. E. Bach: for without the rising bass their purpose would be merely to astonish and not to construct. But with the rising bass and similar resources the whole art of tonality expands. This soon enabled Beethoven to choose remoter keys for his second group. (*See* Harmony, section 5.)

Ex. 8 gives the outline of the first movement of Beethoven's "Eroica" symphony. Blank bars indicate the continuance of a harmony. They are often without theme, and are the lungs of the organism. Quaver-bars or other rhythmic indications above the line indicate the prevalent movement in accessory parts, whether contrapuntal or homophonic. Fine detail is not indicated, and short passages marked as repeated may be assumed to be rescored often beyond recognition. The outline, however, gives a comprehensive summary of the structure of this highly significant movement, and by means of it the reader will be enabled to apprehend, almost at a glance, the inexhaustible expansive and contractile power of Beethoven's phrase-rhythm. Nine conductors out of ten overlook the first theme of the second group entirely, but it is the one constant element in all Beethoven's dozens of sketches.

Freedom in a recognizable recapitulation can go no further than the marvellous modulations with which Beethoven transforms the first group; and anybody inclined to cavil at the exact recapitulation of no less than 100 bars comprising the transition and second group, may be surprised to learn that this is, by the clock precisely the same length as Isolde's Liebestod (*vide* Rhythm) and that in the Liebestod Wagner exactly recapitulates, without transposition, the last movement of the love-duet in a previous act. Recapitulation is as inveterate in musical form as symmetry is in architecture; and nobody understood this better than the first and most uncompromising realist in the application of music to drama.

Other Movements.—A thorough understanding of the style and methods of first movements makes all the rest easy. As to slow movements, the first thing that must be realized is that if a theme conceived in an average quick tempo be played four times as slow it will take four times as long. Some composers, and even some teachers, do not seem to have learnt this remarkable fact. In the music of a master slowness means bigness. The first 16 bars of the slow movement of Beethoven's D minor sonata (Op. 31, no. 2) look like, and are, a single binary sentence closing into the 17th bar. But the all-seeing eye that takes this in at a glance many miss the important fact that that binary sentence takes a whole minute by the clock. Quavers at 96 is a very good metronome-tempo for this movement, and it gives exactly 16 of those bars to a minute. The metronome at 72 to a bar gives a good, moderate tempo for the finale. Now, see how far one minute takes us in the finale. The simple binary first sentence of the adagio takes as long as the two closely-printed pages from the beginning of the finale to the middle of its cadence-theme! Thus in the slow movement of Beethoven's fourth symphony (another case of 16 bars to the minute) the 15 bars beginning in E flat minor and dwelling in G flat (bars 50–64) are a very spacious development; and so are the 7 bars in the middle of the slow movement of the trio in D major, Op. 70, no. 1. Such passages are ample developments if they modulate widely and contain important changes of rhythm, instead of merely dwelling on the dominant before the return of the main theme as in the slow movement of the D minor sonata.

No wonder that in any movement slower than *andante* the full sonata form is unusual and of gigantic effect. The full-sized rondo-form (*see* Rondo) as in the case of the fourth symphony just mentioned, is still more voluminous in a slow tempo. Movements of more normal size may be in A, B, A form, or sonata-form without development (Mozart's favourite form); or may consist of a theme with five or six variations and a short coda. Haydn's form of variations on two alternating major and minor themes is sometimes used by him in slow movements, and sometimes (in small works) as the first movement or as finale. (*See* Variations.)

The finale is often in first-movement form, but will, in such cases, have a much simpler texture. The last part of a work that moves in time will always relieve the strain on the attention. Hence the large number and importance of rondo-finales; and hence the paradox that both Haydn and Beethoven found the fugue an excellent form for a finale. For the fugue, while continually stimulating and exercising the mind by means of details, makes no claim on the listener's memory over long stretches in a major composition.

The first movement, slow movement and finale have thus an unlimited dramatic scope. A purely lyric or dance movement added to such a scheme would in itself be dramatic by contrast, as a song may be a dramatic element in a play. This justifies the dance-form of the Mozart-Haydn minuet and trio, of which Beethoven accentuated the dance-character when he expanded it to the scherzo (*q.v.*). Haydn's very earliest minuets show an inveterate irregularity of rhythm which stamps them even sooner than his other movements, as dramatic. Mozart's minuets are smoother, but he can pack operas into them without bursting the bounds of melodic forms. The minuet of his E flat quartet, for example (K. 428), has five distinctly expressed themes; and its trio, which in contrast has only one theme, moves, however, in four distinct new keys.

The Sonata as a Whole.—The full scheme of a sonata consists, then, of these four movements, the minuet or scherzo being either second or third. Two movements, suitably contrasted, will make a sonata, even if (as in Beethoven's Op. 54) neither of them is in full first-movement form. But it is exceptional for a mature work to claim the title of sonata on merely lyric forms. And in


Ex. 8
Allegro con brio
First Group begins
till bar 23
a
b
melody
counter-statement
(ab)
(b)
New theme
c
(c)
rise instead of the fall of bar 6
(movement stops)
for 8 bars
third statement; transition
for 10 bars
Dominant preparation for B♭
d
theme continues
(movement stops)
Second Group
e
etc.
New theme
Counter-statement in minor
New theme
E♮ = F♭
(b) diminished


Cadence-phrase
Return to opening
(a)
1ma
x
2nd
Development begins
x
x
themeless
Bars 166–177 = bars 45–56 on dominant of C with a new counterpoint
(b)
D♭ minor = C♯ minor
etc.
(e) continued
(a)
(e)
D minor
(a) diminished
(e)
(a) diminished
Bars 198–208 = 186–198 Starting from G minor
etc.
themeless
(with lively
Bars 220–230 = 186–197 = 45–56 on dominant of A♭
(d)
counterpoint)
C minor
G minor
D minor
(movement stops)
(d)
(c)
6 similar bars
Ditto
Ditto
simile
Episode (new theme)
E minor
(y)
284–290 in A minor
C major
(ab)
(b) developed
303-306 in C minor
303-306 in E Flat
284-287 in E♭ minor.
G Flat (y)
(y)
(y)
(ab)
(ab)
(ab)
(c)
continued for 28 bars
simile

*The allusion is probably intentional as Beethoven had great difficulty with those introductory bars. At all events he found that their proper shape was that of final bars.

the case of quartets, the feeling of the classical masters is that when so many as four players are assembled it is a waste of opportunity to give them less than a four-movement work to play.

Why do the classical sonatas maintain this scheme of self-centred movements with no community of theme? The answer to this lies in the relation between their time-scale and their emotional content. In its early forms the sonata is a new kind of suite, complete in its contrasts. In its later developments the individual movements, while complete as designs, raise emotional issues which each movement is unable to satisfy without the others. The first movement of Beethoven's not inaptly named *Appassionata* sonata (Op. 57) whirls us through an immense tragedy in eight minutes. The movement is irrevocably completed; but our emotional reactions have not more than begun. We need the unutterable calm of the slow movement with its theme rooted to its tonic chord, and its simple and solemn variations in the ancient form of *doubles*. A foreign chord replaces that of its cadence; the vision is broken and the finale rushes headlong to the end of a tragic fate. The whole emotional scheme is perfect; but for one movement to take up the themes of another would be to tell a twice-told tale. Hence the classics, including Brahms, are not only cautious but cryptic in the few cases where they allow one movement to allude to another. The only occasion for clearness in such allusions is with introductions, which may well foreshadow the following movement, and, in the case of introductions to finales, may dramatically recall the past.

The emotional unity of the sonata is already significant in Mozart and Haydn. Their artistic hypotheses are those of comedy; and even so tragic a note as the last page of Haydn's F sharp minor quartet (Op. 50, no. 4) can be sounded only in the severe form of fugue. One of the most significant gestures in all the history of music is that of the introduction to the finale of Mozart's G minor quintet. The slow movement is one of the profoundest things possible before Beethoven. One is inclined to resent the notion that such music can have limitations. Being perfect it is infinite, and you cannot compare infinities. But you can be clear as to their elements; and the terms of its art forbid this pathetic music to handle tragic action. For tragedy, music needs such resources as are shown in Ex. 7, and these would shatter Mozart's aesthetic system. But after that slow movement even the finale of Mozart's own G minor symphony would sound peevish. So Mozart writes a solemn slow introduction which bids the art of music run away and play, for the rest is too sad for it. And so the bright rondo-finale is another story. Mozart would neither violate his aesthetic system nor anticipate Mendelssohn's naïve way of striking a religious note with a complete unconsciousness of its blasphemy.

The Sonata Since Beethoven.—The sonata-style belongs to the sonata time-scale and to the classical key-system. Music in the Wagnerian time-scale, or in "atonal" or other new harmonic systems, has no more to do with it than Greek prose. Nor do changes in the general outlines of the form mean much in themselves. The classical forms are, even externally, far more varied than those of later sonata-works; and the essentials of the sonata lie much deeper.

Schubert achieved wonderful things in his sonata works, but died before he had perfected his forms. His expositions digress into developments, his developments subside into long twice-repeated lyric episodes, and his recapitulations reveal that recapitulating is the very thing his expositions are not designed to bear. Nevertheless Schubert was on the high road towards genuine new forms.

What these forms were to be was best revealed by Brahms. It is fashionable to deny that Brahms invented new forms; and this is like Humpty-Dumpty's complaint that Alice's features were arranged so exactly like other people's that he could not be expected to recognize her. Forms must be studied in detail from phrase to phrase, and classified afterwards: not classified by guess-work and warped to fit the guess. Brahms has many new ways of phrasing and of developing themes (*see* Melody, Ex. 11); and no two of his forms are alike. Least of all composers does he resemble Schumann, whom he was at first accused of imitating.

Schumann's sonata works show an interesting artificial system. His ideas were lyric and epigrammatic; and they shaped themselves squarely and with a Macaulayesque habit of antithesis. With this style he contrived to build important sonata works as one might construct a landscape in mosaic. He knew what he was doing, and the result is often delightful. In his D minor symphony he achieved a new continuity of form and theme, retaining the classical group of four main movements, but running them together without break and using transformations of the same themes in all four. Schumann's hard outlines and square rhythms have been copied without his wit in countless later sonata works, especially by those Russian composers who, led by Nicolas Rubinstein, danced upon his grave in derision of these very features.

Mendelssohn handled all sonata forms with an often dangerous facility but sometimes with genius. The opening of his D minor trio is the prototype of those innumerable allegros which are really andantes riding an ambling horse or running up a descending escalator.

The masterly scheme (there is only one) of Spohr is (as Schumann remarked) not so easy to imitate as it looks; but it is the prototype of most pseudo-classical works up to the present day; and many teachers believe it to be the only orthodox form. Against such teaching young artists do well to revolt, but why call it classical?

The quality most conspicuously absent in sonata-work since Brahms is movement. The fundamental mistake of Bruckner (*q.v.*) was in associating his Wagnerian style with sonata forms at all. Sibelius solves Bruckner's problem, and takes and leaves the sonata style as he pleases, and always with clear purpose, whether convincingly or not. Reger's meticulously regular forms are hard to accept as the really proper vessel for his strong chromatic brew; and as for imitating him, one might as well try to write a Meredith novel from one metaphor to the next. The art of movement is the crux of the sonata problem; and the classical solutions of it from Haydn to Brahms are the greatest things in pure music.

(*See* also Symphony; Sonata; Music; Variations; Rondo; Scherzo; and the articles on the various individual composers who have been referred to.) (D. F. T.)

SONDERBORG, a seaport and seaside resort in North Slesvig, Denmark, on the south-west coast of the island of Alsen, of which it is the chief town, and 17 m. N.E. from Flensburg. Pop. (1925), 10,454. The town, which existed in the middle of the 13th century, was burnt down in 1864 during the assault by the Prussians upon the Düppler trenches. It then passed into the possession of Germany, but was restored to Denmark by the plebiscite of 1920. It is connected with the mainland by a pontoon bridge, and has a castle with a beautiful chapel.

SONDERSHAUSEN, a town of Germany, in the republic of Thuringia, 37 m. by rail N. of Erfurt. Pop. (1925) 10,122. It possesses a castle and manufactures of woollens and bricks. Potassium salts are also mined here. The town was formerly the capital of the principality of Schwarzburg-Sondershausen.

SONDRIO, a town of Lombardy, Italy, capital of the province of Sondrio, in the Valtellina, 1,140 ft. above sea-level, on the river Adda, 26 m. E. of Lake Como and 82 m. by rail N.E. of Milan. Pop. (1921) 9,807. Sondrio has silk-works. Above the town to the north rise the snowclad peaks of the Bernina group. The railway goes on to Tirano, 16 m. farther east, and thence over the Bernina pass into Switzerland, while the Stelvio road crosses to Spondigna in the upper valley of the Adige (now called the Val Venosta).

SONE or Son, river of central India identified with the Erannoboas of the Greek geographers. With the exception of the Jumna it is the chief tributary of the Ganges on its right bank. It rises in the Amarkantak highlands about 3,500 ft. above sea-level, and flows north-west until it strikes the Kaimur range, which constitutes the southern wall of the Gangetic plain. Here it turns east and continues until it falls into the Ganges about 10 m. above Patna, after a total course of 465 m. The Sone canals, fed by the river, form a great system of irrigation in the province of Bíhar.

SONG. All song, indeed all music, is based upon folk-song. Folk-song in Europe reached what may be considered its highest point of development in the 15th and 16th centuries. There is, to be sure, an antiquarian interest attaching to the melodic side of the songs of the troubadours, trouvères and minnesingers, who flourished in the 12th and 13th centuries; but it may reasonably be said that till the 17th century, the only form of song of musical importance was the folk-song, and that the songs of the minstrels were most successful when they took their inspiration from it. They were in fact poets, who, whether musically gifted or not, were forced by tradition to provide their poems with a musical, *i.e.*, melodic, counterpart. What the nature of their instrumental accompaniments was, is unknown.

From the musical standpoint, folk-song represents vocal melody evolved with no thought of harmony or an accompanying instrument. Its poems are in stanzas, the same melody serving for each. The melodies are formed on certain natural scales or modes, which were the heritage of the Indo-European races, and were in common use in all music, till about the year 1600, when harmony established itself as the basis of music, bringing the era of vocal counterpoint to an end, and substituting for the old modes our present major and minor scales; lastly, the folk-song is instinctive music, arising from the necessity inherent in the human race to use the voices which nature has bestowed upon it, in order to give expression to feelings, for which speech alone is felt to be inadequate. From whatever rude beginnings it evolved, the final fruit of this instinct is the melody we find in folk-song, a natural product, an unconscious art, which stands in contrast with the creations of conscious art, *i.e.*, songs by trained musicians, who invent their own melodies and provide them with instrumental accompaniments.

It is with these latter alone that this article is concerned, folk-song being dealt with in a separate article.

At the close of the 16th century the lute was the popular musical instrument of the educated classes. It was at this time that the first really important body of song was produced, especially in England. At first it may be described as a small satellite detached from the large planet of the madrigal, which had for about a century held the field as the favourite diversion of musical amateurs. There is little doubt that the idea of solo song arose when in madrigal singing the parts of missing voices were taken by instruments; it is plain that if all the voices but one were missing, the effect of a solo song with instrumental accompaniment was realized; a still nearer approach to artistic solo song was reached when the singer sang his own part of a madrigal, playing the other parts himself. In Dowland's *First Book of Songs or Airs* in four parts (published in 1597), the principal vocal melody has an alternative accompaniment for three additional voices or the lute. Most of the English madrigals were published "for voices or viols."

In Italy Caccini published in 1601 his famous collection of songs for the lute (*Nuove Musiche*). He claimed in his preface to be the first to invent songs "for a single voice to the accompaniment of a single instrument." It is true that his friends in Rome (his native city), at whose houses these new compositions were performed, assured him that they had never heard the like before, and that his style exhibited possibilities for the expression of feeling that were excluded when the voice sang merely one part in a contrapuntal work. But, about 30 years before Caccini, lutenists in France had anticipated his innovation, and composed solo songs with lute accompaniments in which is evidenced the struggle, not always successful, to break away from polyphonic traditions. Le Roy's *Airs de Cour,* published in 1571, may be cited in proof of this statement (*see* a book of *French Ayres,* Peter Warlock, 1928, in which the lute accompaniment has been transcribed for the piano). Of these airs "Je suis amour" is somewhat in the declamatory recitative style of Caccini's *Nuove Musiche* (see *Sämmelbande Int. Musik Gesellschaft,* article "Airs de Cours d'Adrien Le Roy," by Janet Dodge). Generally speaking, it may be said of early French songs that they were longer in shaking off the influence of the past than the songs of the Italians, many tricks of expressions, belonging to polyphonic times, surviving both in voice parts and accompaniments.

In England, about the end of the 16th century several volumes of songs to be sung with lute accompaniment made their appearance. It is worth observing that several were of earlier date than the "new music" of Caccini; they were an entirely English product. Some were songs or airs of four parts with tablature for the lute, so made that all the parts together or either of them separately could be sung to the lute, or orpharion; some were published only for a solo voice and lute. Dowland, who composed 87 songs, was undoubtedly the greatest of the large band of English lutenists. Even when, as in the first book of airs (1597), his songs could be sung by four voices, they distinguished themselves from the madrigal by the special melodic interest given to the top part. He was thus really the creator of the modern art-song. Though Byrd had (about 1583) composed "My Little Sweet Darling" and a few other songs with string accompaniment he did not, like Dowland, make the new type of song a special study. Dowland's fame, apart from the peculiar charm of his melodies, their expressive character, and their fitness to the words—a point which is characteristic of the work of the early lutenists—rests upon the important part he assigns to the lute. In many songs it contributes more to the expression than the vocal melody itself. Being himself not only a distinguished lutenist but a distinguished singer, he understood what it is that makes a song a joy to sing—as later Schubert, also a singer, understood. It became in fact an art-form. "Dowland was the first to specialize in this form and to develop it, and the art songs of Schubert, Schumann and Brahms with pianoforte accompaniment are lineal descendants of Dowland's songs with lute accompaniment" (Dr. Fellowes). The following songs, "Can she excuse my Wrongs," "Sorrow Stay," "Flow My Tears," "Weep You no More Sad Fountains," "In Silent Night," "Fine Knacks for Ladies," and "Once Again," may be cited as supporting this statement.

Campion, Rosseter and Jones are, after Dowland, the most individual composers in the same field. Campion's "There is a Garden in Her Face," "Shall I come if I Swim?"; Rosseter's "If She forsake Me," "When Laura Smiles" and "Would you see My Mistress' Face"; Jones's "Go to bed Sweet Muse" and "Sweet Kate" are good examples of their work. Each of these composers wrote about 100 songs.

Italy.—Meanwhile Italian composers, in spite of the frottole, villote, villanelle, balletti and falalas (arrangements in vocal parts of popular melodies common in Italy and other countries in the last half of the 16th century) seem to have been unaffected in the new song movement by popular influences (we have practically no knowledge of the Italian folk-song in mediaeval times); they went straight from the polyphonic to the recitative style (invented by Peri and Caccini for their early experiments in opera in 1600) and advanced with extraordinary rapidity.

MELODY AND RECITATIVE

In opera and cantata melody was quickly added to relieve the monotony of recitative, which must have been acutely felt by the hearers of such works, and considerable advance in this direction was made by Cavalli and Cesti (see *Oxford History of Music,* vol. iii., for details of their methods). Monteverde, though a greater genius than either of them, did not succeed in forcing the daring qualities of his own conceptions on others. The famous lament of Ariadne was the expression of an individual genius casting all rules aside for the sake of poignant emotional effect, rather than the beginning of new style in song. Carissimi and Rossi in oratorio and cantata (a word which then merely described a piece that was sung, as sonata a piece that was played, consisting generally of alternate recitative and aria) brought the organization of melody to a high degree of elaboration, far beyond anything attempted by Cavalli or Cesti. In their hands the declamatory methods of Monteverde were made subordinate to larger purposes of design. A broad and general characterization of emotional situations was more natural to them and to their successors than a treatment in which points were emphasized in detail. It was, moreover, inevitable in these early developments of musical style, in which melody played the leading part, that such sacrifices as

were necessary in balancing the rival claims of expression and form should be in favour of the latter, rather than the former. But the formal perfection of melody was not the only problem which 17th century Italian composers had to face. The whole question of instrumental accompaniment had to be worked out; the nature and capacities of instruments had to be explored; the reconciliation of the new art of harmony with the old art of counterpoint to be effected. It speaks volumes for the innate musical sense and technical skill of the early Italian composers that the initial stage of tentative effort passed so quickly, and that at the close of the 17th century we are conscious of breathing an atmosphere not of experimental work, but of mature art.

Alessandro Scarlatti (1659–1725) sums up the period for Italy. That much of his work is dry and uninspired is not surprising when the quantity of it is realized (he composed over 100 operas and 500 vocal cantatas) and also the unfavourable conditions under which operatic composers had to work; but the best of it is singularly noble in conception and perfect in design. The same is true of the best work of Legrenzi, Durante, Leonardo Leo and Caldara, work which was of incalculable importance for the development of musical, and particularly of vocal art, and which will always, for minds attuned to its atmosphere of severity and self-restraint, possess an abiding charm; but comparatively few specimens have retained the affections of the world at large. Carissimi's "Vittoria," Scarlatti's "O cessate" and "Le Violette" are the most notable exceptions ("Pietà Signore" is not included, as no one now attributes it to Stradella).

The almost universal preference of the Italians in the 17th and 18th centuries for the *da capo* aria involved some sacrifice on the dramatic and emotional side; this becomes clear at once if we think of an opera in which nearly all the songs end by repeating not only the melody of the opening part, but the words attached to it. It is this double repetition which from the point of view of dramatic propriety is the most disturbing. But composers were too much occupied in exploring the formal possibilities of melody to establish a really intimate connection between music and text, a detailed interpretation of which lay outside their scheme of song. Much repetition of words was not felt as an absurdity so long as the music was broadly in accordance with the atmosphere or situation required.

When detailed and impassioned treatment was needed, composers turned to what is known as *recitativo arioso,* of which remarkably fine specimens appear in Scarlatti's operas and cantatas. But the masterpieces in this style are in the works of Handel and Bach.

Before Scarlatti's death in 1725 symptoms of decline had appeared. He was himself often compelled to sacrifice his finer instincts to the popular demand for vocal display. A race of singers, of whom the majority were virtuosi rather than artists, dominated the taste of the public, and forced composers to furnish opportunities in each rôle for a full display of their powers. It was not long before more obvious types of melody, expressing more obvious feelings, became the fashion. The varied forms of accompaniment, in which a contrapuntal bass had been a conspicuous feature, were wasted upon a public which came to hear vocalists, not music; and stereotyped figures, of the kind which second-rate art after the first half of the 18th century had made only too familiar, took the place of sound workmanship, so that the Italian school, which had stood as a model for the world, became identified with all that was trivial, insipid, and conventional. Not that the Italian tendency in the direction of tunefulness was in itself either unhealthy or unworthy. It was indeed a necessary reaction, when the severe earlier style began to pass into cold and calculating formalism. But the spirit of shallowness and frivolity which accompanied the reaction helped to transfer the musical supremacy hitherto enjoyed by Italy to Germany, the only country which, while accepting what was necessary to it of Italian influences, remained true to its own ideals.

Germany.—The musical genius of Germany, which has created for the world the highest forms as yet known of symphony, oratorio and opera, has also created the *Lied*—the term by which is most easily conveyed the modern conceptions of ideal song. Germany is, moreover, the only country in which the art of song in orderly and progressive development can be traced from the simple mediaeval Volkslied to the elaborate productions of Schubert, Schumann and Brahms. If Germany is united to the rest of Europe in her debt to Italy, still her final conception of song belongs to herself alone. And this conception has more profoundly influenced the rest of Europe than any Italian conception ever influenced Germany. The student, therefore, is more profitably employed in studying the phases of song development in Germany than in any other country.

It is not necessary to dwell, except in very general terms, upon German song of the 17th century. It can point to nothing corresponding with the *Airs de cour* of France, or the far more important songs of the English lutenists. The kind of literature necessary for such development was wanting. German art was too deeply affected by the spirit which produced the Reformation to develop freely in secular directions. Even in the domain of the Volkslied the sacred songs were scarcely less numerous than the secular, quantities of secular airs being provided with sacred words in accordance with the spirit of the times. In the 17th century, the work of the Italian monodists was bound eventually to stimulate German composers to make songs, but their interest at first lay more in opera and choral-instrumental works, in which solo songs appear, than in song as an independent branch of art. A good general view of such isolated songs as appeared can be obtained from Reimann's collections *Das Deutsche Geistliche Lied* and *Das Deutsche Lied* (Simrock).

In spite of some stiffness and awkwardness, many of these exhibit a touching earnestness and sincerity which mark them as distinct from any work done elsewhere at the same time. On the other hand, they lack the certainty of touch, as well as the melodic and declamatory power, which make Purcell in England stand out pre-eminently as the greatest song composer of the 17th century. The treatment of the aria by Bach and Handel lies outside the scope of this article. Nor shall we pause to consider the songs of lesser composers, eminent in their day, such as Telemann (1691–1767), Graun (1701–1759) and Agricola (1720–1774), whose vocal work was confined to oratorio, opera and cantata.

At the outset it is necessary to distinguish between that more distinctly popular type of song, known as the *Volksthümliches* Lied, in which the same melody served for all the stanzas of a poem (as in the Volkslied itself, on which the *Volksthümliches* Lied was modelled), and the *durchcomponiertes* Lied, or song "composed through," in which the music forms a running commentary on a poem, without respect to its form, or, if stanza form is preserved, varying the music in some stanzas or in all in accordance with their poetical significance. Generally speaking, the former aims at a wider audience than the latter, the appreciation of which involves some degree of culture and intelligence, inasmuch as it aims at interpreting more complex and difficult kinds of poetry. In the 18th century the simple *Volksthümliches* Lied in strophic form was most in favour, and those who care to trace its history in the hands of popular composers like J. A. Hiller, J. A. P. Schulz, Reichardt, and Zelter, can easily do so by consulting Härtel's *Liederlexicon* (Leipzig, 1867), one of a number of similar publications. Side by side with the outpouring of somewhat obvious and sentimental melodiousness which such volumes reveal, it must be remembered that the attention of greater men to instrumental composition, the growing power to compose for keyed instruments (which began to replace the lute in the middle of the 17th century) and the mechanical improvements through which spinet, clavichord and harpsichord were advancing towards the modern pianoforte, were preparing the way for the modern Lied, in which the pianoforte accompaniment was to play an increasingly important part. C. P. E. Bach (d. 1788) alone of his contemporaries gave serious attention to lyrical song, selecting the best poetry he could get hold of, and aspiring to something beyond merely tuneful melody. The real outburst of song had to wait for the inspiration, which came with the poetry of Goethe and Schiller.

Haydn and Mozart.—It is unfortunate that Haydn and Mozart, endowed with all the gifts that make for beautiful song

except that of literary discrimination, should have left so little of real value. There is, indeed, much to admire in some of Haydn's canzonets, of which "My mother bids me bind my hair" fully deserves its popularity, while Mozart's "Trennung," "Unglückliche Liebe," and "Komm' lieber Mai," are small treasures which we could not afford to lose. But in only two songs by Mozart, "Abendempfindung" and "Das Veilchen," is the goal to which the art was to advance clearly discerned and in the latter case perfectly attained. Both are *durchcomponiert,* in both the general spirit, as well as each isolated point of beauty in the verses is seized and portrayed with unerring insight. "Abendempfindung" is seriously marred by carelessness in accentuation (still worse examples may be seen in "An Chloe") and by annoying repetition of words, due to the development of the melody into a formal and effective climax, on instrumental, not vocal, lines.

In "Das Veilchen," however, where Mozart touched a poem that was worthy of his genius, he produced a masterpiece—rightly regarded as the first perfect specimen of the *durchcomponiertes* Lied. Every incident in the flower's story is minutely followed, with a detailed pictorial and dramatic treatment (involving several changes of key, contrasts between major and minor, variations of rhythm and melody, declamatory or recitative passages), which was quite new to the art.

Beethoven.—With Beethoven, song was suddenly exalted to a place among the highest branches of composition. Taken in hand with the utmost seriousness by the greatest musician of the age and associated by him, for the most part, with lyrical poetry of a high order, it could at last raise its head and, freed from the conventional puerilities of the salon, look a larger world confidently in the face.

It cannot, however, be admitted that Beethoven was an ideal song composer. His genius moved more easily in the field of abstract music. The forms of poetry were to him rather a hindrance than a help. His tendency is to press into his melodies more meaning than the words will bear. The very qualities, in fact, which make his instrumental melodies so inspiring, tell against his songs. Though his stronger critical instinct kept him, as a rule, from the false accentuation which marred some of the work of Haydn and Mozart, yet, like them, he could not free himself from the instrumentalist's point of view, at any rate in the larger song-forms. The concluding melody of "Busslied" would be equally effective played as a violin solo; the same is true of the final movements of "Adelaïde" and of the otherwise noble cycle "An die ferne Geliebte"—movements in which the words have to adapt themselves as well as they can to the exigencies of thematic development and to submit to serious displacements and tiresome repetitions.

In songs of a solemn or deeply emotional nature, Beethoven is at his best, as in that cycle, to sacred words of Gellert, of which "Die Ehre Gottes aus der Natur" stands as a lasting monument of simple but expressive grandeur, in "Trocknet nicht," "In questa tomba," "Partenza," in the first of four settings to Goethe's "Nur wer die Sehnsucht kennt," and more than all, in the cycle mentioned above, "An die ferne Geliebte." We have left behind the pretty artificialities so dear to the 18th century, that play around fictitious shepherds and shepherdesses, and enter the field of deeper human feeling, with the surrounding influences upon it of nature and romance.

The new spirit of the age, represented in German poetry by the lyrics of Bürger, Voss, Claudius and Hölty, members of the famous Göttinger Hainbund, and more notably by those of Goethe and Schiller, communicates itself in Beethoven to song. It needs no large study of his songs to perceive that the accompaniment has assumed, especially in the "Liederkreis," an importance immeasurably greater than in the songs of any previous composer. It begins to take a real, not a perfunctory, part in interpretation, providing both a background and a commentary to the poet's verses.

Schubert.—The pioneer work of Schulz, Reichardt and Zelter in the setting of Goethe's lyrics deserves—for they did not confine their activities to popular songs—mention as indicating the direction in which composers were moving; a word is also due to Zumsteeg, who, in spite of the sometimes childish simplicity of his work, yet, in the use which he made of modulation as a means of lyrical expression, had some influence upon the greatest song writer of all ages, Franz Schubert.

Schubert's "Erlkönig" was written a few months before Beethoven's "Liederkreis"; "Gretchen am Spinnrade," about a year before the "Erlkönig." He was 18 when he composed the latter, in 1815. Lyrical song, divorced from all hindering elements and associations, whether of salon or theatre, was here at the threshold of his short career in almost full maturity and plenitude of power. It is sufficiently remarkable that a lad with so little education should have composed such music; it is more astonishing still that he should have penetrated with unerring insight into the innermost secrets of the best poetry. Two of the necessary qualifications for a great song composer were thus at last united. Schubert possessed the third—a knowledge of the human voice, partly intuitive, partly the result of his experience as a chorister boy. The beauty of his melodies is scarcely more striking than the gratefulness of their purely vocal qualities. The technique of singing had, indeed, been understood for nearly two centuries; but Schubert was the first to divine fully its emotional range, and to dissociate it in lyrical work from the traditions of the schools. From the beginning to the end of his career he never penned a note or a phrase merely because it was vocally effective. What he wrote for the voice to sing was there because for him the poetry could not have it otherwise. This was inherent in his method of working, in which he relied implicitly upon his musical inspiration for a response, usually instantaneous, to the inordinate receptivity of his mind to the impressions of poetry. To read through a poem was for him not only to seize its innermost significance and the salient points of its language and its form, but also to visualize the scheme by which both the whole and the parts could be translated and glorified through the medium of music. As the singer Vogl, the first of his profession to appreciate him, remarked, "He composed in a state of clairvoyance." Hence the impossibility of summarizing in a short space the innovations he introduced: for new poems immediately suggested new types of song. His settings to Goethe's lyrics, that is, the best of them, differ as essentially from his settings to those of W. Müller in the cycles "Die schöne Müllerin" and "Die Winterreise," as these, again, from the settings of the six poems of Heine.

Hardly a single development in subsequent phases of the art (except those which eliminate the melodious element) is not foreshadowed in one or other of his songs (about 656 in number). Brahms, the greatest of his successors, said that there was something to be learned from every one of Schubert's songs. He was as perfectly at home in the *durchcomponiertes* Lied as in the simple strophic type, or the purely declamatory. "Der Wegweiser," "Haidenröslein," "Der Doppelgänger" are familiar but supreme examples of each. Certain features may be selected for emphasis: first, his use of modulation as a means of emotional expression. "Du liebst mich nicht" traverses, in two pages, more keys than would serve most composers for a whole symphony—while the discords on the words "Die Sonne vermissen" and "Was blühen die Narcissen" give a piercingly thrilling effect which is quite modern. The modulations in "Wehmuth" illustrate the subtle atmospheric effects which he loved to produce by sudden contrasts between major and minor harmonies. More familiar instances occur in "Gute Nacht," "Die Rose," and "Rosamunde." Secondly, his inexhaustible fertility in devising forms of accompaniment which serve to illustrate the pictorial or emotional background of a poem; we have the galloping horses and the horn in "Die Post," the spinning wheel in "Gretchen," murmuring brooks in many songs from "Die schöne Müllerin" and "Liebesbotschaft," the indications of an emotional mood in "Die Stadt" or "Litanei." Occasionally, it is true, the persistence of a particular figure or rhythm induces monotony, as in "Ave Maria" or "Normans Gesang," but generally Schubert had plenty of means at his command to prevent it, such as the presence of an appropriate subsidiary figure making its appearance at intervals, as in "Halt," "Der Einsame," or some enchanting ritornello, by which a phrase of the vocal melody is echoed in the accompaniment, as in "Liebesbot-

schaft," "An Sylvia," "Ständchen" and "Fischerweise," or variations in the accompaniment to the different stanzas, as in "Der Frühling." Thirdly, the sudden entrance of declamatory passages, as in "Der Neugierige," "Am Feierabend," in "Gretchen" at the famous "Ach, sein Kuss." Fourthly, the realistic touches, by which suggestions in a poem are incorporated into the accompaniment, such as the cock crowing in "Frühlingstraum," the convent bell in "Die junge Nonne," the nightingale's song in "Ganymed," or the falling tears in "Ihr Bild." Finally should be noted the rarity of slips in the matter of the just accentuation of syllables; and this is specially remarkable in a song writer who relies so much upon pure melody as Schubert; for to find and preserve a melodic outline which is felt as a true expression of a poem and yet does no violence to its text is far more difficult than to compose in the declamatory style. But nothing is difficult to Schubert. He is as successful in "Liebesbotschaft" as in "Prometheus."

For further details the reader is referred to the brilliant essay on song, with which Sir Henry Hadow concludes vol. v. of the *Oxford History of Music.* It must suffice here to point out in a general way that in wideness of scope and aim, in intensity of expression, Schubert produced the same transformation in the lyrical field that Beethoven had produced in the larger forms of sonata, string quartette and symphony. Beethoven's work was necessary before Schubert could arise, but Schubert's conceptions and methods were the fruit of his own genius.

Loewe and Weber.—Of his contemporaries, Loewe deserves mention for his singular success in overcoming the difficulties involved in setting long ballads to music. To preserve homogeneity in a form in which simple narration presents perpetually shifting changes of action, of picture, of mood, is a problem which Schubert himself only once triumphantly solved. Weber contributed nothing of permanent value to song, outside his operas, beyond a few strophic songs of a popular nature. He disqualified himself for higher work by that singular preference for vapid and trivial verse, which so often led Haydn and Mozart astray.

Mendelssohn and Schumann.—Mendelssohn's literary tastes took him often to the best poems but he made but little attempt to penetrate beyond their superficial and obvious import. His own lovable personality is far more clearly revealed in his songs than the spirit of his poets. Differences of literary style affected the style of his music less than that of any other distinguished composer. He attained his highest level in "Auf Flügeln des Gesanges," in the first of the two songs to "Zuleika," and "Nachtlied."

It is noteworthy that there is no trace of Schubert's influence. Had he never lived, Mendelssohn's songs would have been just the same. Hence, in spite of graceful and flowing melodies, simple in form and instinct with that polished taste and charm of manner which endeared both himself and his works to his own generation, his songs have exercised no permanent influence upon the art. Their immediate influence, it is true, was enormous: it is felt occasionally in Schumann, only too often in Robert Franz, and in the work of many composers of more or less distinction in many countries besides his own, such as Gade, Lindblad, Sterndale Bennett and others who need not be specified.

Of far greater importance is the work of Robert Schumann, whose polyphonic methods of technique and peculiarly epigrammatic style enabled him to treat complex phases of thought and feeling, which had hardly become prominent in Schubert's time, with extraordinary success. Both by temperament and by choice he identified himself with the so-called Romantic movement, a movement in which both poetry and music have tended more and more to become a personal revelation rather than "a criticism of life." With Schubert, who was the very incarnation of romance, the note of universality, that abiding mark of the classical composers, is stronger than the impress of his own personality.

With Schumann the reverse is the case. If the Romantic movement gave a new impetus of vast importance both to music and literature, it had its weaker side in extremes of sensibility which were not always equivalent to strength of feeling. Mendelssohn's songs admittedly err on the side of sentimentality—Schumann, with Liszt, Jensen, and Franz, frequently betrays the same weakness. His best work appears in the settings of Heine's lyrics (especially the *"Dichterliebe"*), in the "Eichendorff," "Liederkreis," in Chamisso's *"Frauenliebe und Leben,"* and a fair number of other songs, such as "Widmung," "Der Nussbaum," "Aufträge," and on the dramatic side in "Der Soldat," "Die Karten-Legerin" and "Die beiden Grenadiere," all strong in feeling and full of poetic and imaginary qualities of a high order. He realized that the new poetry called for new methods of treatment. These Schumann, instinctively an experimenter, provided, first, by a closer attention to the minutiae of declamation than had hitherto been attempted, and herein syncopation and suspension provide possibilities unsuspected even by Schubert (in whose work hardly a case of syncopation will be found in the voice part); secondly, by increasing the rôle of the pianoforte accompaniment—and in this he was helped on the one hand by novel methods of technique, of which himself and Chopin were the chief originators, and on the other by his loving study of Bach, which imparted a polyphonic element which was new to modern song. In nearly all Schubert's songs, and in all of Mendelssohn's, the melody allotted to the voice is an essential factor. In Schumann the rôle of interpreter often passes to the accompaniment, while the voice declaims the words, as in "Es ist ein Flöten und Geigen," or "Rösslein," but the notes in which it declaims them are musically important. Consistently with this attitude, he gave increased prominence to the opening and closing instrumental symphonies; these became in his hands no merely formal introductions or conclusions, but an integral part of the whole conception and fabric of the Lied. This may be illustrated by many numbers of the "Dichterliebe," but most remarkable is its final page, in which the pianoforte, after the voice has stopped, sums up the whole meaning of the cycle.

A third point is his fondness for short, interrupted phrases (often repeated at different levels) in place of the developed Schubertian melodies; a practice which has been extended by later composers, but often, as in the case of Franz, without Schumann's tact. On many grounds, then, Schumann may be regarded as having widely extended the conception of the Lied; his example has indeed encouraged later composers to regard no lyric poetry as too subtle for musical treatment.

A bold experimenter in song was Franz Liszt, whose wayward genius, with its irrepressible bent towards the theatrical and melodramatic, was not at home within the limits of a short lyric. It is true that there is sincerity of feeling, if not of the deepest kind, in "Es muss ein Wunderbares sein" and "Ueber allen Gipfeln," but concentrated emotion, which involves for its expression highly organized form, was alien to Liszt's genius, which is more truly represented in songs like "Die Lorelei," "Kennst du das Land" or "Am Rhein," in which are presented a series of pictures loosely connected, giving the impression of clever extemporizations. It is not sufficiently recognized that such work is far easier to produce than successful strophic song, even of the simplest kind.

The popularity, therefore, of "Die Lorelei," is not so much a tribute to Liszt's genius, as an example of the extent to which gifted singers and undiscerning critics can mislead the public. Mere scene painting, however vivid, however atmospheric—and these qualities may be conceded to Liszt, and to others who have followed his example—takes its place upon the lower planes of art.

The admiration expressed by Liszt and Wagner for the songs of Robert Franz, and the cordial welcome extended by Schumann to those which first made their appearance, have led to an undue estimate of their importance in many quarters. They are characterized by great delicacy both of feeling and of workmanship, but the ingenuity of his counterpoint, which he owed to his intimate knowledge of Bach and Handel, cannot conceal the frequent poverty of inspiration in his melodic phrases, nor the absence of genuine constructive power. To build a song upon one or two phrases repeated at different levels and coloured by changing harmonies to suit the requirements of the poetic text (as in "Für Musik" and "Du bist Elend") is a dangerous substitute for the power to formulate large and expressive melodies. But it is the method which Franz frequently pursued. His songs are mostly short and in the strophic form, some alteration being reserved to

give point to the last verse. His tricks of style and procedure so quickly become familiar as to exhaust the patience even of the most sympathetic student. But the sincerity of his aims, the idealistic and supersensitive purity of his mind (which banished as far as possible even the dramatic element from his lyrics), its receptiveness to the chaste, tender and refined elements in human character render his songs an important contribution to our knowledge of the intimate side of German feeling, and provide some compensation for the lack of the larger qualities of style and imagination. His best qualities are represented in the beautiful setting to Lenau's "Stille Sicherheit."

Peter Cornelius.—A higher value than is usually conceded, attaches to the songs of Peter Cornelius, a friend of Liszt and Wagner, but a follower of neither. Before he came under their influence, he underwent a severe course of contrapuntal training, so that his work, though essentially modern in spirit, has that stability of structure which makes for permanence. He was, moreover, an accomplished linguist, a brilliant essayist and a poet. That intimate fusion between poetry and music, which since Schubert has been the ideal of German song, is realized in an exceptional manner, when, with Cornelius as with Wagner, librettist and musician are one person.

Finer declamation is rarely found than in his subtly imaginative "Auftrag," whilst for beauty of feeling, apart from technical excellencies of a high order, the "Weihnachtslieder," the "Brautlieder" and much of the sacred cycle *"Vater Unser"* are hardly surpassed even by Schumann at his best, and point to Cornelius as one of the most beautiful and original spirits of the 19th century.

In the song work of the 19th century, though Schubert is the rock upon which it has been built, Schumann represents the most directly inspiring influence, even when, as in the case of Adolph Jensen (whose spontaneously melodious and graceful songs deserve to be better known), there are importations from such widely divergent sources as the works of Mendelssohn and Wagner.

The application of the principles of Wagnerian music-drama to lyrical work was, sooner or later, bound to come and, for a time, to bring confusion. Song was rescued from it by the work of two men of genius who, though they approached the task from very different standpoints, may be considered to have placed the crown of final achievement upon the aspirations of 19th century song—Johannes Brahms and Hugo Wolf. The songs of Wolf are treated elsewhere. (*See* Wolf.) Here it is only necessary to say that he exhibits an entirely unconventional and original style. He is as untroubled by tradition as Schubert, whom he resembles, not often (as in "Fussreise" and "Der Gärtner") in pure melodiousness, but in the intensity of his power to penetrate to the heart of poetry. To him may also be fitly applied the epithet "clairvoyant." He was the first to publish songs "for voice and pianoforte," not "songs with pianoforte accompaniment," thus asserting the equality of singer and accompanist in interpretation.

NINETEENTH-CENTURY SONG ACHIEVEMENT

Brahms.—The unerring sagacity of Brahms discerned that the possibilities of song on the lines set by Schubert were far from being exhausted: his practical mind preferred to develop those possibilities rather than to seek after strange and novel methods, conforming thus, in song, to his practice in other branches of composition. A broad melodic outline was for him essential; also a strong contrapuntal bass. In form, the majority of his songs are strophic and follow the orthodox ABA or AABA pattern (the letters standing for stanzas), the central portion, B, being so organized as to offer, with the least possible introduction of new material, a heightened contrast with the opening portion through changes of rhythm and tonality, and at the same time to justify itself by producing the mood in which the return to the opening portion is felt as a logical necessity. Chromatic effects in Brahms's scheme of melody are rarely introduced till the middle section, the opening being almost invariably diatonic. It must, however, be admitted that Brahms's formal perfection involves some awkward handling of words, as in the second stanza of "Feldeinsamkeit"; sometimes, as in Nos. 3 and 4 of the *Magelone Lieder,* they are frankly sacrificed to that formal development of material which has already been criticized in the cases of Mozart and Beethoven.

No part of his songs deserves closer study than the few bars of instrumental prelude and conclusion; in them is enshrined the very essence of his conception of a poem. It may almost be said that, since Schumann set the example, the first and the last word have passed from the voice to the instrument, from the singer to the accompanist, who is called upon to understand poetry as well as music. Mastery in close organization of form was allied in Brahms not only with the warmth and tenderness of romance, but with the imagination and insight of an earnest thinker. Concentration of style and of thought are nowhere else in the history of the Lied combined on a plane so high as that which is reached, with all perfection of melodic and harmonic beauty, in "Schwermuth," "Der Tod, das ist die kühle Nacht," "Mit vierzig Jahren," "Am Kirchhof," "O wüsst' ich doch den Weg zurück," and the "Vier ernste Gesänge," which closed the list of his 197 songs. The alliance to song of so dangerous a companion as philosophy, or at any rate of thoughts which are philosophical rather than lyrical, proved no obstacle to Brahms's equal success in the realm of romance. This side of his genius may be illustrated by numerous songs from the *Magelone* cycle (notably "Wie froh und frisch" and "Ruhe, süss Liebchen") and by many others such as "Liebestreu," "Die Mainacht," "Feldeinsamkeit," "Wie rafft' ich mich auf in der Nacht," "Minnelied," "Immer leise wird mein Schlummer," "Lerchengesang," "Wie Melodien zieht es," "Geheimniss" and "Dein blaues Auge."

It has already been said that Brahms was a student of Schubert. If he had not Schubert's spontaneity of melody, he restored it to its Schubertian place of supreme importance. In spite of all the tendencies of his age, he never shirked that supreme test of a composer, the power to originate and organize melody, but it is melody which with its long phrases, its wide skips and something uncompromising in its nature may repel those hearers who are unable to attain to his level of thought and feeling. All mere prettiness and elegance are as alien to his nature as sentimental weakness on the one hand, or realistic scene painting on the other, so that, for the world at large, his popularity has been jeopardized by an attitude which is felt to be unnecessarily lofty and austere. It has found it difficult to reconcile itself to the treatment of modern lyrical poetry in a style whose elaborate contrapuntal texture differs as much from the delicate polyphony of Schumann, as that in its turn differed from the broad harmonic style of Schubert. But that Brahms is not difficult without reason, or elaborate when he might have been simple, may perhaps be assumed from the preference he felt for his slighter songs in the *Volksthümlich* form and style (*e.g.*, "Abschied," "Sonntag," "Vergebliches Ständchen" and "Wiegenlied").

He was strongly influenced by the Volkslieder of his country, the words of which he loved to repeat to himself, as they suggested ideas even for his instrumental compositions. His arrangements of Volkslieder, though not uniformly successful, mark an epoch in that field of work. Curiously enough, his love of folk-songs did not involve the sense which distinguishes between the genuine and the sham. Of the 49 Volkslieder published without opus number in 1894 by far the greater number were imitations which are really quite easy to recognize as such. (See *Brahms's Lieder* by Max Friedländer.)

The value of his arrangements may be tested by comparing them with the small volume containing arrangements by R. Franz, which are ingeniously done but without inspiration, with those of Tappert, which are models of what such things ought not to be, and with the dull, uninviting work of A. Saran. Many of Reimann's arrangements, however, deserve recognition as both sympathetic and scholarly. One fact emerges clearly from the study of folk-song arrangements, in Germany and elsewhere, that complete success depends upon qualities which are as rare as, and seldom dissociated from, the power of original composition. Only a great composer can be a great arranger. When Brahms's songs are considered as a whole, it is difficult to conceive of more

complete work on lines that are essentially classical. The soundest traditions find in them their justification and their consummation. He has enshrined the best thought and the noblest feeling of his age in forms where elaboration and complexity of detail serve essential purposes of interpretation and are never used as a brilliant artifice to conceal foundations which are insecure.

The above summary of German song, though necessarily incomplete and confined to the most conspicuous names, may yet provide some points of view from which the songs of other countries may be regarded, especially those in which German conceptions and German methods of technique have been dominant factors. Actual settings of German lyrics figure largely in the works of many non-German composers and can hardly be judged except by German standards; Rubinstein, Tschaikovsky, Grieg, are cases in point.

It remains now to conclude the survey of German song by touching on the work of a few prominent modern composers, who may be regarded as having enlarged the scope of the Lied without entirely breaking with its past.

Hans Pfitzner (b. 1869), a composer who may be counted among the old romantics, has enriched traditional forms rather than created new ones. His songs are felt to be individual experiences, they are "original but not at the cost of music" (Oscar Bie), poetical and full of beauty. The charm of "Herbstlied," "Sie haben heut'Abend Gesellschaft," "So fällt ein Stern herunter," does not fade. Others worth quoting are "Das verlass'ne Mägdlein" and "Denk' es, O Seele," which may be compared with Hugo Wolf's settings of the same words, and "Du milchjunger Knabe," of which Brahms's setting is the best known.

Max Reger (b. 1873—d. 1916) composed 225 songs; they are worth exploring on account of the originality of his harmonies, and his extraordinary contrapuntal skill, which he used deliberately with more thought for expression than for beauty. Overweighted with much learning, they make no great appeal to the singer's instincts. With the exception of some of the Wiegenlieder, especially "Wiegenlied-Maria," some of the Schlichte Weisen (especially "Waldeinsamkeit") and a few of his later songs, such as "Volkslied," "Sterbendes Kind" and "Unvergessen," the bulk of his work in song is not likely to be remembered.

Richard Strauss and Gustav Mahler.—The songs of Richard Strauss (b. 1864) represent a new departure, new, that is to say, to the 19th century, to which the bulk of them belongs. He is after Hugo Wolf, the most interesting of the modern composers who have applied the principles of Wagner to song. Discarding in many cases accepted forms, he has found freer play for his exceptional gifts in the matter of pictorial illustration and emotional colour. It is not surprising, therefore, that he has originated no great melodies, or indeed, composed many purely melodic songs, such as "Morgen," and "Du meines Herzens Krönelein," the melodies of which, if not highly organized, are graceful and appropriate. More often the phrase with which a song opens does not develop into a melody; we discover at once that the accompaniment with its rhythmical figure and changing harmonies is really in charge; and that the vocal phraseology, as the song proceeds, adapts itself to it. Though the plan is derived from Wagner, Strauss's music is both in style and feeling his own. "Ruhe, meine Seele," "Spätbot," "Traum durch die Dämmerung," one of his most beautiful creations, "Gefunden" and "Schlechtes Wetter" exhibit his best qualities; among them his power of depicting a given mood or atmosphere and sustaining it to the end. It must be admitted however that many of his songs, apart from their exceeding brilliance and effectiveness, both for voice and piano, *e.g.,* the popular "Ständchen" and "Heimliche Aufforderung," have no permanent value.

It is noteworthy that Strauss's name is not associated, as in the case of most of the German song composers, with any particular poet; he has composed no cycle; with all his varieties of style and resource, he exhibits but little power of characterization. His songs come to him too easily. There is nowhere the burning intensity of Schubert or Wolf.

In the songs of Gustav Mahler (1860–1911) we feel at once the presence of a tempestuous nature, tormented, restless, unsatisfied. He poured his heart into his songs and closest to his heart from boyhood were his native land (Moravia) and the old German folk-song. These were the inspiration of his music. What they meant to him is revealed in the series of vivid pictures, instinct with life, movement and colour, contained in the four "Lieder eines Fahrenden Gesellen" (originally for voice and orchestra) and in the three volumes of songs taken from *Des Knaben Wunderhorn* (a famous collection of old German songs and ballads). They are essentially dramatic songs, even realistic, full of melody of the folk-song type and provided with an accompaniment more orchestrally than pianistically conceived; the construction is apt to be loose and diffuse, with rough corners and purple passages; but they are original, alive, refreshing, worth knowing, in spite of blemishes, which are emphasized because they represent a danger to song; they bring it too close to the theatre. Lyrical moments have their place in opera, but the atmosphere of the Lied is disturbed by even a suggestion of the footlights. Rolland has pointed out that German music is losing "its intimate spirit" (a spirit which in a special sense belongs to the Lied) and he attributes this, with other disquieting signs, to the "detestable influence of the theatre to which nearly all these artists are attached as kapellmeisters or directors of opera." He is alluding specially to Strauss and Mahler. It should be added that the later songs composed by Mahler, after he had freed himself from operatic work, are quite different in style; they consist of five songs (not without interest) and the touching and deeply felt group of *Todtenkinderlieder,* the words of all being by Rückert.

There is a long list of composers, who like the above named are in touch with the old régime; many have written a number of attractive and well written songs, of which, in this country the best known are those of Felix Weingärtner (b. 1863) and Erich Wolff (*e.g.,* "Du bist so jung," "Alle Dinge haben Sprache," and "Faden"). Those of Joseph Marx (b. 1882) are at least equally striking, and perhaps more original. Philip Jarnach (b. 1892) has contributed some remarkable songs. Sensuous beauty has little attraction for him for its own sake, but he attains it sometimes, as it were, *malgré lui;* there is no superfluous ornament: when he strikes it is with *macabre* power. The concentration which he has given to his songs he expects from his hearers: he seems to have wrestled with the words he has set and drawn out their very heart. Among the most striking are "An eine Rose," "Jasmin," "Das mitleidige Mädel," "Lebenswege," "Freibeuter," "Japanesisches Regenlied," "Mailied" and many songs from the *Italienisches Liederbuch* (Paul Heyse). He may be said in his later work to belong to the school of Brahms—though the influence of Hugo Wolf is also felt.

PRESENT-DAY SONG

In recent years changes have taken place in the world of music quite as startling and revolutionary as those which, at the beginning of the 17th century, suddenly brought the days of vocal counterpoint and the modal system to an end and substituted harmony for melody as the basis of the "new music." Now, in its turn, the harmonic structure based on key relationship after three centuries of development, is being shaken to its very base and the world is talking once more of the "new music." Many composers in all European countries are exploring its possibilities and producing music, the value and meaning of which in its latest phases cannot be justly estimated at the present time.

Those who would study the "new music" in German song will find it in the later songs of Schönberg (b. 1874), in those of Webern (b. 1883), Krenek (b. 1900), and in Hindemith's (b. 1895) *Die junge Magd* (for contralto with flute, clarinet and string quartet) and especially *Das Marienleben* (a cycle for soprano with pianoforte accompaniment).

The Latin countries have been but little subject to German influences: France especially has always found from age to age, and notably in modern times, solutions of her artistic problems, which have proved of deep interest to those who live beyond her borders; they bear emphatically her own hall-mark.

France.—Allusion has already been made to the French as pioneers in establishing solo song to lute accompaniment, which

here, as in Italy, originated in adaptations of polyphonic compositions. But in France from the first, the main influence apart from opera, has come from popular sources, the native folk-song and the vaudeville, the ditties of country and of town. In both that union of grace, simplicity and charm, characteristic of the French nation, tended to produce an art of dainty unpretentious attractiveness. It preserved these characteristics in spite of the artificial atmosphere of the French Court, in which it mainly flourished, up to the time of the Revolution, in spite, too, of the somewhat different influences, which might have been expected to affect it, derived from opera, the mania for which did not, as in Italy kill the smaller branch of vocal music. Brunettes, musettes, minuets, vaudevilles, beorgerettes, pastourelles, as the songs were styled according to the nature of the poetry to which they were attached, may be found in Weckerlin's "Echos du temps passé" (3 vols. 1855).

The melodious style of Gounod (1818–1893), whose earlier songs are excellent, is felt as a real influence in the work of Massenet, Godard, Saint-Saëns, Delibes, Bizet, Lalo, Chaminade, Reynaldo Hahn and others, but it has yielded, during the last quarter of a century, to tendencies which corresponded closely with those of the Impressionist movement in French literature and painting. The new movement owed much to the work and inspiration of César Franck (whose actual contribution to song is small) but more to that of Fauré (b. 1845). The style of this master was new and individual. His harmonic conceptions, at first considered strange and revolutionary, were soon justified by the subtle effects of mood which they enabled him to express, as, for example, in "Les roses d'Ispahan," "Dans les ruines d'une abbaye," "Nell," "Le secret," "Lydie" and "Les berceaux."

If much of his work in song may be regarded as experimental, this cannot be said of Duparc (b. 1848) whose 15 songs rank among the choicest treasures of French art. They are characterized by an individual warmth, both of feeling and colour. The quietly moving, subtly blending harmonies and the smooth but expressive melodic line, most grateful to sing, are of a kind which it is impossible to associate with any poetry or any language but that of France. When he is dramatic his work is brilliant but without forced effects or violent transitions. César Franck was his master. (*See* the following songs:—"Extase," "La vague et la cloche," "Phydyle," "Chanson triste," and "Soupir.") To the same school belongs Chausson (b. 1855), whose songs are the expression of a refined and sensitive nature, remarkable for delicate beauty of detail and of form, somewhat after the manner of Duparc but on a smaller scale: *e.g.,* "Le temps de lilas," "Les papillons," "Nanny," "La colibri." With these composers may be associated De Bréville (b. 1861), Ropartz (b. 1864), composer of the well known "Berceuse," and De Séverac (1873–1921).

Debussy.—The startling harmonic innovations of Debussy have exercised a strong influence upon the music and the songs not only of France but of Europe, a fuller understanding of his work having proved that what was once thought incoherent or experimentary in his scheme is perfectly logical and of undeniable beauty. He discovered a pathway which had not been trodden before, and explored it so thoroughly that little is left there within the limits he prescribed for himself, for other seekers. The delicacy and finish of his work, in which the smallest touch tells, is remarkable, as well as the skill with which the notes carrying the words are interwoven into the fabric of the music. The method is Wagner's but the style is Debussy's who makes it seem that it was made for the French language and no other. Only in the early songs and those in *L'enfant prodigue* is his vocal line melodic. Debussy is certainly the greatest of the impressionists.

The following selection from his 48 songs exhibits the extent of his range and the variety of his style:—"Je tremble en voyant son visage," "La flûte de Pan," "Recueillement," "Clair de lune," "Fantoches," the songs in *Ariettes oubliées,* the three Villon Ballades and the terribly powerful "Noël des enfants qui n'ont plus de maison," composed in 1915. Others will be found in the excellent selection *Douze chants* (Durand Fils, Paris). Those who wish to understand what is meant by Debussy's whole-tone scale, "atonality" and "modern music" will find all clearly explained in Dr. Walker's article on Debussy and more fully in Dr. Dyson's article "Harmony" in *Grove's Dictionary of Music,* 1927–28, and in his book *The New Music* (Oxf. Univ. Press, 1924).

Ravel (b. 1875) is a master of clear and effective delineation. What he aims at he achieves. Debussy suggests, Ravel defines, but his definitions are difficult both to play and to sing. His most characteristic songs are the sets *Scheherazade* and the *Histoires naturelles,* the latter a series of brilliant pictures, full of elaborate and effective detail; of these "Le Paon," "Le Cygne" and "Le Martin-pêcheur" are the best known.

Italy.—Italy, absorbed in opera, has not contributed much that is likely to have permanent value to 19th century song, but the finished work of Sgambati (1843–1914) is worth knowing. He composed more than 40 songs, of which *Four Melodies,* Op. 35, and the setting of the old Italian folk-song "Separazione" may be cited as characteristic. Respighi (b. 1879) studied with Rimsky-Korsakov and Max Bruch, but his songs are individual—modern but not eccentric. Among them are "Nebbie," five charming "Canti all' antica," and the dainty "Stornellatrice." His pupil Pizzetti (b. 1880) in "Inpastori," with its fine modal character, effective declamation and cross rhythms has composed a remarkable song full of interest for both singer and pianist. Malipiero's daringly modern songs fall under the category of those which are not included in this article. In Spain the "Three melodies" and particularly the very striking arrangements of seven "Canciones populares" of Manuel de Falla (b. 1876) deserve special mention: as also a collection of 14 old Spanish airs of the 17th and 18th centuries arranged elaborately and with singular insight by Joachin Nin. The composer includes in each volume a valuable introduction—in French as well as Spanish.

Russia.—Russian song deserves more attention than can be given to it here. Since Glinka (1804–1857) released it from Italian influences, and by impregnating it with the spirit and the idiom of the folk-song, made it, at least in his own work, national, it has steadily increased in importance. There is a fairly large store of good songs by Russian musicians, but they are only in part Russian, their general conception and, to a large extent, their technique being derived from the masters of the German Lied; they represent a hybrid art, which, though full of interest, pales beside the entirely Russian work of one man of genius, Moussorgsky (1835–81). Through him, in his songs as much as in his operas, it seems as if the very heart of the strange Russian people were laid bare. His style is sometimes undisciplined, his realistic painting sometimes crude—natural in an art where colour counts for more than line—but there the pictures stand, throbbing with life, memorable. Many a village tragedy is the subject of his song; Death himself appears, terrible but kind; but Moussorgsky can also sing, no one more tenderly, of the cradle and the nursery; there is humour and satire too. Of the romantic sentiment, characteristic of Germany, there is no trace. In the music of Europe to-day, he has proved a potent influence, as having opened the doors of song to admit subjects hitherto thought impossible or unsuitable to set. Of his 40 or 50 songs most are definitely melodious; in others the voice part approximates to the rise and fall of the voice in speech; in all strong rhythm is an outstanding feature. In his last years he composed the four *Dances of Death* and the cycle of six songs *No Sun,* which rank among the most intensely moving songs ever written, tragically sad, but full of beauty. Examples: "Jeremouschka's Cradle Song," "Little Star, where art thou?" "Savishna" (story of the village idiot), "Gathering Mushrooms" and "Hopak" (both on the subject of "La Maumariée" of French folk-song), "Serenade" and "Trepak" (from the *Dances of Death*), *The Nursery* (seven songs about children). Moussorgsky was one of the four whom Balakirev (1837–1916) drew together to form with himself a "nationalist" band of composers. The others were Borodine (1834–87), César Cui (1835–1918) and Rimsky-Korsakov (1844–1908).

Borodine's "Romance" and "The Sleeping Beauty," Cui's "Hungersong," Rimsky-Korsakov's famous "Hindu song," "Believe me not" and Zuleika's song are all good. To this group of composers must be added the names of the more cosmopolitan Tschaikovsky, Rachmaninov, Grechaninov and Glazunov. Tschaikovsky's "Nur

wer die Sehnsucht kennt" is probably the best of his numerous songs; "The Dreary Steppe" and "Slumber Reigns" are characteristic of Grechaninov; Rachmaninov's "To the Children" is truly Russian and of rare tenderness and beauty.

Medtner (b. 1879), a Russian composer of German descent, is in his music both German and Russian. He has composed songs in both languages, orthodox in form, but elaborate in texture, difficult to play and, at first, to understand, but both on musical grounds and for their serious import well worth unravelling. They are the work of an impressive and forceful personality, not making experiments, but recording convictions. If a successor to Brahms were to be named, it would certainly be Medtner. Among his Russian songs may be cited "Whisp'ring Nature faintly stirring," "O'er thee I bend," and "I have come to say, Good-morning" Op. 24, "The Singer" and "The Muse" (Pushkin) Op. 29, "The Valse" and "To the dreamer" (Pushkin) Op. 32, "Sleepless Nights" (Tutchev) and the Valse, Op. 37; among his settings of Goethe, "Die Spröde," "Die Bekehrte" and "Einsamkeit"; of Nietzsche, "Verzweiflung"; of Eichendorf, "Winternacht," and of Chamisso, "Die Quelle" and "Frisch gesungen."

England.—The beginnings of English song have already been alluded to in speaking of Dowland, Campion, Rosseter and Jones. The subsequent work of H. Lawes, and his contemporaries William Lawes, Coleman and Wilson, was unpretentious and simple. Gems here and there, such as "Gather ye rosebuds" (W. Lawes) and others contained in two small vols. edited by Dolmetsch (Boosey), are the student's reward for a good deal of uninspired and tentative work, in which the main object of composers was to "follow as closely as they could the rhythmical outlines of non-musical speech: they listened to their post friends reciting their own verses and then tried to produce artificially exact imitations in musical notes," (Ernest Walker, *History of Music in England*, p. 130), producing what was neither good melody nor good declamation.

Such work, in spite of Milton's Sonnet to H. Lawes, could only have a passing vogue, especially with a Purcell so near at hand to show the world the difference between talent and genius, between amateurish effort and the realized conceptions of a master of his craft. Songs like "Let the Dreadful Engines" and "Mad Bess of Bedlam" reach a level of dramatic intensity and declamatory power, which is not surpassed by the best work of contemporary Italian composers.

"I attempt from love's sickness to fly" is so familiar in its quiet beauty, that we are apt to forget that melodies so perfectly proportioned were quite new to English art (though Dr. Blow's "The Self-banished" deserves to stand side by side with it). Monteverde's "Lament of Ariadne" has already been alluded to, and it is interesting to contrast its emotional force with the equally intense but more sublime pathos of Purcell's "Lament of Dido," in which song a ground bass is used throughout. The "Elegy on the Death of Mr. John Playford" (quoted in full by Dr. Walker, p. 176 of his history) exhibits the same feature and the same mastery of treatment. The "Morning Hymn" is scarcely less remarkable, and has likewise a ground bass. A large collection of his songs is to be found in the last volume (published in 1928) of the Purcell Society's Edition, edited by Sir Arthur Somervell (Novello). Purcell died, aged 37, in 1695; Bach and Handel were then but ten years old, and Scarlatti, born in 1658, had still 30 years to live—facts of which the significance may be left to speak for itself.

It is among the ironies of musical history that so great a beginning was not followed up. There are echoes of Purcell, stronger ones still of Handel, in the generation that succeeded him, in Croft, Greene and Boyce; but they quickly died away. From the death of Purcell to the Victorian era there is no consistent development of artistic song that is worth recording in detail. Arne, it is true, composed many fine songs that deserve to be better known; those which have survived are mostly of the melodious order, still acceptable for an air of freshness and gracefulness that marks them as his own, *e.g.*, "Where the Bee sucks," "Blow, blow thou winter wind" and "Lovely Phyllis." Song writers that followed him, Bishop, Shield, Hook, Dibdin, Storace, Horn and Linley (the elder), were all prolific melodists, who have each left a certain number of popular songs by which their names are remembered, and which are worth hearing occasionally, but there is little attempt to advance in new directions, no hint that song could have any other mission than to gratify the public taste for tuneful melodies allied to whatever poetry, pastoral, bacchanalian, patriotic, or sentimental, lay readiest to hand.

A good song appeared now and then, but seldom of serious import. Who can wonder at the delight with which England welcomed the songs of Mendelssohn? It was in his school of Leipzig that Sterndale Bennett (1816–1875), the first serious composer of songs in England for nearly a century, received his training. His output and range are small, but the quality of his work is delicate and individual. "To Chloe in Sickness," "Dawn, Gentle Flower," "Gentle Zephyr," struck a note that was new in English song. But he gave to his country a new ideal. Sullivan (1842–1900), more original, more richly endowed than Bennett, was also trained at Leipzig. Though his reputation has suffered from songs which satisfied the public rather than his own ideals, there are many which have real value and will live when the others are forgotten, *e.g.*, his settings of Shakespeare's lyrics ("O Mistress mine," "Orpheus with his Lute," "Where the Bee sucks"), of Tennyson's cycle *At the window* (in which the influence of Schubert is clear), "Tears, idle tears" and "Swallow, Swallow, flying South," and of George Herbert's "Sweet day, so cool," in all of which the touch of genius is unmistakable.

It is obvious from songs like these and from the occasional appearance of others, such as Hatton's "To Anthea," Salaman's "I arise from dreams of thee," Clay's "Songs of Araby" and "The Sands of Dee," that new ideals were in the air. In their further realization the increasing familiarity of the musical public with the masterpieces of German song may be reckoned as an important factor.

Parry and Stanford.—In the early 80's, when Parry (1841–1918) and Stanford (1852–1924), who was also at Leipzig, appeared, it was seen that song was at last taking its proper place in musical art. Parry's early songs are delightfully fresh and melodious (*e.g.*,"The Poet's Song," "On a day, alack the day," "Why does azure deck the sky?"). The three stirring "Anacreontic" odes mark the transition to that individual style which made the appearance of "Prometheus Unbound" one of the landmarks in England's musical history. He composed about 150 songs in all, the bulk of which are in the 12 volumes of *English Lyrics*. Breadth, dignity and sincerity, with a nobility of thought and feeling characteristic of the composer, mark the serious numbers (*e.g.*, "Through the Ivory Gate," "When we two parted," "Armida's Garden"). Equally characteristic are those in which he is boisterous or humorous as in "Crabbed Age and Youth," "The Laird of Cockpen," "Follow a Shadow"; or atmospheric, as in "Dirge in Woods" and "A Fairy Town" or in light and happy vein, as in "Ye Little Birds," and the entirely charming "A Lover's Garland." With all the good qualities of Parry's songs something in the majority of them is lacking, which may perhaps be described as that intimate lyric note in which heart and voice and instrument sing together. The melodic freshness of his early days grew less in the increasing awkwardness of his piano technique, and, perhaps, in the determination at all costs to have his word-declamation right. In this he was entirely successful, setting an example which has been of great value to English song.

Stanford composed about 150 songs. If the settings of the poems from George Eliot's *Spanish Gypsy*, Op. 1, are placed beside the songs of the "Elfin Pedlar," probably the last he composed, it is seen at once that the harmony which adorns the melodies of the former is singularly rich, and that in the latter it is reduced to the barest minimum—and yet it suffices. This gives us the trend of Stanford's work in song—increasing mastery of his resources of technique through the severe principle of economy, not two notes where one will serve. If the expressive colour of "The radiant Dark," is fine, the astonishing simplicity of "Spring" is perhaps the greater achievement. Between these poles in the long list of Stanford's songs every variety of colour and complexity will be found, but no unduly lavish display. In the work of no composer are the means more perfectly suited to the

ends. Arresting songs could be cited in many styles, especially those in *An Irish Idyll* (Moira O'Neill). There in six pieces of rarest beauty he has portrayed against a background of Irish wind, sky, mountain burn and loch, all that is most lovable and most deep in the Irish character, its wistfulness and its pathos, its sunshine and gloom, its seriousness and humour, with a poetical and imaginative power of a kind which is unique. In these will be seen the sureness and the delicacy of his touch not only on the spirit of each song but on the exact words with which it is conveyed. Poetry and music are fused without sacrifice on either side; the unity is complete. In further illustration may be cited the "Corsican Dirge," the remarkable ballads, "La Belle Dame sans merci" and "The Pilgrimage to Kevlaar," also "Three Cavalier songs" (Browning), "A soft Day," "The Pibroch," "The Chapel on the Hill," "Easter Snow," "The Monkey's Carol," "Grandeur," "Daddy-long-legs." No less masterly are his arrangements of Irish folk-songs of which there are four volumes.

Parry and Stanford lived to see many results of their influence and example. No one, however, among the younger composers has produced a body of songs equal in importance to either of theirs. It seems as if the impetus they gave to song on classical lines has already spent its force; if this is true, it is also true that no song composer has arisen with sufficient power and imagination, and, what is also essential, sufficient understanding of the fundamental needs of the voice, to convince the world that the new song is better than the old. The result is that though many musicians have written songs, only a few are song-composers. Of these latter Somervell (b. 1863) is one who has followed the bent of his own genius and resisted the temptation to experiment with novelties that were alien to it. He has produced a body of work characterized by sincere and tender feeling, instinct with a quiet beauty which is individual and charming. Larger qualities appear in the admirable cycle from Tennyson's Maud, in "The Shropshire Lad," "James Lee's wife," and "Love in Springtime" (the last named containing the singularly beautiful "Young Love lies sleeping"). "The Shepherd's Cradle Song," "Once at the Angelus," "When I am dead, my dearest," and "Weep ye no more, sad Fountains," "As through the Land" (2nd setting in E♭) and the dainty settings of some of Blake's *Songs of Innocence,* deserve to be remembered. They are real songs, grateful to sing and without pretentiousness or pose. Somervell has arranged many folk-songs, in *Songs of the Four Nations* (Cramer), and two volumes of *Welsh Folk-songs* (Boosey), with notable skill, taste and sympathy.

Roger Quilter.—The songs of Roger Quilter (b. 1877) are also grateful to sing, especially the settings of Shakespeare's lyrics and of seven Elizabethan lyrics; in the former "Blow, blow thou Winter Wind," and "It was a Lover and his Lass" and in the latter "Weep ye no more," "Damask Roses," and "Fair House of Joy," in spite of some syllabic inexactitudes, are specially good. A vein of wistful sentiment or quiet brooding as in "A Land of Silence," "A Last Year's Rose," pervades a good deal of his later work and appears too in his arrangement of "Drink to me only with thine eyes," in which the accompaniment is his own harmonic meditation on that lovely air and verse. In "To Daisies," "Now sleeps the Crimson Petal" and "Love's Philosophy," he has composed three love-songs in different styles and of undoubted beauty.

Vaughan-Williams.—A strong personality is felt in the songs of R. Vaughan-Williams (b. 1872), whose "Silent Noon" (Rossetti) holds a place among the masterpieces of lyrical song. He has composed many songs, all revealing imaginative qualities of an unusual order and unquestioned sincerity. He is bent on getting himself expressed at whatever cost, and has experimented in many styles, giving the impression that neither in the voice nor in the piano has he quite found the medium that he wants. Beauty for its own sake, the sensuous element in music, has little appeal for him; he is introspective rather than lyrical. There is something in his work that is elemental, and at bottom simple, as in the folk-songs of his country, of which he has arranged many with singular insight; "Bushes and Briars" and "A bold young Farmer," are felt not as arrangements, but as original work, so entirely has he absorbed their spirit (*see* his volume of *Folk-songs from the Eastern Counties*). The modal influences of the folk-song contribute much to the atmosphere which pervades the deeply impressive cycle *Wenlock Edge* (from Housman's *Shropshire Lad,* for tenor voice, string quartet and piano), and *Five Mystical Songs* (George Herbert) for solo, chorus and orchestra, of which the rapt intensity of "The Call" and the relentless force of "Antiphon" are equally arresting. Among his songs for voice and piano may be cited "Orpheus with his Lute," "The Roadside Fire," and others from the two volumes of Stevenson's *Songs of Travel,* "The Sky above the Roof," "The Mill Wheel" and "Linden Lea," which has the freshness of a folk-song. Whether the coming generation will set these aside and take to its heart the composer's later style, with its uncompromising modal polyphony, is an obvious question to ask and a dangerous one to answer.

In a survey of modern English song the salient fact is not that the store has grown so large, but that so many composers have contributed to it. It must suffice, therefore, to add to what has been written of individual composers a list of songs, necessarily incomplete, which have established their worth or deserve attention. Those which appear in a collection already published under the auspices of the Society of English Singers, *Fifty modern English songs* (Boosey and Co.) are not included. The reader is reminded that songs of the most modern type are not under review.

Bibliography.—Arnold Bax, *Five Irish Songs,* of which "The Pigeons" is a masterpiece of delicate illustration; E. C. Bairstow, "Orpheus with his Lute," "The Oak Tree Bough" (a grim picture), "I heard the learned Astronomer"; A. Benjamin, "Phyllis milking her Flock," "The Piper," "Diaphenia"; E. Bullock, *Brittany;* George Butterworth, Bredon Hill and other songs from *A Shropshire Lad* of which "Is my Team ploughing" is a gem; also a volume of English Folk-songs (arranged); Granville Bantock, "Yungyang" and "The Feast of Lanterns"; M. Besly, "Time yon old Gypsy Man" and "Epitaph"; Frank Bridge, "Love went a-riding," "Go not, Happy Day," "Come to me in my dreams"; Olive Carey, "Melmillo," "A Rondel" and a volume of English folk-songs (arranged); B. J. Dale, "O Mistress Mine" and "Come away death" (with viola obligato); Harold Darke, "Uphill"; Malcolm Davidson, "A Christmas Carol"; Thomas F. Dunhill, *The Wind among the Reeds,* a cycle (including "The Fiddler of Dooney" and "The cloths of Heaven") and "The Haymakers' Roundelay"; Frederick H. Cowen, "At the mid-hour of Night," "The Birthday," "Onaway, awake, Beloved"; H. Walford Davies, "When Childer plays," "The Bells of Bethlehem" and *Songs of Innocence* (Blake); Gustav Holst, *Hymns from the Rig Veda* (especially "I, the Queen of all," "The Heart worships," and "Four Songs for Voice and Violin"); a volume of "Folk-songs from Hampshire" (arranged); Elgar, *Sea pictures;* Edward German, "Who'll buy my Lavender," and "It was a lover and his lass"; Armstrong Gibbs, "Nod," "Silver," "The Fields are full," and the humorous "With Five Eyes"; Alan Gray, "Tiger, Tiger," and "Eleuloro"; Ivor Gurney, two cycles *Ludlow and Teme, The Western Playland* (for tenor and baritone respectively, with piano and string quartet), "Edward" (Scotch ballad), "Spring," "Desire in Spring" and "Sleep"; Hamilton Harty, "The Rachray Man," "Lane o' the Thrushes," "A Drover"; W. H. Hadow, "Under the Hill" and "Bright is the Ring of Words"; Herbert Howells, "King David," "Mally O" and Gavotte; Herbert Hughes, 2 vols. of *Irish Country Songs* (arranged); John Ireland, "Spring Sorrow," "If there were dreams to sell," "The Vagabond," and "Santa Chiara"; F. Keel, "My Sweet Sweeting," *Salt Water Ballads* (2 sets) and "Helen of Kirconnell," arrangements of "Elizabethan Love Songs" (2 vols.); Peterkin, "The Galliass"; Cyril Scott, "The White Knight"; Martin Shaw, "Hefle Cuckoo Fair," "Song of the Palanquin Bearers," "Cuckoo"; Thiman, "The Silver Swan" and "As Joseph was a-walking"; Ernest Walker, "Corinna goes a-maying," "Snowdrops," and "Bluebells from the Clearing"; Gerrard Williams, "Song in Autumn" and "Moon"; Peter Warlock, "Lullaby," "Piggesnie" and "That ever I saw"; Charles Wood, "Ethiopia Saluting the Colours," "The dead at Clonmacnois," "At Sea," and "Denny's Daughter"; 25 *Irish Folk Songs* (Boosey) (arranged); Maude V. White, "To Mary," "Go, lovely Rose," "Absent yet Present," "So we'll go no more a-roving," and "Mary Morison."

In *Grove's Dictionary of Music* Mrs. E. Woodhouse's article "Song," gives a full bibliography of the whole subject of song and folk-song, country by country. In the edition of 1928 further information will be found in the articles upon the chief composers of songs and in the catalogue of their works which in most cases is appended with dates. The following list is mainly of books which the present writer has found most useful: Ambros, *Geschichte der Musik* (1862–82); Reissmann, *Das deutsche Lied* (1861; rewritten as *Geschichte des deutschen Liedes,* 1874); Schneider, *Das musikalische Lied* (1863); *Oxford History of Music* (1901–05) vols. iii. iv. v. and vi.; W. H. Hadow, *Studies in Modern Music,* 2 vols. (1895–96); Parry, *Art of Music* (1897); Max Friedländer, *Brahms' Lieder* (1922); Oscar Bie, *Das deutsche Lied* (1926); E. Walker, *History of Music in England* (1907); Dr. Fellowes, *The*

English Madrigal composers (1921); E. Dyson, *The New Music* (1924); Boehme, *Altdeutsches Liederbuch* (1877); Reimann's *Das deutsche Lied,* 2 vols. *Das deutsche Geistliche Lied,* 6 vols.; Weckerlin, *Echos du temps passé,* 3 vols. (1855). (W. Fd.)

AMERICAN SONG

For the purposes of this article the expression "American song" will be used to cover the history and development of song writing in the United States by native-born composers. Due to the heterogeneous ancestry of her inhabitants, America has produced, until comparatively recently, few songs that can be considered distinctly indigenous. The singers of America for generations have ranked among the greatest; her foremost song-writers, however, with but rare exceptions, have proved second-rate measured by the standards of the Old World. This lack of musical atmosphere is undoubtedly caused not only by the mixed nationalities of Americans, but also by the fact that America's attention was focussed necessarily at first on producing the bare necessities of life and later to extending her commerce with other countries.

According to the best available authorities, Francis Hopkinson (1737–91) was the first native-born American composer. His "My days have been so wondrous free," composed in 1759, is the earliest known secular song by an American. It is interesting to note the natural English flavour that permeates most of Hopkinson's songs. Almost a century elapses before we encounter the songs of another American composer, those of Stephen Collins Foster (1826–64), unless, of course, we consider as song-writers such compilers of tune-books and composers of hymns as James Lyon (1735–94), William Batchelder Bradbury (1816–68), Thomas Hastings (1787–1872), and Lowell Mason (1792–1872).

Despite the ever-diminishing attitude of patronage of some musicians towards his songs, Stephen Foster stands as one of the few representative American composers. His "Old Folks at Home," "Nelly Bly," "Old Uncle Ned," and "My Old Kentucky Home" are among the best known of his songs. Following him come George Frederick Root (1820–95), George Frederick Bristow (1825–98) (better known for his work in larger forms, but a splendid, sincere writer of songs), Harrison Millard (1830–95) and James Remington Fairlamb (1838–1908). These men belonged to approximately the same period; yet an examination of their work shows a startling lack of similarity. For example, what could be more widely separated than Foster's "Old Folks at Home," Fairlamb's "Little Blue Pigeon," an aria from Bristow's "Rip Van Winkle," Millard's "Waiting," and "Tramp, Tramp, the Boys Are Marching," by which Root is best remembered? We see here a curious factor: the English element is gradually being overshadowed by the Teutonic, Scandinavian, and later on French and Latin.

The era from the Civil War to the end of the 19th century marks the gradual progress of the American song-writer, culminating in the titanic figure of Edward MacDowell, who composed "The Sea," "Thy Beaming Eyes" and "Long Ago." Lack of space permits the mention of only a few lyric composers of this period, the foremost being:—Dudley Buck (1839–1909), "Fear Not Ye, O Israel"; Homer Newton Bartlett (1846–1920), "Thy Dear Eyes"; Arthur William Foote (1853–), "I'm Wearin' Awa'"; George Whitefield Chadwick (1854–), "Allah"; Wilson George Smith (1855–), "If I But Knew"; James Hotchkiss Rogers (1857–), "At Parting"; Clayton Johns (1857–), "I Love and the World Is Mine"; Edgar Stillman Kelley (1857–), "Israfel"; Harry Rowe Shelley (1858–), "Love's Sorrow"; Charles Beach Hawley (1858–1915), "Because I Love You Dear"; Charles Whitney Coombs (1859–), "In the Dark, in the Dew"; Henry Louis Reginald de Koven (1859–1920), "O Promise Me"; Gerrit Smith (1859–1912); William Arms Fisher (1861–), "Under the Rose"; Arthur Battelle Whiting (1861–), "Fuzzy-Wuzzy"; R. Huntington Woodman (1861–1928), "An Open Secret"; Ethelbert Woodbridge Nevin (1862–1901), "The Rosary"; Horatio William Parker (1863–1919), "Once I Loved a Maiden Fair"; William Harold Neidlinger (1863–1924), "The Birthday of a King"; Frederick Field Bullard (1864–1904), "Stein Song"; William Victor Harris (1869–), "The Hills o' Skye."

Several of these composers are writing songs at present (1929), but they did most of their work before the close of the 19th century.

From the beginning of the 20th century to the present time, the tendency in American song writing has been towards a more distinctly national flavour rather than to reflect European traditions. The composers in the following list belong to the 20th century rather than to the 19th:—Sidney Homer (1864–), "Requiem," "Banjo Song"; Harvey Worthington Loomis (1864–), "In the Foggy Dew"; Henry Franklin Belknap Gilbert (1868–1928), "Pirate Song"; Henry Hadley (1871–), "The Face of All the World Has Changed"; Charles Fonteyn Manney (1872–), "Consecration"; Arthur Farwell (1872–), "Drake's Drum"; Daniel Gregory Mason (1873–), "Russians" (a cycle); Edward I. Horsman (1873–1918), "The Bird of the Wilderness"; William Armour Thayer (1874–), "My Laddie"; Charles Gilbert Spross (1874–), "Will o' the Wisp"; Frederic Ayres (1876–1926), "Sea Dirge"; John Alden Carpenter (1876–), "Gitanjali" (a cycle); Oley Speaks (1876–), "On the Road to Mandalay," "Sylvia"; Chester Barker Searle (1876–), "The Rose and the Heart"; Louis Campbell-Tipton (1877–1921), "A Spirit Flower"; David Stanley Smith (1877–), "Portraits" (a cycle); Frank La Forge (1879–), "To a Messenger"; Stanley R. Avery (1879–), "Song of the Timber Trail"; Charles Wakefield Cadman (1881–), "From the Land of the Sky-Blue Water"; Franklin Morris Class (1881–1926), "To You, Dear Heart"; Arthur Bergh (1882–), "The Congo"; Geoffrey O'Hara (1882–), "The Wreck of the Julie Plante"; Bainbridge Crist (1883–), "Chinese Mother-Goose Rhymes" (a cycle); Charles Tomlinson Griffes (1884–1920), "An Old Song Resung"; Deems Taylor (1885–), "Captain Stratton's Fancy"; Wintter S. Watts (1886–), "Miniver Cheery"; Harry Reginald Spier (1888–), "Ultima Rosa"; Arthur Walter Kramer (1890–), "The Faltering Dusk"; Robert Armbruster (1896–), "The High Barbaree"; Oscar J. Fox, "The Hills of Home," "Rounded Up in Glory" (cowboy spiritual); J. Bertram Fox (1881–), "Ich wandre durch die stille Nacht."

Special tribute, as they have developed a type distinctly their own, should be paid such negro composers and compilers as Henry Thacker Burleigh (1866–), negro spirituals; J. Rosamunde Johnson (1873–), "Nobody Knows the Trouble"; William C. Handy (1873–), collection of Blues; Robert Nathaniel Dett (1882–), religious folk-songs of the negro as sung at Hampton Institute.

In America, as in no other country, the women are rapidly approaching the men in the excellence of the songs they are writing. Some of the most prominent women composers of American birth are:—Mary Turner Salter (1856–), "The Cry of Rachel"; Carrie Jacobs Bond (1862–), "A Perfect Day"; Margaret Ruthven Lang (1867–), "Irish Love Song"; Amy March Beach (1867–), "The Year's at the Spring"; Harriet Ware (1877–), "The Cross"; Mabel Wheeler Daniels (1878–), "At Daybreak"; Gena Branscombe (1881–), "Hail Ye Tyme of Holiedayes!"; Lily Teresa Strickland (1887–), "Since Laddie Went Awa'"; Marion Bauer (1889–), "The night has a thousand eyes"; Mana Zucca (1891–), "The Big Brown Bear"; Rhéa Silberta (1900–), "Wild Geese."

What is undoubtedly a purely American type is the so-called popular song, often referred to as "sob-ballad." Some of the leaders in this field have been:—Daniel Decatur Emmett (1818–1904), "Dixie's Land"; Charles K. Harris (1868–), "After the Ball"; Theodore F. Morse (1875–1924), "Blue Bell"; Frederick W. Vanderpool (1877–), "If winter comes"; Ernest R. Ball (1878–1928), "Love Me and the World is Mine," "Mother Machree"; Jerome David Kern (1885–), "Who?," "Left all alone again Blues"; Irving Berlin (1888–), "An Orange Grove in California"; George Gershwin (1898–), "Blue Monday," "Lady, be good!"

The five outstanding names among American song-writers are:— Francis Hopkinson, Stephen Foster, George Whitefield Chadwick, Edward MacDowell and Deems Taylor. Hopkinson

produced his best work in 1788, Foster in 1850–51, Chadwick shortly before 1900, MacDowell around 1900, and Taylor around 1920. The lapses of time between these really outstanding song-writers are becoming less, which presages well, if the present rate of diminution continues. (R. WER.)

The following list of composers includes foreign-born, whose work was entirely or largely in the United States: Charles Martin Loeffler (Alsace, 1861), "To Helen"; Victor Herbert (Ireland, 1859–1924), "The Call to Freedom"; Carl Busch (Denmark, 1862–), "The Sea Hath Its Pearls"; Walter Damrosch (Germany, 1862–), "Danny Deever"; Louis Victor Saar (Holland, 1868–), "To One I Love"; Bruno Huhn (England, 1871–), "Invictus"; Cecil Forsyth (England, 1870–), "O Red Is the English Rose"; Arthur Penn (England, 1880–), "Smilin' Through"; Richard Hagemann (Holland, 1882–), "At the Well."

SONG BIRDS, birds whose vocal expression resembles music. Technically the super-family *Oscines,* "song birds," includes nearly all the families of perching birds (*Passeres*), about five thousand species. Among the perching birds it excludes such groups as the Old World Pittas, and the New World flycatchers (*Tyrannidae*) each species of which has a characteristic word, as "phoebe," "chebec," or the more melodious "pee-wee," in place of a song. The distinguishing mark of the *Oscines* is the possession of four or more pairs of muscles controlling the syrinx, the organ of voice in birds; this brings within the super-family the crows and jays, many of which have rich and supple voices, some of them very human in tone, but in the more popular sense they are not "song birds" because they lack the rhythm and melody which the true songsters possess.

Many of the finest singers are found in the northern temperate zone, among the thrushes (*Turdidae*) and their close kindred the Old World warblers (*Sylviidae*), families which include the European blackbird, the song thrush, the nightingale and blackcap. The nightingale is the most famed of all song birds, though poets singing the praises of Philomela have mistaken the sex of the singer, as Milton, who speaks of "her sad song." The nightingale's summer range extends from southern England through Europe eastward to the Balkans and Asia Minor, and southward to northwest Africa. Its song, writes Hudson, "is exceedingly beautiful; its phrasing is more perfect than that of any other British melodist; and the voice has a combined strength, purity and brilliance probably without a parallel." In Scandinavia, Russia and Siberia it is replaced by the slightly larger eastern nightingale, the bird known to Linnaeus. The blackbird, found throughout Europe, a black thrush with an orange bill, has "a beautiful mellow voice," according to Hudson, who speaks of the peculiar soft, rich melodious quality of the sound, and the placid, leisurely manner in which the song is delivered. As Browning noted, the song thrush "sings each song twice over," or, more truly, each theme or musical element of his song. The missel thrush is best known as a winter singer; from midwinter until spring, as Hudson writes, "his music is most noteworthy. Its loudness and wild character give it a wonderful impressiveness." The European robin redbreast, one of the dozen British birds so well known as to have a personal name, belongs to the same gifted family; Burroughs has written well of his pure and piercing tones, "piercing from their smoothness, intensity, and fulness of articulation." Among the Old World finches (*Fringillidae*) many are good singers; the bullfinch has the best voice, with the mellow contralto quality of the blackbird. In another musical family, the larks (*Alaudidae*), the skylark is pre-eminent, almost as dear to poets as the nightingale; but the best description is in Hudson's rhythmical prose: "I have listened to it by the hour, never wearying nor ceasing to wonder at that mysterious beautiful music which was like the heavenly sunshine translated into sound; subtle, insistent, filling the world and the soul, yet always at a vast distance, falling like a lucid rain."

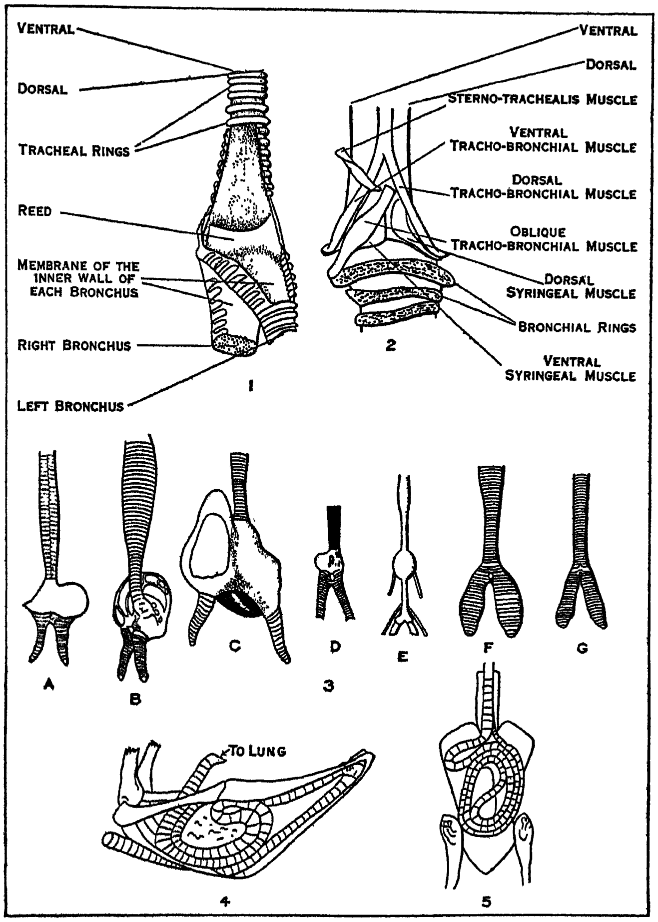
Some of the finest New World singers belong to the thrush family. Among the thrushes of the eastern States are the wood thrush, whose clear, bell-like tones, carrying to a great distance, are linked together by varied notes heard only near at hand, some like a twanged mandolin string; the hermit thrush, still more eminent for richness of tone, melody and the expressive passion and length of his song; the veery, whose circling choral thrills by the richness of its overtones; the gray-cheeked thrush, with a similar choral turning upward at the end; the olive-backed thrush, whose song somewhat resembles the hermit's; the robin, with a clear, happy tone and an endless variation of themes, which he embroiders together for a half hour without stopping; and the bluebird, with pure contralto tones, but less melodic power than the other New World thrushes. Many of the North American finches are gifted singers. The rose-breasted grosbeak has a rich contralto voice, a fine melodic sense, and something of the passionate expression of the hermit thrush; unlike the robin, he sings a single, definite melody, repeated at intervals. The purple finch has contralto tones, in contrast to the high notes of the goldfinches, who gather in a tree top and sing in chorus. Many American sparrows are good singers, the song sparrow being the best endowed as a melodist, almost every song sparrow having his individual song, with a marked sense of rhythm. The fox sparrow sings in early spring a clear, rich melody. The song of the white-throated sparrow has a dactyl rhythm, prefaced by one note, either above or below the monotone dactyls. The white-crowned sparrow opens his song with three notes, like a higher echo of the meadowlark's song, followed by a short trill. In the family *Icteridae* the bobolink, whose wild, sweet rippling song is uttered as he flies across a meadow, is the best singer; the orioles, with rich tones, and expressive themes, suggest eloquent speech rather than song. The New World wood warblers (*Mniotiltidae*), most of which are irrepressible singers on the spring migration, have distinctive themes, but only a few, like the water-thrushes and the Canadian warbler, are melodious singers. The family to which the wrens belong (*Troglodytidae*) includes noted singers like the mocking bird, so famous in the songs of the South, and the brown thrasher which sings each theme twice over from a conspicuous tree top; the rock wren of the western mountains; the clear voiced Carolina wren; the tinkling winter wren of the northern hills; and the widely distributed long-billed marsh wren, who is wafted into air by the vehemence of his song. Of the mocking birds of South America Hudson has written eloquently. Australia has gifted mockers, like the lyre-bird, but they are not true song birds. (C. JOH.)

SONG OF BIRDS. Though aesthetically we ascribe the power of song only to such birds as produce a series of melodious notes forming a coherent refrain, yet, as they are commonly produced in greatest perfection only in association with reproductive activities, all sounds, musical or otherwise, used to give expression to the emotions during this time are included in the definition "song," in this article, as are mechanically produced sounds when used to express the same emotions. Within recent years there has been much discussion over the exact significance of song. Darwin's theory that it was to charm the female (*see* SEXUAL SELECTION) has been attacked by Eliot Howard, who suggested that bird song was concerned primarily with breeding territory. (*See* BIRD.) E. M. Nicholson, however, has shown that this is only partially true. Many birds normally sing from the most prominent perch in the neighbourhood, and when no perch is available, as with open-country birds like the skylark and bobolink, the song is given in the air.

Voice in birds is produced by modification of the lower end of the windpipe, which forms the *syrinx.* While, however, the dissecting knife reveals the apparatus it leaves us in the dark as to the factors which ultimately produce melodious song; as is shown by the fact that there is no perceptible difference in the syrinx between the nightingale and crow.

The most accomplished performers, like the nightingale, hermit thrush, mockingbird and skylark, are members of the Passeres, or perching birds, which whether "musical" or not, have the most highly developed voice-organ among birds. The syrinx here is a bony box, formed by fusion of the last three or four rings of the trachea, and the uppermost of the semi-rings stiffening the outer walls of the bronchi. Within this box a bony bar, the pessulus, crosses the lower end of the trachea anteroposteriorly, forming

a beam to support a vibratile membrane, the "reed." This reed acts with a fleshly lip on the opposite (outer) wall of the tube, which increases or diminishes the aperture between itself and the reed, so varying the pitch of the note. Sound-production is further aided by as many as seven pairs of muscles running from the windpipe to the ends of the last tracheal, and first bronchial, semi-rings, as shown in the diagram. In all non-passerine birds,



FROM (1, 2, 3) FOWLER, "SUMMER STUDIES OF BIRDS AND BOOKS" (MACMILLAN, LTD.), (4, 5) PYCRAFT, "HISTORY OF BIRDS" (METHUEN)

FIGS. 1–5.—VOCAL MECHANISM OF BIRDS: THE "SYRINX" OF BIRDS (1) Interior of the syrinx; (2) side-view of the syrinx from the outside; (3) the syrinx of some of the ducks forming bony chambers, (A) Mallard, (B) Pochard, (C) Goosander, (D) Steller's Eider, (E) Velvet Scoter, (F) Male and (G) Female Common Scoter; (4) Sternum of a crane; (5) the coils of the windpipe of a Manucode

the syrinx is much less complex in structure, and may have only a single pair of muscles.

Certain modifications of the windpipe must now be mentioned. In surface-feeding ducks, *e.g.*, the mallard, the trachea ends in a large, spherical, bony chamber, present only in the male. Ostensibly its purpose is that of a resonator. Yet the raucous "quack-quack" of this species is uttered only by the female, whose trachea has no "sound-box." In diving-ducks, *e.g.*, the pochard, or the canvasback, this resonator is much larger but its walls are greatly fenestrated, semilunar patches of thin, transparent membrane being stretched between delicate bars of bone. The trachea is considerably widened along the middle. A trace of this is seen in the mallard. In the goosander (merganser), the resonator attains great size, and here, again, the walls are fenestrated. In the male the windpipe displays two marked swellings; the female has only one; while in the allied red-breasted merganser, the male has one tracheal expansion, the female none. In the common scoter the resonator has disappeared, but the bronchi of the male are peculiarly swollen. The relation these modifications have to the voice is not known.

Inflated air-sacs, or air pumped into the gullet, play a conspicuous part in the "love-displays" of birds (*see* COURTSHIP OF ANIMALS), accompanied by sounds peculiar to the occasion. But there is no evidence that they do more than serve as resonators. In all these cases there is a "display" of some sort. The common house-pigeon, for example, when striving to rouse the amorous instincts of his mate, inflates the gullet, at the same time giving voice to the familiar "coo-ing" as he bows down before her.

Instruments of percussion for the production of sound, in place of the voice, are used by widely different species. One of the most striking examples is furnished by the white stork. Several birds will often perform at the same time; but here it appears to be an emotional reflex by no means always associated with courtship. While standing at rest they will suddenly thrust the beak skywards, then begin to snap the jaws together with inconceivable rapidity, at the same time bringing the head backwards till the tip of the beak nearly touches the back, and then forwards nearly to the ground, making a noise like the sound of castanets.

The snipe, in the breeding season, mounts high in the air, descending with a mighty rush, at the same time giving forth a loud note which resembles a goat's bleat. These sounds are produced by vibration of the outermost pair of tail-feathers.

Some woodpeckers such as the British greater and lesser spotted, and the American red-headed, hairy and downy woodpeckers, and the flicker produce rapid drumming notes, by striking the bough of a tree with the beak. They will resort to a corrugated iron roof or telegraph pole in preference to a tree-trunk, because of the louder notes obtainable.

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SONNEBERG, a town of Germany, in the republic of Thuringia, situated in a narrow valley of the Thuringian forest, 13 m. by rail N.E. of Coburg. Pop. (1925) 19,156. It is famous for the manufacture of toys.

SONNET. Like most beginnings the genesis of the sonnet is somewhat obscure. On the whole, the most probable account is that it sprang, as the result of endless experiments, from the popular short poems sung, in early mediaeval times, with or without refrain, to musical accompaniment, as the Idyl of Theocritus similarly arose from simple pastoral strains. A very early specimen of the sonnet of a tolerably finished kind, is ascribed to Piero delle Vigne (d. 1249), the famous chancellor of Frederick II., and this poem, alike by its Sicilian origin and by its formal elaboration, is sufficient to prove that a long period of experimenting must have preceded. Time is required both for the *genre* to have reached so far south and for the degree of finish shown by this poem to have been attained. But with every allowance for earlier talent we probably do little injustice if, in accord with the majority of critics, we call Guittone of Arezzo (d. 1294) the "only begetter" of the sonnet as we know it. It was he who firmly established its laws. From his time it was recognized that there must be an "octave," with rhymes (in an unusual notation), a, b, b, a; a, b, b, a, and a "sestet," in which, while some variety is allowed, the final couplet is excluded. Between the octave and the sestet there is a distinct break, and, as a rule, the first quatrain of the octave is, though less strongly, marked off from the second. More important still, in spite of a certain looseness of thought and roughness of style, Guittone established the *unitary* character of the sonnet.

It was the Guittonian sonnet which, in the hands of Dante and Petrarch, became—certain aberrations notwithstanding—the unquestioned model for later Italian writers. Especially as used by Petrarch, in his immortal Laura-poems, it set a standard which the greatest poets could hardly hope to overpass, and it was imitated by such poets throughout the whole of western Europe.

The English Form.—Transplanted to England by Wyatt and

Surrey (it is remarkable that it does not seem to have attracted Chaucer) the sonnet was made universally known by the very popular *Tottel's Miscellany* of 1557, and almost immediately captured the fancy of every poet, great, indifferent, or contemptible. In France, about the same time, it was cultivated with success by Desportes, de Baïf, Pierre de Brach, du Bellay, Ronsard and other writers, whose influence was very strongly felt in England—how strongly has been well shown by Sidney Lee. But in England, for many reasons (one, perhaps, being merely the scarcity of rhymes as compared with their abundance in the Romance languages), the rhyme-system was varied and simplified in endless ways.

For the names of the many sonneteers of this period any history of literature may be consulted. Most of them tried "sequences"—series of more or less connected sonnets; but while some individual poems are of surpassing beauty, few writers succeeded in composing more than two or three that deserve a place in a high-class anthology. Even Spenser was not wholly successful, though he adopted a form which might seem suited to his genius—the rhyme-system, a, b, a, b; b, c, b, c; c, d, c, d; c, c, which reminds us of the stanza of the *Faerie Queene*. Others came gradually to adopt uniformly the especially "English" scheme, a, b, a, b; c, d, c, d; e, f, e, f; g, g; a scheme in which it is immediately obvious that the three quatrains and the "clinching" couplet attain an epigrammatic effect foreign to that of the Petrarchan type.

Milton and Wordsworth.—By the date (1609) of the publication of the supreme examples of the Elizabethan type, Shakespeare's sonnets—which had indeed been probably written long before—the vogue of this style had worn itself out, and the 23 English and Italian sonnets of Milton show, as might be expected, a reversion to a stricter model. Though the poet of the "variously drawn-out" verse of *Paradise Lost* was bound to make no attempt to break the sense at the conclusion of the octave, yet in other respects he conforms (in the main) to the Petrarchan system, and is Italian enough to give us one "caudate" sonnet. Apart from questions of relative merit, the tone of these sonnets is thus altogether different from the Elizabethan. Since his time there have been few endeavours to revive the "English" style. Not that, till much later, the rigid rules were observed. Even the scholarly Gray, in his sonnet on the death of West, allows himself extreme licence; and Cowper's on Mrs. Unwin, beautiful as it is, ends with a couplet. Thus, as the merit of a sonnet is usually in proportion to its strictness, it is perhaps as well that it went out of fashion between 1740 (the date of Gray's sonnet) and 1789 (the date of those of Bowles). The importance of Bowles, again, consists hardly at all in intrinsic worth, but almost solely in the influence he exerted upon Coleridge and Wordsworth; nor are Coleridge's sonnets, few as they are, worth the trouble of reading. It is to Wordsworth that we owe the great and enduring popularity of the form, and possibly even the revived appreciation of Shakespeare's sonnets, which, as is well-known, Steevens refused to reprint on the ground that they were unreadable. Wordsworth, not merely by the surpassing beauty of 20 or 30 of his sonnets, but by his "sequences," is the modern founder of the *genre*. It is true that not many even of his sonnets are quite regular, and that it is not to the "Ecclesiastical Sketches" nor to the "Duddon" series that we look for his best work; but his perception that the form lends itself to the expression of connected thoughts inspired Rossetti in his *House of Life*, Mrs. Browning in her *Sonnets from the Portuguese*, and Meredith in his *Modern Love*, which, though not in the sonnet-form, has much of the character. Since Wordsworth there have never been lacking sonneteers, and at least some of their work has been of great excellence. It is noteworthy how often men not of the highest genius have found in the very constriction of the form "not bonds but wings," and have produced, by a flash of inspiration aided by labour, single sonnets not unworthy to be compared with the best even of Shakespeare's or of Milton's. While, as we saw, Coleridge failed, and while the genius of Shelley was cramped in the "narrow room" (he wrote but one good sonnet, and that not a true one), some great poets, like Keats, and others of a lower order, have moved in it with ease and have attained great heights.

The literature of the subject is large, and but a tithe of it can be mentioned here: for history and criticism Capell Lofft, Leigh Hunt, Mark Pattison (preface to Milton), Trench (preface to Wordsworth), Sidney Les (*Life of Shakespeare*), Lentzner (down to Milton), Addington Symonds, Ashcroft Noble, Theodore Watts-Dunton and T. W. H. Crosland. Good and comprehensive selections also abound, many of them with critical and historical prefaces and notes. Of these we may choose Lofft, Hunt, William Sharp, Waddington, Hall Caine and Tomkinson. But as new sonnets are constantly being written so new selections are constantly being made. (E. E. K.)

SONNINO, SIDNEY Baron (1847–1922), Italian statesman and financier, was born at Florence on March 11, 1847. Entering the diplomatic service at an early age, he was appointed successively to the legations of Madrid, Vienna, Berlin and Versailles, but in 1871 returned to Italy, to devote himself to political and social studies. On his own initiative he conducted exhaustive inquiries into the conditions of the Sicilian peasants and of the Tuscan *métayers*, and in 1877 published in co-operation with Signor Leopoldo Franchetti a masterly work on Sicily (*La Sicilia*, Florence, 1877). In 1878 he founded a weekly economic review, *La Rassegna Settimanale*, which four years later he converted into a political daily journal. Elected deputy in 1880, he distinguished himself by trenchant criticism of Magliani's finance, and upon the fall of Magliani was for some months, in 1889, under-secretary of State for the treasury. In view of the severe monetary crisis of 1893 he was entrusted by Crispi with the portfolio of finance (Dec. 1893), and by energetic measures he averted national bankruptcy, and placed Italian finance upon a sounder basis than at any time since the fall of the Right. Though averse from the policy of unlimited colonial expansion, he provided by a loan for the cost of the Abyssinian War in which the tactics of General Baratieri had involved the Crispi cabinet, but fell with Crispi after the disaster at Adowa (March 1896). Assuming then the leadership of the constitutional opposition, he combated the alliance between the Di Rudini cabinet and the subversive parties, criticized the financial schemes of the treasury minister, Luzzatti, and opposed the "democratic" finance of the first Pelloux administration as likely to endanger financial stability. After the modification of the Pelloux cabinet (May 1899) he became leader of the ministerial majority, and bore the brunt of the struggle against Socialist obstruction in connection with the Public Safety bill. Upon the formation of the Zanardelli cabinet (Feb. 1901) he once more became leader of the constitutional opposition, and in the autumn of the year founded a daily organ, *Il Giornale d'Italia*, the better to propagate moderate Liberal ideas. He was prime minister for a few months in 1906.

On Dec. 2, 1909, Sonnino formed his second ministry. But he did not enjoy the favour of the still Giolittian Chamber, and his cabinet was defeated over the new shipping bill. On March 21, 1910, he resigned.

In the autumn of 1914, he became foreign minister in the Salandra cabinet. He was still foreign minister, under Orlando's premiership, during the Peace Conference, which he attended as second Italian delegate from Jan. 18 to June 19, 1919. On the fall of the Orlando cabinet (June 19, 1919) Sonnino retired into private life. He died on Nov. 24, 1922.

SONORA, a northern State of Mexico, bounded N. by the United States, E. by Chihuahua, S. by Sinaloa and W. by the Gulf of California. It is the second largest State in the republic, having an area of 76,633 sq. miles. Pop. (1910) 265,383; (1921) 275,127, a large part being Indian. The surface of the eastern half of the State is much broken by the Sierra Madre Occidental. The soil of the valleys is fertile, and when it is irrigated sugar-cane, tobacco, maize, cotton, vegetables (especially tomatoes and onions) and fruits are produced. Lack of transportation facilities has been partly relieved by the construction of a branch of the Southern Pacific (American) from Nogales southward to Guadalajara, Mexico City and Mazatlán. Guaymas is the only port of importance on the coast, but it has a large trade and is visited by the steamers of several lines. The capital of the State (since 1882) is Hermosillo (pop. 1910, 14,578; 1921, 14,745), on the Sonora

river, 110m. north of Guaymas, with which it is connected by rail. Other important towns are Nogales, on the American border, and Cananea, an important mining town.

SONS OF LIBERTY, associations which came into existence in the American colonies of Great Britain in opposition to the Stamp Act passed in 1765. They were secret in character, indefinite in organization, radical in temperament. Much of the resistance against British attempts to enforce taxes was organized by them. At times they gathered openly, held parades and dinners, sang liberty songs, burned governors and tax-collectors in effigy and stirred popular enthusiasm. Those in New York and Massachusetts were most active. When the Stamp Act was passed the New York Sons of Liberty appointed the first popular committee of correspondence, adopted the first non-importation agreement, threatened those who used stamps, and protected those who carried on their business on unstamped paper. Members were recruited chiefly from the trade classes, and prominent Whig politicians were usually the leaders. The societies played an important part in spreading a spirit of resistance in preparation for the Revolutionary War.

SOO CHOW, a town in the province of Kiang-su, with a population estimated (1926) at 500,000. It is on the Grand canal to the east of Lake Tai-hu and about 55 m. W.N.W. of Shanghai, with which it is connected by rail. The walls are about 10 m. in circumference and there are many large suburbs. The town was founded in 484 by Ho-lu-Wang, whose grave is covered by the artificial "Hill of the Tiger," in the vicinity of the town.

SOPHIA (1630–1714), electress of Hanover, twelfth child of Frederick V., elector palatine of the Rhine, by his wife Elizabeth, a daughter of the English king James I., was born at The Hague on Oct. 14, 1630. Residing after 1649 at Heidelberg with her brother, the restored elector palatine, Charles Louis, she married in 1658 Ernest Augustus, who became elector of Brunswick-Lüneburg, or Hanover, in 1692. Her married life was not a happy one. Sophia became a widow in the year 1698, but before then her name had been mentioned in connection with the English throne. When considering the Bill of Rights in 1689 the House of Commons refused to place her in the succession, and the matter rested until 1700 when the state of affairs in England was more serious. William III. was ill and childless; William, duke of Gloucester, the only surviving child of the princess Anne, had just died. The electress was the nearest Protestant heir. Accordingly by the Act of Settlement of 1701 the English Crown, in default of issue from either William or Anne, was settled upon "the most excellent princess Sophia, electress and duchess-dowager of Hanover" and "the heirs of her body, being Protestant." Sophia watched affairs in England during the reign of Anne with great interest, although her son, the elector George Louis, objected to any interference in that country, and Anne disliked all mention of her successor. An angry letter from Anne possibly hastened Sophia's death, which took place at Herrenhausen on June 8, 1714; less than two months later her son, George Louis, became king of Great Britain and Ireland as George I. on the death of Anne.

See *Memoiren der Kurfürstin Sophie von Hannover,* edited by A. Köcher (Leipzig, 1879; Eng. trans., 1888); *Briefwechsel der Herzogin Sophie von Hannover mit ihrem Bruder,* etc., edited by E. Bodemann (Leipzig, 1885 and 1888); A. W. Ward, *The Electress Sophia and the Hanoverian Succession* (London, 1909); O. Klopp, *Der Fall des Hauses Stuart* (Vienna, 1875–88); *Correspondance de Leibnitz avec l'électrice Sophie,* edited by O. Klopp (Hanover, 1864–75); and R. S. Rait, *Five Stuart Princesses* (London, 1902).

SOPHIA ALEKSYEEVNA (1657–1704), tsarevna and regent of Russia, was the third daughter of Tsar Alexius and Maria Miloslavskaya. Educated on semi-ecclesiastical lines by the learned monk of Kiev, Polotsky, she emancipated herself betimes from the traditional tyranny of the *terem,* or women's quarters. Setting aside court etiquette, she had nursed her brother Tsar Theodore III. in his last illness, and publicly appeared at his obsequies, though it was usual only for the widow of the deceased and his successor to the throne to attend that ceremony. Three days after little Peter, then in his fourth year, had been raised to the throne, she won over the *stryeltsy,* or musketeers, who at her instigation burst into the Kreml, murdering everyone they met, including Artamon Matvyeev, Peter's chief supporter, and Ivan Naruishkin, the brother of the tsaritsa-regent Natalia, Peter's mother (May 15–17, 1682). When the rebellion was over there was found to be no government. Everyone was panic-stricken and in hiding except Sophia, and to her, as the only visible representative of authority, the court naturally turned for orders. She paid off and pacified the *stryeltsy,* and secretly worked upon them to present (May 29) a petition to the council of state to the effect that her half-brother Ivan should be declared senior tsar, while Peter was degraded into the junior tsar. This duumvirate was but a stepping-stone to the ambition of Sophia, who thus became the actual ruler of Russia.

By Nov. 6, Sophia's triumph was complete. The conduct of foreign affairs she committed entirely to her paramour, Prince Vasily Golitsuin, while the crafty and experienced clerk of the council, Theodore Shaklovity, looked after domestic affairs and the treasury. Sophia's fondness for Golitsuin induced her to magnify his barely successful campaigns in the Crimea into brilliant triumphs which she richly rewarded, thus disgusting everyone who had the honour of the nation at heart. Most of the malcontents rested their hopes for the future on the young tsar Peter, who was the first to benefit by his sister's growing unpopularity. Sophia took council of Shaklovity, and it was agreed (1687) between them that the *stryeltsy* should be employed to dethrone Peter. The *stryeltsy,* however, received the whole project so coldly that it had to be abandoned. A second conspiracy to seize him in his bed (August 1689) was betrayed to Peter, and he fled to the fortress-monastery of Troitsa. Here all his friends rallied round him, including the bulk of the magnates, half the *stryeltsy,* and all the foreign mercenaries. From Aug. 12 to Sept. 7 Sophia endeavoured to set up a rival camp in the Kreml; but her professed adherents gradually left her. She was compelled to retire within the Novo-Dyevichy monastery, but without taking the veil. Nine years later (1698), on suspicion of being concerned in the rebellion of the *stryelsty,* she was shorn a nun and imprisoned for life.

See J. E. Zabyelin, *Domestic Conditions of the Russian Princes* (Rus.; Moscow, 1895); R. N. Bain, *The First Romanovs* (1905).

SOPHIA DOROTHEA (1666–1726), wife of George Louis, elector of Hanover (George I. of England), only child of George William, duke of Brunswick-Lüneburg-Celle, by a Huguenot lady named Eleanore d'Olbreuze (1639–1722), was born on Sept. 15, 1666. Sophia Dorothea was married, for dynastic reasons, to her cousin George Louis, son of Duke Ernest Augustus, who became elector of Hanover in 1692. This union was a very unhappy one. The electress Sophia hated her daughter-in-law, and this feeling was soon shared by the prince himself. Under these circumstances Sophia Dorothea made the acquaintance of Count Philipp Christoph von Königsmark (*q.v.*), who assisted her in one or two futile attempts to escape from Hanover, and rightly or wrongly was regarded as her lover. In 1694 the count was assassinated, and the princess was divorced and imprisoned at Ahlden, remaining in captivity until her death on Nov. 23, 1726. Sophia Dorothea is sometimes referred to as the "princess of Ahlden." Her two children were the English king, George II., and Sophia Dorothea, wife of Frederick William I. and mother of Frederick the Great.

SOPHISM, in logic and philosophy, is used in various senses. Sometimes it is synonymous with fallacy (*q.v.*) and means any inconclusive argument. Sometimes it denotes an invalid argument which is particularly difficult to refute, like the paradoxes of Zeno (*q.v.*). Lastly, it is also used in an offensive sense to denote an argument that is not only wrong and known to be wrong, but which is deliberately intended to deceive. *See* FALLACY, LOGIC.

SOPHISTS, the name given by the Greeks about the middle of the 5th century B.C. to certain teachers of a superior grade who, distinguishing themselves from philosophers on the one hand and from artists and craftsmen on the other, claimed to prepare their pupils, not for any particular study or profession, but for civic life (σοφιστής, literally, man of wisdom). For nearly a hundred years the sophists held almost a monopoly of general or liberal education. Yet, within the limits of the profession, there was considerable diversity both of theory and of practice. Four principal

varieties are distinguishable, and may be described as the sophistries of culture, of rhetoric, of politics and of "eristic," *i.e.*, disputation. Each of these predominated in its turn, though not to the exclusion of others, the sophistry of culture beginning about 447, and leading to the sophistry of eristic, and the sophistry of rhetoric taking root in central Greece about 427, and merging in the sophistry of politics. Further, since Socrates and the Socratics were educators, they too might be, and in general were, regarded as sophists; but, as they conceived truth—so far as it was attainable—rather than success in life, in the law court, in the assembly or in debate, to be the right end of intellectual effort, they were at variance with their rivals, and are commonly ranked by historians, not with the sophists, who confessedly despaired of knowledge, but with the philosophers, who, however unavailingly, continued to seek it. With the establishment of the great philosophical schools—first, of the Academy, next of the Lyceum—the philosophers took the place of the sophists as the educators of Greece.

The sophistical movement was then, primarily, an attempt to provide a general or liberal education which should supplement the customary instruction in reading, writing, gymnastics and music. But, as the sophists of the first period chose for their instruments grammar, style, literature and oratory, while those of the second and third developments were professed rhetoricians, sophistry exercised an important influence upon literature. Then again, as the movement, taking its rise in the philosophical agnosticism which grew out of the early physical systems, was itself persistently sceptical, sophistry may be regarded as an interlude in the history of philosophy. Finally, the practice of rhetoric and eristic, which presently became prominent in sophistical teaching, had, or at any rate seemed to have, a mischievous effect upon conduct; and the charge of seeking, whether in exposition or in debate, not truth but victory—which charge was impressively urged against the sophists by Plato—grew into an accusation of holding and teaching immoral and unsocial doctrines, and in our own day has been the subject of eager controversy.

Genesis and Development of Sophistry.—Sophistry arose out of a crisis in philosophy. The earlier Ionian physicists, Thales, Anaximander and Anaximenes, in their attempts to trace the Multiplicity of things to a single material element, had been troubled by no misgivings about the possibility of knowledge. But, when Heraclitus to the assumption of fire as the single material cause added the doctrine that all things are in perpetual flux, he found himself obliged to admit that things cannot be known. Thus, though, in so far as he asserted his fundamental doctrine without doubt or qualification, he was a dogmatist, in all else he was a sceptic. Again, the Eleatic Parmenides, deriving from the theologian Xenophanes the distinction between ἐπιήστμη and δόξα, conceived that, whilst the One exists and is the object of knowledge, the Multiplicity of things becomes and is the object of opinion; but, when his successor Zeno provided the system with a logic, the consistent application of that logic resolved the fundamental doctrine into the single proposition "One is One," or, more exactly, into the single identity "One One." Thus Eleaticism, though professedly dogmatic, was inconsistent in its theory of the One and its attributes, and openly sceptical in regard to the world of nature. Lastly, the philosophers of the second physical succession—Empedocles, Anaxagoras, Leucippus—not directly attacking the great mystery of the One and the Many, but in virtue of a scientific instinct approaching it through the investigation of phenomena, were brought by their study of sensation to perceive and to proclaim the inadequacy of the organs of sense. Thus they too, despite their air of dogmatism, were in effect sceptics. In short, from different standpoints, the three philosophical successions had devised systems which were in reality sceptical, though they had none of them recognized the sceptical inference.

Towards the middle of the 5th century, however, Protagoras of Abdera, taking account of the teaching of the first, and possibly of the second, of the physical successions, and Gorgias of Leontini, starting from the teaching of the metaphysical succession of Elea, drew that sceptical inference from which the philosophers had shrunk. If, argued Protagoras in a treatise entitled *Truth*, all things are in flux, so that sensation is subjective, it follows that "Man is the measure of all things, of what is, that it is, and of what is not, that is not"; in other words, there is no such thing as objective truth. Similarly, Gorgias, in a work *On Nature, or on the Nonent,* maintained (*a*) that nothing is, (*b*) that, if anything is, it cannot be known, (*c*) that, if anything is and can be known, it cannot be expressed in speech; and the summaries which have been preserved by Sextus Empiricus (*Adv. Math.* vii. 65–87) and by the author of the *De Melisso,* etc. (chs. 5, 6), show that, in defending these propositions, Gorgias availed himself of the arguments which Zeno had used to discredit the popular belief in the existence of the Many; in other words, that Gorgias turned the destructive logic of Zeno against the constructive ontology of Parmenides, thereby not only reducing Eleaticism to nothingness, but also, until such time as a better logic than that of Zeno should be provided, precluding all philosophical inquiry whatsoever. Thus, whereas the representatives of the three successions had continued to regard themselves as philosophers or seekers after truth, Protagoras and Gorgias, plainly acknowledging their defeat, withdrew from the ungrateful struggle.

Meagre as were the results which the earlier thinkers had obtained, the extinction of philosophy just at the time when the liberal arts became more technical and consequently less available as employments of leisure, threatened to leave a blank in Hellenic life. Accordingly Protagoras, while with the one hand he put away philosophy, with the other offered a substitute. Emphasizing the function of the teacher, which with the philosophers had been subordinate, and proclaiming the right end of intellectual endeavour to be, not "truth" (ἀλήθεια) or "wisdom" (σοφία), which was unattainable, but "virtue" or "excellence" (ἀρετή), he sought to communicate, not a theory of the universe, but an aptitude for civic life. "The lesson which I have to teach," Plato makes him say (*Prot.* 318 E), "is prudence or good counsel, both in respect of domestic matters that the man may manage his household aright, and in respect of public affairs, that he may be thoroughly qualified to take part, both by deed and by word, in the business of the state. In other words, I profess to make men good citizens." As instruments of education Protagoras used grammar, style, poetry and oratory. Thus, whereas hitherto the young Greek, having completed his elementary training in the schools of the γραμματιστής, the κιθαριστής, and the παιδοτρίβης, was left to prepare himself for his life's work as best he might, by philosophical speculation, by artistic practice, or otherwise, one who passed from the elementary schools to the lecture-room of Protagoras received from him a "higher education." The programme was exclusively literary, but for the moment it enabled Protagoras to satisfy the demand which he had discovered and evoked. Wherever he went, his lecture-room was crowded with admiring pupils, whose homage filled his purse and enhanced his reputation.

After Protagoras the most prominent of the literary sophists was Prodicus of Ceos. Establishing himself at Athens, he taught "virtue" or "excellence," in the sense attached to the word by Protagoras, partly by means of literary subjects, partly in discourses upon practical ethics. It is plain that Prodicus was an affected pedant; yet his simple conventional morality found favour, and Plato (*Rep.* 600 C) couples him with Protagoras in his testimony to the popularity of the sophists and their teaching.

At Athens, the centre of the intellectual life of Greece, there was soon to be found a host of sophists; some of them strangers, others citizens; some of them bred under Protagoras and Prodicus, others self-taught. In the teaching of the sophists of this younger generation two points are observable. First, their independence of philosophy and the arts being assured, though they continued to regard "civic excellence" as their aim, it was no longer necessary for them to make the assertion of its claims a principal element in their exposition. Secondly, for the sake of novelty they extended their range, including scientific and technical subjects, but handling them, and teaching their pupils to handle them, in a popular way. In this stage of sophistry then, the sophist, though not a specialist, trenched upon the provinces of specialists; and accordingly Plato (*Prot.* 318 E) makes Protagoras pointedly refer

to sophists who, "when young men have made their escape from the arts, plunge them once more into technical study, and teach them such subjects as arithmetic, astronomy, geometry and music." The sophist of whom the Platonic Protagoras is here thinking was Hippias of Elis, who gave popular lectures, not only upon the four subjects just mentioned, but also upon grammar, mythology, family history, archaeology, Homerology and the education of youth. In this polymath we see at once the degradation of the sophistry of culture and the link which connects Protagoras and Prodicus with the eristics, who at a later period taught, not, like Hippias, all branches of learning, but a universally applicable method of disputation.

Meanwhile, Gorgias of Leontini, who, as has been seen, had studied and rejected the philosophy of western Greece, gave to sophistry a new direction by bringing to the mother country the technical study of rhetoric—especially forensic rhetoric (Plato, *Gorg.* 454 B; *cf.* Aristotle, *Rhet.* 1354, b 26)—which study had begun in Sicily with Corax and Tisias nearly forty years before. Gorgias was already advanced in years and rich in honours when, in 427, he visited Athens as the head of an embassy sent to solicit aid against Syracuse. Received with acclamation, he spent the rest of his long life in central Greece, winning applause by the display of his oratorical gifts and acquiring wealth by the teaching of rhetoric. There is no evidence to show that at any period of his life he called himself a sophist; and, as Plato (*Gorg.* 449 A) makes him describe himself as a *ῥήτωρ,* it is reasonable to suppose that he preferred that title. That he should do so was only natural, since his position as a teacher of rhetoric was already secure when Protagoras made his first appearance in the character of a sophist; and, as Protagoras, Prodicus and the rest of the sophists of culture offered a comprehensive education, of which oratory formed only a part, whilst Gorgias made no pretence of teaching "civic excellence" (Plato, *Meno,* 95 C), and found a substitute for philosophy, not in literature generally, but in the professional study of rhetoric alone, it would have been convenient if the distinction between sophistry and rhetoric had been maintained. But though, as will be seen hereafter, these two sorts of education were sometimes distinguished, Gorgias and those who succeeded him as teachers of rhetoric, such as Thrasymachus of Chalcedon and Polus of Agrigentum, were commonly called by the title which Protagoras had assumed and brought into familiar use.

Rhetorical sophistry, as taught by Gorgias with special reference to the requirements of the law courts, led by an easy transition to political sophistry. During the century which had elapsed since the expulsion of the Peisistratids and the establishment of the democracy, the Athenian constitution had developed with a rapidity which produced an oligarchical reaction, and the discussion of constitutional principles and precedents, always familiar to the citizen of Athens, was thus abnormally stimulated. The Peloponnesian War, too, not only added a deeper interest to ordinary questions of policy, but also caused the relations of dissentient parties, of allied and belligerent states, of citizens and aliens, of bond and free, of Greeks and barbarians, to be eagerly debated in the light of present experience. It was only natural then that some of those who professed to prepare young Athenians for public life should give to their teaching a distinctively political direction; and accordingly we find Isocrates recognizing teachers of politics, and discriminating them at once from those earlier sophists who gave popular instruction in the arts and from the contemporary eristics. To this class, that of the political sophists, may be assigned Lycophron, Alcidamas and Isocrates himself. For, though that celebrated personage would have liked to be called, not "sophist" but "political philosopher," and tried to fasten the name of "sophist" upon his opponents the Socratics, it is clear from his own statement that he was commonly ranked with the sophists, and that he had no claim, except on the score of superior popularity and success, to be dissociated from the other teachers of political rhetoric. It is true that he was not a political sophist of the vulgar type, that as a theorist he was honest and patriotic, and that, in addition to his fame as a teacher, he had a distinct reputation as a man of letters; but he was a professor of political rhetoric, and, as such, in the phraseology of the day, a sophist. He had already reached the height of his fame when Plato opened a rival school at the Academy, and pointedly attacked him in the *Gorgias,* the *Phaedrus* and the *Republic.* Thenceforward, there was a perpetual controversy between the rhetorician and the philosopher, and the struggle of educational systems continued until, in the next generation, the philosophers were left in possession of the field.

While the sophistry of rhetoric led to the sophistry of politics, the sophistry of culture led to the sophistry of disputation. It has been seen that the range of subjects recognized by Protagoras and Prodicus gradually extended itself, until Hippias professed himself a teacher of all branches of learning, including in his list subjects taught by artists and professional men, but handling them from a popular or non-professional point of view. The successors of the polymath claimed to possess and to communicate, not the knowledge of all branches of learning, but an aptitude for dealing with all subjects, which aptitude should make the knowledge of any subject superfluous. In other words, they cultivated skill in disputation. Now skill in disputation is plainly a valuable accomplishment; and, as the Aristotelian logic grew out of the regulated discussions of the eristics and their pupils, the disputant sophistry of the 4th century deserves more attention and more respect than it usually receives from historians of Greek thought. But when men set themselves to cultivate skill in disputation, regarding the matter discussed not as a serious issue, but as a thesis upon which to practise their powers of controversy, they learn to pursue, not truth, but victory; and, their criterion of excellence having been thus perverted, they presently prefer ingenious fallacy to solid reasoning and the applause of bystanders to the consciousness of honest effort. Indeed, the sophists generally had a special predisposition to error of this sort, not only because sophistry was from the beginning a substitute for the pursuit of truth, but also because the successful professor, travelling from city to city, or settling abroad, could take no part in public affairs, and thus was not at every step reminded of the importance of the "material" element of exposition and reasoning. Paradox, however, soon becomes stale, and fallacy wearisome. Hence, despite its original popularity, eristical sophistry could not hold its ground. The man of the world who had cultivated it in his youth regarded it in riper years as a foolish pedantry, or at best as a propaedeutic exercise; while the serious student, necessarily preferring that form of disputation which recognized truth as the end of this, as of other intellectual processes, betook himself to one or other of the philosophies of the revival.

In order to complete this sketch of the development of sophistry in the latter half of the 5th century and the earlier half of the 4th, it is necessary next to take account of Socrates and the Socratics. A foe to philosophy and a renegade from art, Socrates took his departure from the same point as Protagoras, and moved in the same direction, that of the education of youth. Finding in the cultivation of "virtue" or "excellence" a substitute for the pursuit of scientific truth, and in disputation the sole means by which "virtue" or "excellence" could be attained, he resembled at once the sophists of culture and the sophists of eristic. But, inasmuch as the "virtue" or "excellence" which he sought was that of the man rather than that of the official, while the disputation which he practised had for its aim, not victory, but the elimination of error, the differences which separated him from the sophists of culture and the sophists of eristic were only less considerable than the resemblances which he bore to both; and further, though his whole time and attention were bestowed upon the education of young Athenians, his theory of the relations of teacher and pupil differed from that of the recognized professors of education, inasmuch as the taking of fees seemed to him to entail a base surrender of the teacher's independence. The principal characteristics of Socrates's theory of education were accepted, *mutatis mutandis,* by the leading Socratics. With these resemblances to the contemporary professors of education, and with these differences, were Socrates and the Socratics sophists or not? To this question there is no simple answer, yes or no. It is certain that Socrates's contemporaries regarded him as a sophist; and it was only reasonable that they should so regard him, because

in opposition to the physicists of the past and the artists of the present he asserted the claims of higher education. But, though according to the phraseology of the time he was a sophist, he was not a typical sophist—his principle that, while scientific truth is unattainable by man, right opinion is the only basis of right action, clearly differentiating him from all the other professors of "virtue." Again, as the Socratics—Plato himself, when he established himself at the Academy, being no exception—were, like their master, educators rather than philosophers, and in their teaching laid especial stress upon discussion, they, too, were doubtless regarded as sophists, not by Isocrates only, but by their contemporaries in general; and it may be conjectured that the disputatious tendencies of the Megarian school made it all the more difficult for Plato and others to secure a proper appreciation of the difference between dialectic, or discussion with a view to the discovery of truth, and eristic, or discussion with a view to victory. Changing circumstances, however, carry with them changes in the meaning and application of words. Whereas, so long as philosophy was in abeyance Socrates and the Socratics were regarded as sophists of an abnormal sort, as soon as philosophy revived it was dimly perceived that, in so far as Socrates and the Socratics dissented from sophistry, they preserved the philosophical tradition. This being so, it was found convenient to revise the terminology of the past, and to include in the philosophical succession those who, though not philosophers, had cherished the sacred spark. As for Socrates, he ranked himself neither with the philosophers, who professed to know, nor with the sophists, who professed to teach; and, if he sometimes described himself as a *φιλόσοφος* he was careful to indicate that he pretended to no other knowledge than that of his own limitations.

It would seem then, (1) that popular nomenclature included under the term "sophist" all teachers—whether professors, or like Socrates, amateurs—who communicated, not artistic skill, nor philosophical theory, but a general or liberal education; (2) that, of those who were commonly accounted sophists, some professed culture, some forensic rhetoric, some political rhetoric, some eristic, some (*i.e.*, the Socratics) dialectic; (3) that the differences between the different groups of sophists were not inconsiderable, and that in particular the teaching of the rhetoricians was distinct in origin, and, in so far as its aim was success in a special walk of life, distinct in character, from the more general teaching of the sophists of culture, the eristics, and the dialecticians, while the teaching of the dialecticians was discriminated from that of the rest, in so far as the aim of the dialecticians was truth, or at least the bettering of opinion; and, consequently, (4) that, in awarding praise and blame to sophistry and its representatives, the distinctive characteristics of the groups above enumerated must be studiously kept in view.

Lapse of time and change of circumstances brought with them not merely changes in the subjects taught, but also changes in the popular estimate of sophistry and sophists. The first and most obvious sentiment which sophistry evoked was an enthusiastic and admiring interest. The sophist seemed to his youthful hearers to open a new field of intellectual activity and thereby to add a fresh zest to existence. But in proportion to the fascination which he exercised upon the young was the distrust which he inspired in their less pliable elders. Not only were they dismayed by the novelty of the sophistical teaching, but also they vaguely perceived that it was subversive of authority, of the authority of the parent over the child as well as of the authority of the state over the citizen. Of the two conflicting sentiments, the favour of the young, gaining as years passed away, naturally prevailed; sophistry ceased to be novel, and attendance in the lecture-rooms of the sophists came to be thought not less necessary for the youth than attendance in the elementary schools for the boy. The lively enthusiasm and the furious opposition which greeted Protagoras had now burnt themselves out, and before long the sophist was treated by the man of the world as a harmless, necessary pedagogue.

Relations of Sophistry to Education, Literature and Philosophy.—If then the sophists, from Protagoras to Isocrates, were before everything educators, it becomes necessary to inquire whether their labours marked or promoted an advance in educational theory and method. At the beginning of the 5th century B.C. every young Greek of the better sort already received rudimentary instruction, not only in music and gymnastics, but also in reading and writing. Further, in the colonies, and especially the colonies of the West, philosophy and art had done something for higher education. Thus in Italy the Pythagorean school was, in the fullest sense of the term, an educational institution; and in Sicily the rhetorical teaching of Corax and Tisias was presumably educational in the same sense as the teaching of Gorgias. But in central Greece, where, at any rate down to the Persian Wars, politics, domestic and foreign, were all-engrossing, and left the citizen little leisure for self-cultivation, the need of a higher education had hardly made itself felt. The overthrow of the Persian invaders changed all this. Henceforward the best of Greek art, philosophy and literature gravitated to Athens, and with their concentration and consequent development came a general and growing demand for teaching. As has been seen, it was just at this period that philosophy and art ceased to be available for educational purposes, and accordingly the literary sophists were popular precisely because they offered advanced teaching which was neither philosophical nor artistic. Their recognition of the demand and their attempt to satisfy it are no small claims to distinction. That, whereas before the time of Protagoras there was little higher education in the colonies and less in central Greece, after his time attendance in the lecture-rooms of the sophists was the customary sequel to attendance in the elementary schools, is a fact which speaks for itself.

But this is not all. The education provided by the sophists of culture had positive merits. When Protagoras included in his course, grammar, style, interpretation of the poets and oratory, supplementing his own continuous expositions by disputations in which he and his pupils took part, he showed a not inadequate appreciation of the requisites of a literary education; and it may be conjectured that his comprehensive programme, which Prodicus and others extended, had something to do with the development of that versatility which was the most notable element in the Athenian character.

There is less to be said for the teachers of rhetoric, politics and eristic, who, in limiting themselves each to a single subject—the rhetoricians proper or forensic rhetoricians to one branch of oratory, the politicians or political rhetoricians to another, and the eristics to disputation—ceased to be educators and became instructors. Nevertheless, rhetoric and disputation, though at the present day strangely neglected in English schools and universities, are, within their limits, valuable instruments; and, as specialization in teaching does not necessarily imply specialization in learning, many of those who attended the lectures and the classes of a rhetorician or an eristic sought and found other instruction elsewhere. It would seem then that even in its decline sophistry had its educational use. But in any case it may be claimed for its professors that in the course of a century they discovered and turned to account most of the instruments of literary education.

With these considerable merits, normal sophistry had one defect, its indifference to truth. Despairing of philosophy—that is to say, of physical science—the sophists were prepared to go all lengths in scepticism. Accordingly the epideictic sophists in exposition, and the argumentative sophists in debate, one and all, studied, not matter but style, not accuracy but effect, not proof but persuasion. In short, in their hostility to science they refused to handle literature in a scientific spirit. That this defect was serious was dimly apprehended even by those who frequented and admired the lectures of the earlier sophists; that it was fatal was clearly seen by Socrates, who, himself commonly regarded as a sophist, emphatically reprehended, not only the taking of fees, which was after all a mere incident, objectionable because it seemed to preclude independence of thought, but also the fundamental disregard of truth which infected every part and every phase of sophistical teaching. To these contemporary censures the modern critic cannot refuse his assent.

To literature and to oratory the sophists rendered good service. Themselves of necessity stylists, because their professional suc-

cess largely depended upon skilful and effective exposition, the sophists both of culture and of rhetoric were professedly teachers of the rules of grammar and the principles of written and spoken discourse. Thus, by example as well as by precept, they not only taught their hearers to value literary and oratorical excellence, but also took the lead in fashioning the style of their time. Their influence in these respects was weighty and important. Whereas, when sophistry began, prose composition was hardly practised in central Greece, the sophists were still the leaders in literature and oratory when Plato wrote the *Republic,* and they had hardly lost their position when Demosthenes delivered the *Philippics.* In fact, it is not too much to say that it was the sophists who provided those great masters with their consummate instrument, and it detracts but little from the merit of the makers if they were themselves unable to draw from it its finer tones.

The relation of sophistry to philosophy was throughout one of pronounced hostility. From the days of Protagoras, when this hostility was triumphant and contemptuous, to the days of Isocrates, when it was jealous and bitter, the sophists were declared and consistent sceptics. But, although Protagoras and Gorgias had examined the teaching of their predecessors so far as to satisfy themselves of its futility and to draw the sceptical inference, their study of the great problem of the day was preliminary to their sophistry rather than a part of it; and, as the overthrow of philosophy was complete and the attractions of sophistry were all-powerful, the question "What is knowledge?" ceased for a time to claim or to receive attention. There is, then, no such thing as a "sophistical theory of knowledge." Similarly, the recognition of a "sophistical ethic" is, to say the least, misleading. It may have been that the sophists' preference of seeming to reality, of success to truth, had a mischievous effect upon the morality of the time; but it is clear that they had no common theory of ethics, and there is no warrant for the assumption that a sophist, as such, specially interested himself in ethical questions. When Protagoras asserted "civic excellence" or "virtue" to be the end of education, he neither expressed nor implied a theory of morality. Prodicus in his platitudes reflected the customary morality of the time. Gorgias said plainly that he did not teach "virtue." If Hippias, Polus and Thrasymachus defied conventional morality, they did so independently of one another, and in this, as in other matters, they were disputants maintaining paradoxical theses, rather than thinkers announcing heretical convictions. The morality of Isocrates bore a certain resemblance to that of Socrates. In short, the attitude of the sophists towards inquiry in general precluded them, collectively and individually, from attachment to any particular theory. Yet among the so-called sophists there were two who had philosophical leanings, as appears in their willingness to be called by the title of philosopher. First, Socrates, whilst he conceived that the physicists had mistaken the field of inquiry, absolute truth being unattainable, maintained, as has been seen, that one opinion was better than another, and that consistency of opinion, resulting in consistency of action, was the end which the human intellect properly proposes to itself. Hence, though an agnostic, he was not unwilling to be called a philosopher, in so far as he pursued such truth as was attainable by man. Secondly, when sophistry had begun to fall into contempt, the political rhetorician Isocrates claimed for himself the time-honoured designation of philosopher, "herein," says Plato, "resembling some tinker, bald-pated and short of stature, who, having made money, knocks off his chains, goes to the bath, buys a new suit, and then takes advantage of the poverty and desolation of his master's daughter to urge upon her his odious addresses" (*Rep.* vi. 495 E). It will be seen, however, that neither Socrates nor Isocrates was philosopher in any strict sense of the word, the speculative aims of physicists and metaphysicians being foreign to the practical theories both of the one and of the other.

BIBLIOGRAPHY.—On the significance of the sophistical movement, *see* E. Zeller, *Philosophie d. Griechen,* i. 932–1041 (4th ed., Leipzig, 1876); *Presocratic Philosophy,* ii. 394–516 (London, 1881); G. Grote, *History of Greece,* ch. lxvii. (London, 1851, etc.); E. M. Cope, "On the Sophists," and "On the Sophistical Rhetoric," in *Journ. Class. and Sacr. Philol.* vol. ii. (Cambridge, 1855), and vol. iii. (1857), an erudite but inconclusive reply to Grote; H. Sidgwick, "The Sophists," in *Journ. of Philol.,* vol. iv. (Cambridge, 1872), and vol. v. (1874), a brilliant defence of Grote; A. W. Benn, *The Greek Philosophers* i. 53–107 (London, 1882). For lists of treatises upon the life and teaching of particular sophists, *see* Ueberweg, *Grundriss d. Gesch. d. Philos.,* i. §§ 27–32 (*History of Philosophy,* London, 1880). On the later use of the term "sophist," *see* RHETORIC. (H. JN.)

SOPHOCLES (495–406 B.C.), Greek tragic poet, the son of Sophillus, was born at Colonus in the neighbourhood of Athens. The date assigned for the poet's birth is in accordance with the tale that young Sophocles, then a pupil of the musician Lamprus, was chosen to lead the chorus of boys in the celebration of the victory of Salamis (480 B.C.). The time of his death is fixed by the allusions to it in the *Frogs* of Aristophanes and in the *Muses,* a lost play of Phrynichus, the comic poet, which were both produced in 405 B.C. Apart from tragic victories, the event of Sophocles' life most fully authenticated is his appointment, at the age of 55, as one of the generals who served with Pericles in the Samian War (440–439 B.C.). Conjecture has been rife as to the possibility of his here improving acquaintance with Herodotus, whom he probably met some years earlier at Athens. But the distich quoted by Plutarch—

> *'Ωιδὴν Ἡροδότῳ τεῦξεν Σοφοκλῆς ἐτέων ὢν*
> *Πέντ' ἐπὶ πεντήκοντα*—

is a slight ground on which to reject the stronger tradition, according to which Herodotus was ere this established at Thurii. The fact of Sophocles' generalship is the less surprising if taken in connection with the interesting remark of his biographer (whose *Life,* though absent from the earliest ms. through some mischance, bears marks of an Alexandrian origin) that he took his full share of civic duties, and even served on foreign embassies. The large acquaintanceship which this implies, not only in Athens, but in Ionic cities generally, is a point of main importance in considering the opportunities of information at his command.

The testimony borne by Aristophanes in the *Frogs* to the amiability of the poet's temper (*ὁ δ' εὔκολος μὲν ἐνθάδ', εὔκολος δ' ἐκεῖ*) agrees with the record of his biographer that he was universally beloved. And the anecdote recalled by Cephalus in Plato's *Republic,* that Sophocles welcomed the release from the passions which is brought by age, accords with the spirit of his famous Ode to Love in the *Antigone.* The Sophocles who, according to Aristotle (*Rhet.* iii. 18), said of the government of the Four Hundred that it was the better of two bad alternatives (probably the same who was one of the *probuli*), may or may not have been the poet. Other gossiping stories are hardly worth repeating—as that Pericles rebuked his love of pleasure and thought him a bad general, though a good poet; that he humorously boasted of his own "generalship" in affairs of love; or that he said of Aeschylus that he was often right without knowing it, and that Euripides represented men as they are, not as they ought to be. (This last anecdote has the authority of Aristotle.) And the story of his indictment by his son, Iophon, for incompetence to manage his affairs—to which Cicero has given some weight by quoting it in the *De senectute*—appears to be really traceable to Satyrus (*fl. c.* 200 B.C.), the same author who gave publicity to the most ridiculous of the various absurd accounts of the poet's death—that his breath failed him for want of a pause in reading some passage of the *Antigone.* Satyrus is at least the sole authority for the defence of the aged poet, who, after reciting passages from the *Oed. Col.,* is supposed to have said to his accusers, "If I am Sophocles I am no dotard, and if I dote I am not Sophocles."

There is a tradition that Sophocles, because of the weakness of his voice, was the first poet who desisted from acting in his own plays. Various minor improvements in decoration and stage carpentry are attributed to him. It is more interesting, if true, that he wrote his plays having certain actors in his eye; that he formed an association for the promotion of liberal culture; and that he was the first to introduce three actors on the stage. It is asserted on the authority of Aristoxenus that Sophocles was also the first to employ Phrygian melodies. Ancient critics had also noted his familiarity with Homer, especially with the *Odyssey,* his power of selection and of extracting an exquisite grace from all he touched (whence he was named the "Attic Bee"), his mingled felicity and boldness, and, above all, his subtle delineation of human nature

and feeling.

His minor poems, elegies, paeans, etc., have all perished; and of his 100 and odd dramas only seven remain. These all belong to the period of his maturity (he had no decline); and not only the titles but some scanty fragments of more than 90 others have been preserved. Suïdas says that "Sophocles began the practice of pitting play against play, instead of the tetralogy." If it were meant that Sophocles did not exhibit tetralogies, this statement would have simply to be rejected. For the word of Suïdas (A.D. 950) has no weight against quotations from the lists of tragic victories (διδασκαλίαι), which there is no other reason for discrediting. But it seems probable that the trilogy had ceased to be the continuous development of one legend or cycle of legends—if, indeed, it ever was so exclusively; and if a Sophoclean tetralogy was still linked together by some subtle bond of tragic thought or feeling, this would not affect the criticism of each play considered as an artistic whole. And these changes, or something like them, may have given rise to the statement of Suïdas.

If the diction of Sophocles sometimes reminds his readers of the *Odyssey*, the subjects of his plays were more frequently chosen from those later epics which subsequently came to be embodied in the epic cycle, including probably, though there is no mention of such a thing, some early version of the Argonautic story. In one or other of these heroic poems the legends of all the great cities of Hellas were by this time embodied, and Sophocles drew from these the materials for his more concentrated art, much as Shakespeare made use of Hollingshed or Plutarch, or as the subjects of Tennyson's *Idylls of the King* were taken from Sir Thomas Malory.

The principle of selection seems to have been simply his perception of the tragic possibilities of a particular fable. But to say that subsidiary or collateral motives were never present to Sophocles in the selection of a subject would be beyond the mark. His first drama, the *Triptolemus*, must have been full of local colouring; the *Ajax* appealed powerfully to the national pride; and in the *Oedipus Coloneus* some faint echoes even of oligarchical partisanship may be possibly discerned (*see* below). But even where they existed, such motives *were* collateral and subsidiary; they were never primary. All else was subordinated to the dramatic, or, in other words, the purely human, interest of the fable. This central interest is even more dominant and pervading in Sophocles than the otherwise supreme influence of religious and ethical ideas. The idea of destiny, for example, was of course inseparable from Greek tragedy. Its prevalence was one of the conditions which presided over the art from its birth, and, unlike Aeschylus, who wrestles with gods, Sophocles simply accepts it, both as a *datum* of tradition and a fact of life. But in the free handling of Sophocles even fate and providence are adminicular to tragic art. They are instruments through which sympathetic emotion is awakened, deepened, intensified. And, while the vision of the eternal and unwritten laws was holier yet, for it was not the creation of any former age, but rose and culminated with the Sophoclean drama, still to the poet and his Periclean audience this was no abstract notion, but was inseparable from their impassioned contemplation of the life of man—so great and yet so helpless, aiming so high and falling down so far, a plaything of the gods and yet essentially divine.

Sophocles is often praised for skilful construction. But the secret of his skill depends in large measure on the profound way in which the central situation in each of his fables has been conceived and felt. Concentration is the distinguishing note of tragedy, and it is by greater concentration that Sophocles is distinguished from other tragic poets. In the *Septem contra Thebas* or the *Prometheus* of Aeschylus there is still somewhat of epic enlargement and breadth; in the *Hecuba* and other dramas of Euripides separate scenes have an idyllic beauty and tenderness which affect us more than the progress of the action as a whole. But in following a Sophoclean tragedy we are carried steadily and swiftly onward, looking neither to the right nor to the left; the more elaborately any scene or single speech is wrought the more does it contribute to enhance the main emotion, and if there is a deliberate pause it is felt either as a welcome breathing space or as the calm of brooding expectancy.

The seven extant tragedies probably owe their preservation to some selection made for educational purposes in Alexandrian times. A yet smaller "syllogè" of three plays (*Ajax, Electra, Oedipus Tyrannus*) continued current amongst Byzantine students and many more copies of these exist than is the case with the other four. Of these four the *Antigone* seems to have been the most popular, while an inner circle of readers were specially attracted by the *Oedipus Coloneus.*

No example of the poet's earliest manner has come down to us. The *Antigone* certainly belongs to the Periclean epoch. Modern readers have thought it strange that Creon, when convinced, goes to bury Polynices before attempting to release Antigone. It is obvious how this was necessary to the catastrophe, but it is also true to character, for Creon is not moved by compunction for the maiden nor by anxiety on Haemon's account, but by the fear of retribution coming on himself and the State, because of the sacred law of sepulture which he has defied. Antigone is the martyr of natural affection and of the religion of the family. But, as Kaibel pointed out, she is also the high-born Cadmean maiden, whose defiance of the oppressor is accentuated by the pride of race. She despises Creon as an upstart, who has done outrage not only to eternal ordinance, but to the rights of the royal house.

The *Ajax,* that tragedy of wounded honour, still bears some traces of Aeschylean influence, and may be even earlier than the *Antigone.* The construction of the *Ajax* has been adversely criticized, but without sufficient reason. If it has not the concentration of the *Antigone*, or of the *Oedipus Tyrannus,* it has a continuous movement which culminates in the hero's suicide, and develops a fine depth of sympathetic emotion in the sequel.

In the *King Oedipus* the poet attains to the supreme height of dramatic concentration and tragic intensity. The drama seems to have been produced soon after the outbreak of the Peloponnesian War. The worship of the Delphic Apollo is associated with a profound sense of the value and sacredness of domestic purity, and in the command to drive out pollution there is possibly an implied reference to the expulsion of the Alcmaeonidae.

The *Electra*, a less powerful drama, is shown by the metrical indications to be somewhat later than the *Oedipus Rex.* Electra's heroic impulse, the offspring of filial love, through long endurance hardened into a "fixed idea," is irrepressible, and Orestes, supported by Pylades, goes directly to his aim in obedience to Apollo. But nothing can exceed the tenderness of the recognition scene—lines 1098–1321, and the description of the falsely reported chariot race (681–763) is full of spirit.

In the *Trachinian Maidens* there is a transition towards that milder pathos which Sophocles is said to have finally approved (ἠθικώτατον καὶ ἄριστον). The fate of Deianira is tragic indeed. But in her treatment of her rival, Iole, there are modern touches reminding one of Shakespeare. The play may have been produced at a time not far removed from the peace of Nicias. The "modern" note is even more conspicuous in the *Philoctetes,* where the inward conflict in the mind of Neoptolemus, between ambition and friendship, is delineated with equal subtlety and force, and the contrast of the ingenuous youth with the aged solitary, in whom just resentment has become a dominant idea, shows great depth of psychological insight. The contending interests are reconciled by the intervention of the deified Heracles. The *Philoctetes* is known to have been produced in the year 408 B.C., when Sophocles was 87 years old. The *Oedipus Coloneus* is said to have been brought out after the death of Sophocles by his grandson in the archonship of Micon, 402 B.C. Theseus in Euripides (*Supplices*) is the first citizen of a republic. In this drama he is the king whose word is law, and he is warned by Oedipus to avoid the madness of revolutionary change (lines 15,361–538). The tragic story of Oedipus is resumed, but in a later and deeper strain of thoughtful emotion. Once more the noble spirit, rejected by man, is accepted by the gods. The eternal laws have been vindicated. Their decrees are irreversible, but the involuntary unconscious criminal is not finally condemned. He has no more hope in this world, but is in mysterious communion with unseen powers. The sufferer is now a holy person and an author of blessing.

The spectator of a Sophoclean tragedy was invited to witness the supreme crisis of an individual destiny, and was possessed at the outset with the circumstances of the decisive moment. Except in the *Trachiniae,* where the retrospective soliloquy of Deianira is intended to emphasize her lonely position, this exposition is effected through a brief dialogue, in which the protagonist may or may not take part. In the *Oedipus Tyrannus* the king's entrance and his colloquy with the aged priest introduce the audience at once to the action and to the chief person. In the *Ajax* and *Philoctetes* the entrance or discovery of the hero is made more impressive by being delayed. Immediately after the prologos the chorus enter, numbering 15, either chanting in procession as in the *Antigone* and *Oedipus Tyrannus,* or dispersedly as in the *Oedipus Coloneus* and *Philoctetes,* or, thirdly, as in the *Electra,* where, after entering silently during the monody of the heroine, and taking up their position in the orchestra, they address her one by one. With one exception, the chorus, having once entered, remain to the end. They always stand in some carefully adjusted relation to the principal figure. The elders of Thebes, whose age and coldness throw into relief the fervour and the desolation of Antigone, are the very men to realize the calamity of Oedipus, and, while horror-stricken, to lament his fall. The rude Salaminian mariners are loyal to Ajax, but cannot enter into his grief. The Trachinian maidens would gladly support Deianira, who has won their hearts, but they are too young and inexperienced for the task. The noble Argive women can sympathize with the sorrows of Electra, but no sympathy can soothe her distress.

The parodos of the chorus is followed by the first scene or epeisodion, with which the action may be said to begin. For in the course of this the spectator's interest is strongly roused by some new circumstance involving an unforeseen complication—the awakening of Ajax (*Aj.*), the burial of Polynices (*Ant.*), the dream of Clytaemnestra (*El.*), the dark utterance of Teiresias (*Oed. Tyr.*), the arrival of Lichas with Iole (*Trach.*), the report of Ismene announcing Creon's coming (*Oed. Col.*), the sudden entreaty of Philoctetes crossed by the entrance of the pretended mariner (*Phil.*). The action from this point onwards is like a steadily flowing stream into which a swift and turbulent tributary has suddenly fallen, and the interest advances with rapid and continuous climax until the culmination is reached and the catastrophe is certain. The manner in which this is done, through the interweaving of dialogue and narration with the various lyrical portions, is very different in different dramas, one of the principal charms of Sophocles being his power of ingenious variation in the employment of his resources. Not less admirable is the strength with which he sustains the interest after the *peripeteia,* whether, as in the *Antigone,* by heaping sorrow upon sorrow, or, as in the first *Oedipus,* by passing from horror to tenderness and unlocking the fountain of tears. (A tragic action has five stages, whence the five acts of the modern drama: the start, the rise, the height, the change, the close.) The extreme point of boldness in arrangement is reached in the *Ajax,* where the chorus of Tecmessa, having been warned of the impending danger, depart severally in quest of the vanished hero, and thus leave not only the stage but the orchestra vacant for the soliloquy that precedes his suicide.

The proportion of the lyrics to the level dialogue is considerably less on the average in Sophocles than in Aeschylus, as might be expected from the development of the purely dramatic element, and the consequent subordination of the chorus to the protagonist. In the seven extant plays the lyrical portion ranges from one-fifth to nearly one-third, being highest in the *Antigone* and lowest in the *Oedipus Tyrannus.*

The union of strict symmetry with freedom and variety, which is throughout characteristic of the work of Sophocles, is especially noticeable in his handling of the tragic metres. In the iambics of his dialogue, as compared with those of Aeschylus, there is an advance which may be compared with the transition from "Marlowe's mighty line" to the subtler harmonies of Shakespeare. Felicitous pauses, the linking on of line to line, trisyllabic feet introduced for special effects, alliteration both hard and soft, length of speeches artfully suited to character and situation, adaptation of the caesura to the feeling expressed, are some of the points which occur most readily in thinking of his *senarii.* A minute speciality may be noted as illustrative of his manner in this respect. Where a line is broken by a pause towards the end and the latter phrase runs on into the following lines, elision sometimes takes place between the lines, e.g. (*Oed. Tyr.,* 332–333):—

Ἐγὼ οὔτ' ἐμαυτὸν οὔτε σ' ἀλγυνῶ. τί ταῦτ'
ἄλλως ἐλέγχεις

This is called *synaphea,* and is peculiar to Sophocles.

He differentiates more than Aeschylus does between the metres to be employed in the *κομμοί* (including the *κομματικά*) and in the choral odes. The dochmius, cretic, and free anapaest are employed chiefly in the *κομμοί.* In the stasima he has greatly developed the use of logaedic and particularly of glyconic rhythms, and far less frequently than his predecessor indulges in long continuous runs of dactyls or trochees. The light trochaic ⏑́ ⏑ — ⏑ ⏑́ ⏑ —, so frequent, in Aeschylus, is comparatively rare in Sophocles. If, from the very severity with which the choral element is subordinated to the purely dramatic, his lyrics have neither the magnificent sweep of Aeschylus nor the "linked sweetness" of Euripides, they have a concinnity and point, a directness of aim, and a truth of dramatic keeping, more perfect than is to be found in either. And even in grandeur it would be hard to find many passages to bear comparison with the second stasimon, or central ode, either of the *Antigone* (*εὐδαίμονες οἷσι κακῶν*) or the first *Oedipus* (*εἴ μοι ξυνείη φέροντι*). Nor does anything in Euripides equal in grace and sweetness the famous eulogy on Coloneus (the poet's birthplace) in the *Oedipus Coloneus.*

Bibliography.—Sophocles was edited (probably from the Venetian mss.) by Aldus Manutius, with the help of Musurus, in 1502. The Juntine editions, in which the text of Aldus was slightly modified with the help of Florentine mss., were published in 1522, 1547, respectively. An edition of the Scholia, very nearly corresponding to those on the margin of the Medicean or chief Laurentian ms. (La or L), previously appeared at Rome in 1518. The first great modification of the text was due to Turnebus, who had access to the Parisian mss.; but he was not fortunate in his selection. The earliest editors had been aware that the traditional arrangement of the metres was faulty, but little way had been made towards a readjustment. Now it so happens that the Parisian ms. T, which is a copy of the recension of Triclinius, an early 14th century scholar, contains also the metrical views of the same editor; and, having found (as he erroneously supposed) a sound authority, Turnebus (1552) blindly adopted it, and was followed in this by H. Stephanus (1568), and by Canter in Holland (1579), who was the first to recognize the arrangement of the odes in strophe and antistrophe. The error was to a large extent corrected by Brunck (1786), who rightly preferred Par. A (2712), a 13th century ms., belonging, as it happened, to the same family with Ven. 467, which Aldus had mainly followed. Thus after nearly three centuries the text returned (though with conjectural variations) into the former channel. Musgrave's edition was published posthumously in 1800, and Gilbert Wakefield had published a selection shortly before. Erfurdt in Germany then took up the succession, and his edition formed the basis of Hermann's, whose psychological method set the example of a new style of commentary which was adopted by Wunder. A new era commenced with Peter Elmsley's collation of the Laurentian ms. (made in 1818, but only published in full after his death). His transcription of the Scholia still exists in the Bodleian library. The most important German commentaries since Hermann's have been those of L. Campbell (1871–81); N. Wecklein, (1875–80); F. W. Schneidewin (7 vols., 1880–86); R. C. Jebb (7 vols., with Eng. trans., 1885–96). *See* also *Sophocles* (Greek and English trans. F. Star, Loeb ed., 2 vols., 1912–13); *Sophocles* (Greek and French, P. Masqueray, 1922, etc.). Editions of one or more dramas worth consulting are: P. Elmsley, *Oedipus Tyrannus* (1821) and *Oedipus Coloneus* (1823); C. A. Lobeck, *Ajax* (1835); A. Böckl, *Antigone* (1843); J. W. Donaldson, *Antigone* (1848); O. Jahn, *Electra* (1872); J. William White, *Oedipus Tyrannus* (1889); J. E. Sheppard, *Oedipus Tyrannus* (Greek and English, 1920). *See* G. Kaibel, *De Sophoclis Antigona* (1897). There are many translations into modern languages. *See* R. C. Jebb, *The Tragedies of Sophocles* (prose, reprinted in 1 vol., 1905). *See* also L. Campbell, *Tragic Drama in Aeschylus, Sophocles and Shakespeare* (1904); J. W. MacKail, *Lectures on Greek Poetry* (1911); and A. E. Haigh, *The Attic Theatre* (rev. A. W. Pickard, Cambridge, 1907).

SOPHRON, of Syracuse, writer of mimes, flourished about 430 B.C. He was the author of prose dialogues in the Doric dialect, containing both male and female characters, some serious, others humorous in style, and depicting scenes from the daily

life of the Sicilian Greeks. Plato is said to have been devoted to them. Some idea of their general character may be gathered from the 2nd and 15th idylls of Theocritus, which are said to have been imitated from Sophron.

Fragments edit. in H. L. Ahrens, *De graecae linguae dialectis* (1843), ii.; separately by C. J. Botzon (1867); and *see* his *De Sophrone et Xenarcho mimographis* (1856).

SOPRANO (a variant of Ital. *sovrano,* supreme, sovereign), in music, the highest class of human voice, the term being often restricted to that range in the female voice, "treble" being used of a boy's voice. Male *soprani,* either natural or artificially produced, as formerly in the *castrati* of the papal choirs (*see* EUNUCH), are also found.

SOPRON, a town in west Hungary commanding an important route from Transdanubia to Vienna through the so-called "Odenburg Gate" between the Leitha Mts. and Rosalien Mts. Through this gap German forms of culture have penetrated and Sopron has in part the appearance of a west European town. The critical site has been continuously occupied since pre-Roman times, a Roman colony, *Scarabantia,* having existed there, and has a wealth of old buildings, notably the 13th century Benedictine church, the 15th century church of St. Michael in Gothic style and the 17th century Dominican church. Pop. (1920), 35,248, about 50% German.

SOPWITH, THOMAS OCTAVE MURDOCH (1888–), British airman and inventor, was educated at Cottesmore and at Seafield Engineering college. Having won the Baron de Forest Prize of £4,000 for a flight from England to the Continent in 1910, in 1912 he founded the Sopwith Aviation Co., Ltd., at Kingston-on-Thames. During the World War this firm designed and produced large numbers of aeroplanes and seaplanes for the British Government. Sopwith also became joint managing director of the H. G. Hawker Engineering Co., Ltd., Kingston-on-Thames. In 1918 he was made a C.B.E. He married in 1914 Beatrix, daughter of the 8th Baron Ruthven.

SORA, a city of Campania, Italy, in the province of Frosinone 77 m. N. by W. of that town on the railway between Roccasecca and Avezzano, 920 ft. above sea-level. Pop. (1911), 9,781 (town); 17,612 (commune). It is built in a plain on the banks of the Liris. This part of the valley is the seat of some important paper-mills and other factories. On the precipitous rock above the town (1,768 ft.) which guards the Liris valley and the entrance to the Abruzzi are remains of polygonal walls of the citadel of the original Volscian town. There are also remains of mediaeval fortifications, and the Cathedral is a building of 1229.

Sora, an ancient Volscian town, was thrice captured by the Romans, in 345, 314 and 305 B.C., before they managed, in 303, by means of a colony 4,000 strong, to confirm its annexation. Under Augustus it was colonized by soldiers of the legio IV. Sorana, which had been mainly enrolled there. Sora was the birthplace of the Decii, Attilius Regulus, and Lucius Mummius.

See A. Lauri, Sora (Isola del Liri, 1913).

SORABJI, CORNELIA (1866–), Indian author and publicist, born at Nasik, was a daughter of the Rev. Sorabji Kharsedji, an agent of the Church Missionary Society at Poona, and of Francina Sorabji, a Hindu convert and educational pioneer. The first girl student of the Deccan college, Poona, Cornelia graduated in 1887, went to Somerville, Oxford, in 1888 as a scholar, and in 1893 received the B.C.L. of Oxford. In 1904 she was appointed a legal adviser to the court of wards, Bengal, and later held the same position in Behar and Orissa, and Assam. In these and other provinces she rendered very effective service to female landowners who suffered from the handicap of the *purdah* system. Miss Sorabji was awarded the Kaisar-i-Hind gold medal in 1909 and received the bar of the first class in 1922. She was enrolled in 1921 as a vakil of the Allahabad High Court. In 1923, soon after the removal of the sex disqualification she was called to the bar by Lincoln's Inn, and returned to India to practise.

Her best known books were *Love and Life Behind the Purdah* (1901) and *Sun-Babies* (1904), of which there was a second series in 1920. She also published *Between the Twilights* (1908), *Indian Tales of the Great Ones* (1916), the *Purdahnashin* (1917) and *Therefore* (1924).

SORACTE, a mountain in the province of Rome, Italy. It is a narrow, isolated limestone ridge, some 5 m. S.E. of Civita Castellana, and 3½ m. in length. The highest summit is 2,267 ft. above sea-level; just below is a monastery originally founded about 748 by Carloman, son of Charles Martel (the altar has fragments of sculptures of this period). Owing to the isolated position of the mountain the view is magnificent, and Soracte is a conspicuous object in the landscape, being visible from Rome.

SORANUS, Greek physician, born at Ephesus, lived during the reigns of Trajan and Hadrian (A.D. 98–138). According to Suïdas, he practised in Alexandria and subsequently in Rome. He was the chief representative of the school of physicians known as "methodists." Two treatises by him are extant: *On Fractures* (in J. L. Ideler, *Physici et medici minores,* i. 1841) and *On Midwifery and the Diseases of Women* (first printed in 1838, later by V. Rose, in 1882, with a 6th-century Latin translation by Moschio). The work of Soranus on midwifery was the source of many works on obstetrics; the book also contains a chapter on the care and feeding of infants. Of his most important work (*On Acute and Chronic Diseases*) only a few fragments in Greek remain, but we possess a complete Latin translation by Caelius Aurelianus (5th century). The *Life of Hippocrates* (in Ideler) probably formed one of the collection of medical biographies by Soranus referred to by Suïdas, and is valuable as the only authority for the life of the great physician, with the exception of articles in Suïdas and Stephanus of Byzantium (*s.v.* Κώς).

See article by J. Hahn, in Dechambre's *Dictionnaire encyclopédique des sciences médicales,* 3rd series, tom. 10; W. Christ, *Geschichte der griechischen Litteratur* (1808); J. Ilberg, *Die Überlieferung der Gynaekologie des Soranos von Ephesos* (Leipzig, 1910).

SORAU, a town in the Prussian province of Brandenburg, on the Sorebach, 54 m. S.E. of Frankfort-on-Oder by rail, and at the junction of lines to Kottbus and Görlitz. Pop. (1925) 18,363. Sorau is said to have existed in 840, and to have belonged to the abbey of Fulda till the 12th century. It received civic rights in 1260. The surrounding district formed the barony of Sorau, and in 1400 was united with the barony of Triebel. The last Count of Promnitz sold both baronies in 1765 to the elector of Saxony. In 1815 Saxony ceded them to Prussia. One of the oldest towns in Lower Lusatia, Sorau contains a number of churches (one dating from 1204), a town hall, built in 1260, and an old palace of 1207 (now a prison).

SORBONNE: *see* PARIS UNIVERSITY.

SORBS, the tribal name of the Slavonic people, whom the Germans call Wends in Lusatia (Lausitz); they call themselves Serbs or Lužičane. Their country includes the western extremity of Saxony and parts of Prussia; they are now surrounded by Germans. In the Middle Ages the protection of Nordic stock against Wendish blood was secured by monopolizing civil rights. The Sorbs are divided into High and Low along a line from Sagan to Muskau and Spremberg. Some Sorbs are Protestants, though the Saxon Sorbs are mostly Roman Catholics.

The two dialects stand between Polish and Czech. Sorb is usually printed in German blackletter variously adapted; the *Macica* publishes some books spelt after the Czech system.

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SORCERY: *see* MAGIC, DIVINATION and WITCHCRAFT.

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